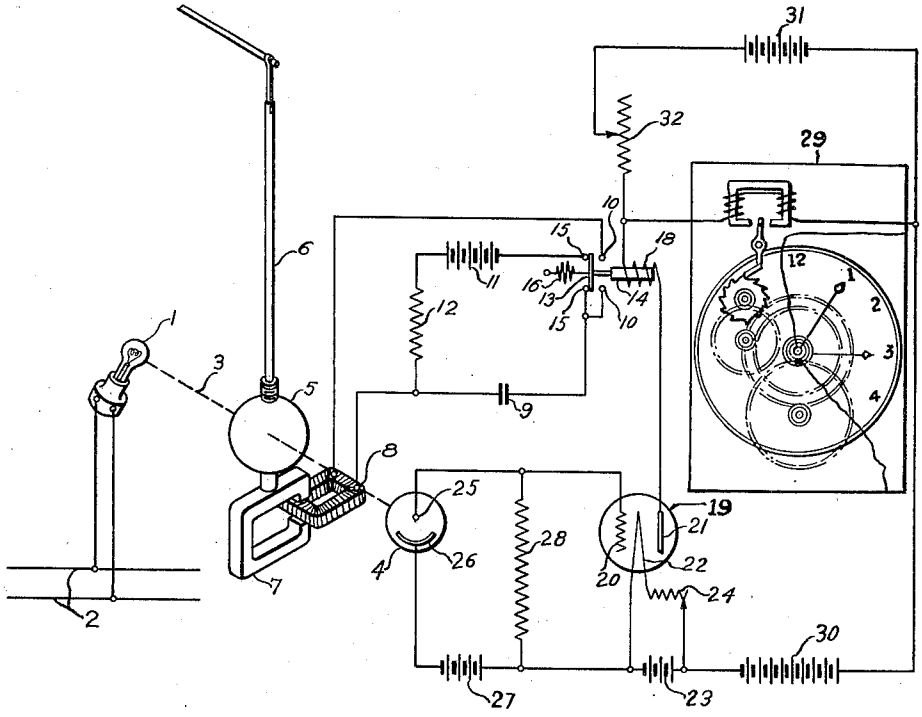
Aug. 21, 1934. V. E. TROUANT 1,971,086

STANDARD FREQUENCY APPARATUS

Filed Oct. 11, 1929



INVENTOR

Virgil E. Trouant

BY

ATTORNEY

Patented Aug. 21, 1934 1,971,086

UNITED STATES PATENT OFFICE

1,971,086

STANDARD-FREQUENCY APPARATUS

Virgil E. Trouant, Wilkinsburg, Pa., assignor to Westinghouse Electric & Manufacturing Company, a corporation of Pennsylvania

Application October 11, 1929, Serial No. 399,008

6 Claims. (Cl. 58—24)

My invention relates to standard-frequency apparatus and more particularly to automatic-electric clock systems.

My invention has for an object the provision of a master-clock pendulum for controlling one or more secondary clocks, and means whereby the use of electrical contacts on the pendulum is avoided.

Another object of my invention is to operate the secondary clocks of an automatic-electric-clock system from a master-clock pendulum without the use of relays or contactors in the circuit of the secondary clocks.

A further and the fundamental object of my invention is to increase the reliability and simplify the standard-frequency apparatus of automatic-electric-clock systems.

A still further object of my invention is to provide novel means for operating a polarized mechanism without the aid of mechanical relays.

My invention is related to, and is an improvement upon, the subject matter of the copending application for Letters Patent, Serial No. 176,061, filed March 17, 1927, now Patent No. 1,911,062 of May 23, 1933 of Frank Conrad for an improvement in electric clocks.

In the apparatus disclosed in the above noted application, for satisfactory operation of the master clock, the pendulum contacts and the secondary relay and its contacts must have perfect regularity and reliability of operation. The purpose of my invention is to improve the operation of systems of this type by the elimination of the pendulum contacts and the secondary relay and its contacts, thereby increasing the reliability and accuracy of the system.

In the apparatus of the above application, the secondary-clock mechanisms are polarized and require, therefore, a reversal of current to cause the operation thereof. By my invention, the current through the secondary-clock mechanisms is reversed without the use of mechanical relays and their associated contacts.

My invention is discolsed in the following description that is to be read in connection with the accompanying drawing, in which the single figure is a schematic diagram of an electric-clock system constructed in accordance with my invention.

Referring to the drawing, a source of light 1, such as an ordinary incandescent lamp, energized from a suitable electric circuit 2, is mounted so that a beam 3 of light therefrom is projected upon a photo-electric cell 4. The beam of light energizes the cell 4 until it is intercepted by a bob 5 of a swinging pendulum 6 constituting a part of the master clock (not shown). The bob 5 is disposed to intercept the beam of light 1 to thereby deenergize the photo-electric cell 4, as the bob reaches one of the limiting positions of its oscillatory movement. The pendulum 6 is normally biased, as by gravity, to maintain the bob 5 out of the path of the light beam.

The amplitude of the oscillatory swing of the pendulum is maintained constant by means of a magnetic member 7 of C-shape secured thereto for cooperation, at one end of the pendulum swing, with a stationary coil 8. The coil 8 is connected in series-circuit relation with a condenser 9 and the contacts 10 of an electromagnetic relay 14, as indicated. Additional contacts 15, which are disposed to be engaged by the armature 13 of the relay 14 when moved out of engagement with the contacts 10, control the completion of a shunt circuit including said condenser 9, a battery 11 or other suitable source of electromotive force, and a reactor 12.

The relay armature 13 is controlled by a winding 18 which is periodically energized, as hereinafter described, to move the armature into engagement with the contacts 10, in opposition to the force exerted by a spring 16. When the coil 18 is deenergized, the relay contacts 15 are bridged by the armature 13, and the condenser 9 is charged by the battery 11. When coil 18 is energized, however, the armature is moved away from contacts 15 and into engagement with contacts 10, thereby completing a circuit through winding 8 to permit the discharge of condenser 9 therethrough. The resultant energization of the winding 8 occurs when the pendulum magnet 7 is adjacent thereto, and exerts an attractive force to maintain the amplitude of swing of said pendulum substantially constant.

The photo-electric cell 4 controls the relay 14 through the medium of a vacuum tube 19 having the usual grid 20, plate 21 and filament 22. The latter is heated by an A battery 23 through a variable resistor 24. One element 25 of the photo-electric cell 4 is connected to the grid 20 and the other element 26 of the cell 4 is connected to the filament 22 through a C battery 27. A resistor 28, connected across the grid 20 and the filament 22, is of such resistance that, when the photo-electric cell 4 is energized, the C battery 27 decreases the negative bias on the grid 20 to thereby cause operation of the tube 19.

The circuit of the plate 21 of the vacuum tube includes the coil 18 of the relay 14, a clock 29 having a polarized operating mechanism of a usual type, a B battery 30 and the filament 22 in series-circuit relation. A positive change in the bias of the grid 20 produces an electric impulse from the B battery 30 through the plate circuit to energize the winding 18 of relay 14 and the polarized mechanism of the clock 29.

The polarized characteristic of the clock 29 is obtained by a battery 31 in series-circuit relation with a variable resistor 32. The batteries 30 and 31 are so connected in circuit that the clock mechanism is normally energized to operate in one direction by the battery 31 but such energization is changed to the opposite direction by the battery 30 when the grid bias of the tube 19 is changed.

In operation, the lamp 1 throws a beam of light 3 on the photo-electric cell 4, causing it to decrease the negative bias on the grid 20. The tube 19 thereupon becomes conductive, and the B battery 30 sends a current through the plate circuit to operate the relay 14 and the polarized mechanism of the clock 29. The operation of the relay 14 causes the relay armature 13 to move away from the contacts 15 and into engagement with the contacts 10. Bridging the contacts 10 causes the condenser 9 to discharge through the coil 8, thereby attracting the magnetic member 7 to a position where the bob 5 on the pendulum 6 intercepts the beam of light from the source 1 and, consequently, deenergizes the photo-electric cell 4. This re-establishes the negative bias on the grid 20 and breaks the conducting path of the plate circuit. The relay 14 is thereupon deenergized, and the relay spring 16 moves the armature 13 away from the contacts 10 and into engagement with the contacts 15. At the same time, the polarized mechanism of the clock 29 is operated in the opposite direction by the battery 31.

The coil 8 is deenergized by the separation of the armature 13 from contacts 10 to permit the pendulum 6 and its bob 5 to swing out of the path of the light beam 3. The photo-electric cell is thereupon again energized by the beam of light, and the above cycle is repeated, the pendulum swinging back and forth at a uniform, predetermined and substantially constant frequency.

Only a single secondary clock 29 is shown, by way of example, it being clear to those skilled in the art that any desired number of secondary clocks may be embodied in the above-described system. Also, the pendulum 6 normally constitutes a part of, and operates, a master clock which, for clarity of illustration, is not shown.

It will be observed that I have obviated all mechanical electrical contacts in connection with the pendulum 6, and that no relays are used in the secondary clock circuit. These changes provide a more simple and reliable electrical-clock system than has been possible in prior practice.

It will be apparent to those skilled in the art that changes and modifications may be made in my invention without departing from the spirit and scope thereof, and I desire, therefore, that only such limitations shall be placed thereon as are imposed by the prior art and set forth in the appended claims.

I claim as my invention:

1. The combination with a three-element thermionic tube, and means including a photo-electric cell and a pendulum for altering the grid bias on said tube periodically, of a clock having a polarized operating mechanism in electric-circuit relation with the filament and plate of said tube, means for energizing said operating mechanism in one direction and means in said plate circuit for energizing said operating mechanism in the other direction in accordance with the frequency of the change of said grid bias.

2. The combination with a clock having a polarized relay for effecting its operation, means normally biasing said relay to one position and means including a tube relay device for periodically overcoming said biasing means and operating said polarized relay to another position.

3. In an electric-clock system, a secondary clock, a polarized relay for effecting the operation of said clock, means normally biasing said relay to one position and means for periodically causing said polarized relay to be operated to a second position, said last-mentioned means including an electronic device having an output circuit in which is connected said polarized relay and a source of energy, and means, for periodically causing said electronic device to operate to cause said polarized relay to move to the second position in accordance with a standard of frequency, including a pendulum having a substantially standard period of oscillation, a photo-electric cell, a light source for directing a beam of light across the path of movement of a portion of said pendulum upon said cell, whereby said cell is deenergized when the beam of light is intercepted by said pendulum to cause said electronic device to be operated and said polarized relay to be moved to said second position.

4. The combination with a thermionic tube having a control circuit and an output circuit, and means including a photo-electric cell and a pendulum for periodically altering the control circuit of said tube, of a clock having an operating mechanism including a polarized relay, unidirectional voltage means of one polarity for sending an energizing current through said polarized relay in one direction, and a second unidirectional voltage means of another polarity for overcoming said first-mentioned unidirectional voltage means and sending an energizing current through said polarized relay in the opposite direction, said second unidirectional voltage means being in the output circuit of the tube whereby it is made effective in accordance with the frequency of the alterations in said control circuit.

5. In a timing device, the combination of a pendulum and actuating means adapted to effect a substantially constant amplitude of oscillatory movement of said pendulum, said actuating means including an electro-magnetic device disposed adjacent the path of movement of said pendulum for magnetic association therewith, a condenser, and means for periodically causing said condenser to be charged and discharged through said electromagnetic device, including a source of light adapted to have a beam of light therefrom periodically intercepted by the said pendulum during its movement, a light-sensitive means adapted to be energized and deenergized in response to said beam of light, and means operably responsive to said light-sensitive device for effecting said discharge of said condenser through said electro-magnetic device.

6. In a timing device, the combination of a

pendulum and actuating means adapted to effect a substantially constant amplitude of oscillatory movement of said pendulum, said actuating means including an electro-magnetic device disposed adjacent the path of movement of said pendulum for magnetic association therewith, a condenser, and means for effecting alternately the charging of said condenser and the discharging of said condenser through said electro-magnetic device, including a source of light adapted to have a beam of light therefrom periodically intercepted by said pendulum during its movement, a light-sensitive device adapted to be energized by the beam of light and deenergized when said pendulum intercepts the beam of light, and means operably responsive to energization of said light sensitive means for effecting the charging of said condenser and operably responsive to deenergization of said light sensitive means for effecting the discharge of said condenser.

VIRGIL E. TROUANT.