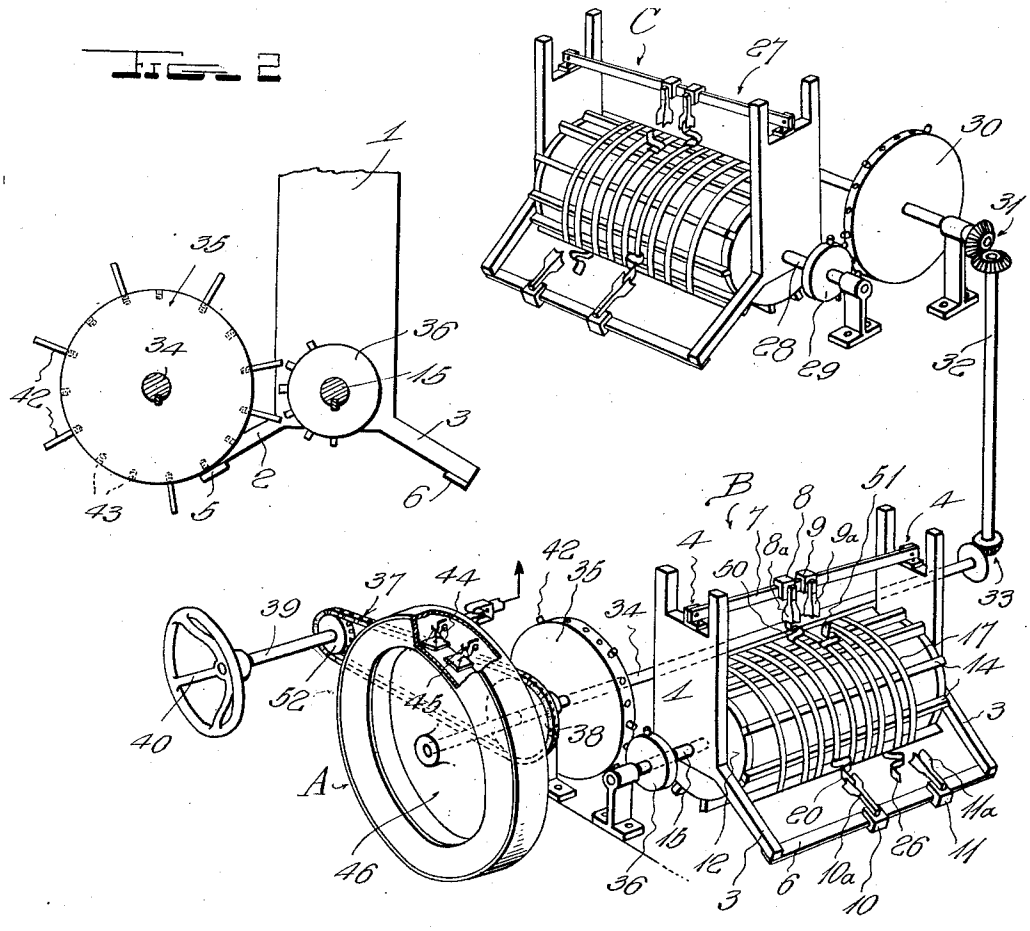
May 31, 1932. A. M. TROGNER 1,861,371

FREQUENCY CHANGING SYSTEM

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FIG. 1

FIG. 2



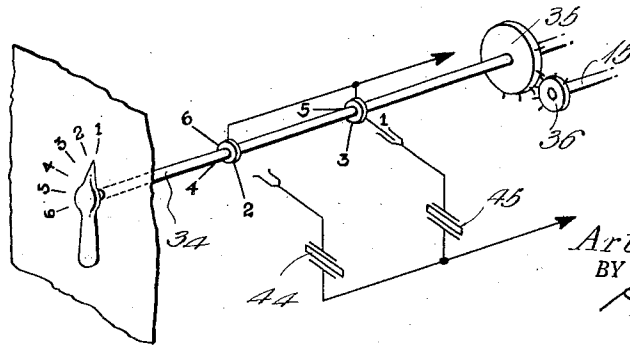


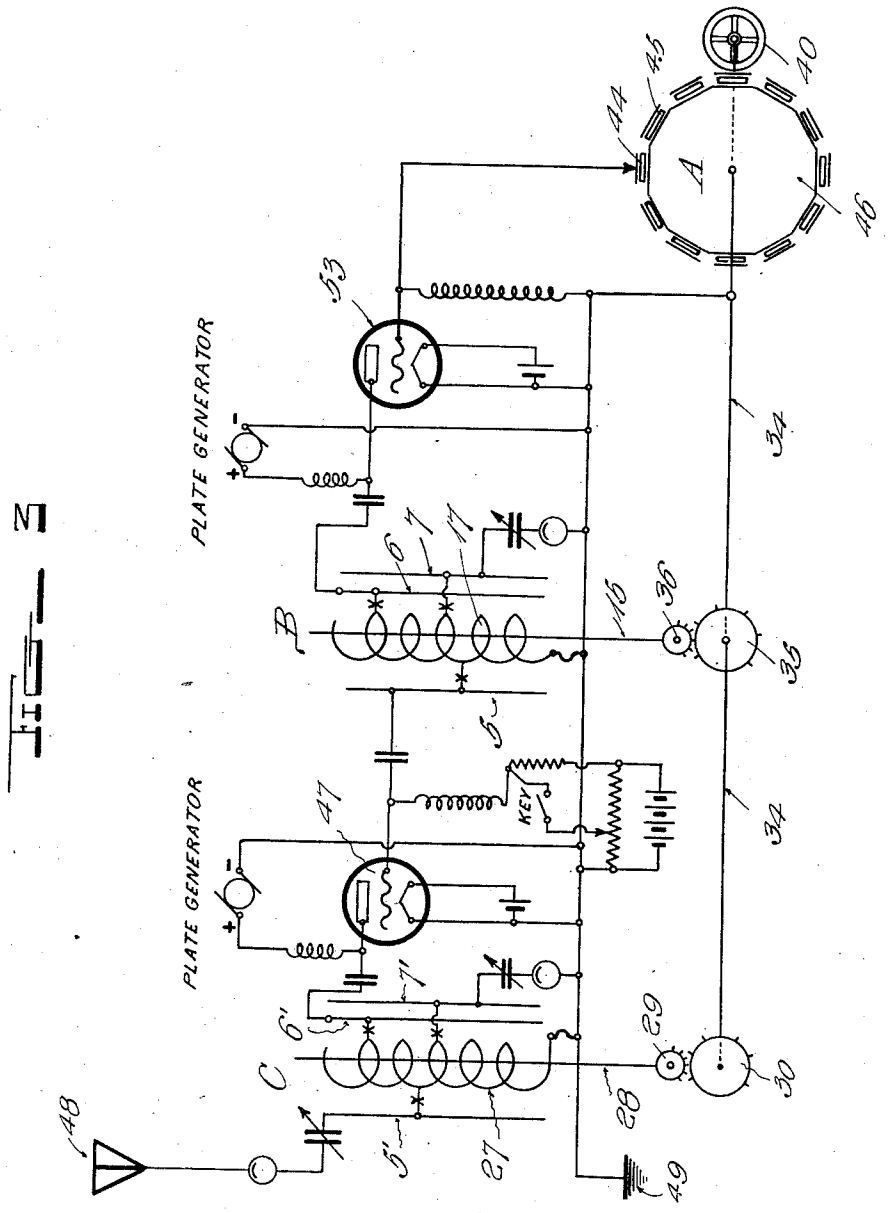
FIG. 4

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FREQUENCY CHANGING SYSTEM

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UNITED STATES PATENT OFFICE

ARTHUR M. TROGNER, OF TAKOMA PARK, MARYLAND, ASSIGNOR, BY MESNE ASSIGNMENTS, TO WIRED RADIO, INC., OF NEW YORK, N. Y., A CORPORATION OF DELAWARE

FREQUENCY CHANGING SYSTEM

Application filed October 8, 1926. Serial No. 140,376.

My invention relates broadly to high frequency signal transmission systems and more particularly to a switching system for effecting rapid changes in the operating frequency of signal transmitters.

One of the objects of my invention is to provide a simplified system of adjustment for a high frequency signal transmitter in which piezo electric crystal devices are preferably employed for controlling the frequency of the transmitter.

Another object of my invention is to provide a frequency change system for transmission circuits in which a single control is provided for effecting a change in the variables of the electrical circuits, simultaneously with the selection and connection of a piezo electric crystal in the oscillator circuit.

A further object of my invention is to provide a tuning system for a crystal controlled signal transmitter including a system of gearing by which the operation of a single control effects a selection of a particular piezo electric crystal and adjusts the circuit variables of the transmitter corresponding to the frequency value of the crystal.

Other and further objects of my invention will be understood from the following specification by reference to the accompanying drawings in which:

Figure 1 is a perspective view showing the schematic arrangement of the frequency changing system of my invention; Fig. 2 is a detailed front elevational view showing the lost motion connection that may be provided between the control shaft and the inductance system employed in the tuning system of my invention; Fig. 3 is a diagrammatic circuit arrangement of a radio transmitter employing the frequency changing system of my invention; and Fig. 4 shows a schematic diagram of a modified form of frequency control apparatus embodying the principles of my invention.

In my Patent No. 1,609,744, granted December 7, 1926, on application Serial No. 113,791, filed June 4, 1926, for multiple piezo electric crystal holder, I have described a system of mounting a plurality of piezo electric crystal elements of different frequency characteristics.

My present invention is directed to a frequency changing system employing apparatus such as is described in my aforementioned patent in such manner that the operation of the several instrumentalities is coordinated and a single control provided for effecting rapid changes in frequency in the electrical system in which the apparatus is connected and selecting the desired piezo electric crystal while simultaneously effecting the necessary inductance changes in one or more parts of the circuits for enabling the circuits to be operated at a predetermined frequency.

My invention will be more clearly understood by a detailed reference to the drawings wherein reference character 1 designates a frame structure provided with extended arms 2 and 3 with supports 4 at one side thereof by which the rod members 5, 6 and 7 are supported in lines substantially parallel to the axis of the inductance system. The rods or metal strips provide supports for the members 8, 9, 10 and 11 which are provided with contacting jaws 8*a*, 9*a*, 10*a* and 11*a*, respectively. A drum 12 is mounted upon a shaft 15 journaled with respect to the frame structure 1, and on the strips 14 carried by the drum 12 there is wound the conductive strip member 17 having its turns in spaced relation. Secured to selected points along the inductance 17, I provide contact members 20, 26, 50 and 51 arranged to engage the contacting jaws 10*a*, 11*a*, 8*a* and 9*a*, respectively, as the drum is rotated.

A control wheel 36 is keyed to the shaft 15 and imparts rotary motion to member 35 carried by the shaft 34. Shaft 34 is connected through bevel gear 33 with vertical shaft 32, which is in turn connected through bevel gears 31, for driving the rotary member 30. A second inductance system designated generally at 27 is in this manner controlled simultaneously with the operation of the first inductance system by means of the rotary member 29 on shaft 28 actuated by movement of rotary member 30. In order to effect rotation of the inductance system I provide a hand wheel 40 controlling a shaft

39 which turns a sprocket 52 for moving chain 37 that passes over the sprocket wheel 38. Each of the coil switch systems is controlled by movement of hand wheel 40 through intermittent motion mechanism 35—36 and 30—29. Keyed on the shaft 34 I provide a piezo electric crystal holder 46 which carries a plurality of different piezo electric crystal elements 44 and 45 disposed about the periphery of the holder and arranged to be selectively connected in the control circuit in accordance with changes in the values of the inductance in the inductance systems. In order to permit ready adjustment of the tuning system to the desired frequencies the larger wheels 35 and 30 of the intermittent mechanism are provided with tapped holes in their peripheries indicated at 43 in Fig. 2, one for each piezo electric crystal in the multiple holder. Threaded pins 42 may be screwed into these holes at the points where switch movement is desired. Where various crystal frequencies are close together, it is desirable to effect the circuit tuning by means of variable condensers over bands of a number of crystals, it being only necessary to change the inductance values at the limits of these bands.

The pins 42 engage corresponding pins or projections on the smaller wheels 36 and 29 secured to the coil switch shafts. These pins or projections correspond to the various switch positions as represented more clearly in Fig. 2. Where it becomes necessary one coil switch may be rotated at different times than the other coil switch by the proper location of the pins, so that the system is highly practicable in its operation and arrangement.

In Fig. 3 I have shown a typical wiring diagram for a transmitter equipment with the frequency changing system of my invention. The moving elements have been shown at A, B and C, that is the piezo electric crystal holder 46, inductance 17 and an inductance system 27. The electron tube 53 functions as the oscillator under control of the selected piezo electric crystal 44 or 45 in accordance with the movement of control handle 40. The inductance system shown at B is controlled through the wheels 35 and 36, while the inductance system shown at C is controlled through wheels 29 and 30. The power amplifier tube 47 has its input circuit associated with the inductance 17 while its output circuit is associated with the inductance 27 which is adjustably connected in the antenna ground circuit 48—49.

It will be seen that where normally ten separate adjustments might be required in a radio transmitter, that is, one adjustment to shift the piezo electric crystal control, three condenser adjustments and six inductance tap adjustments, in the frequency changing system of my invention only four adjustments are required, one control being provided for all of the inductance taps and for the selection of the proper piezo electric crystal and three adjustments for fixing the capacity values.

The practical problem solved by the frequency changing system is the simultaneous control of all of the inductance taps as these are normally more tedious and laborious to effect than the other adjustments. I have designated the conductive strips adjacent each of the inductances 17 and 27 by reference characters 5, 6 and 7 and 5′, 6′ and 7′.

In Fig. 4, I have illustrated schematically how the control apparatus may be modified for eliminating the large piezo electric crystal holder 46 and replacing the holder by a relatively few selected crystals which are connected in the control circuit by properly arranged switch blades on the drive shaft. As an example, in this form, for positions 1 and 2 the circuits may be arranged so that the transmitter emits fundamental frequencies of the particular crystal selected. In positions 3 and 4 the output or amplifier circuit may be adjusted to emit the double frequency, and in positions 5 and 6 the triple frequency, etc., while the crystal master circuit stays on the fundamental frequency.

While I have described my invention as embodying piezo electric crystal elements as frequency determining elements, it will be understood that other forms of frequency determining elements may be employed such as small tuned circuits in place of the piezo electric crystal elements. The tuned circuits may be so arranged that a change in the connection of a particular circuit may be effected simultaneously with the change in inductance in the transmission system.

While I have described my invention in its preferred forms, I desire that it be understood that modifications may be made and that no limitations upon the invention are intended other than are imposed by the scope of the appended claims.

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

1. A frequency changing system for signal transmitting circuits comprising in combination a variable circuit element arranged to be adjusted to a plurality of positions corresponding to differing frequencies, a plurality of piezo electric crystal elements of differing frequency characteristics, each mechanically shiftable to selected positions corresponding to the settings of said variable circuit element and means for simultaneously selecting a particular piezo electric crystal element for particular positions of said variable circuit element.

2. A frequency changing system for signal transmission circuits comprising in combination a transmission circuit, a variable circuit element arranged to be moved to a plu-

rality of selected positions for adjusting said transmission circuit to particular different frequencies, and piezo electric crystal apparatus having a plurality of piezo electric crystal elements arranged to be mechanically shifted simultaneously with the change in position of said variable circuit element and connections established between a selected piezo electric crystal element and said transmission circuit for controlling the signaling frequency of said transmission circuit.

3. In a signal transmission system the combination of a transmitting circuit, a variable circuit element connected in said circuit, said variable circuit element having a plurality of differing positions corresponding to different transmission frequencies, piezo electric crystal apparatus containing a plurality of piezo electric crystal elements, each having a frequency corresponding to the plurality of positions to which said variable circuit element may be adjusted, and means for simultaneously rotatably adjusting said piezo electric crystal apparatus and said variable circuit element for the connection of a selected piezo electric crystal element in said signal transmitting circuit.

4. In a high frequency signal transmission system the combination of a transmitting circuit, a variable tuning element connected in said circuit and arranged to be adjusted to a plurality of selected positions corresponding to different transmitting frequencies, piezo electric crystal apparatus carrying a plurality of piezo electric crystal elements, each ground to different frequency characteristics, means for movably supporting said piezo electric crystal elements and means for simultaneously moving said supporting means to selected positions and effecting circuit connections between selected piezo electric crystal elements and selected portions of said variable tuning element for controlling the frequency of said transmitting circuit.

5. In a high frequency signal transmission system the combination of a transmitting circuit, a variable tuning element connected in said circuit and arranged to be adjusted to a plurality of selected positions corresponding to different transmitting frequencies, a movably mounted piezo electric crystal apparatus carrying a plurality of piezo electric crystal elements, each ground to different frequency characteristics, an intermittent motion connection between said movably mounted piezo electric crystal apparatus and said variable tuning element, and means for imparting movement to said movably mounted piezo electric crystal apparatus for effecting intermittent motion of said variable tuning element for selectively connecting one of said piezo electric crystal elements and a portion of said variable tuning element in said transmitting circuit for controlling the transmission frequency.

6. In a high frequency signal transmission system an electron tube oscillator including input and output circuits, an inductance system connected in said output circuit, a movable support carrying piezo electric crystal apparatus thereon and including a plurality of piezo electric crystal elements having different frequency characteristics, and means for connecting a selected portion of said inductance in said output circuit simultaneously with the movement of said support for the connection of a selected piezo electric crystal element in said input circuit for the control of said oscillator at a predetermined frequency.

7. In a high frequency signal transmission system the combination of an electron tube having grid, filament and plate electrodes, circuits interconnecting said electrodes, a variable tuning element arranged to be adjusted to a plurality of selected positions corresponding to different transmission frequencies, piezo electric crystal apparatus including a movable supporting frame, a plurality of piezo electric crystal elements carried by said frame, each having differing frequency characteristics, and means for simultaneously establishing connection between said variable tuning element, said piezo electric crystal apparatus and said electrodes, for selected signaling frequencies.

8. In a high frequency signal transmission system the combination of a plurality of electron tubes each having grid, filament and plate electrodes, input and output circuits interconnecting said electrodes, a signal transmission circuit, variable tuning elements interposed between the output circuit of one of said electron tubes and said signal transmission circuit and between the output circuit of another of said electron tubes and the input circuit of said aforementioned electron tube, piezo electric crystal apparatus including a movable carrier having a plurality of piezo electric crystal elements positioned thereon each having different frequency characteristics, and means for simultaneously moving said carrier and effecting adjustment of said piezo electric crystal apparatus and said variable tuning element.

9. A high frequency signal transmission system comprising an electron tube oscillator and power amplifier, a signal transmission circuit, variable inductance systems interposed between said signal transmission circuit and said power amplifier and between said oscillator and said power amplifier, piezo electric crystal apparatus comprising a movable carrier having a plurality of piezo electric crystal elements of different frequency characteristics mounted thereon, and means for effecting simultaneous adjustments of said variable inductance systems with corresponding movement of said movable carrier in selecting a particular piezo electric crys-

tal element for controlling the operating frequency of said transmission system.

10. In a high frequency signal transmission system the combination of a rotatable inductance having a plurality of taps with cooperating contact members arranged adjacent thereto, piezo electric crystal apparatus carrying a plurality of piezo electric crystal elements each having differing frequency characteristics, a signal transmission circuit and circuit connections by which a selected piezo electric crystal element and a selected contact on said rotatable inductance may be included in said circuit by the simultaneous rotation of said piezo electric crystal apparatus and said rotatable inductance.

11. In a high frequency signal transmission system a transmitting circuit, a rotatable inductance arranged to be moved to a plurality of predetermined selected positions for establishing certain contacts, a rotatable piezo electric crystal apparatus carrying a plurality of piezo electric crystal elements thereon, and means for imparting rotary movement to said rotatable piezo electric crystal apparatus for intermittently imparting movement to said rotatable inductance for controlling the transmission frequency of said transmitting circuit.

12. In a high frequency signal transmission system the combination of a signal transmitting circuit, a rotatable inductance arranged to be moved to a plurality of selected positions for the connection of selected portions of said inductance in said signal transmitting circuit, a rotatable piezo electric crystal carrier having a plurality of piezo electric crystal elements of differing frequency characteristics thereon, contacts for establishing connection with a selected piezo electric crystal element and said transmitting circuit, and means for rotatably driving said piezo electric crystal apparatus and imparting intermittent rotation to said inductance for effecting simultaneous connection of a portion of said inductance in said transmitting circuit having a value proportioned to the frequency of a selected piezo electric crystal element.

13. A frequency changing system for signal transmitting circuits comprising in combination a variable circuit element arranged to be adjusted to a plurality of positions corresponding to differing frequencies, a movable frame member, a plurality of piezo electric frequency regulating elements of differing frequency characteristics carried by said movable frame member, and means for simultaneously shifting the position of said movable frame member and selecting a particular frequency regulating element thereon for cooperation with corresponding positions of said variable circuit element.

14. A frequency changing system for signal transmission circuits, comprising in combination, a transmission circuit, frequency regulating apparatus including a movable carrier having a plurality of piezo electric frequency regulating elements thereon, and a variable circuit element arranged to be moved to a plurality of selected positions for adjusting said transmission circuit to corresponding frequencies, simultaneously with the change in position of said movable carrier for selectively setting said frequency regulating apparatus to a position for rendering effective a particular frequency regulating element of the desired frequency.

15. In combination, a circuit responsive to electrical oscillations, a variable element in said circuit adapted to change the resonant frequency thereof by changes in position of said element, a plurality of piezo electric frequency regulating elements and a movable support therefor, means for selectively connecting one of said frequency regulating elements to said circuit by movement of said support, and means, co-acting with the first mentioned means, for moving said variable element to a position whereby said circuit is made resonant at substantially the frequency of said frequency regulating element.

16. A frequency changing device for a signal transmission system comprising a transmission circuit, a variable inductance element arranged to be moved to a plurailty of selected positions for adjusting said transmission circuit to correspondingly different frequencies, piezo electric frequency control apparatus having a plurality of crystal elements arranged to be selectively connected into said transmission circuit, a unitary mechanical control for said inductance element and for said piezo electric frequency control apparatus and rotatable means to simultaneously effect crystal selection and movement of said inductance element so as to maintain a frequency correspondence therebetween.

17. A frequency changing device for a signal transmission system comprising a transmission circuit, an inductance element the electrical characteristics of which are mechanically adjustable for tuning said transmission circuit to different frequencies, a piezo electric frequency control apparatus having a plurality of crystal elements arranged to be selectively connected into said transmission circuit, a unitary mechanical control for adjusting said inductance element and for selecting one of the crystals in said piezo electric frequency control apparatus, and rotatable means driven by said unitary mechanical control for simultaneously effecting suitable crystal selection and corresponding adjustment of said inductance element so as to maintain a frequency correspondence therebetween.

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