Oct. 29, 1929. O. H. WILLIFORD 1,733,569

TELEPHONE EXCHANGE SYSTEM

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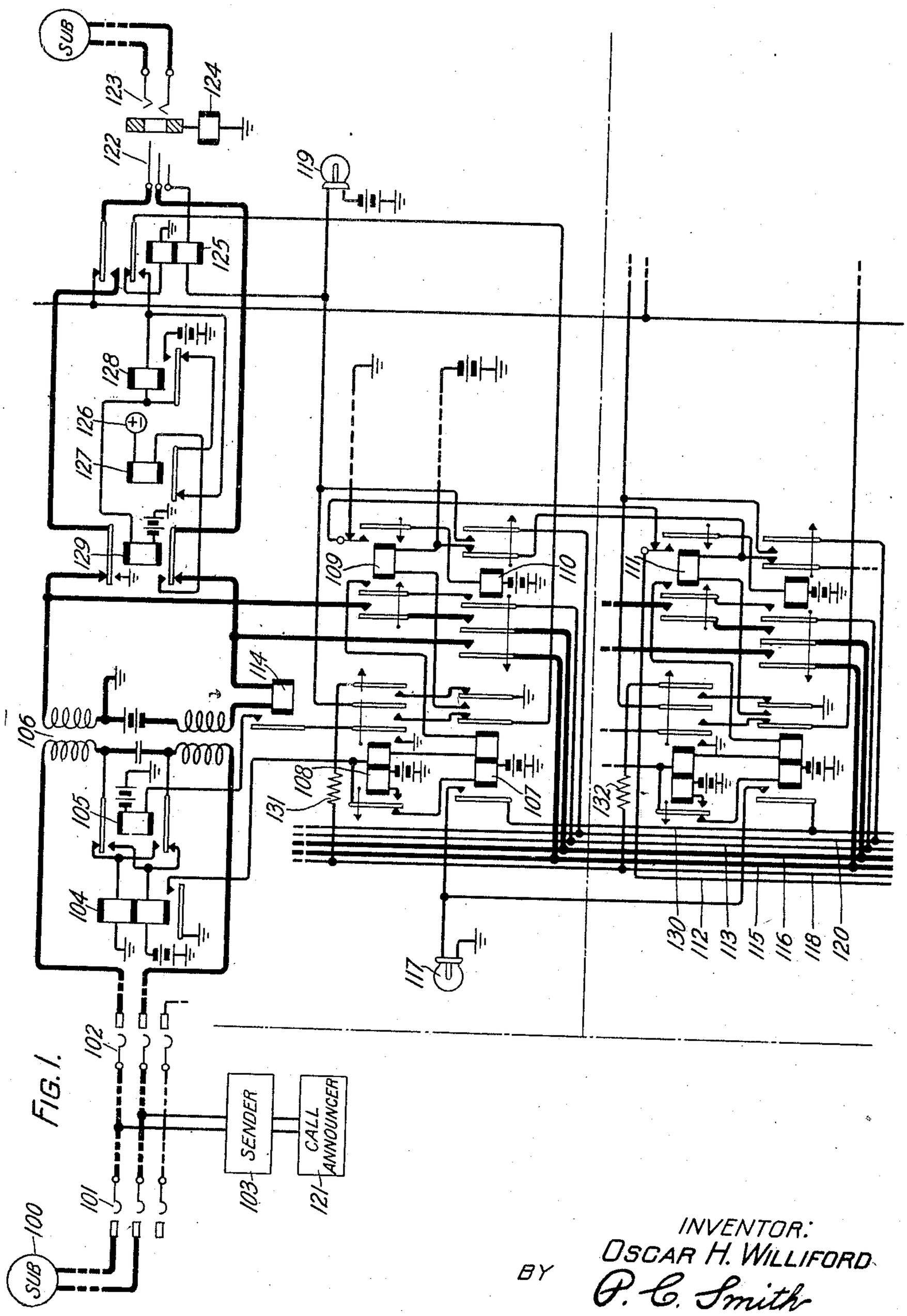

FIG. 1.

INVENTOR:
OSCAR H. WILLIFORD
BY P. C. Smith
ATTORNEY

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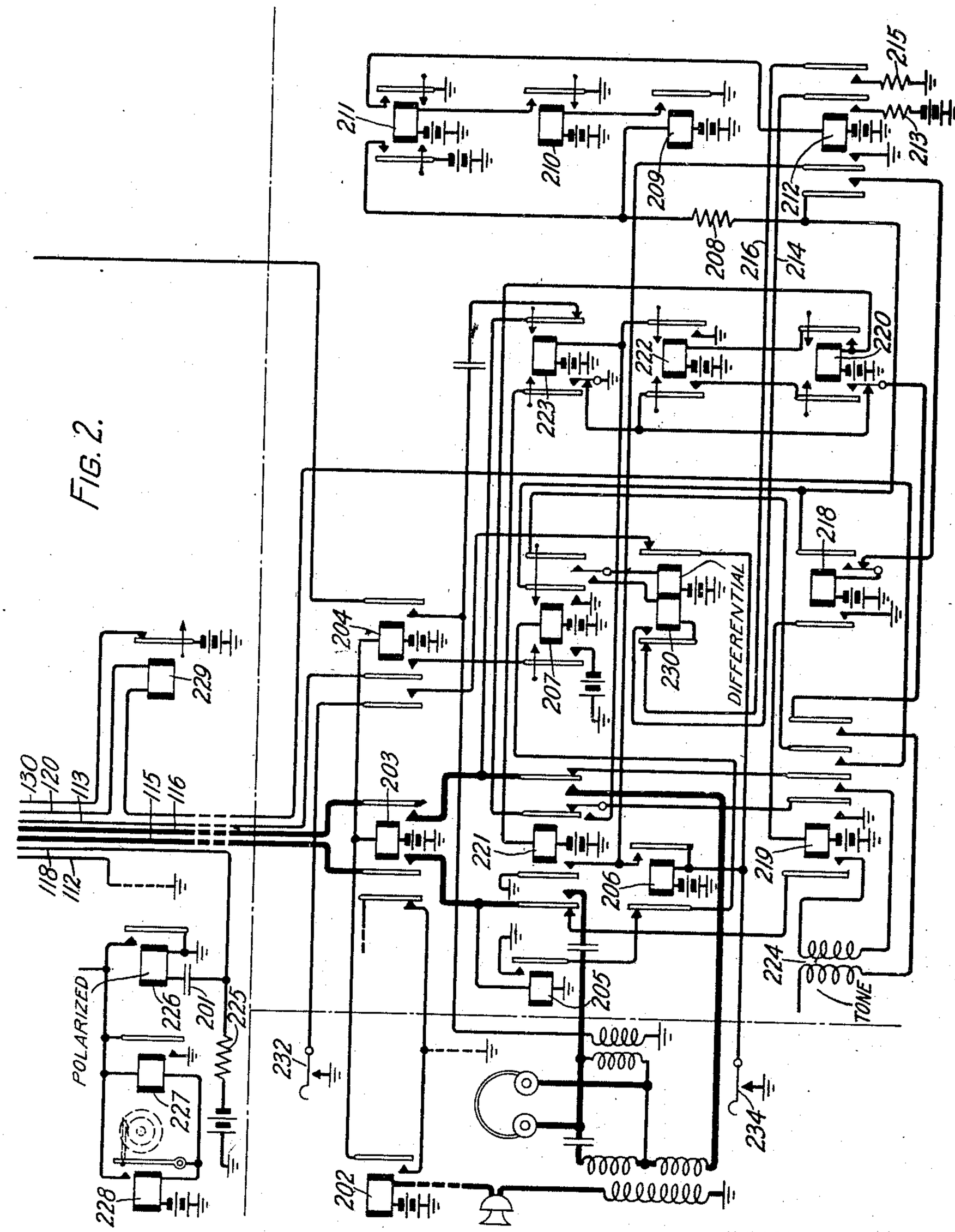

FIG. 2.

INVENTOR:
OSCAR H. WILLIFORD
BY P. C. Smith
ATTORNEY

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UNITED STATES PATENT OFFICE

OSCAR H. WILLIFORD, OF RIDGEWOOD, NEW JERSEY, ASSIGNOR TO BELL TELEPHONE LABORATORIES, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK

TELEPHONE-EXCHANGE SYSTEM

Application filed August 8, 1928. Serial No. 298,226.

This invention relates to telephone systems and has for its object economy in recording the use of central office equipment.

Broadly stated the invention relates to means for producing repeated momentary circuit closures from the successive prolonged closures of a plurality of parallel circuits.

This invention finds specific embodiment in a telephone system in which a plurality of trunks are served by a single operator and provides means for counting the number of times calls are extended by the operator while employing the minimum amount of apparatus not necessary to the establishment of the talking connection. When the operator completes a connection, ground through a resistance is connected to the peg count arrangement where the circuit extends to battery through a common resistance. One side of a condenser is connected to a point between the common resistance and the individual resistances so that when all trunks are idle, full battery potential exists at the condenser. As each of a plurality of connections is established the condenser potential is reduced and a momentary discharge current is available to operate a meter. To prevent the charging current which results from the disconnection of one or more of the resistances from affecting the meter, a polarized relay is used which responds only to discharge current.

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

Figure 2 shows the operator's equipment common to a plurality of such trunks and the peg count circuit.

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. Reference is also made to the application of W. A. Rhodes, Serial Number 203,051, filed July 2, 1927, on which disclosure the present drawings are based.

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 wanted line number from 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 130, back contact of relay 229 to battery. 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 to ground. Relays 110 and 109 extend the tip and ring conductors of the trunk, as well as certain control conductors, to the common position equipment shown in Fig. 2.

The equipment shown in Fig. 2 is common to all the trunks appearing at that particular position and is available only if the oper-

ator 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 of 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 ground at the front contact of relay 104, through the right winding of relay 108, right winding of relay 107, inner left front contact of relays 109 and 110, conductor 113, inner left front contact of relay 204 to battery at the left front contact of relay 207. Relay 108 operates in this circuit and locks through its left winding to the 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 at its inner right front contact for relay 209 which initiates the cyclic operation of relays 209 to 212. These relays form an interrupting mechanism whereby battery and ground are intermittently connected to conductors 214 and 216 respectively. The first operation of relay 212 closes a circuit for relay 218 which causes the sequential operation of relays 219, 220, 222, 223 and 221 for the purpose of transmitting two short impulses of tone or zip tones to the trunk circuit from the tone coil 224 after which the operator's telephone is connected to the trunk to receive the number of the wanted line from the call announcer.

The zip tones are, of course, ineffectual in the case of a call incoming from a dial office but the connection of the secondary winding of the tone coil 224 to the trunk conductors by the operation of relay 219 permits relay 114 to operate in 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 closes 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 connects the operator's telephone set with the trunk and disconnects coil 224 from the winding of relay 114. Relay 114 releases in turn releasing relay 105 thus restoring the polarity of current over the trunk circuit and causing the sender to announce the number of the wanted subscriber.

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 opening the circuit of lamp 117.

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. With relay 107 released, relays 109 and 110 release and the position circuit may be used with another trunk.

The release of relay 107 also closes a metering circuit to record the fact that a call has been handled at this operator's position. This circuit extends from ground at the outer right back contact of relay 107, outer right front contact of relay 108, resistance 131, conductor 118, resistance 225 to battery. The apparatus for controlling the meter comprises condenser 201 which is connected at one terminal to battery through resistance 225 and at the other terminal to ground through relay 226. Therefore, when all the trunks are idle and no current is flowing through resistance 225 the potential drop across the condenser is the full potential of the central office battery. However, when the above traced metering circuit is closed current flows through resistance 225 and the potential at the terminal of the condenser adjacent resistance 225 is reduced by the potential drop due to the current flow through resistance 225. The sudden reduction in potential due to the closure of the metering circuit causes a momentary discharge current to flow through the relay 226 operating that relay. The operation of relay 226 closes the circuit from battery, through the winding of meter magnet 228, winding of relay 227 to ground at the front contact of relay 226. Relay 227 is quick to operate and locks over its own front contact until the meter has completely attracted its armature and registered the call. When this occurs the winding of relay 227 is short-circuited and relay 227 releases restoring the register circuit to normal. Relay 226 is polarized so that the charging current which flows when resistance 131 is disconnected will not operate the meter. If a second call is extended to another trunk at this operator's position, for example that indicated by the relays at the bottom of Fig. 1, resistance 132 will be connected in parallel with resistance 131. The connection of these two resistances in parallel increases the current flow through resistance 225 thus again reducing the potential at condenser 201 and causing another operation of relay 226 to record another call. Similarly the connection of additional resistances in parallel with resistances 131 and 132 causes additional reductions of the potential at condenser 201 and further operations of relay 226. It is therefore possible by this arrangement to momentarily and repeatedly close a metering circuit in response to the prolonged and successive closure of a number of operating circuits. At busy positions where a great many calls might exist at the same time the trunks may be subdivided into groups and duplicates of resistance 225, condenser 201 and relay 226 provided for operating the meter. It is obvious that there can be no interference between such duplicates since the meter will be freed in less time than the operator can perform her duties.

Following the operation of release key 232 the operator tests the called subscriber's line in the usual maner and if it is idle inserts plug 122 in the subscriber's jack after which the called subscriber is signaled in the usual manner. When the called subscriber answers, a circuit is again provided for supervisory relay 114 which again operates relay 105 and reverses the current over the trunk conductors 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, in turn releasing relays 108 and 128. Lamp 119 now lights steadily in series with relays 124 and 125 as a disconnect signal. The removal of plug 122 from the jack restores relays 124 and 125 and extinguishes lamp 119.

What is claimed is:

1. In a telephone system, a plurality of parallel circuits, means to close one or more of said parallel circuits for a prolonged period, and means to momentarily close an additional circuit each time that one of said parallel circuits is closed comprising a condenser, means in said parallel circuits to discharge said condenser, and means responsive to said condenser discharge to close said additional circuit.

2. In a telephone system, a plurality of parallel circuits, means to close one or more of said parallel circuits for a prolonged period, and means to momentarily close an additional circuit each time that one of said parallel circuits is closed comprising a condenser, means in each parallel circuit to partially discharge said condenser, and means responsive only during said condenser discharge to close said additional circuit.

3. In a telephone system, a group of trunk circuits, means to establish connections over said trunk circuits, and means to count the number of said connections comprising a meter, a condenser, means to establish a given potential on one side of said condenser, means responsive during the establishment of a connection to reduce said potential, and means responsive to said reduction in potential to operate said meter.

4. In a telephone system, a group of trunk circuits, means to establish connections over said trunk circuits, and means to count the number of said connections comprising a meter, a condenser, means to establish a given potential on one side of said condenser, means responsive during the establishment of each connection to reduce said potential, and means responsive to each reduction in potential to operate said meter once.

5. In a telephone system, a group of trunk circuits, means to establish connections over said trunk circuits, and means to count the

number of said connections comprising a meter, a condenser, means to establish a given potential on one side of said condenser, means responsive during the establishment of a connection to reduce said potential, and means responsive to reductions in potential and unresponsive to increases in potential to operate said meter once for each seizure of a trunk.

6. In a telephone exchange system, a plurality of trunk circuits, operator's equipment, means to automatically associate said operator's equipment with a trunk circuit, means for disconnecting said equipment from said trunk circuit, and means for counting the number of connections established by an operator comprising a condenser, means for normally establishing a particular potential on said condenser, means responsive to said disconnecting means to reduce said potential, a meter, and means responsive to said reduction to operate said meter.

7. In a telephone exchange system, a plurality of trunk circuits, operator's equipment, means to automatically associate said operator's equipment with a trunk circuit, operator controlled means for disconnecting said equipment from said trunk circuit, and means for counting the number of connections established by an operator comprising a condenser, means for normally establishing a particular potential on said condenser, means responsive to said disconnecting means to reduce said potential, a meter, and means responsive to said reduction to operate said meter.

8. In a telephone exchange system, a plurality of trunk circuits, operator's equipment, means to automatically associate said operator's equipment with a trunk circuit, means for disconnecting said equipment from said trunk circuit, and means for counting the number of connections established by an operator comprising a condenser, means for normally establishing a particular potential on said condenser, means responsive to said disconnecting means to reduce said potential, a meter, and a polarized relay responsive to said reduction to operate said meter.

9. In a telephone exchange system, a plurality of trunk circuits, operator's equipment, means to automatically associate said operator's equipment with a trunk circuit, means for disconnecting said equipment from said trunk circuit, means thereafter effective to complete a connection over said trunk circuit, and means for counting the number of connections established by an operator comprising a condenser, means for normaly establishing a particular potential on said condenser, means responsive to said disconnecting means to reduce said potential, means responsive to the disconnection of a completed connection to increase said potential, a meter, and means responsive to said reduction in potential and unresponsive to said increase of potential to operate said meter.

10. In a telephone exchange system, a plurality of trunk circuits, operator's equipment, means to automatically associate said operator's equipment with a trunk circuit, means for disconnecting said equipment from said trunk circuit, means thereafter effective to complete a connection over said trunk circuit, and means for counting the number of connections established by an operator comprising a condenser, means for normally establishing a particular potential on said condenser, means responsive to said disconnecting means to reduce said potential means responsive to the disconnection of a completed connection to increase said potential, a meter, and a relay polarized to be responsive to said reduction in potential and unresponsive to said increase of potential to operate said meter.

In witness whereof, I hereunto subscribe my name this 6th day of August, 1928.

OSCAR H. WILLIFORD.