

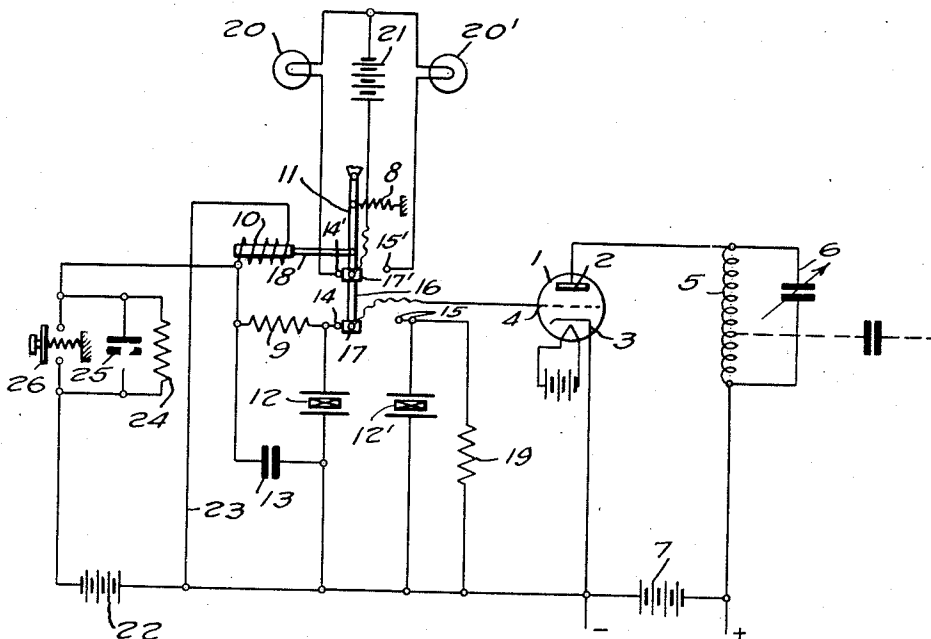
Nov. 25, 1941.

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2,263,755

AUTOMATIC CRYSTAL TRANSFER DEVICE

Filed Aug. 2, 1940



WITNESSES:

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2,263,755

AUTOMATIC CRYSTAL TRANSFER DEVICE

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Application August 2, 1940, Serial No. 349,762

6 Claims. (Cl. 250—36)

This invention relates to vacuum tube oscillators and, more particularly, to oscillators utilizing mechanical vibratile elements for controlling the frequency of oscillations.

Vacuum tube oscillators of the type employing a piezo-electric crystal for controlling the frequency of oscillations are particularly used in radio transmitters, mainly for the increased stability obtained at the operating frequency.

Radio transmitters for broadcasting or police work must at all times be in operating condition and provision must be made to avoid operating failure due to all possible causes. A breakdown of the crystal element will produce such operating failure silencing the transmitter until another crystal can be inserted in place of the faulty one. Although such crystals are generally in a compact mechanical assembly and may be replaced in the same manner as vacuum tubes by merely plugging into a suitable receptacle, considerable time is needed for replacement.

The primary object of this invention is to effect the replacement of crystals in a transmitter with the least possible delay, thereby insuring reliability of continued operation.

Another object of this invention is to effect replacement of a crystal element automatically upon fault developed therein with another crystal similar in its operating characteristics.

A further object of this invention is to control the selection of crystals in a vacuum tube oscillator by the presence of grid current in the circuit.

Other objects and advantages will be apparent in connection with the description of the invention, pointed out in particularity by the appended claims, and taken in connection with the accompanying drawing, in which:

The figure illustrates a schematic circuit arrangement of a vacuum tube oscillator incorporating switching means for crystal transfer in accordance with this invention.

Referring to the drawing, a conventional crystal oscillator is shown comprising vacuum tube 1 having anode 2, cathode 3 and control electrode 4. The output circuit of the tube between anode 2 and cathode 3 includes the conventional tank circuit comprising inductance 5 and tuning capacity 6 in parallel therewith and the operating voltage source shown by battery 7. The input circuit between the grid 4 and cathode 3 includes in series the load resistance 9 and the winding 10 of relay 11. In parallel with the last mentioned circuit elements connected directly between cathode and the high potential side of the load

resistance 9 is a piezo-crystal element 12. A capacity 13 is effectively in parallel with the winding 10. The relay includes stationary contacts 14 and 15 and 14' and 15'. The armature 16 thereof is biased by the spring 8 against movement by the plunger 18 and carries moving contacts 17 and 17'. One of the moving contacts 17 is connected directly to the grid electrode 4, whereas the stationary contact 15 is connected to the cathode through a load resistance 19 which is paralleled by another piezo-electric crystal element 20.

Stationary contacts 14' and 15' connect with indicator lights 20 and 20', respectively. A source of operating voltage for these lights comprise battery 21 and is connected between the junction point of the two indicator lights 20 and 20' and the moving contact 17 of the relay 11.

An auxiliary source for operating the winding 10 includes the battery 22, one terminal of which connects to the cathode 3 and through conductor 23 to the winding 10 and the other terminal in series with a network including resistor 24 and capacity 25 in parallel therewith to the other terminal of the winding 10. A switch 26 is provided to short-circuit the network and connect the battery 22 directly across the winding 10.

In the operation of the crystal transfer, the vacuum tube 1, when in an oscillatory condition, produces grid current which flows between cathode 3 and grid 4. Tracing the circuit, it is seen that this current must flow through the load resistance 9 and the winding 10 of the relay 11. The resistance of the winding is so calculated that the normal grid current produces sufficient magnetizing voltage drop to actuate the relay 11 in the position which connects the crystal element 12 in the circuit and maintain this connection until for any reason this current should cease to flow. The primary reason for cessation of current flow would be any defect of the crystal 12 whereby the oscillator tube would cease to function. In this case, the winding 10 becomes deenergized and the relay armature is automatically returned by the spring 8 in the second position to complete the circuit to contacts 17 and 15 placing thereby the second crystal element 20 and its associated load resistance 19 in the grid circuit. The second crystal 20 is identical with that of 12 and being transferred almost instantaneously in the circuit upon failure of the first crystal element 12, the tube 1 will resume producing oscillations at the identical frequency, as previously, with practically unappreciable interruption.

The indicator lights 20 and 20' are for the pur-

pose of showing at the oscillator panel or at a remote point which of the crystals 12 or 20 are operating in conjunction with the tube 1. When the crystal 12 is in the circuit, current from the battery 21 will flow through contacts 17' and 15', energizing the indicator light 20, whereas when the armature is released, the current from the battery 21 will flow through contacts 17' and 15' to energize the light 20'. When the latter is lit, the operator of the transmitter takes cognizance of the fact that the spare crystal has been switched in the circuit and may take the necessary preparations for replacing the defective crystal 12 at any time without interfering with the normal operation of the transmitter.

Each time the transmitter is started, since power supply B₂ and B₁ are applied simultaneously to actuate carrier, the surge current charging condenser 25 through winding 10 energizes relay 11, and the slow-release characteristic of relay 11 holds crystal 12 in the circuit until oscillations build up sufficient grid current to supply magnetizing current for relay 11.

Should the operator desire to cut out the automatic transfer feature in order to make adjustments of the transmitter and be unimpeded by the transfer device operating because of adjustments, the switch 26 is closed, thereby locking crystal 12 into the circuit as long as switch 26 is closed.

Resistor 24 is a high value, that passes insufficient current to energize relay 11. It provides a path of discharge for condenser 25 upon cessation of carrier, in order to promptly repeat the starting of carrier whenever it becomes necessary for carrier to be initiated and shut off alternately at short intervals.

While the drawing and the description shows a preferred embodiment of the invention, it is to be understood that other circuits in connection with relays of various types may be used without departing from the essence of this invention.

What is claimed is:

1. In an oscillator circuit, a vacuum tube having anode, cathode and control electrodes, an input circuit between said control electrode and cathode including a mechanical vibratile element, an output circuit between said anode and cathode, switching means for connecting said element to said input circuit, a second vibratile element and means responsive to current flow in said input circuit for controlling the actuation of said switching means for selectively connecting one of said elements to said input circuit.

2. In an oscillator circuit, a vacuum tube having anode, cathode and control electrodes, an input circuit between said control electrode and cathode including a first mechanical vibratile element, an output circuit between said anode and cathode, switching means for connecting said element to said input circuit, a second vibratile element and means operable upon cessation of grid current flow in said input circuit for actuating said switching means and thereby automatically disconnecting said first vibratile element from said circuit and connecting said second element thereto.

3. In an oscillator circuit, a vacuum tube having anode, cathode and control electrodes, an in-

put circuit between said control electrode and cathode including a mechanical vibratile element, an output circuit between said anode and cathode, switching means for connecting said element to said input circuit, a second vibratile element and means responsive to cessation of current flow in said input circuit for controlling the actuation of said switching means for connecting said second element to said input circuit, and means for indicating the position of said switching means.

4. In an oscillator, a vacuum tube having anode, cathode and control electrodes, a pair of piezo-electric crystal elements, switching means comprising a relay for connecting in one position one of said elements and in another position said other element to said control electrode, a coil for actuating said relay in one position, a circuit for connecting said coil effectively in series between said control electrode and cathode, whereby it is energized by the current flow in said circuit produced upon generation of oscillations by said tube, and spring means for actuating said relay in the other position upon deenergization of said coil.

5. In an oscillator, a vacuum tube having anode, cathode and control electrodes, a pair of piezo-electric crystal elements, switching means comprising a relay for connecting in one position one of said elements and in another position said other elements to said control electrode, a coil for actuating said relay in one position, a circuit for connecting said coil effectively in series between said control electrode and cathode, whereby it is energized by the current flow in said circuit produced upon generation of oscillations by said tube, spring means for actuating said relay in the other position upon deenergization of said coil, and a pair of indicator lights one of which is energized by one position of said relay and the other by the other position thereof.

6. In an oscillator, a vacuum tube having anode, cathode, and control electrodes, a pair of piezo-electric crystal elements, switching means comprising a relay of slow-release characteristics for connecting in one position one of said elements and in another position said other element to said control electrode and cathode, a coil for actuating said relay in one position, a circuit for connecting said coil effectively in series between said control electrode and cathode, whereby it is energized by the current flow in said circuit produced upon generation of oscillations by said tube, spring means for actuating said relay in the other position upon deenergization of said coil, and an auxiliary circuit for said relay including a source of current for energizing said coil, a condenser and resistor network in series with said supply and said coil, for energizing said coil momentarily, the slow-release characteristic of said relay in cooperation of said supply circuit being utilized to maintain energization of said relay prior to the generation of oscillations and during such time as required for initiating current flow in said input circuit, a switch in the energizing circuit for removing the automatic transfer feature to permit adjustments of the output circuit when desired.

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