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OSCILLATION GENERATOR

Filed Feb. 20, 1943

Fig. 1.

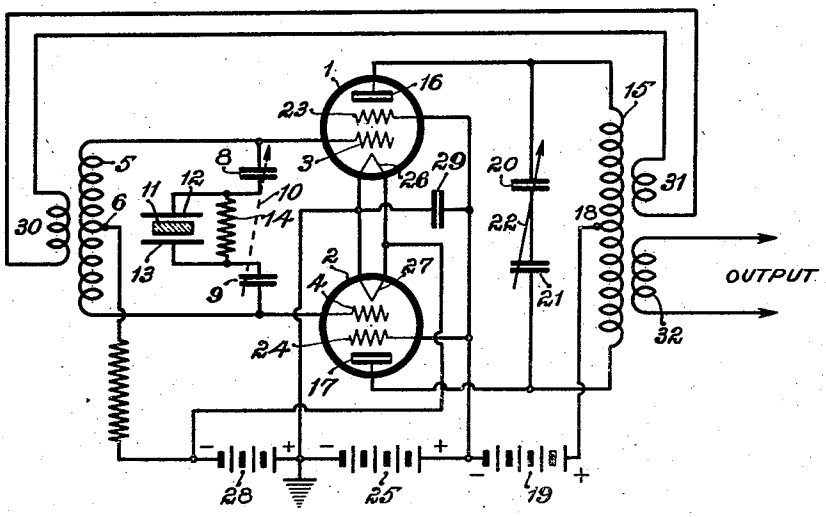
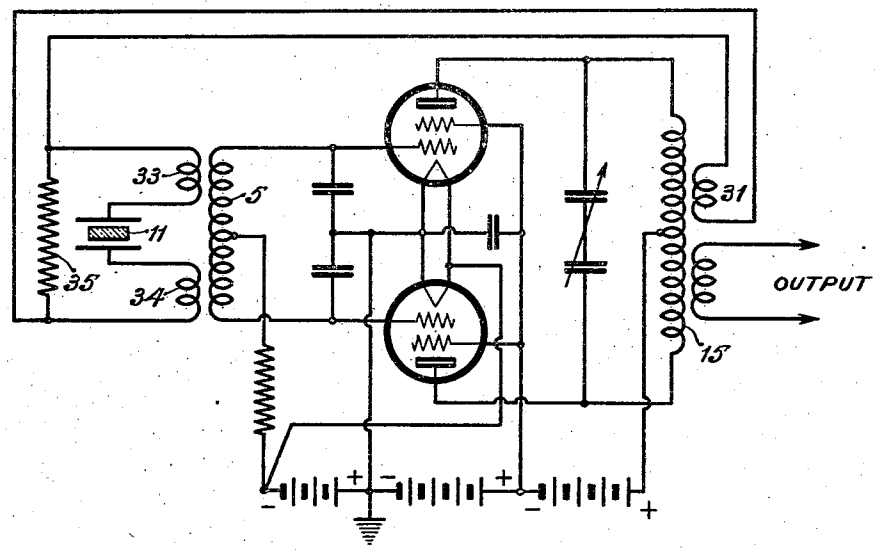


Fig. 2.



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OSCILLATION GENERATOR

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13 Claims. (Cl. 250—36)

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This invention relates to an improved signaling system and in particular to an oscillation generator having a push-pull piezo-electric crystal circuit arrangement.

An object of this invention is to improve the operation of a crystal controlled push-pull oscillator having both a tuned grid and a tuned plate circuit.

Another object of this invention is to provide an improved oscillator circuit which will be arranged so that it would be difficult for the oscillator to oscillate at any frequency except that of the one desired frequency of the crystal for the reason that the crystal acts as a very narrow band pass filter.

A feature of this invention is that of a simple inductive coupling method wherein the crystal is connected in series with the grids of the tubes thus providing oscillator circuits such that if the electrodes of the crystal are short circuited, oscillations will occur if the grid and anode tank circuits have the same or approximately the same resonant frequency when proper potentials are applied to the circuits.

The piezo-electric crystal in this invention acts as a very narrow band pass filter which holds the oscillations to substantially one frequency as determined by the characteristics of the crystal. The piezo-electric properties of crystals used for frequency control are well understood in the prior art and need not be described here. Also it is known how oscillations start and build up in an oscillator circuit. In this invention the crystal is placed in the oscillator circuit where it can most effectively control the oscillation frequency.

This invention will best be understood by reference to the accompanying drawing in which

Fig. 1 is a circuit diagram of a push-pull oscillator of this invention,

Fig. 2 is a modification of the circuit shown in Fig. 1.

Referring now in detail to Fig. 1 of the drawing, there is shown the tuned grid circuit which includes a pair of electron discharge tubes 1 and 2, each one of which has their input grids 3 and 4 connected to the outer ends of inductance coil 5 which has a midpoint connection 6. Also connected to input grids 3 and 4 are variable condensers 8 and 9 which may be simultaneously varied as indicated at 10. Connected in series between variable condensers 8 and 9 is a piezo-electric crystal 11 having electrodes 12 and 13. A resistance 14 is connected across the crystal electrodes 12 and 13 to prevent the circuit from oscillating when the crystal is not oscillating.

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By this arrangement it will be seen that the crystal is connected in series and between the grid tank condensers 8 and 9 which provides the tuning of the grid circuit. The tuned plate circuit includes an inductance 15, the outer ends of which are connected to the output anode electrodes 16 and 17 of the electron discharge tubes 1 and 2. Inductance 15 is provided with a midpoint connection 18 which is maintained at a positive anode potential from any suitable D. C. source indicated at 19. There is connected in parallel with inductance 15 two variable condensers 20 and 21 which are simultaneously varied by suitable means indicated at 22. The screen grids 23 and 24 of electron discharge tubes 1 and 2 are connected together and maintained at a suitable positive potential by being connected to a D. C. source 25. The cathodes 26 and 27 of tubes 1 and 2 are maintained at the proper operating potential by being connected to a source of potential 28. A bypass condenser 29 is connected from one of the cathode leads to the connection between the screen grids 23 and 24. Since the electron discharge tubes shown include screen grids, feedback energy from the plate tank inductance coil 15 is obtained by means of coupling coils 30 and 31. Also, if it is desired to use three-element tubes in this circuit, neutralization can be obtained by providing suitable regeneration condensers. In the operation of this circuit there will be substantially no oscillations which can be built up in the grid tank circuit unless the frequency is such that it can pass through the crystal. With this improved circuit, it will be seen that it is difficult for the circuit to oscillate at any other frequency except that of the one desired frequency, and, therefore, the system as shown by Fig. 1 will result in an improved push-pull arrangement of a crystal oscillator or oscillation generator which is useful in a radio frequency signaling system.

The modification shown by Fig. 2 is somewhat similar to the circuit shown by Fig. 1 except that the crystal 11 is connected in series between the two feedback coupling coils 33 and 34 which are coupled to the grid tank inductance coil 15. A resistor 35 is placed in parallel with coupling coils 33 and 34 and crystal 11 to make it more difficult for the crystal to oscillate at any frequency different from that of the desired frequency. In the operation of this improved circuit substantially no coupling can be obtained between the anode and the grid tank circuits except at the desired frequency which will pass through the crystal so that oscillations can occur

only at crystal frequency. Also in this circuit three-element tubes may be used by providing neutralizing condensers to neutralize the plate and grid capacities. Also, if desired, conductive coupling may be employed in place of the coupling coil 31.

While we have indicated and described a system for carrying our invention into effect, it will be apparent to one skilled in the art that our invention is by no means limited to the particular organization shown and described, but that many modifications may be made without departing from the scope of our invention, as set forth in the appended claims.

What we claim is:

1. An oscillation generator comprising a pair of electron discharge devices connected in push-pull relationship, each electron discharge device having at least a control grid, an anode and a cathode, a tuned grid circuit, a tuned plate circuit, an inductive coupling means between said tuned grid and tuned plate circuit, a piezo-electric crystal, said tuned grid circuit including two impedance devices, different impedance device being connected between each one of the grids of said electron discharge devices and opposite terminals of said piezo-electric crystal, so that the crystal will act as a very narrow band pass filter and thereby hold the generator oscillations to substantially one frequency as determined by the characteristics of said crystal.

2. An oscillation generator comprising a pair of electron discharge devices connected in push-pull relationship, each electron discharge device having at least a control grid, an anode and a cathode, a tuned grid circuit, a tuned plate circuit, an inductive coupling means between said tuned grid and tuned plate circuit, a piezo-electric crystal, said tuned grid circuit including two impedance devices, different impedance device being connected between each one of the grids of said electron discharge devices, and opposite terminals of said piezo-electric crystal, and a resistance device connected in parallel with said crystal whereby the desired generator frequency is maintained at substantially one frequency by the crystal acting as a very narrow band pass filter and to prevent the generator from oscillating at any undesired frequencies.

3. A push-pull oscillator comprising a pair of electron discharge devices each having a control grid, a screen grid, a cathode and an anode, a tuned grid circuit, a tuned plate circuit, an inductive coupling means between said tuned grid and said tuned plate circuit, the screen grids of each electron discharge device being connected together and to a source of positive potential, a piezo-electric crystal having an electrode located at each side thereof, said tuned grid circuit including two condensers, each one of said condensers being connected to each one of the grids of said electron discharge devices and in series between said grids and each one of said electrodes of said piezo-electric crystal so that the oscillating grid circuit current passes through said crystal to prevent the circuit from oscillating at frequencies other than the desired fundamental crystal frequency.

4. A push-pull oscillator comprising a pair of electron discharge devices each having a control grid, a screen grid, a cathode and an anode, a tuned grid circuit, a tuned plate circuit, an inductive coupling means between said tuned grid and said tuned plate circuit, the screen grids of each electron discharge device being connected together and to a source of positive potential, a piezo-electric crystal having an electrode located at each side thereof, said tuned grid circuit including two condensers, each one of said condensers being connected to each one of the grids of said electron discharge devices and in series between said grids and each one of said electrodes of said piezo-electric crystal, and a resistance connected in parallel with said crystal electrodes so that the oscillating grid circuit current passes only the desired fundamental frequency through said crystal to prevent the circuit from oscillating at undesired frequencies.

5. A push-pull oscillator comprising a pair of electron discharge devices each having a control grid, a screen grid, a cathode and an anode, a tuned grid circuit, a tuned plate circuit, an inductive coupling means between said tuned grid and said tuned plate circuit, the screen grids of each electron discharge device being connected together and to a source of positive potential, a piezo-electric crystal having an electrode located at each side thereof, said tuned grid circuit including two variable condensers, each one of said condensers being connected to each one of the grids of said electron discharge devices and in series between said grids and each one of said electrodes of said piezo-electric crystal so that the oscillating grid circuit current passes through said crystal to prevent the circuit from oscillating at frequencies other than the desired fundamental frequency.

6. A push-pull oscillator comprising a pair of electron discharge devices each having a control grid, a screen grid, a cathode and an anode, a tuned grid circuit, a tuned plate circuit, an inductive coupling means between said tuned grid and said tuned plate circuit, the screen grids of each electron discharge device being connected together and to a source of positive potential, a piezo-electric crystal having an electrode located at each side thereof, said tuned grid circuit including two variable condensers, each one of said condensers being connected to each one of the grids of said electron discharge devices and in series between said grids and each one of said electrodes of said piezo-electric crystal, and a resistance connected in parallel with the electrodes of said crystal so that the oscillating grid circuit current passes only the desired fundamental frequency through said crystal to prevent the circuit from oscillating at undesired frequencies.

7. In a signaling system including a push-pull oscillator comprising a pair of electron discharge devices each having at least an anode, a grid, a screen grid and cathode electrodes, a tuned grid circuit including an inductance having its outer ends connected to the grids of said electron discharge devices, a tuned plate circuit including an inductance having its outer ends connected to the anodes of said electron discharge devices, a midpoint tap connected to the inductance coils of both said grid and plate circuits, the screen grids of each electron discharge device being connected together and to a source of positive potential, a coupling coil coupled to each half of said inductance coil which is connected to said grid circuit, a piezo-electric crystal having its electrodes connected in series between the inductance coils which are coupled to said tuned grid circuit, and the third inductance coil connected in series between the first and second mentioned coupling coils and inductively coupled to a portion of said tuned plate circuit, the arrangement

being such that the crystal will not oscillate at any undesired frequency.

8. In a signaling system including a push-pull oscillator comprising a pair of electron discharge devices each having at least an anode, a grid, a screen grid, and cathode electrodes, a tuned grid circuit including an inductance having its outer ends connected to the grids of said electron discharge devices, a tuned plate circuit including an inductance having its outer ends connected to the anodes of said electron discharge devices, a mid-point tap connected to the inductance coils of both said grid and plate circuits, the screen grids of each electron discharge device being connected together and to a source of positive potential, a couping coil coupled to each half of said inductance coil which is connected to said grid circuit, a piezo-electric crystal having its electrodes connected in series between the inductance coils which are coupled to said tuned grid circuit, and the third inductance coil connected in series between the first and second mentioned coupling coils and inductively coupled to a portion of said tuned plate circuit, a resistor connected in parallel between the first and second mentioned coupling coils, the arrangement being such that the crystal will not oscillate at any undesired frequency.

9. An oscillation generator comprising a pair of electron discharge devices, each having an anode, a cathode and a grid, a tuned circuit connected between the anodes of said electron discharge devices, said circuit including an inductance coil, a feed-back path for feeding waves from said tuned circuit in opposition to the grids of said electron discharge devices, said feed-back path being provided with a coil which is inductively coupled to the coil of said tuned circuit, a crystal connected between points of opposite instantaneous polarity in said feed-back path, a resistance connected in shunt to said crystal, said resistance being so dimensioned as to prevent the generation of oscillations when the crystal is removed from the circuit.

10. An oscillation generator comprising a pair of electron discharge devices, each having an anode, a cathode and a grid, a tuned circuit connected between the anodes of said electron discharge devices, said circuit including an inductance coil, a feed-back path for feeding waves from said tuned circuit in opposition to the grids of said electron discharge devices, said feed-back path being provided with a coil which is inductively coupled to the coil of said tuned circuit, a crystal connected between points of opposite instantaneous polarity in said feed-back path, a resistance path connected across the electrodes of said crystal to prevent the circuit from osillating when the crystal is not oscillating.

11. An oscillator comprising an electron discharge device having a control grid, a screen grid, a cathode and an anode, a tuned grid circuit, a tuned plate circuit, an inductive coupling means between said tuned grid and said tuned plate circuit, the screen grid of said electron discharge device being connected to a source of positive potential, a piezo-electric crystal having an electrode located at each side thereof, said tuned grid circuit including a condenser which is connected to the grid of said electron discharge device and in series between said grids and each one of said electrodes of said piezo-electric crystal so that the oscillating grid circuit current passes through said crystal to prevent the circuit from oscillating at frequencies other than the desired fundamental crystal frequency.

12. An oscillator comprising an electron discharge device having a control grid, a screen grid, a cathode and an anode, a tuned grid circuit, a tuned plate circuit, an inductive coupling means between said tuned grid and said tuned plate circuit, the screen grid of said electron discharge device being connected to a source of positive potential, a piezo-electric crystal having an electrode located at each side thereof, said tuned grid circuit including a condenser which is connected to the grid of said electron discharge device and in series between said grids and each one of said electrodes of said piezo-electric crystal, and a resistance connected in parallel with said crystal electrodes so that the oscillating grid circuit current passes only the desired fundamental frequency through said crystal to prevent the circuit from oscillating at undesired frequencies.

13. An oscillation generator comprising an electron discharge device, having an anode, a cathode and a grid, a tuned circuit connected to the anode of said electron discharge device, said circuit including an inductance coil, a feed-back path for feeding waves from said tuned circuit to the grid of said electron discharge device, said feed-back path being provided with a coil which is inductively coupled to the coil of said tuned circuit, a piezo-electric crystal having an electrode located each side thereof, said crystal having said electrodes connected to the coil in said feed-back path, a condenser connected between said coil in the feed-back path and at least one electrode of said crystal, a resistance having its terminals conductively connected to the electrodes of said crystal, said resistance being so dimensioned as to prevent the generation of oscillations when the crystal is removed from the circuit and means for coupling said crystal to said grid.

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