Feb. 19, 1924. 1,484,405

A. A. OSWALD

SIGNALING SYSTEM

Filed Jan. 12, 1920

Fig. 1.

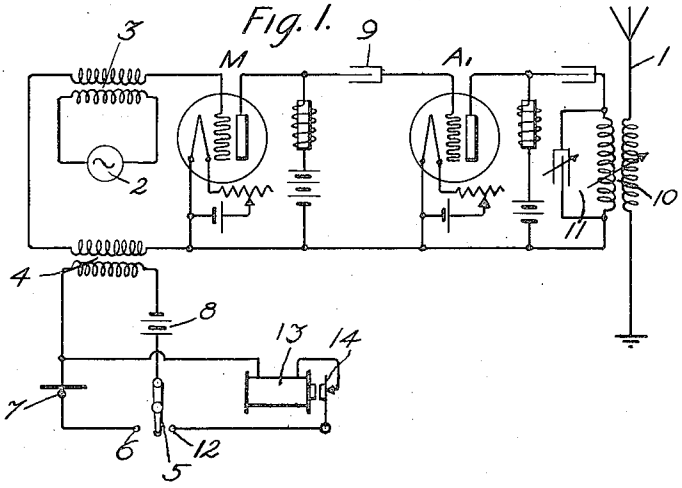


Fig. 2.

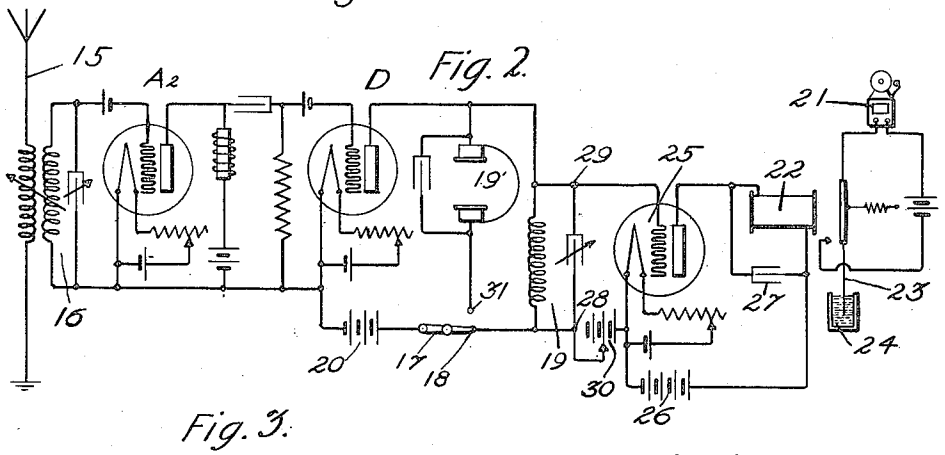


Fig. 3.

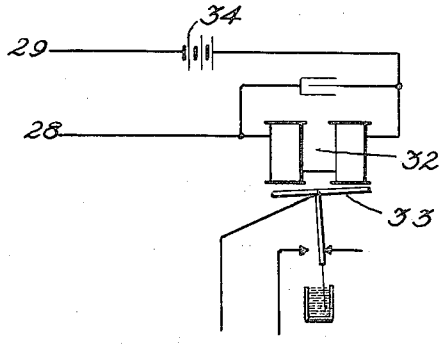
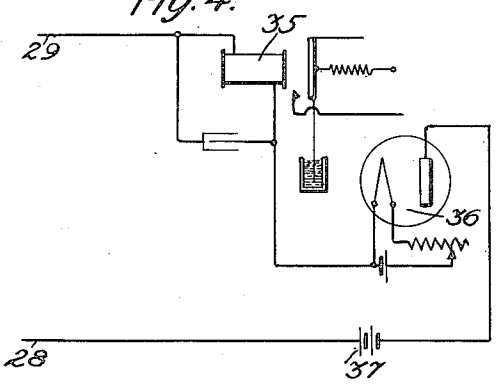


Fig. 4.



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UNITED STATES PATENT OFFICE.

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SIGNALING SYSTEM.

Application filed January 12, 1920. Serial No. 350,983.

To all whom it may concern:

Be it known that I, ARTHUR A. OSWALD, a citizen of the United States, residing at East Orange, in the county of Essex, State of New Jersey, have invented certain new and useful Improvements in a Signaling System, of which the following is a full, clear, concise, and exact description.

The present invention relates to signaling systems and is particularly adapted for use as a call-signal in a radio or other signaling system. The invention relates broadly to circuit arrangements for electrically controlling a distant responsive device and for preventing the device from being actuated or controlled by false signals or electrical disturbances whether the device is in a radio system or in some other electrical system.

An object of the invention is to provide a call-signal which will respond only to signaling currents intended for its actuation and which will positively cease to respond when the application of the signaling current ceases. A defect in the usual radio call-signal is that the signaling means is liable to respond to false signals such as atmospheric disturbances, or having been actuated by a signal current, it is liable to continue to respond after the signaling current ceases if disturbing current is present. This invention removes this difficulty by making the signal respond only to persistent current of given characteristics and by providing means requiring the application of current of practically the same strength to maintain the signal actuated as is necessary to initiate its response.

An embodiment of the invention in a radio-call system is illustrated in the accompanying Figs. 1 and 2; while Figs. 3 and 4 illustrate other ways of controlling the signal.

The system illustrated in Figs. 1 and 2 is a radio telephone system for transmitting speech from the station in Fig. 1 to the station in Fig. 2 and for causing a call-bell or other suitable signal at the station of Fig. 2 to be actuated.

The apparatus at the station in Fig. 1 comprises a transmitting antenna 1 to which the radio frequency generator 2 is electrically coupled through the medium of the vacuum tube modulator M and amplifier A_1. The generator 2 which may be of any suitable type, is coupled to the input circuit of modulator M by means of the inductive coupling 3. The input of the modulator is provided also with a coupling 4 for impressing signal or modulating waves upon the modulator. If the key 5 is thrown to the left to engage contact 6, a circuit is completed from battery 8 through the microphone transmitter 7 and the primary coil of the coupling 4 for impressing speech waves developed in the microphone 7 upon the modulator. With the key 5 in this position, a speech-modulated radio-frequency wave is produced in the output of modulator M and this passes through the large condenser 9 to the amplifier A_1, of any suitable type, from which it is impressed on the antenna through the coupling 10. Preferably a circuit 11 is provided in the output of this amplifier tuned to the frequency of the transmitted waves.

Prior to talking, it is desirable to transmit a signal to the distant station to indicate that the calling party is about to speak to the called station. Other uses of the call signal will also be obvious, such, for instance, as the transmitting of code messages when it is impossible or undesirable to transmit speech. This is accomplished by throwing key 5 to the right to engage contact 12, thereby including the buzzer 13 in circuit with the battery 8 to produce pulsating ringing current through the primary of coupling 4. By adjusting the stiffness of the vibrator spring 14 or in any other suitable manner, the buzzer may be made to interrupt its circuit at a definite and predetermined rate. A note of this frequency will be impressed on the modulator and the wave from source 2 will be modulated by the note of this frequency as long as contact 12 is engaged by the key. This wave will be amplified at A_1 and transmitted in the same manner as the voice waves.

At the station of Fig. 2, the transmitted waves are intercepted on the antenna 15 and currents of radio frequency are set up in the circuit 16 tuned to the frequency of the waves to be received. These currents are amplified by amplifier A_2, of any suitable type, and are impressed upon the detector D which is shown as being of the

usual thermionic type. In the output of the detector D is a key 17 which is normally closed against the lower contact 18, as shown. Key 17 may conveniently be a hook switch for supporting the receiver 19′ as is usual practice in wire telephony. When the station of Fig. 2 is idle and in position to be called, the output circuit of the detector will lead from the cathode of the detector through plate-battery 20, through key 17 and contact 18, the tuned circuit 19 and to the plate or anode of the detector. The circuit 19 is made resonant to the frequency to which the buzzer is tuned as explained, and is therefore selective to the frequency of the modulation component which is detected at D when the buzzer is used for transmission. This tuning to the buzzer frequency makes possible the selective actuation of a desired call-signal at one of a number of stations even though all of the stations use the same radio or carrier frequency for telephone transmission.

The call-signal 21, of any suitable type, which is to be actuated by current of the buzzer frequency in circuit 19, is controlled immediately by the relay 22, the armature of which is made slow to move by providing it with a vane projecting into a dash-pot 24. Any other means may be provided of which many are known for damping the motion of the armature. By this provision, a sustained current must be supplied to the relay 22 before the local circuit of signal 21 will be closed at the front contact of the relay.

Energy from the circuit 19 for operating the call-signal is conveyed to the relay 22 by means of a specially arranged discharge device 25 which may be, as shown, the well known three-element vacuum tube. The output of the tube contains a plate-battery 26 and the relay 22 in the usual manner. A small shunt condenser 27 is placed around the relay to make its operation more smooth. The input terminals of the discharge device are connected across the points 28, 29 of the tuned circuit 19 and the input circuit includes a source of potential 30 for making the grid of the discharge device negative. By proper adjustment of the negative voltage impressed on the grid from source 30, a certain minimum voltage must be set up between points 28 and 29 before current is transmitted to the relay 22. It is a property of an electromagnetic relay such as 22 to maintain its armature attracted under the application of less voltage to its windings than is required to attract its armature. By the use of the discharge device 25, as will hereinafter be described, the ratio between the current in the circuit 19 necessary to maintain the armature of relay 22 attracted, and the current in circuit 19 necessary to cause the relay 22 to pull up its armature may be made substantially unity. Assuming, for the moment, that this is true, the action of the receiving circuit will first be briefly described.

The buzzer-modulated wave is selectively received by circuit 16 and the wave of the buzzer frequency after being detected, is selectively transmitted through circuit 19. When this current in circuit 19 is of sufficient strength so that the potential of point 29 relative to the point 28 is positive notwithstanding the negative potential from source 30, transmission of energy through the tube 25 takes place. If the energy so transmitted is great enough, and if this transmission persists for the time limit for which the armature of relay 22 is set, the relay will be actuated and will operate the call-signal 21. When the call-signaling current in circuit 19 falls below the value necessary to maintain the transmission of energy through the device 25 or thereabouts, the relay 22 releases. The operator at the called station throws the key 17 to engage contact 31, by removing the receiver 19′ from the hook, or otherwise, and the receiver 19′ is substituted for the circuit 19 in the output of the detector D so that speech may be received. At the conclusion of the speech transmission switch 17 is again thrown to engage contact 18, by the restoration of receiver 19′, or otherwise, and the call signal is thus placed in position to be actuated.

Disturbing impulses, such as static, are usually of variable intensity and largely consist of sudden "splashes" of energy. Such a disturbance upon the antenna 15 impacts the circuit 16 and sets up therein a transient current of relatively short duration. This is amplified and detected. Although the detected current might contain incidentally a component of the frequency to which circuit 19 is tuned, the magnitude of such a component would be insignificant in comparison with the current required to operate the signal. All other components which reach circuit 19 will be highly attenuated. This selection, first of the radio frequency and then of the modulation frequency, results in discriminating against the nondescript disturbing currents to a considerable degree. The current in circuit 19, due to atmospherics being highly attenuated and of relatively short duration does not effect the complete energization of relay 22 and the call-signal is therefore prevented from being falsely actuated by such disturbances. If the relay 22 has been energized by signaling currents, the static disturbances will fail to maintain it energized by reason of the large voltage which the device 25 makes necessary to hold the relay armature attracted.

Assuming now that a current I_1 is required in the winding of relay 22 to cause

the attraction of the armature and that a current I_0 is just insufficient to maintain the armature attracted, the current-operating ratio is then $\frac{I_0}{I_1}$. Let e be the value of the voltage of source 30 which is just sufficient to reduce the current through the relay 22 to zero when there is no current impressed on circuit 19 from the detector D. Under these conditions, let E be the voltage necessary between points 28 and 29 to produce a current I_1 through the winding of relay 22 and let E_0 be the corresponding voltage to produce a current I_0 in the relay 22. The voltage-operating ratio of the relay as regards the voltage between points 28 and 29 is then $\frac{E_0}{E_1}$. If now the negative voltage e from source 30 be increased to $e+e_1$, the voltage-operating ratio becomes

$$\frac{E_0+e_1}{E_1+e_1}$$

which may be made as near unity as we please by making e_1 sufficiently large. It should also be noted that $\frac{E_0}{E_1}$, the voltage-operating ratio, is greater than $\frac{I_0}{I_1}$, the current-operating ratio, on account of the upward concavity of the characteristic curve of the three-element discharge device 25. It will be seen that this means of making the voltage ratio of the call-signal near unity whereby it releases for substantially the same value of applied voltage as is necessary to initiate its response, at the same time makes the call-signal marginal in its operation so that a voltage of a certain value must be exceeded in order to operate the signal.

In Fig. 3, a somewhat different means for controlling the signal is shown. This means consists of a polarized relay 32 having an armature 33 provided with a vane and dashpot similar to 23 and 24. The relay is to be connected into the circuit at points 28 and 29 as indicated and, included in the circuit of the relay, is a source 34 of voltage poled opposite to the direction of voltage necessary to cause the movement of the armature 33 to its marking position. If the voltage of source 34 is e_1, and if the voltage ratio of the relay 32 without the source 34 in its circuit is $\frac{E_0}{E_1}$, then the voltage ratio with the source 34 in circuit as shown is

$$\frac{E_0+e_1}{E_1+e_1}$$

which may be made near unity by making e_1 sufficiently large. Since relay 32 is polarized, if the circuit is closed across 28, 29, current flowing in the relay from source 34 will not actuate the relay because of the direction of the current flow.

In Fig. 4 still another means is shown for controlling the signal, the means being a neutral relay 35 having in its circuit a valve or rectifier 36 and a source of opposing voltage 37. The valve 36 prevents current from source 37 from affecting the relay and no current can be transmitted through valve 36 until the opposing voltage of 37 is overcome. The expression for the voltage ratio of the system is similar to that for the circuit of Fig. 3.

While the invention has been illustrated and described with particular reference to a specific circuit arrangement, it is understood that it is not to be limited to the particular circuit shown as a whole or to the specific details, but only by the scope of the appended claims.

What is claimed is:

1. In a radio signaling system, means for transmitting waves having a wave frequency and a signaling frequency, a receiving circuit tuned to the wave frequency, a detector for the received waves, a circuit in the output of said detector tuned to the signaling frequency, a slow-acting indicator actuated by current of signaling frequency in said circuit, and means including a source of opposing voltage for causing the indicator to cease to respond upon cessation of the signaling waves.

2. In a radio signaling system, means for transmitting a radio frequency wave modulated by a wave of signaling frequency, receiving circuits for selecting the modulated wave and detecting and selecting the wave of signaling frequency, a slow-acting indicator actuated by the wave of signaling frequency and means in circuit with said indicator for increasing the voltage-operating ratio of said indicator.

3. In a signaling system, a receiving circuit and a signal device controlled thereby, means for rendering said device slow-acting to prevent response to disturbing currents, and additional means connected in said circuit to increase the ratio of the release voltage to the actuating voltage of said device for signals impressed upon said circuit.

4. In a signal receiving circuit, a discharge device having an input and an output circuit, an indicator included in said output circuit, a source of current for said output circuit, and an opposing source of current for said input circuit normally causing the current in said output circuit to be zero for increasing the ratio of the release voltage to the actuating voltage of said indicator for received signals.

5. In a signaling system, a receiving circuit including a discharge device having an

input and an output circuit, an indicator and a source of voltage in said output circuit, means for increasing the ratio of the release voltage to the actuating voltage for received signaling current and for normally making the current in said output circuit zero, comprising an opposing source of voltage in said input circuit and means for causing actuating current to flow in said output circuit comprising a circuit for impressing signaling current upon said input circuit.

6. In a signal receiving circuit, an indicator and means for transmitting to said indicator signaling currents only exceeding a predetermined strength, comprising a discharge device having an output circuit including said indicator, and an input circuit coupled to said receiving circuit, and a source of current in said input circuit for increasing the voltage-operating ratio of said indicator.

7. In a signaling system, a circuit for conveying signaling currents, a signal controlled by said currents, and means for causing said signal to respond and to cease to respond to currents of relatively the same strength in said circuit comprising a discharge device for transmitting said currents from said circuit to said signal, said device having its input terminals coupled to said circuit and its output terminals coupled to said signal, and a source of voltage for said discharge device for preventing transmission through said device of currents in said circuit of less than a predetermined strength.

8. A signal receiver and a circuit for controlling said receiver including a discharge device having a cathode, an anode, and an impedance controlling element, said receiver being connected to said cathode and anode, means for varying the potential between said cathode and said impedance controlling element in accordance with signal currents and a source of voltage connected between said cathode and impedance controlling element for increasing the voltage-operating ratio of said receiver and for preventing transmission through said discharge device of all signaling currents delivered to said device of less voltage than the voltage of said source.

9. In a signal receiving circuit, a signal device, means in circuit with said device for making the voltage-operating ratio of said device near unity, and other means for rendering said device slow-acting.

10. In a signaling system, an indicator, means in circuit with said indicator for rendering it responsive initially only to applied voltage exceeding a predetermined value and for increasing the voltage-operating ratio of said indicator, and other means for rendering said indicator slow-acting.

11. In a signaling circuit, an indicator, means associated with said indicator for preventing its rapid initial response to increasing applied current, and means in circuit with said indicator for increasing the voltage-operating ratio of said indicator.

12. In a signaling circuit, an indicator, the response of which lags behind increasing applied current and the release of which lags behind decreasing applied current, means associated with said indicator for increasing the lag of its response and means in circuit with said indicator for decreasing the lag of its release.

13. In an indicating circuit, indicating means which responds differently to voltage variations of opposite directions, a source of voltage in circuit with said means for increasing the voltage-operating ratio of said indicating means, and means for damping the response of said indicating means.

In witness whereof, I hereunto subscribe my name this 7th day of January, A. D. 1920.

A. A. OSWALD.