Sept. 14, 1937. L. K. SWART 2,092,861

OSCILLATION GENERATING CIRCUITS INCLUDING GAS-FILLED TUBE

Filed July 22, 1936

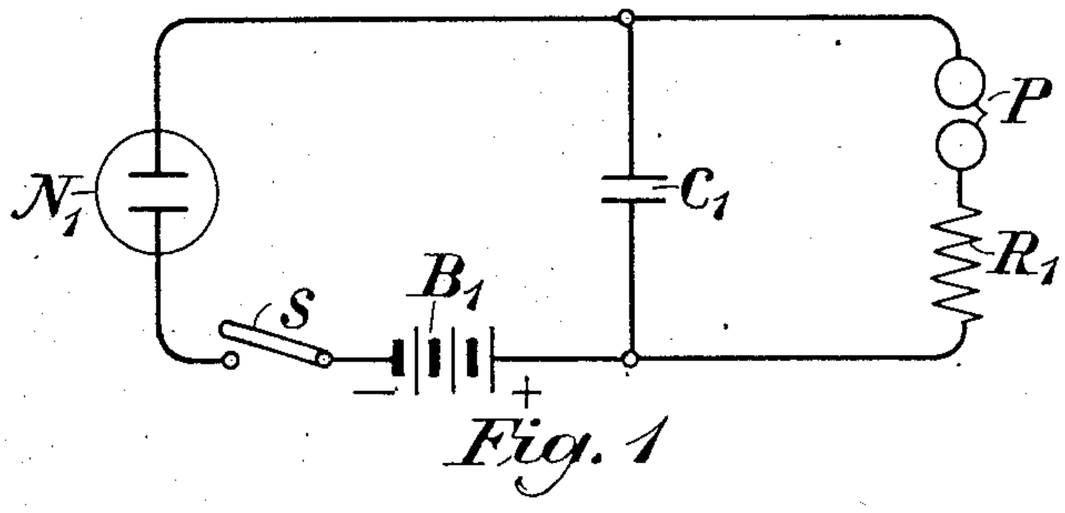

Fig. 1

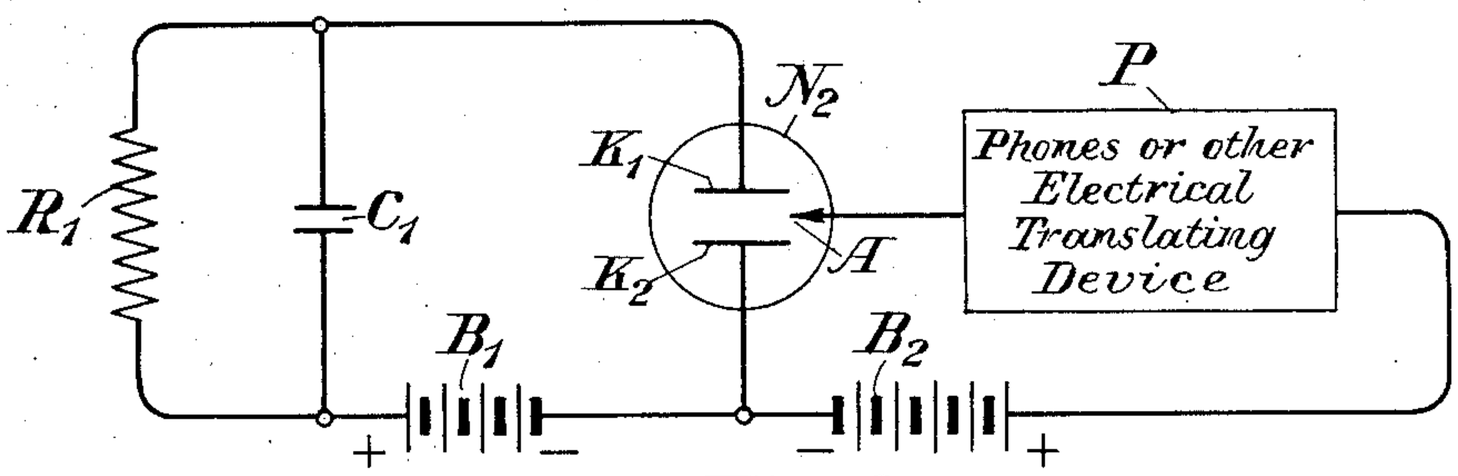

Fig. 2

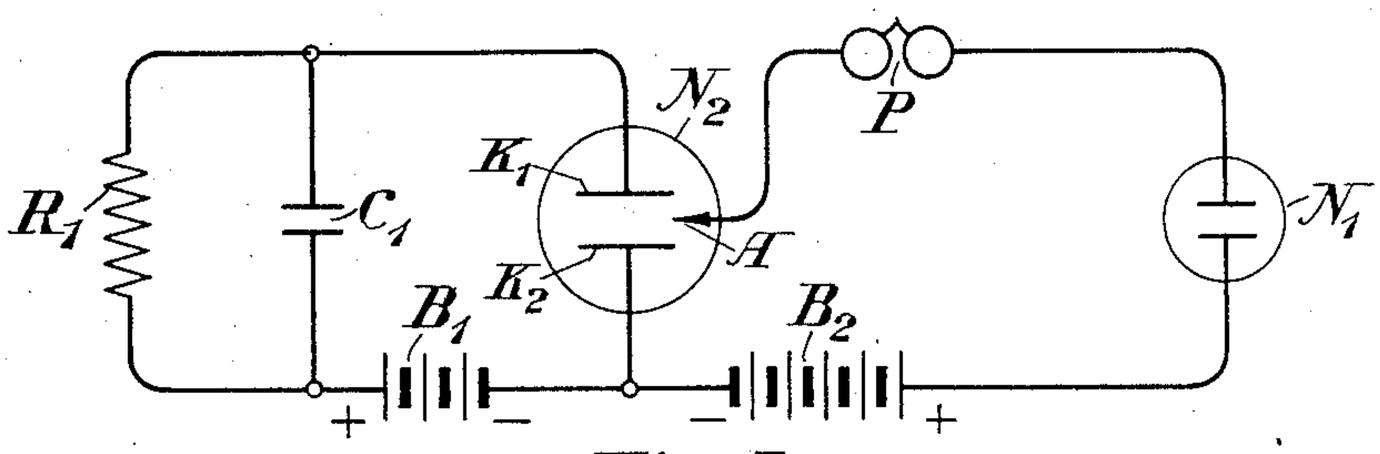

Fig. 3

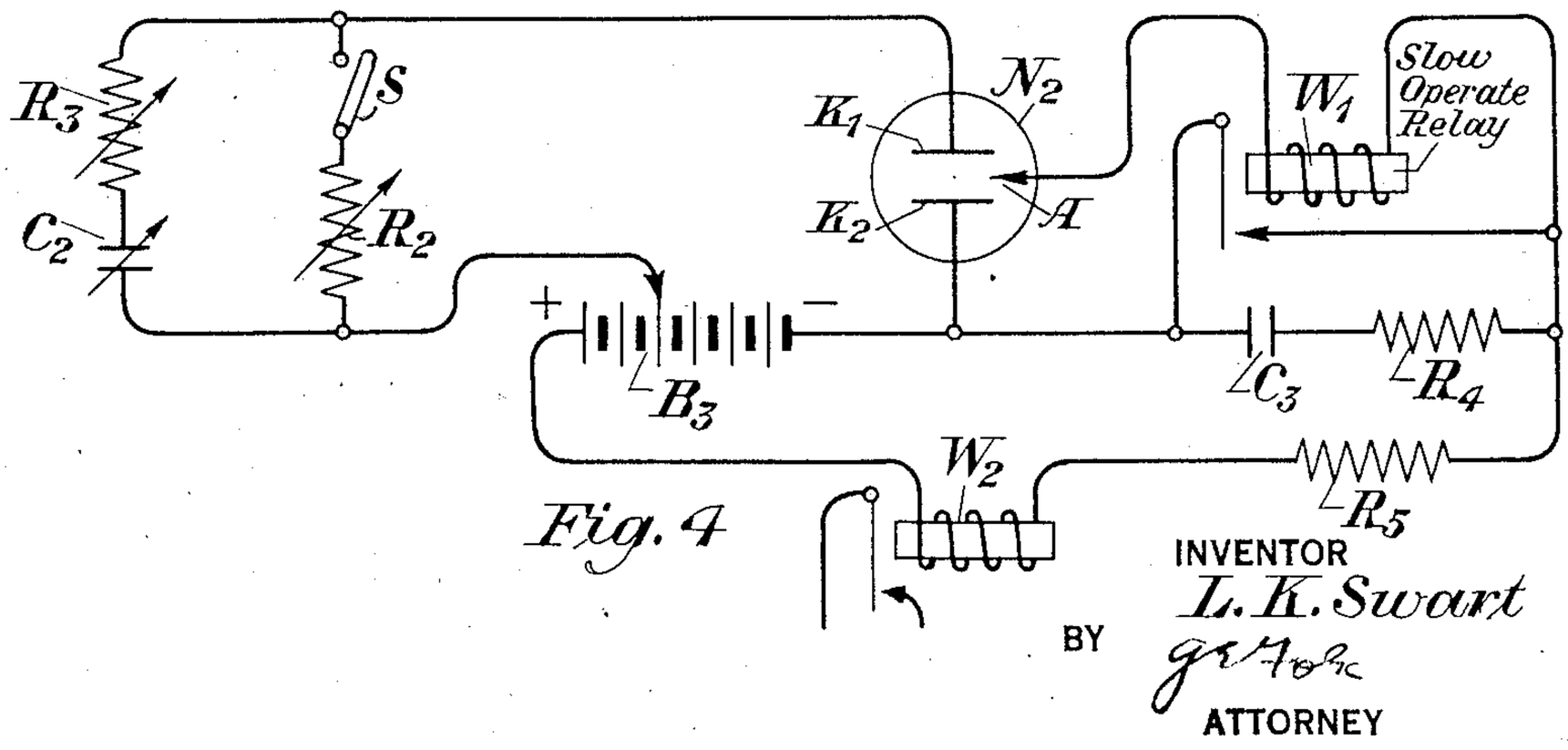

Fig. 4

INVENTOR
L. K. Swart

BY

ATTORNEY

Patented Sept. 14, 1937

2,092,861

UNITED STATES PATENT OFFICE

2,092,861

OSCILLATION GENERATING CIRCUITS INCLUDING GAS-FILLED TUBE

Leland Kasson Swart, Mountain Lakes, N. J., assignor to American Telephone and Telegraph Company, a corporation of New York

Application July 22, 1936, Serial No. 91,977

5 Claims. (Cl. 175—320)

This invention relates to gas-filled tubes and to circuits therefor. This invention also relates to time control circuits and apparatus. This invention further relates to oscillation generating circuits.

This invention may be briefly described as involving a relatively simple method of operating a relay or other control device automatically and periodically. It is possible to arrange a circuit having two adjustable factors or components which, when varied, will correspondingly adjust the time intervals between periodical operations of the circuit. Such an arrangement may automatically control a machine so that it may operate intermittently but at a constant rate. This rate, however, may be varied at will to give an operating range from several operations per minute, for example, to, let us say, one operation in several minutes. According to the present invention the sequence of operations will be automatic and the device will function indefinitely and will require only an occasional replacement or replenishment of the batteries or other elements employed for supplying current or voltage.

The circuit or circuits involved in this invention may be employed to produce audible pulses or tones. But it will be understood that the frequencies of the currents produced need not be within the audible range but may obviously be below the audible range or above the audible range extending to any desired high frequency.

This invention will be better understood from the detailed description hereinafter following, when read in connection with the accompanying drawing, in which Figure 1 represents one embodiment of the invention applied to a single cold cathode tube having but two electrodes; Fig. 2 is a modification of the invention applied to a gas tube with three electrodes; Fig. 3 shows an arrangement having two gas tubes; and Fig. 4 shows a further modification of the invention applied to a single tube having three electrodes.

Referring to Fig. 1 of the drawing, the reference character N_1 designates a two-element cold cathode gas-filled tube connected in series with a switch S, a battery or generator B_1, and a parallel combination including a condenser C_1 in one branch, and a resistor R_1 and a telephone receiver P or other translating device in the other branch. The voltage of the battery or generator B_1 should be somewhat in excess of the ionizing voltage of the tube N_1. The condenser C_1 may be of relatively small capacity. The resistor R_1 should be of a high value; for example, one or more megohms.

The gas within the tube N_1 will be automatically ionized and deionized at constant intervals of time, this interval being a function of the values of the condenser C_1 and the resistor R_1. By decreasing the capacity of the condenser C_1 the interval between operations will be reduced. Any increase of the resistance of the resistor R_1 will, however, increase this interval between operations.

Upon the closure of the switch S, the tube N will fire and the condenser C_1 will charge until it reaches a voltage at charge equivalent to the difference between the voltage of the battery of generator B_1 and the voltage for sustaining gaseous ionization between the electrodes of the tube N_1. Assuming, for example, that the battery or generator B_1 is of 90 volts and that the sustaining voltage of the tube is 53 volts, then the condenser C_1 may be charged to a voltage of 37 volts—the difference between the battery voltage of 90 volts and the sustaining voltage of 53 volts. As soon as this voltage at the condenser C_1 is reached, the gas within the tube N becomes deionized and its glow extinguished. The condenser C_1 starts to discharge through the circuit of the resistor R_1 and the receiver P or other translating device.

The condenser will continue to discharge until it reaches a point at which the potential of the battery or generator B_1 is greater than the residual charge on the condenser C_1 by a voltage which is equal to the ionizing or breakdown voltage of the gas within the tube N_1. The tube will then fire again and the condenser C_1 will once more start to charge. This cycle will repeat itself indefinitely—assuming the voltage of the generator or battery B_1 to remain constant—and continue indefinitely until the circuit is opened at the switch S.

The ionizing and deionizing of the gas within the tube N_1 will be accompanied by corresponding clicks in the receiver P or corresponding current pulses in an equivalent translating device employed instead of the receiver P. It will be obvious, of course, that the cycle may be adjusted by changing the capacity of the condenser C_1 or by changing the resistance of the resistor R_1 so that the clicks in the phones P may appear as audible tones.

Fig. 2 shows the arrangement applied to a three-element cold cathode gas tube N_2. The cathodes K_1 and K_2 of the tube N_2 are connected to the resistor R_1 and condenser C_1 arranged in parallel relationship as in Fig. 1 and in series with the battery or generator B_1. The anode or

work circuit of the tube N_2 includes the electrode or anode A, the phones or other translating device P, another battery or generator B_2, and the cathode K_2.

The firing circuit of tube N_2 includes the resistor R_1, the condenser C_1, and a source of potential B_1 as in Fig. 1. This circuit is a trigger circuit for periodically ionizing the gas between electrodes or cathodes K_1 and K_2 of the tube N_2.

Whenever the gas between electrodes or cathodes K_1 and K_2 of tube N_2 becomes ionized, the impedance between the anode A and the cathode K_2 will become reduced to a low value and current will then freely flow from the battery or generator B_2 through the phones or other translating device P and through the path between the anode A and cathode K_2 of the tube N_2. This will operate the device P of the work circuit. When this work circuit is operated it will continue to pass current from the battery or generator B_2 until the circuit is effectively opened thereafter for an interval of time sufficient to enable the gas within the tube N_2 to become deionized. The apparatus required for resetting the tube N_2 and its circuit may be any well known resetting arrangement which may be incorporated into the circuit as, for example, the one shown in Fig. 7 of my Patent No. 1,977,256, issued October 16, 1934.

As in Fig. 1 the potential of the source B_1 is greater than the voltage required to initiate ionization of the gas between the electrodes K_1 and K_2 of the tube N_2. The potential between the latter electrodes will fluctuate periodically between the voltage exceeding this ionization-initiating potential and another voltage which is below the sustaining voltage value between the same electrodes, and the period of the voltage alternations will be determined by the magnitudes to which the resistor R_1 and condenser C_1 have been adjusted. Electrical oscillations or current pulses will flow through the device P.

Fig. 3 is a modification of the arrangement of Fig. 2 in which the firing circuit of Fig. 3 is the same as that of Fig. 2, but the work circuit includes a two-element cold cathode gas tube N_1 in addition to the battery or generator B_2 and the phones or other electrical translating device P.

When the gas between the electrodes K_1 and K_2 of tube N_2 of Fig. 3 becomes ionized, the potential of the source B_2 will be sufficient to ionize the gas within the tube N_1 and transmit a current through tube N_1 and through the device P, and over the path between the anode A and the electrode K_2 of the tube N_2. This current will produce an audible click or current component in the device P.

If the battery or generator B_2 is of a voltage such that it is only slightly less than the sum of the sustaining voltage of the tube N_1 and the sustaining voltage between the anode A and cathode K_2 of the tube N_2, the circuit will automatically reset itself—without any additional resetting or deionizing circuit—as rapidly as the deionizing constants of the tubes will permit. The number of cycles per unit of time during which current pulses will be transmitted through the device P will be dependent upon the magnitudes to which the resistor R_1 and condenser C_1 have been adjusted, as in the case of the arrangement shown and described with respect to Fig. 2.

Fig. 4 illustrates a modification of the arrangement of Fig. 2 and provides periodical operation of relays W_1 and W_2 which are connected in the anode or work circuit of the tube N_2.

The firing circuit of the tube N_2 includes the cathodes K_1 and K_2 and that part of the battery or generator B_3 provided by the adjustable tap and the negative terminal of the device B_3 as well as the parallel circuit having in one branch the switch S and the adjustable resistor R_2, and in the other branch the adjustable resistor R_3 and the adjustable condenser C_2. The resistor R_3 regulates the amount of current flowing to the condenser C_2. The periodicity of the firing within the tube N_2 is determined in most part by the adjustments of the condenser C_2 and resistor R_2. The battery or generator B_3 is common to the firing circuit and the anode or work circuit of the tube N_2. The anode or work circuit of the tube N_2 includes the winding of the slow operate relay W_1, the resistor R_5, the winding of the relay R_2 and all of the battery or generator B_3. The relay W_2 is employed for controlling a circuit connected to its armature and contact.

The armature and contact of the relay W_1 are connected in a circuit to shunt the path between the anode A and cathode K_2 of the tube N_2 through the winding of the relay W_1, and this circuit is for the purpose of removing all effective potential from these electrodes of the tube N_2 immediately after each operation of the relay W_1. The condenser C_3 and resistor R_4, which are in series with each other and in shunt with the armature and make contact of relay W_1, prevent the building up of voltage across anode A and cathode K_2 superimposed on device B_3 to produce reionization of the gas within the tube. The latter arrangement is a resetting or deionizing circuit for the tube N_2 and is fully illustrated and described in my aforementioned patent, referred to hereinabove.

The value of the resistor R_3 should be relatively low. Its employment tends to prolong the period during which the tube remains ionized after the gas therein has become ionized. Aside from this the firing circuit proximates that already described with respect to Figs. 2 and 3.

Upon the closure of the switch S the gas between electrodes K_1 and K_2 of the tube N_2 will become ionized. Current will then flow from the battery or generator B_3 through the winding of the relay W_2, the resistor R_5, the winding of the slow operate relay W_1, and through the path between the anode A and the cathode K_2 of the tube N_2. This will cause relay W_2 to operate and thereby actuate the associated circuit and the equipment controlled by its armature and contact. A brief interval later the slow operate relay W_1 will also operate. Upon the closure of its make contact the potential between the anode A and the cathode K_2 of the tube N_2 will be reduced to a value well below the sustaining voltage value of these electrodes of the tube. The closure of this make contact of relay W_1 will also by-pass current flowing from the battery or generator B_3 through this make contact and its associated armature so that none of this current will then flow through the winding of the relay W_1. Consequently the relay W_1 will drop off. If the gas within the tube N_2 is not ionized at that time by virtue of lack of applied voltage of sufficient magnitude between electrodes K_1 and K_2, no further current will flow from the battery or generator B_3 through the anode or work circuit of the tube. This latter circuit will return to the normal condition in which the contact of the relay W_2 will be opened and will remain open

until the anode or work circuit is again operated thereafter. The time required for the slow operate relay W_1 to open and close its contact will always be greater than the time during which the gas between the cathodes K_1 and K_2 of the tube is and remains ionized.

By proper adjustment of the constants practically any desired operating times can be obtained.

While this invention has been shown and described in certain particular arrangements merely for the purpose of illustration, it will be understood that the general principles of this invention may be applied to other and widely varied organizations without departing from the spirit of the invention and the scope of the appended claims.

What is claimed is:

1. An oscillation generating circuit comprising a three-electrode cold cathode gas-filled tube, a two-electrode cold cathode gas-filled tube, a resistor, a condenser connected in shunt with said resistor, and two sources of potential one of which is connected in series with two electrodes of the three-electrode tube and with the shunt resistor and the condenser, the other source of potential being connected in series with the third electrode of the three-electrode tube and one of its other electrodes and with the electrodes of the two-electrode tube.

2. A timing system comprising a three-electrode cold cathode gas-filled tube, an adjustable condenser, an adjustable resistor in parallel with the adjustable condenser, a source of potential, part of which is connected in series with two of the electrodes of the tube as well as in series with the parallel condenser and resistor, a slow operate relay, a load device connected in series with the windings of the slow operate relay and with the source of said potential and with the third electrode and one of the other electrodes of said tube, and means for periodically deionizing the gas within the tube.

3. The combination of a gas-filled tube having three electrodes, a resistor, a source of voltage of a magnitude exceeding the voltage required to ionize the gas between two of the electrodes of the tube, said source being connected in series with said resistor and said two electrodes of the tube, a condenser connected in shunt with said resistor, and a circuit for periodically deionizing the gas within the tube, said circuit being connected between the third electrode and one of the other electrodes of the tube and including a second source of voltage and another gas-filled tube having a single pair of electrodes.

4. The combination of a gas-filled tube having a plurality of electrodes, variable resistance and capacitance elements connected in parallel with each other with respect to two of the electrodes of the tube, means for transmitting through said parallel elements a voltage sufficient to ionize the gas between said two electrodes of the tube, and means connected between the third electrode and one of the other electrodes of the tube for periodically deionizing the gas within the tube.

5. The combination of a gas-filled tube having three electrodes, parallel elements of resistance and capacitance, a source of voltage exceeding the value required to ionize the gas between two of the electrodes of the tube, said source being connected to said two electrodes through said parallel elements, and a circuit connected between the third electrode and one of the other electrodes of the tube for periodically deionizing the gas within the tube, said circuit including a second source of voltage and a second gas-filled tube.

LELAND KASSON SWART.