May 6, 1930. W. A. RHODES 1,757,217

TELEPHONE SYSTEM

Filed July 2, 1927 2 Sheets-Sheet 1

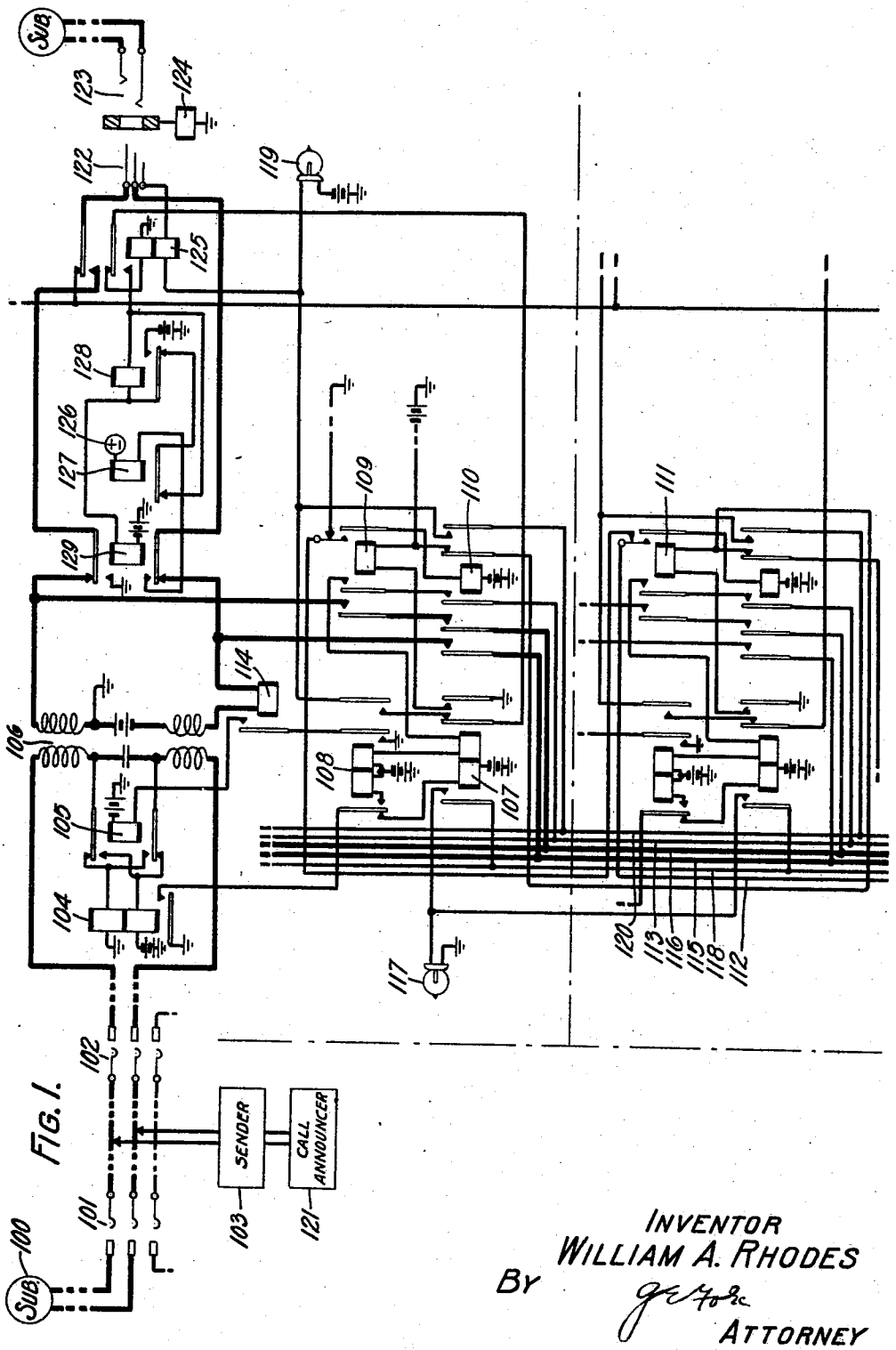


FIG. 1.

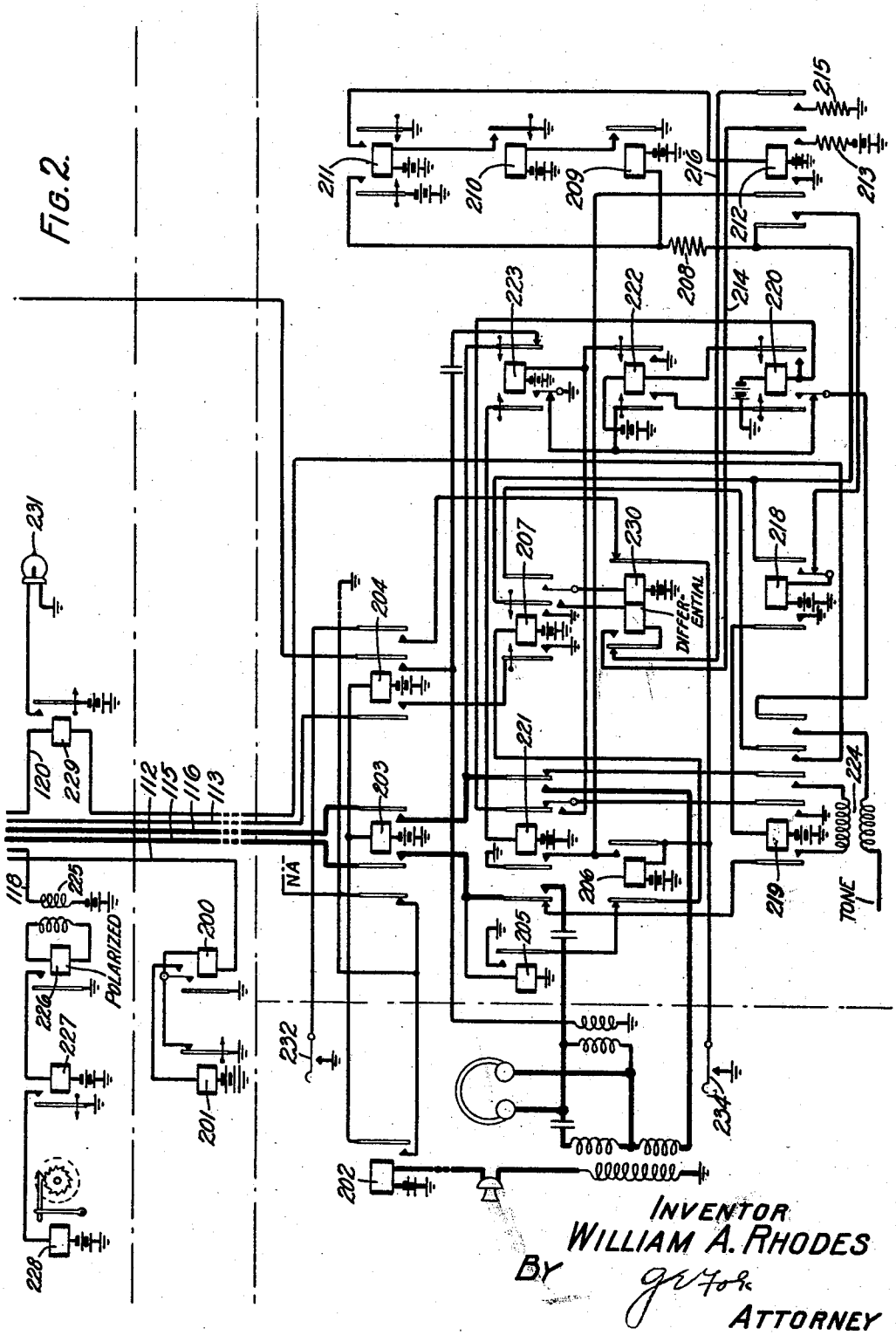
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FIG. 2.



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UNITED STATES PATENT OFFICE

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TELEPHONE SYSTEM

Application filed July 2, 1927. Serial No. 203,051.

This invention relates to telephone systems and has for its object the provision of improved signaling means for such systems.

More specifically the invention provides means for causing the intermittent operation of a signal whether said signal is operated or non-operated at the time. This is accomplished by the insertion of a differential relay between the signal and the interrupting device, which tests to ascertain whether or not the signal is operated. If the signal is not operated, this relay completes a circuit for intermittently operating the signal and if the signal is operated, it completes a circuit for intermittently extinguishing the signal. The invention also provides improved means for counting the number of times equipment is used.

This invention finds one embodiment in trunk circuits of the type terminating in a plug and automatically seized at the distant end. Such trunks may be reseized at the distant end before the operator has removed the plug from a subscriber's jack. The seizure of an idle trunk is indicated by flashing the trunk lamp, while the same lamp is lighted steadily over the called subscriber's jack as a disconnect signal when the trunk is released. In order to flash the lamp of the trunk when reseized before the plug is removed from the jack, it is necessary to intermittently extinguish the disconnect lamp. This is brought about by the inclusion of a differential relay in the flashing circuit for the lamp. This relay is so arranged that when the flashing circuit is closed due to the seizure or reseizure of the trunk, it tests the condition of the lamp and applies the proper condition for flashing it. This relay also prevents the application of ringing current to the trunk until the plug has been removed from the jack and inserted in the proper jack. A polarized relay controlled by the discharge through an induction coil when a particular circuit is closed, serves to operate a peg count meter.

The invention will be more clearly understood from a consideration of the following detailed description in connection with the attached drawings, in which:

Figure 1 shows a trunk circuit for use with a call announcer; and

Fig. 2 shows an operator's equipment common to a plurality of such trunks.

One form of call announcer system is disclosed in U. S. Patent 1,277,440, granted to A. E. Lundell, September 3, 1918, and a general reference is made thereto although the details thereof are not in all cases applicable to the present disclosure.

When the subscriber at substation 100 initiates a call, his line is extended by means of line finder 101 to district selector 102 and to a register sender 103. The subscriber then dials the number of the wanted subscriber, setting up a registration on the sender 103 which controls the operation of the district selector 102 in selecting an idle trunk to the office at which the subscriber is located.

Assuming that the called subscriber is located in an office equipped to receive the called line number by means of a call announcer, a class registration will be set up in the sender which will cause the association of call announcer 121 with the sender 103. When an idle trunk has been selected, the sender will connect a relay across the trunk conductors in the well known manner, completing a circuit from battery through the lower winding of relay 104, lower back contact of relay 105, lower left winding of repeating coil 106, and thence through district selector 102 and the relay of the sender back to the upper left winding of coil 106, upper back contact of relay 105, upper winding of relay 104 to ground. Relay 104 operates closing a circuit from battery through the left winding of relay 107, back contact of relay 108, to ground at the front contact of relay 104.

Relay 107 in operating closes a circuit from ground through lamp 117, left front contact of relay 107, conductor 118, primary winding of coil 225 to battery. The rush of current produced by the establishment of this circuit induces a current in the secondary winding of the coil 225 operating polarized relay 226 in the direction to close its contact to operate relay 227 and meter 228. Relay 226 is polarized so as to prevent its opera-

tion on the opening of the circuit of lamp 117 at which time the induced current is in the opposite direction. Relay 227 is slow to release so that possible momentary operations of relay 226 will not reoperate the meter. Lamp 117 is common to a plurality of trunks and indicates that one of the group of trunks has been selected at the distant end.

Relay 107 also closes a circuit from ground over its outer right contact, winding of relay 109 to battery. Relay 109 in operating closes a circuit from battery through the winding of relay 110, right front contact of relay 109, right normal contact of relay 111, which is individual to the next trunk of the group, conductor 112, winding of relay 200 to ground at the back contact of relay 201. Relays 110 and 109 extend tip and ring conductors of the trunk to the common position equipment, shown in Fig. 2, as well as certain control conductors.

The equipment shown in Fig. 2 is common to all the trunks appearing at that particular position and is available only if the operator is at the position. When the operator associates her trunk with the position by means of a jack (not shown) relay 202 operates in series with the operator's transmitter and repeating coil, in turn operating relays 203 and 204 from ground over the position splitting circuit which has been omitted from the disclosure.

With relays 203 and 204 operated, the operation of relays 109 and 110 completes a circuit from battery through the lower right winding of repeating coil 106, supervisory relay 114, outer left front contact of relay 110, conductor 115, left front contact relay 203, winding of relay 205 to ground. Relay 205 operates but due to the high resistance of that relay, relay 114 cannot operate. Relay 205 closes a circuit from ground over its front contact, back contact of relay 206, winding of relay 207 to battery.

Relay 207 closes an operating circuit for relay 108 and a holding circuit for relay 107 which may be traced from battery through the right winding of relay 108, right winding of relay 107, inner left front contact of relays 109 and 110, conductor 113, left front contact of relay 204 to ground at the left front contact of relay 207. Relay 108 operates in this circuit and locks through its left winding to ground at the front contact of relay 104, opening the operating circuit of relay 107 and connecting ground to the armature of relay 114.

Relay 207 also closes a circuit from ground at its inner right front contact, resistance 208, winding of relay 209 to battery. Relay 209 closes an obvious circuit for relay 210 and relay 210 closes one for relay 211. Relays 210 and 211 are both slow to operate so that a measured interval elapses between the operation of relay 209 and the operation of relay 211. When relay 211 operates it connects battery over its left front contact to resistance 208 thus shunting and releasing relay 209 and in turn relays 210 and 211. Relay 211 in operating also closes a circuit from ground at its right front contact through the winding of relay 212 to battery. Relay 212 at each operation connects battery through the resistance 213 to conductor 214 and ground through resistance 215 to conductor 216. Relays 209 to 212 form an interrupting mechanism whereby battery and ground are intermittently connected to conductors 214 and 216.

At the first operation of relay 212 a circuit is closed from battery through the winding and normal contact of relay 218, outer left contact of relay 212, to ground at the inner right front contact of relay 207. Relay 218 locks to ground at relay 207 independent of relay 212. Relay 218 closes an obvious circuit for relay 219 which in turn operates relay 220 over the inner right back contact of relay 21. Relay 220 extends its operating circuit to relay 222 and relay 222 closes an obvious circuit for relay 223. Relay 223 then closes a circuit for relay 221, but relay 221 in operating closes a holding circuit for relay 223 over the inner right alternate contact of relay 221 to ground at the front contact of relay 219. However, the operation of relay 221 opens the circuit of relay 220 and that in turn opens the circuit of relay 222, opening the energizing circuit for relay 223. Relays 220, 222 and 223 are slow to operate in order to introduce a measured interval between the operation of the various relays. The purpose of this chain of relays is to transmit a pair of tones to the distant end of the trunk when the trunk is seized by an operator. When the trunk is seized by a sender, they serve to prepare the sender for transmitting a called line number. When relay 219 operates it completes a circuit from battery through the lower right winding of repeating coil 106, winding of relay 114, outer left front contact of relay 110, conductor 115, left front contact of relay 203, left back contact of relay 221, left front contact of relay 219, secondary winding of tone coil 224, the next to the inner right contact of relay 219, outer right back contact of relay 221, right front contact of relay 203, conductor 116, middle left contact of relay 110, outer left contact of relay 109, upper right winding of repeating coil 106 to ground. Relay 114 now operates closing a circuit from battery through the winding of relay 105, front contact of relay 114, to ground at the inner right contact of relay 108. The operation of relay 105 reverses the connection of relay 104 to the tip and ring conductors of the trunk and by reversing the polarity of the current flowing thereover prepares the sender to make call announcement. When relay 221 operates, it discon-

nects coil 224 from the winding of relay 114 and relay 114 releases in turn releasing relay 105 and restoring the polarity over the trunk circuit.

Relay 219 in operating also closes a circuit from battery through lamp 119, outer right front contact of relay 110, conductor 120, winding of relay 229, next to the outer right contact of relay 219, to the outer right armature of relay 207, whence the circuit extends through the left winding and left back contact of relay 230 to intermittent ground over conductor 216. Lamp 119 is caused to flash in this circuit. It will be noted that a second circuit exists from battery through the right winding of relay 230, contacts of relay 207, left winding and left back contact of relay 230 to intermittent ground over conductor 216. However, relay 230 is so wound that the combined effect of the two circuits through the left winding of relay 230 just neutralizes the effect of the circuit through the right winding thereof and relay 230 remains deenergized. Relay 229 operates in the above traced circuit closing an obvious circuit for lamp 231 which is individual to the position. Relay 229 being slow to release holds lamp 231 lighted steadily.

When relay 221 operates disconnecting coil 224 from the winding of relay 114, it connects the operator's telephone set with the trunk over the front contacts of relay 221. The release of relay 114 restores the polarity of current over the trunk circuit and causes the sender to announce to the operator the number of the wanted subscriber.

When the operator has received the number of the wanted subscriber, she operates release key 232, which completes a circuit from ground over key 232, outer right front contact of relay 204, left back contact of relay 230, winding of relay 206 to battery. Relay 206 locks over its front contact to ground at the front contact of relay 221 or the front contact of interrupter relay 212, thus insuring that relay 206 will be the last relay to release. At its left contact relay 206 opens the circuit of relay 207 in turn opening the energizing circuit of relay 108 and the holding circuit of relay 107. Relay 207 also opens the flashing circuit for lamp 119, releasing relay 229 and opening the circuit of relay 230. It also opens the holding circuit of relay 218 which causes the release of relays 219, 223, and 221 in succession. As soon as relay 212 opens its contact, relay 206 releases and the position circuit is restored to normal. The release of relay 207 causes the release of relay 107 and extinguishes lamp 117. With relay 107 released, relays 109 and 110 release and the position circuit may be used with another trunk.

The operator then tests the called subscriber's line in the usual manner and finding it idle inserts plug 122 in jack 123, whereupon a circuit is closed from ground through the winding of the subscriber's cut-off relay 124, sleeve of jack 123 and plug 122, lower winding of relay 125 through lamp 119 to battery. Relays 124 and 125 operate in this circuit, relay 125 closing a circuit in parallel with lamp 119 which may be traced from ground, through the winding of relay 124, sleeve of jack 123 and plug 122, lower winding of relay 125, left front contact of relay 108, right back contact of relay 107, inner upper front contact of relay 125, back contacts of relays 127 and 128 in parallel with the winding of relay 128, winding of relay 129 to battery. Relay 129 operates closing a circuit from ground over its upper front contact and the outer upper front contact of relay 125, to the tip of plug 122 and the tip conductor of the subscriber's line, back over the ring conductor, over the ring of jack 123 and plug 122, lower front contact of relay 129, winding of relay 127 to source of ringing current 126. Relay 127 is insensitive to ringing current but as soon as the called subscriber answers closing a direct current path, relay 127 operates, opening the shunt around relay 128, which in turn operates and locks to battery at its front contact. This battery shunts relay 129 causing that relay to release and extend the subscriber's line through to the right windings of repeating coil 106. This completes a circuit for relay 114 which again operates relay 105 and reverses the current over the trunk conductors which reversal is now effective for any desired supervisory purpose. The circuit remains in this condition until conversation is ended at which time the restoration of the called subscriber's receiver releases relay 114, releasing relay 105 and restoring the connection of relay 104. When the calling subscriber restores his receiver, relay 104 releases and relay 108 also releases in turn releasing relay 128. Lamp 119 now lights steadily in series with relays 125 and 124 as a disconnect signal.

Should the trunk be reseized at the distant end before the operator removes plug 122 from jack 123, the operations will proceed as above described until the circuit is established to the outer right armature of relay 207, through lamp 119. Due to the presence of plug 122 in jack 123, ground will be connected to the armature of relay 207 instead of battery as in the previous case. This results in the establishment of a circuit through the right winding of relay 230, but since ground is connected to the left winding of relay 230 over the back contact of that relay as well as through the winding of relay 124, the current flow in this winding will be greatly reduced and the relay will operate due to the unbalanced condition. With relay 230 operated the circuit through the left winding of that relay is extended over its left front contact to intermittent battery over conductor

214. This circuit aids in the operation of relay 230 each time it is closed, so that relay 230 remains operated as long as ground is connected to lamp 119 over the plug 122. Lamp 119 is therefore intermittently shunted and thus flashes to attract the attention of the operator.

Should the operator attempt to disconnect her position equipment from the trunk without first removing the plug from the jack, the operation of key 232 is ineffective, since the circuit of relay 206 is open at the contact of relay 230. The removal of plug 122 from the jack removes ground from the armature of relay 207 and from relay 230 which releases to continue flashing lamp 119 by means of intermittent ground on conductor 216. The release of relay 230 renders release key 232 effective and the connection may be completed in the usual manner. In case the circuit of lamp 119 should be grounded falsely, an emergency key 234 is provided which will operate relay 206 directly, even though relay 230 may be operated.

What is claimed is:

1. In a signaling system, an electrically operable signal connected at one of its terminals to battery of a given polarity, and means connected to another terminal of said signal to cause a characteristic operation of said signal by associating with said other terminal battery of the same or opposite polarity.

2. In a signaling system, an electrically operable signal connected at one of its terminals to battery of a given polarity, and means connected to another terminal of said signal to cause said signal to be intermittently operated under varying conditions by associating with said other terminal interrupted battery of the same or opposite polarity.

3. In a signaling system, an electrically operable signal connected at one of its terminals to battery of a given polarity, means connected to a second terminal of said signal to vary the conditions under which said signal is operated, and a differentially connected relay responsive to the condition connected to said second terminal for controlling the association of battery of the same or opposite polarity with said second terminal to cause the operation of said signal.

4. In a signaling system, an electrically operable signal connected at one of its terminals to battery of a given polarity and voltage, and means connected to another terminal of said signal to cause said signal to be intermittently operated under varying conditions by associating with said other terminal interrupted battery of the same or opposite polarity and the same voltage.

5. In a signaling system, an electrically operable signal connected at one of its terminals to battery of a given polarity and voltage, means connected to a second terminal of said signal to vary the conditions under which said signal is operated, and a differentially connected relay, responsive to the condition connected to said second terminal, for controlling the association of battery of the same or opposite polarity and the same voltage with said second terminal to cause the operation of said signal.

6. In a signaling system, an electrically operable signal, means to cause the steady operation of said signal, and means to cause the intermittent operation of said signal, said last means being effective alone or in combination with said first mentioned means.

7. In a telephone system, a plug ended trunk, a jack, a signal associated with said trunk, means effective when the plug of the trunk is in said jack to cause the steady operation of said signal, and means for causing the intermittent operation of said signal comprising a plurality of interrupters, and means for testing whether or not said signal is operated for discriminating between said interrupters.

8. In a telephone system, a plug ended trunk, a jack, a signal associated with said trunk connected at one of its terminals to battery of a given polarity, means effective when the plug of said trunk is inserted in said jack to cause the steady operation of said signal, and means for causing the intermittent operation of said signal comprising an interrupter connected to the same battery polarity as is connected to said signal, a second interrupter connected to battery of the opposite polarity, and means for testing whether or not said signal is operated to discriminate between said interrupters.

9. In a telephone system, a plug ended trunk, a jack, a signal associated with said trunk connected at one of its terminals to battery of a given polarity, means effective when the plug of said trunk is inserted in said jack to cause the steady operation of said signal, and means for causing the intermittent operation of said signal comprising an interrupter connected to the same battery polarity as is connected to said signal, a second interrupter connected to battery of the opposite polarity, and a differentially connected relay for testing whether or not said signal is operated to discriminate between said interrupters.

10. In a telephone system, plug ended trunks, jacks, operator's equipment common to said trunks, a signal associated with each of said trunks, means effective when a plug of one of said trunks is in one of said jacks to cause the steady operation of the corresponding signal, means in said common apparatus to cause the intermittent operation of said signal comprising a plurality of interrupters, means for testing whether or not said signal is operated for discriminating between said interrupters, and means for re-

leasing said common apparatus from said trunk, said means being under the control of said testing means.

11. In a signaling system, an electrically operable signal connected at one of its terminals to battery of a given polarity and voltage, means connected to a second terminal of said signal to vary the conditions under which said signal is operated, and means for causing the intermittent operation of said signal comprising an interrupter connected to the same battery polarity as is connected to said signal, a second interrupter connected to battery of the opposite polarity and a differentially wound relay for testing whether or not said signal is operated, said relay being normally in series with said signal and said second interrupter over its back contact and when operated in series with said signal and said first interrupter over its front contact.

12. In a signaling system, an electrically operable signal connected at one of its terminals to battery of a given polarity and voltage, means for connecting the other terminal of said signal to battery of opposite polarity to operate said signal, and means for causing the intermittent operation of said signal comprising an interrupter connected to the same battery polarity as is connected to the first terminal of said signal, a second interrupter connected to battery of the opposite polarity and a differentially wound relay for testing whether or not said signal is operated, said relay being normally in series with said signal and said second interrupter over its back contact and inoperative if said signal is not at the time operated and operative if said signal is operated to connect itself in series with said signal and said first interrupter over its front contact.

In testimony whereof, I have signed my name to this specification this 1st day of July, 1927.

WILLIAM A. RHODES.