Feb. 16, 1932. W. H. EDWARDS 1,845,017

TELEPHONE SIGNALING SYSTEM

Filed June 27, 1931

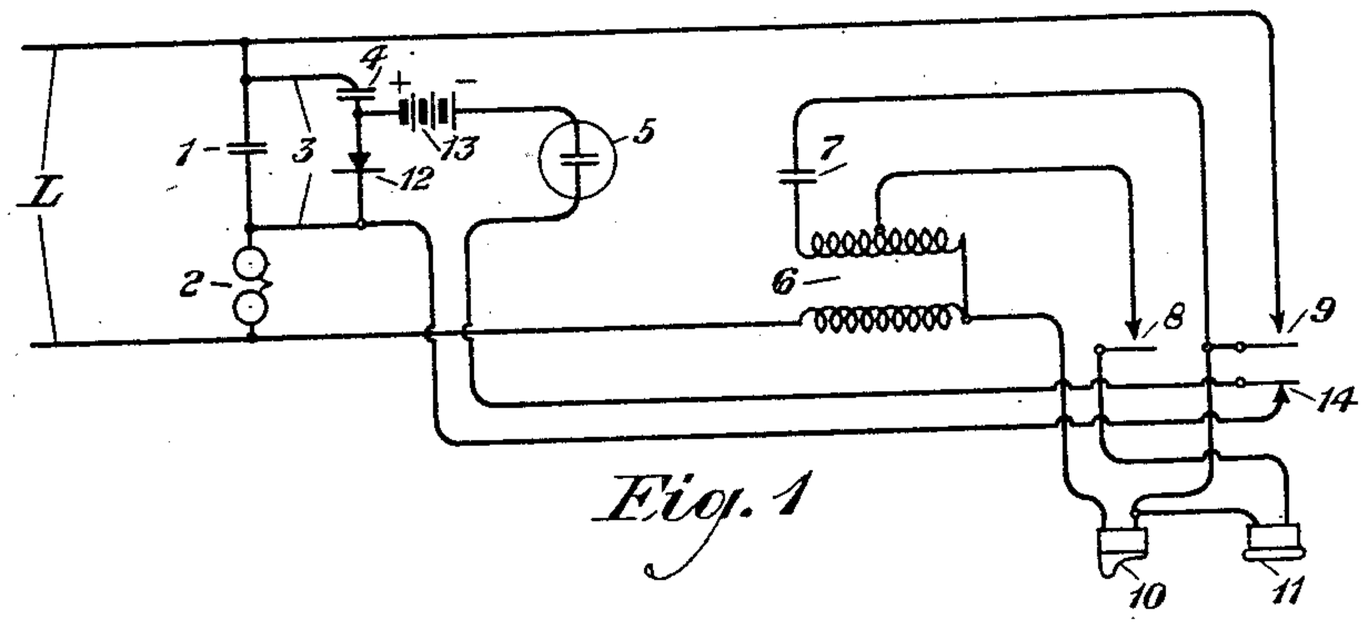

Fig. 1

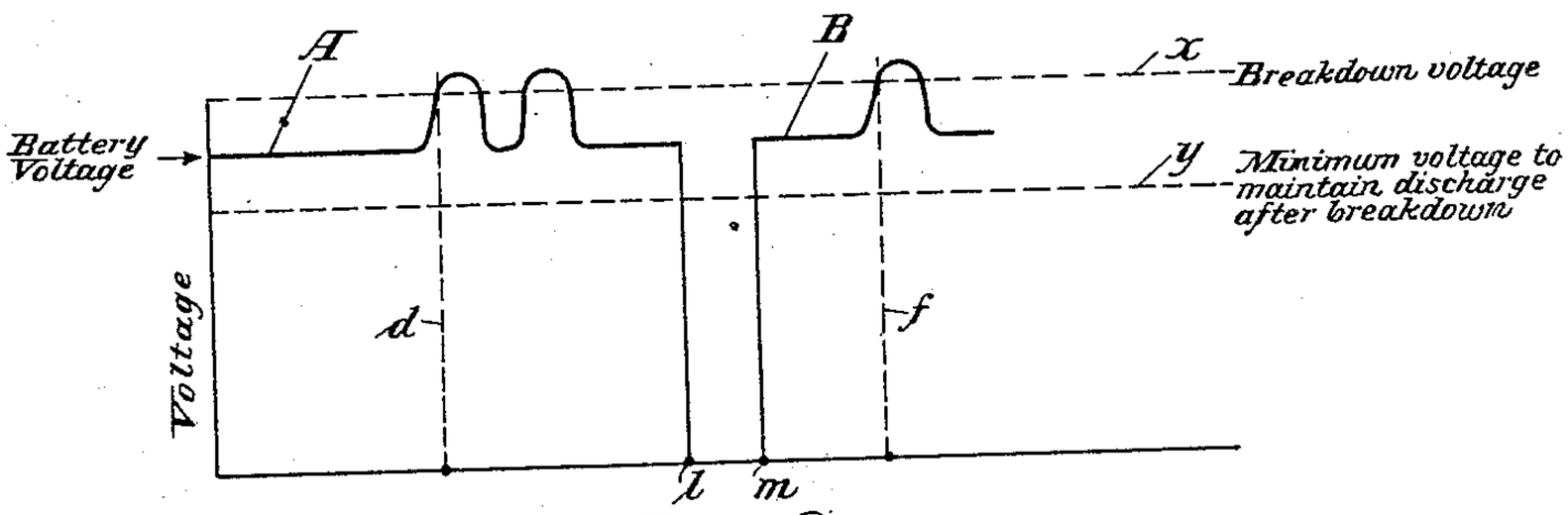

Fig. 2

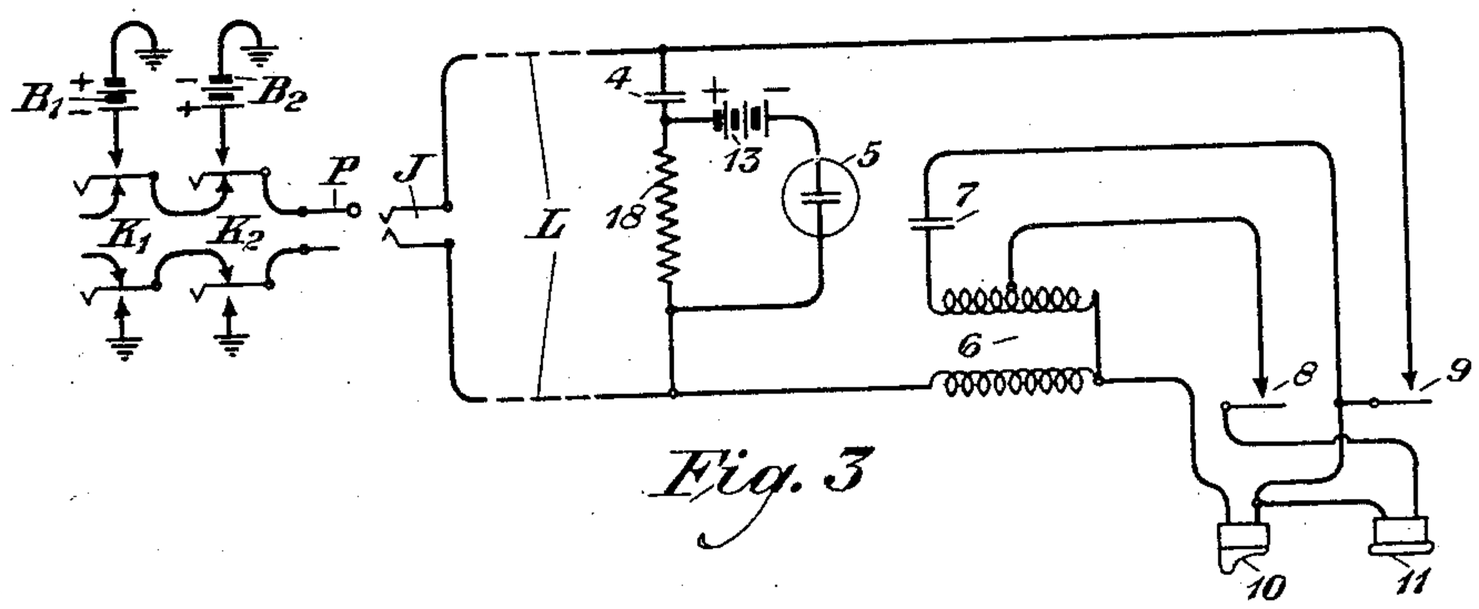

Fig. 3

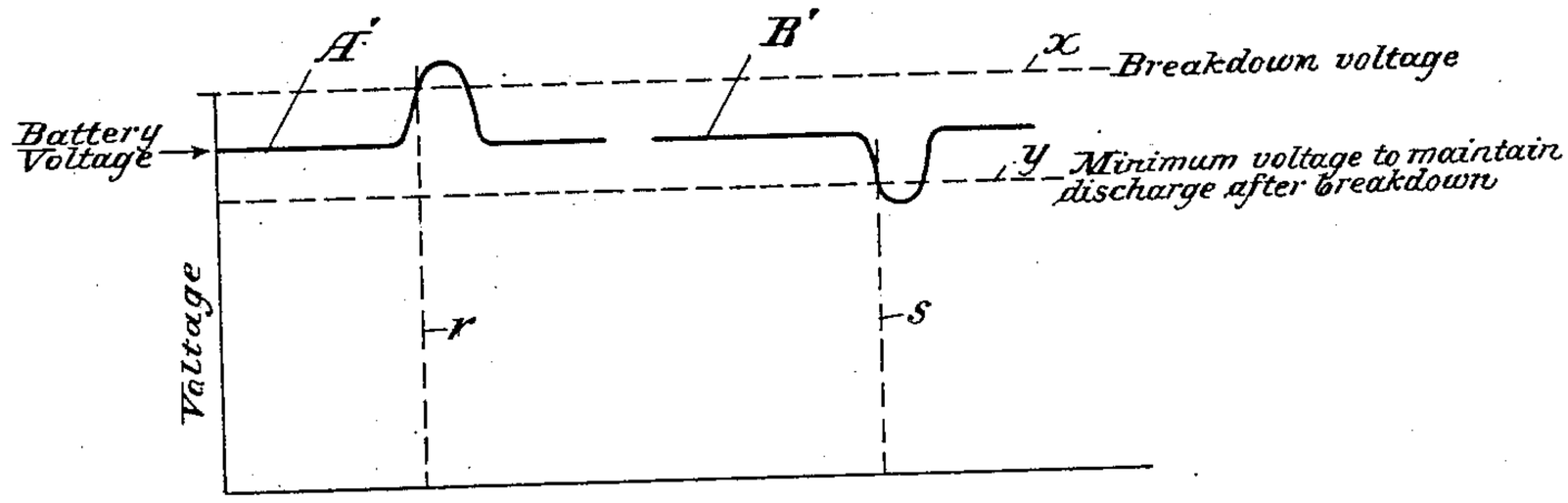

Fig. 4

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UNITED STATES PATENT OFFICE

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TELEPHONE SIGNALING SYSTEM

Application filed June 27, 1931. Serial No. 547,336.

This invention relates to telephone systems and more particularly to improvements in signaling arrangements associated with telephone stations on the lines of such systems.

One of the primary objects of the invention consists in providing improved means for breaking down and operating a visual signal, such as a cold cathode discharge tube of the neon lamp type, at a subscriber's telephone station. A further object of the invention consists in providing a locking circuit for said lamp and means for causing the release of said lamp when the subscriber removes the receiver from the switchhook to answer the call. A further object of the invention consists in providing improved means for increasing the voltage applied to the lamp to cause it to break down and operate together with means for reducing the operating voltage below the minimum required for maintaining the lamp in operated condition and thereby extinguishing the lamp. The arrangements of the invention will accomplish in a comparatively simple manner certain results which in the prior art require a complicated relay arrangement, thus resulting in a saving in equipment and maintenance costs. Other objects and features of the invention will appear more fully from the detailed description thereof hereinafter given.

In the arrangements of the invention the drop in potential caused by the applied ringing current across a copper-oxide rectifier bridged across the line at the station provides sufficient voltage in addition to that provided in the local neon lamp circuit to break down the neon lamp. Due to the characteristics of these lamps they will stay operated on a lower voltage than that required to break them down. Consequently when this external voltage is removed, the lamp will stay operated until the circuit is broken by removing the receiver from the switchhook. The unidirectional characteristic of the copper-oxide rectifier is utilized to prevent the extinguishing of the lamp during the half cycle when the polarity of the external voltage is opposed to that of the local battery for the lamp. The copper-oxide rectifier may be replaced with a resistance bridged across the line and the lamp may be connected across the resistance. Under such conditions a pulse of current of one polarity may be applied to the line to raise the battery voltage sufficiently to break down the lamp and operate it. By applying to the line a pulse of current of the opposite polarity, such as to oppose the local battery, the voltage across the lamp may be reduced below that required to maintain the discharge of the lamp and the lamp may be thus extinguished.

The invention may be more fully understood from the following description together with the accompanying drawings in the Figs. 1, 2, 3 and 4 of which the invention is illustrated. Fig. 1 is a circuit diagram illustrating a preferred form of the invention. Fig. 3 is a modification thereof. Similar reference characters have been used to denote like parts in both of these figures. Figs. 2 and 4 are curves showing the voltage characteristics of the operating currents for Figs. 1 and 3, respectively.

In Fig. 1 is shown a telephone line L terminating at a subscriber's station. The subscriber's station comprises the usual ringing apparatus comprising the condenser 1 and the ringer 2 bridged across the line. It also comprises the induction coil 6, condenser 7, switchhook contacts 8 and 9, the transmitter 10 and receiver 11. An additional switchhook contact 14 is provided for purposes to be pointed out hereinafter. Connected either across the condenser 1 or across the line L is a circuit 3 including a condenser 4 and a rectifier 12 which may be of the copper-oxide type. Connected across the rectifier 12 is a circuit including the battery 13, the visual signal lamp 5 which may be a neon lamp, and the switchhook contact 14. When ringing current is applied to the line the drop in potential caused thereby across the rectifier 12 provides sufficient voltage in addition to that provided by the battery 13 to break down the lamp 5. A neon lamp such as lamp 5 has the characteristic that it will stay operated at a lower voltage than that required to break it down. Consequently when the external voltage caused by the ringing current is removed the lamp will be maintained operated

by the voltage of battery 13 until the circuit is broken by removing the receiver 11 from the switchhook and opening the contact 14. The copper-oxide rectifier 12 is utilized and is poled as shown to prevent extinguishing lamp during the half cycle when the polarity of the external voltage of the ringing current is opposed to that of the local battery 13.

In Fig. 2 are shown curves illustrating the voltage characteristics of the operating currents for the lamp 5. The voltage of the battery 13 is indicated at A. This is between the dotted lines X and Y. X indicates the breakdown voltage needed to break down the tube 5. Y indicates the minimum voltage needed to maintain the discharge of the tube after its break down. When alternating ringing current is applied to the line the voltage drop across the rectifier 12 will be added to the voltage of the battery 13 and the peak voltage will exceed the breakdown voltage as indicated at the dotted line *d*. Upon the removal of the external voltage caused by the ringing current the tube will be held operated by the voltage of battery 13 until switchhook contact 14 is opened. At this point, designated *e*, the voltage will drop below the dotted line Y and the lamp will be extinguished. When the receiver is again restored to the switchhook such as at the point *m*, the battery voltage again will fall between the dotted lines X and Y. When ringing current is again applied to the line the peak voltage at a point indicated by the dotted line *f* will rise above the breakdown voltage and again cause the lamp to be operated.

In Fig. 3 is shown a modification of the invention in which means are provided for extinguishing the lamp from a point such as the central office rather than upon the removal of the receiver from the switchhook. A line L is shown terminating at a central office in the jack J and connected to a subscriber's telephone set. This set includes the usual induction coil 6, condenser 7, switchhook contacts 8 and 9, the transmitter 10 and receiver 11. Bridged across the line L at the subscriber's station is a condenser 4 and a resistance 18. Connected across the resistance 18 is a circuit including the battery 13 and the visual signal 5, such as a neon lamp. At the central office is provided a plug P adapted to be connected to the jack J. Associated with the plug P are the switches K_1 and K_2 whereby pulses of current of either positive or negative polarity may be applied to the line L. If it is desired to operate the lamp 5 the key K_1 will be operated. This will apply from the battery B_1 a pulse of negative current to the tip side of the line L and will charge the condenser 4. The voltage drop across the resistance 18 will then be added to the voltage drop of the battery 13, and would increase the voltage drop across the lamp 5 sufficiently to cause it to break down. It will remain operated due to the voltage of the battery 13. If it is desired to extinguish the lamp the key K_2 at the central office will be operated. This will apply a pulse of positive current to the tip side of the line and charge the condenser 4 in the reverse direction. The voltage drop across the resistance 18 will now oppose the voltage drop of the battery 13 and will reduce the voltage drop across the lamp 5 so that it will be below the minimum voltage needed to maintain the lamp in a discharging condition. This will extinguish the lamp.

In Fig. 4 are shown the curves A′ and B′ illustrating the voltage characteristics of the operating currents for the arrangements of Fig. 3. When a negative pulse of current is applied to the line L the battery voltage will be raised at the point indicated by the dotted line *r* so that the peak voltage will be sufficient to break down the lamp. The battery voltage will then hold the lamp in the operated condition. When a positive pulse of current is applied to the line L the voltage of the battery 13 will be reduced at a point such as indicated by the dotted line *s* so that the peak voltage will fall below the minimum voltage to maintain the tube in the discharging condition and will thus extinguish the tube.

While the invention has been disclosed as embodied in certain specific forms which are deemed desirable, it is understood that it is capable of embodiment in many and other widely varied forms without departing from the spirit of the invention as defined by the appended claims.

What is claimed is:

1. A transmission line terminating at a station, a signaling circuit bridged across said line at said station, a rectifier included in said signaling circuit, and a circuit bridged across said rectifier, said last mentioned circuit including a source of potential and a cold cathode discharge tube.

2. A telephone line terminating at a subscriber's station, a signaling circuit bridged across said line at said station, a rectifier included in said signaling circuit, and a circuit bridged across said rectifier, said last mentioned circuit including a cold cathode discharge tube with a source of potential therefor and circuit breaking means controlled by the telephone apparatus at said subscriber's station.

3. A transmission line terminating at a station, a signaling circuit bridged across said line at said station, a resistance included in said signaling circuit, and a circuit bridged across said resistance element including a source of potential and a cold cathode discharge tube.

4. A transmission line to which signaling currents having components of either positive or negative polarity may be applied, a sta-

tion connected to said line, a signaling circuit including elements of capacity and resistance bridged across said line at said station, and a circuit including a cold cathode discharge tube and a source of potential bridged directly across said resistance element whereby the potential drop across said resistance of said currents may be utilized to change the potential applied to said tube.

5. A transmission line interconnecting two stations, means at one station for applying to said line current of positive polarity and means for applying to said line current of negative polarity, a signaling circuit bridged across said line at said other station having included serially therein elements of capacity and resistance, and a circuit including a cold cathode discharge tube and a source of potential therefor bridged directly across said resistance element whereby the voltage drop across said resistance for current of one of said polarities applied to said line will augment the effect of said source of potential so as to operate said discharge tube and the voltage drop across said resistance for current of the other of said polarities applied to said line will decrease the effect of said source of potential so as to release said discharge tube.

In testimony whereof, I have signed my name to this specification this 26th day of June 1931.

WILLIAM H. EDWARDS.