Nov. 29, 1938. H. M. BASCOM 2,138,565

SIGNALING SYSTEM

Filed April 30, 1937

FIG. 1

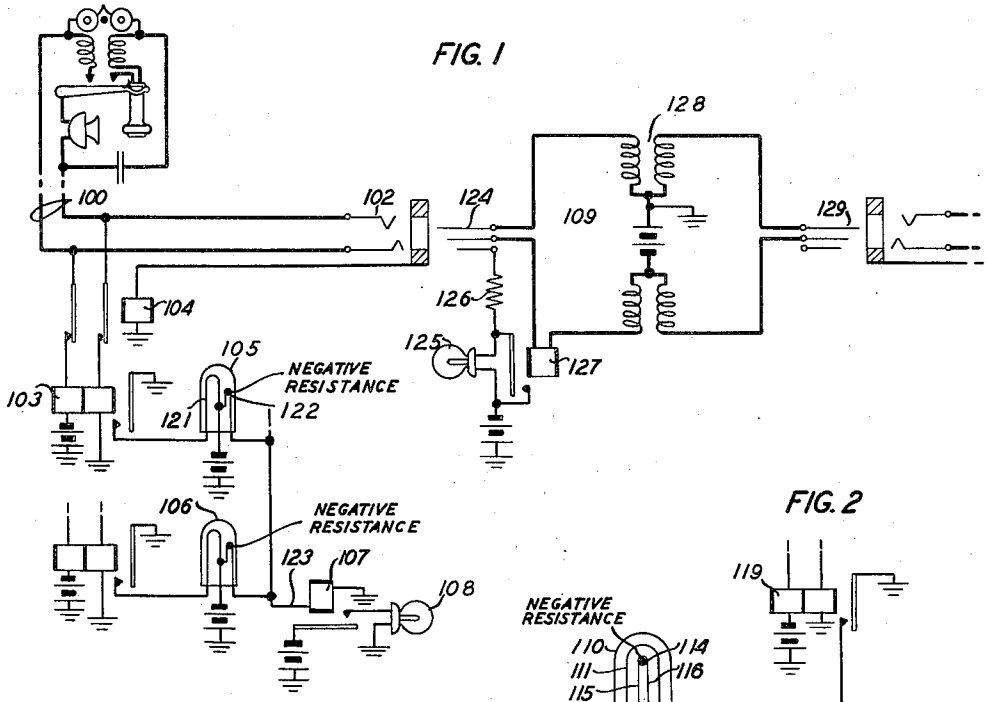
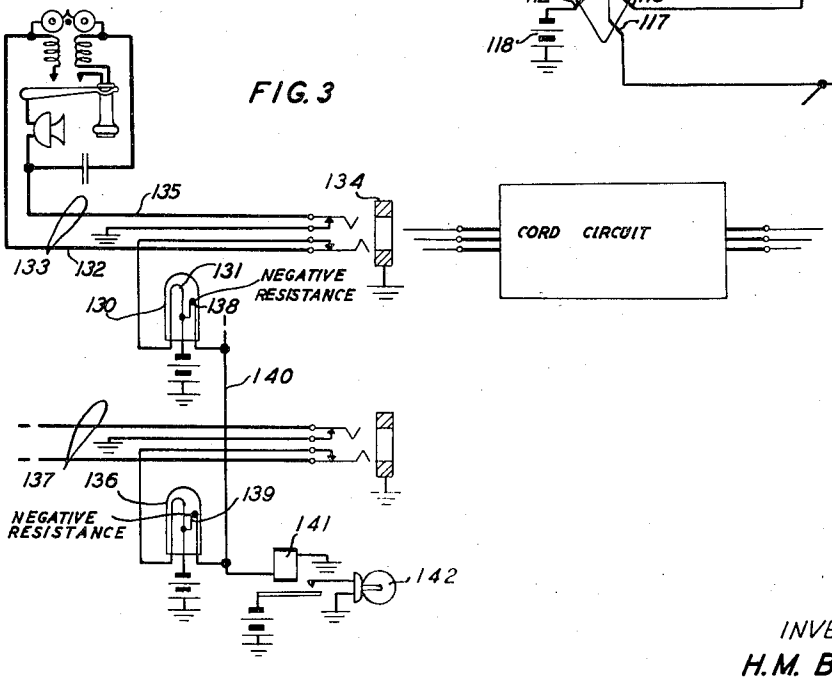


FIG. 2

FIG. 3



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SIGNALING SYSTEM

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7 Claims. (Cl. 179—55)

This invention relates to electrical signaling and particularly to signaling systems employing lamps or other devices for producing visual signals.

The objects of the invention are to secure improved operation in electrical signaling; to obtain additional functions from the lamps or other signaling devices; and in general to improve the construction of these signaling devices and to increase the usefulness of the systems in which they are employed.

It has been the practice in the past to provide telephone subscribers' signaling circuits with pilot signals, which are common to a number of individual line lamp signals. The pilot signal, which operates to attract the operator's attention whenever one of the individual line lamps is illuminated, is usually connected in a circuit having parallel branches extending through the several individual line lamps to which it is common. The presence of the pilot signal, which may be a relay or a lamp, in the common circuit tends to limit the current and to interfere with the proper operation of the individual signals. Also it is difficult to design a pilot device, such as a relay, that is sensitive enough to operate on one line signal and rugged enough to withstand the current when several line signals are burning.

According to the present invention improvements are obtained in signaling systems of the particular character above mentioned as well as in signaling systems in general by the provision of a signaling lamp in which the luminous filament serves to give the usual visual signal and also to control an auxiliary circuit device. According to a feature of the invention a signal lamp, such as a subscriber's line lamp, is equipped with a luminous filament and with a small resistor of some material, such as boron, having a high temperature coefficient of resistance, the boron resistor being mounted within the lamp bulb in proximity to the filament thereof and connected in circuit with a pilot relay or a pilot lamp common to a number of the line lamps, whereby the heat produced by the illumination of any one of the line lamps changes the resistance of the boron resistor individual thereto to cause the flow of sufficient current through the common pilot device to bring about the operation thereof. With this arrangement it is possible to operate the filaments of the subscribers' line lamps in individual circuits free from the impedance of pilot devices. These individual circuits for lighting the line lamps may be local to the central office or they may include the loops of the subscribers' lines. The common pilot relay or lamp is connected in circuit with the several boron resistors, the initial or cold resistance of which is sufficiently high to prevent the flow of any appreciable current in the pilot circuit. When, however, any one of the lamps is lighted, its filament, as above explained, heats the associated resistor, producing a large drop in the resistance thereof and the consequent flow of enough current in the common pilot circuit to operate the pilot relay or the pilot lamp as the case may be.

The foregoing and other features of this invention will be described more fully in detail in the following specification. In the drawing accompanying this specification:

Fig. 1 shows a portion of a telephone system in which subscribers' lines are equipped with line lamps embodying the features of this invention;

Fig. 2 illustrates one of the individual line lamps of Fig. 1 and a modification of the common pilot circuit; and

Fig. 3 illustrates the invention applied to a system in which the line lamps are lighted over the subscribers' loops.

Each of the subscribers' lines, such as the line 100, appears in the central office in a suitable connecting device. The line 100 is shown terminating in an answering jack 102 and is provided with the usual individual line relay 103 and cut-off relay 104. In addition the line 100 is equipped with an individual line lamp 105 mounted in any suitable position before the operator. The line lamp 105 of subscriber's line 100, the line lamp 106 of a second subscriber's line, and other lamps, not shown, are connected in circuit with a common pilot relay 107. Pilot relay 107 controls the circuit of the pilot signal lamp 108. The operator's position is equipped with the usual cord circuits, such as the cord 109 illustrated.

Referring to Fig. 2, the novel signal lamp, which is there illustrated in enlarged form, comprises the usual glass bulb 110 and the luminous filament 111. The filament 111 is sealed within the bulb 110 and is connected to the exterior terminals 112 and 113. Also sealed within the glass bulb 110 is a resistor 114 of some material having a high negative temperature coefficient of resistance. It has been found that the element boron is especially well suited to this purpose. It has an extremely high temperature coefficient, it is hard and durable, and it does not deteriorate

when subjected either to direct current or alternating current. Furthermore the required resistance values can be obtained with boron units of small dimensions which occupy a small amount of space and lend themselves readily to mounting within the restricted spaces available in signal lamps. For example, some of these units may have dimensions of the order of 1/50 of an inch. The boron resistor 114 is mounted within the bulb 110 in such a position that it is in close proximity to the filament 111. This mounting arrangement places the resistor 114 in position to receive heat conveyed from the burning filament 111. One of the terminals of the resistor 114 is joined by a fine lead wire 115 to the terminal 112, and the other terminal of the resistor 114 is joined by a fine lead wire 116 to a third exterior terminal 117. The terminals 112 and 113 of the lamp filament are connected respectively to the battery 118 and to ground through the operated contact of the subscriber's line relay 119. Thus the line lamp 110 is lighted in a circuit containing only the central office battery and a contact of the line relay. The pilot device, such as the pilot lamp 120, is connected to the terminal 117. This connection includes the pilot lamp 120 in a circuit from the battery 118, terminal 112 through the resistor 114, terminal 117 through the filament of lamp 120 to ground. The lamp 120, being common to a number of line lamps, is connected in multiple to the terminals 117 of other line lamps, not shown.

Since the pilot device, such as the relay 107 in Fig. 1 or the lamp 120 in Fig. 2, is connected in series-parallel relation with a plurality of the boron resistor units, it is necessary that the resistance of these units be high when they are cold so that the combined resistance of the several parallel circuits is sufficiently high to prevent flow of any appreciable current through the common pilot device. And this requirement is easily met with boron units because of their extremely high normal resistance.

A brief description will now be given of the manner in which the system of Fig. 1 operates. When the subscriber of line 100 initiates a call by removing his telephone receiver, the usual circuit is closed for the line relay 103. This relay operates and closes a circuit from ground through its armature and contact, through the filament 121 of line lamp 105 to battery. The filament 121 assumes an incandescent state and emits heat which is transferred to the boron resistor 122 mounted in proximity thereto. As the temperature of the resistor 122 rises, its resistance undergoes a large and rapid drop, permitting a substantial current to flow in the circuit from battery through the resistor 122, conductor 123, common pilot relay 107 to ground. The relay 107 operates in this circuit and closes an obvious circuit for lighting the pilot lamp 108 to attract the operator's attention to the fact that the line lamp 105 is lighted as a calling signal. The operator answers the call by inserting the plug 124 of her cord 109 in the jack 102 of the calling line. The insertion of the plug in the jack completes a circuit from battery through the supervisory lamp 125, resistance 126 through the sleeve of the plug and jack and the winding of the cut-off relay 104 to ground. The lamp, however, does not light because it is short-circuited at the contact of the supervisory relay 127, which is operated in a circuit from battery through the lower left winding of the repeating coil 128, winding of relay 127, ring contacts of the plug and jack over the subscriber's line loop and returning through the tip contacts of the jack and plug through the upper left winding of the repeating coil 128 to battery. The cut-off relay 104 operates and disconnects the line relay 103 from the subscriber's line. Relay 103 releases and extinguishes the filament 121 of the line lamp. The boron unit 122 now cools and assumes its normal high resistance. This decreases the flow of current through the relay 107, provided this relay is not deriving current from some other line lamp, and the relay releases to extinguish the pilot signal 108. The operator completes the connection with the other plug 129 of her cord circuit, and, when conversation is over, she removes her cord circuit, permitting the cut-off relay to release and reconnect the line relay 103 to the subscriber's line.

Referring now to the modification of Fig. 3, the system here illustrated is one in which the individual line and cut-off relays are omitted, and the line lamps are lighted in circuits including the loops of the subscribers' lines. If the current for a number of these line lamps is supplied through a common pilot signal relay, there is a danger of operating the common relay falsely in the event that the line loops develop a substantial amount of leakage. This, however, may be avoided by using the improved signal lamp and by connecting it as illustrated in Fig. 3. The lamps in this arrangement, like those in Fig. 1, are supplied with current over circuits excluding the common pilot relay. For example, the lamp 130 has its luminous filament 131 connected directly to the conductor 132 of the subscriber's line 133 through a contact of the cut-off jack 134. The other conductor 135 of the subscriber's line is connected through a contact of the cut-off jack to ground. Therefore, a closure of the line 133 at the substation completes a direct circuit for supplying current to the filament 131 of the lamp 130. In a similar manner the lamp 136, individual to the subscriber's line 137, is lighted in a circuit extending from battery directly through the filament of the lamp and over the loop of the subscriber's line.

The negative-resistance elements of the several line lamps, such as the elements 138 and 139 of the two lamps shown, are connected to a common conductor 140, which may either extend to ground directly through a pilot lamp as illustrated in Fig. 2 or to ground through a pilot relay 141. The cold resistance of these negative resistors is so high that substantially no current flows normally over the common conductor 140 and through the relay 141. And although any one of the subscriber's lines 133, 137, etc. may have some leakage, resulting in a flow of some current through the filament of the lamp of the leaking line and thence to ground, the amount of heat produced by this leaking current in the filament of the lamp is insufficient to cause enough of a change in the resistance of the resistor within the lamp to enable enough current to flow in the common conductor 140 to operate the pilot relay. Some of these negative resistance materials are known to have critical points in their temperature-resistance characteristics, and they may, therefore, be designed so that they can receive and dissipate substantial amounts of heat without exceeding the critical points in their characteristics beyond which their resistance decreases by large amounts.

To briefly describe the operation of the system

of Fig. 3, assume that the subscriber at the substation of line 133 wishes to make a call. When he removes his receiver from the switchhook, the loop is closed, and current flows from battery through the filament 131 of lamp 130, through the lower contact of jack 134 over the closed loop and returning to ground through the upper contact of said jack. The filament 131 is heated in this circuit to give the line lamp signal and to raise the temperature of the negative resistor 138. This lowers the resistance of the element 138, and substantial current now flows from battery through said resistor over conductor 140, through the winding of relay 141 to ground. Relay 141 operates and closes an obvious circuit for the common pilot lamp 142. The lamp 142 attracts the operator's attention, and, observing the individual line lamp 130 burning, she knows that a call is waiting on line 133. The operator, whose position may be equipped with cord circuits similar to the one shown in Fig. 1, responds by inserting the answering plug of one of her cords in jack 134. Insertion of the plug in the jack opens the cut-off contacts and severs the circuit through the filament of lamp 131. The lamp extinguishes, and the element 138 decreases its resistance to cause the deenergization of the common relay 141 and the effacement of pilot signal 142, provided no other line is calling at the moment. From this point on the operation of the system continues in the well-known manner.

While boron has been discussed herein as a suitable material for the resistors, it should be understood that the invention is not limited to any material and that other substances, such as silver sulphide, having suitable temperature coefficients of resistance may be used. For a general disclosure of a resistance device having a negative temperature coefficient of resistance, reference is made to the patent to Grondahl, No. 1,526,139, of February 10, 1925.

What is claimed is:

1. The combination in a signaling system of a lamp comprising a closed chamber, a luminous filament within said chamber, a current carrying element mounted within said chamber to receive heat from said filament, said element undergoing a change of its electrical characteristic when heat is received from said filament, electrical circuits including said filament and said element, and means in circuit with and dependent upon the electrical characteristic of said element.

2. The combination in a signaling system of a signal lamp comprising a glass bulb, a resistor, having a temperature coefficient of resistance, mounted within said bulb and arranged to receive heat from said filament when lighted, a circuit including said resistor, and means in said circuit operable in response to a change in the resistance of said resistor.

3. The combination in a signaling system of a lamp comprising a closed chamber and three circuit terminals, a filament mounted within said chamber and connected to a pair of said terminals, a circuit connected to said pair of terminals for supplying current to heat said filament, a variable resistance element mounted within said chamber to receive heat from said filament, said element being connected between one of the terminals of said pair and said third terminal, an electrical circuit including said variable resistance element, and means in said last-mentioned circuit operable in accordance with the resistance of said element.

4. The combination in a signaling system of a lamp having a closed chamber and a luminous filament therein, an element of boron mounted within said lamp to receive heat from the luminous filament, a normally deenergized relay connected in circuit with said boron element, and means for heating said filament to alter the resistance of said boron element and cause the operation of said relay.

5. The combination in a signaling system of a plurality of signal lamps, each containing a luminous filament and a variable resistance element arranged to receive heat from the associated filament, individual circuits for the respective luminous filaments of said lamps, a common circuit having branches including the respective variable resistance elements, an operating device in said common circuit, and means for heating any one of the luminous filaments to cause a change in the resistance of the associated variable resistance element to cause the operation of the device in said common circuit.

6. In combination, a telephone line, a signaling lamp having a closed chamber and a luminous filament therein, a circuit including the talking conductors of said line for supplying current to said filament, a resistor having a temperature coefficient of resistance mounted within said chamber and arranged to receive heat from said filament when lighted, a circuit including said resistor, and means in said last-mentioned circuit operable in response to a change in the resistance of said resistor.

7. The combination in a telephone system of a plurality of subscribers' lines, each line having a line relay and a signal lamp comprising a bulb with a luminous filament therein, energizing circuits for said filaments closed, respectively, by the corresponding line relays when energized, each of said lamp bulbs having a variable resistance element mounted therein to receive heat from the corresponding filament when the latter is energized, said elements undergoing a change of resistance in response to the heat received from their associated luminous filaments, a common circuit including said variable resistance elements, and means in said common circuit operable in response to a change in the resistance of any one of said elements.

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