

May 2, 1933.

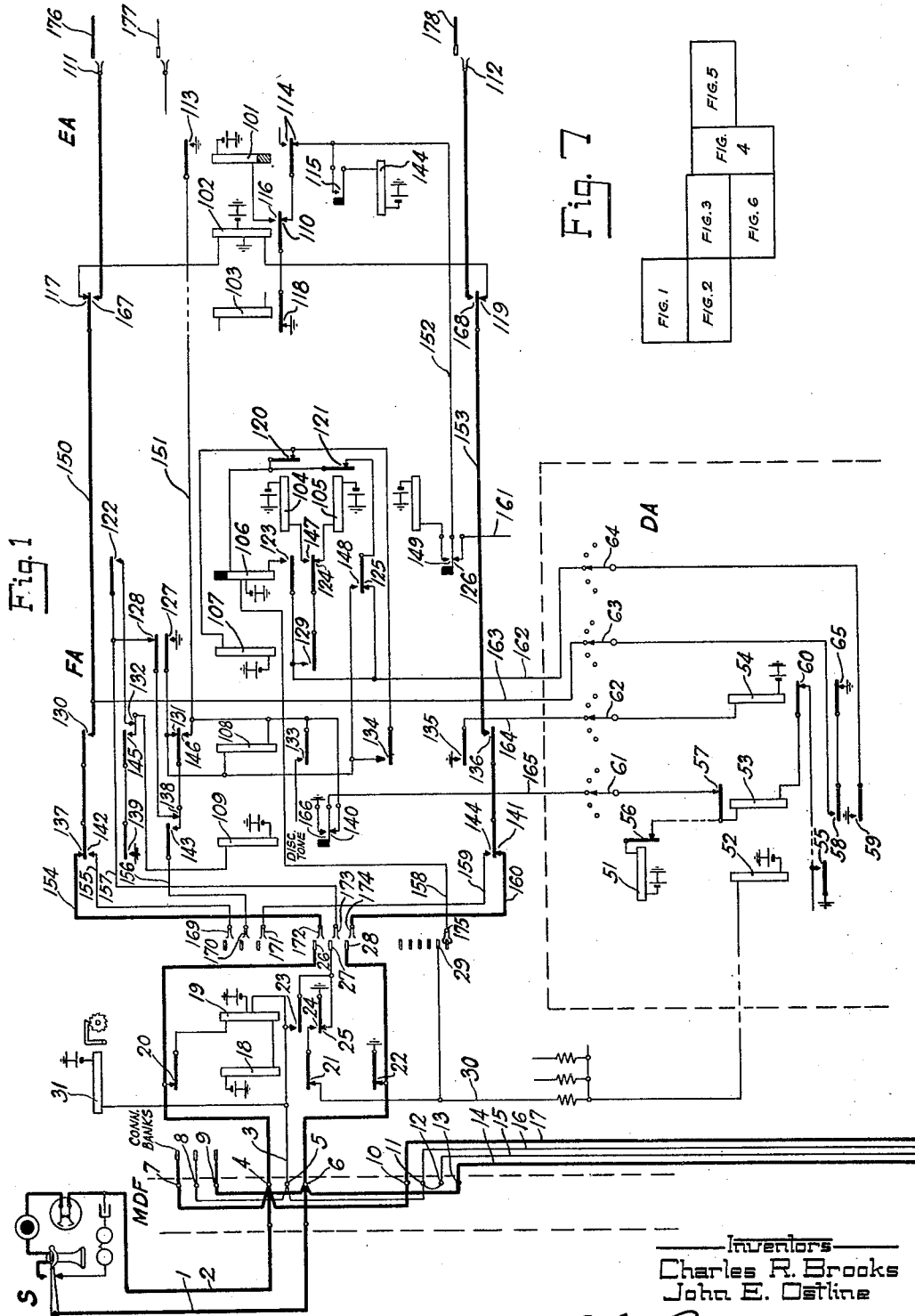
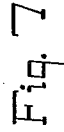
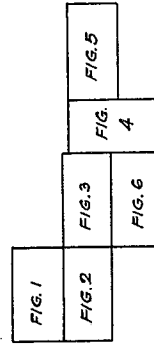
C. R. BROOKS ET AL

1,907,240

SERVICE OBSERVING EQUIPMENT

Filed Sept. 21, 1931

6 Sheets-Sheet 1



Inventors
Charles R. Brooks
John E. Ostline

R. B. Richardson
Fitz.

May 2, 1933.

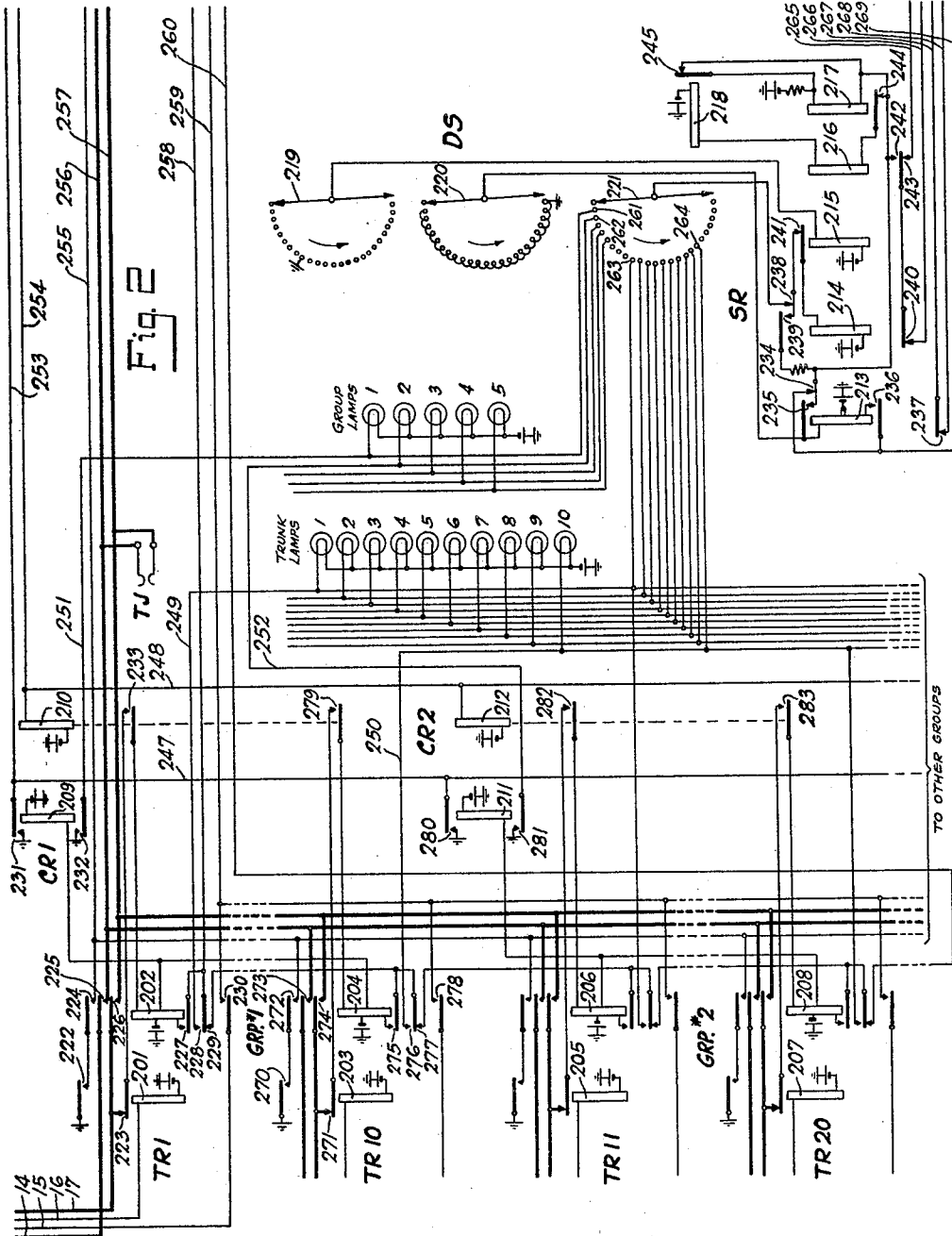
C. R. BROOKS ET AL

1,907,240

SERVICE OBSERVING EQUIPMENT

Filed Sept. 21, 1931

6 Sheets-Sheet 2



Inventors
Charles R. Brooks
John E. Ostline

Att. Richardson

May 2, 1933.

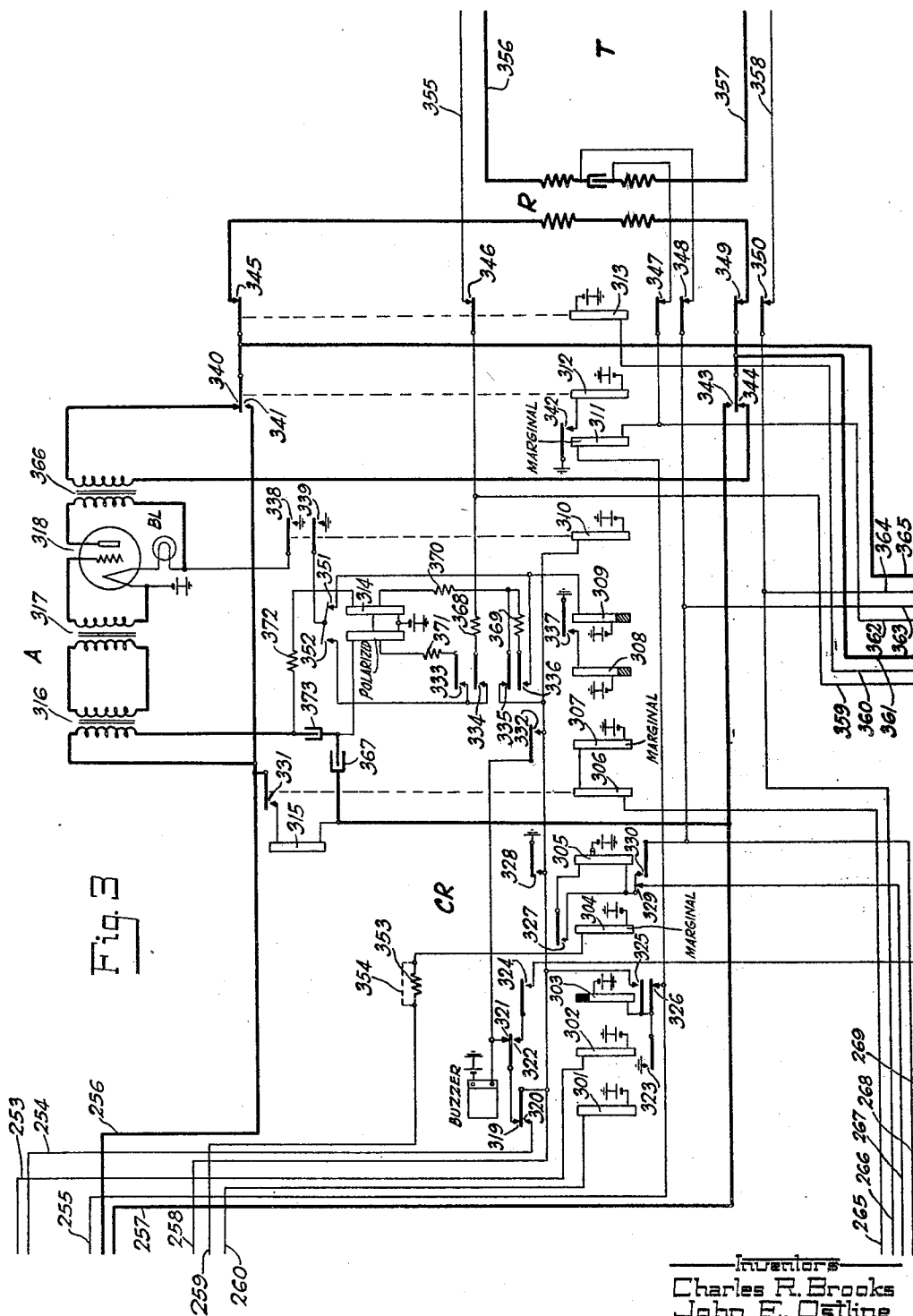
C. R. BROOKS ET AL

1,907,240

SERVICE OBSERVING EQUIPMENT

Filed Sept. 21, 1931

6 Sheets-Sheet 3



Inventors
Charles R. Brooks
John E. Ostline

Charles R. Brooks
John E. Ostline

John E. Ostline

RB Richardson
Atty.

Atty

May 2, 1933.

C. R. BROOKS ET AL

1,907,240

SERVICE OBSERVING EQUIPMENT

Filed Sept. 21, 1931

6 Sheets-Sheet 4

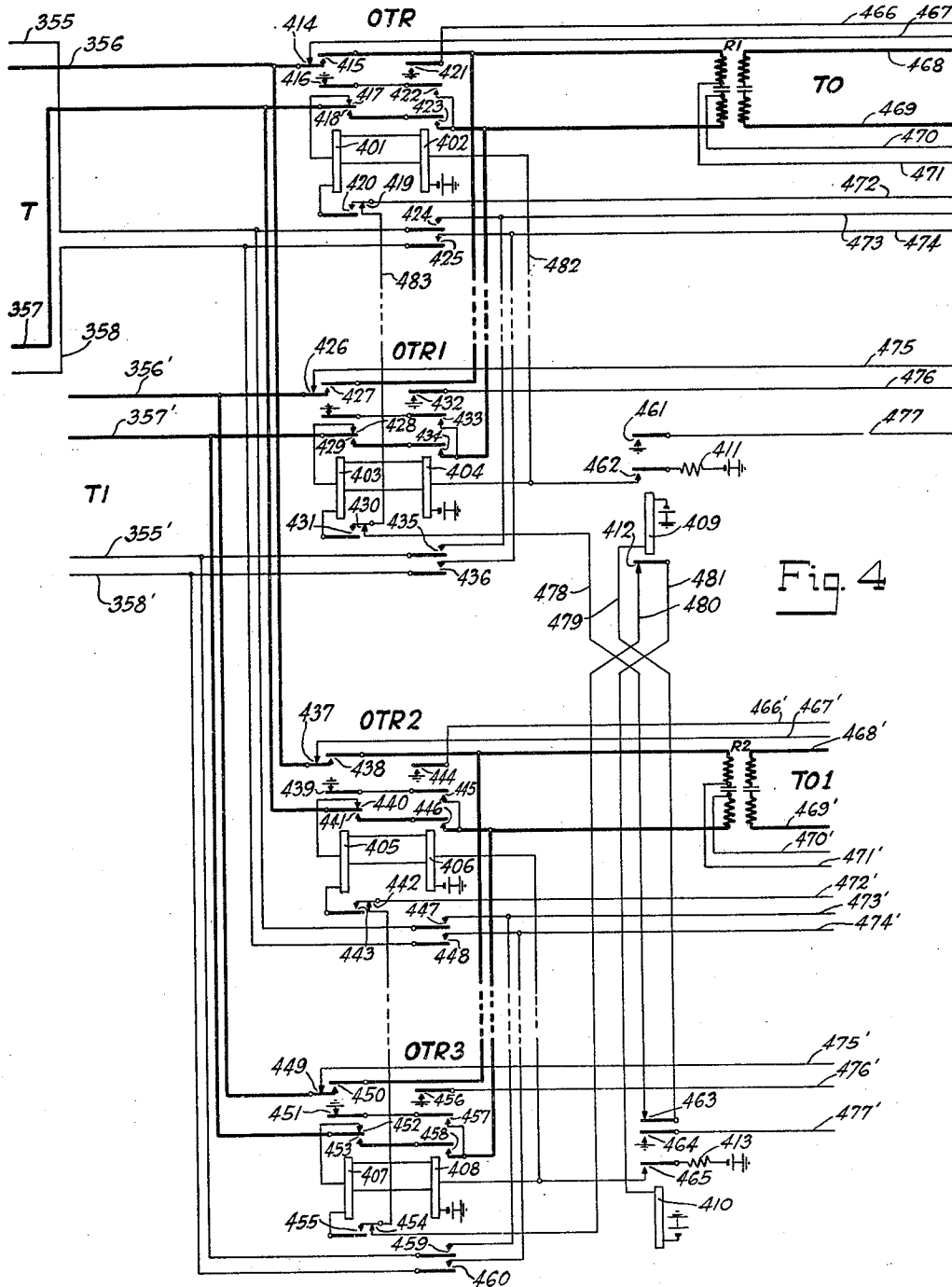


Fig. 4

Inventors
Charles R. Brooks
John E. Ostline

R. B. Richardson
Att'y.

May 2, 1933.

C. R. BROOKS ET AL

1,907,240

SERVICE OBSERVING EQUIPMENT

Filed Sept. 21, 1931

6 Sheets-Sheet 5

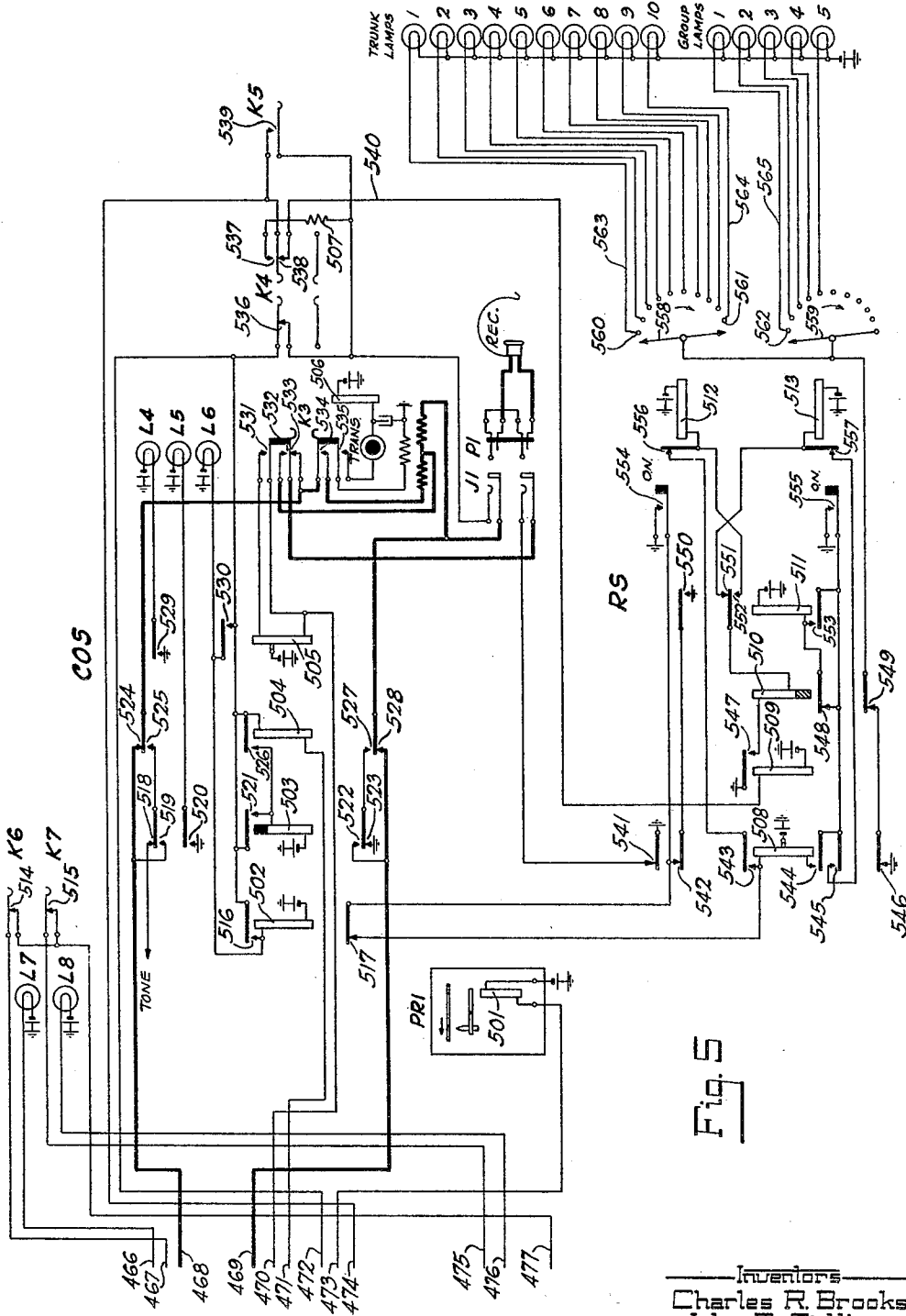


Fig. 5

Inventors
Charles R. Brooks
John E. Ostline

RB Richardson
Att'y.

May 2, 1933.

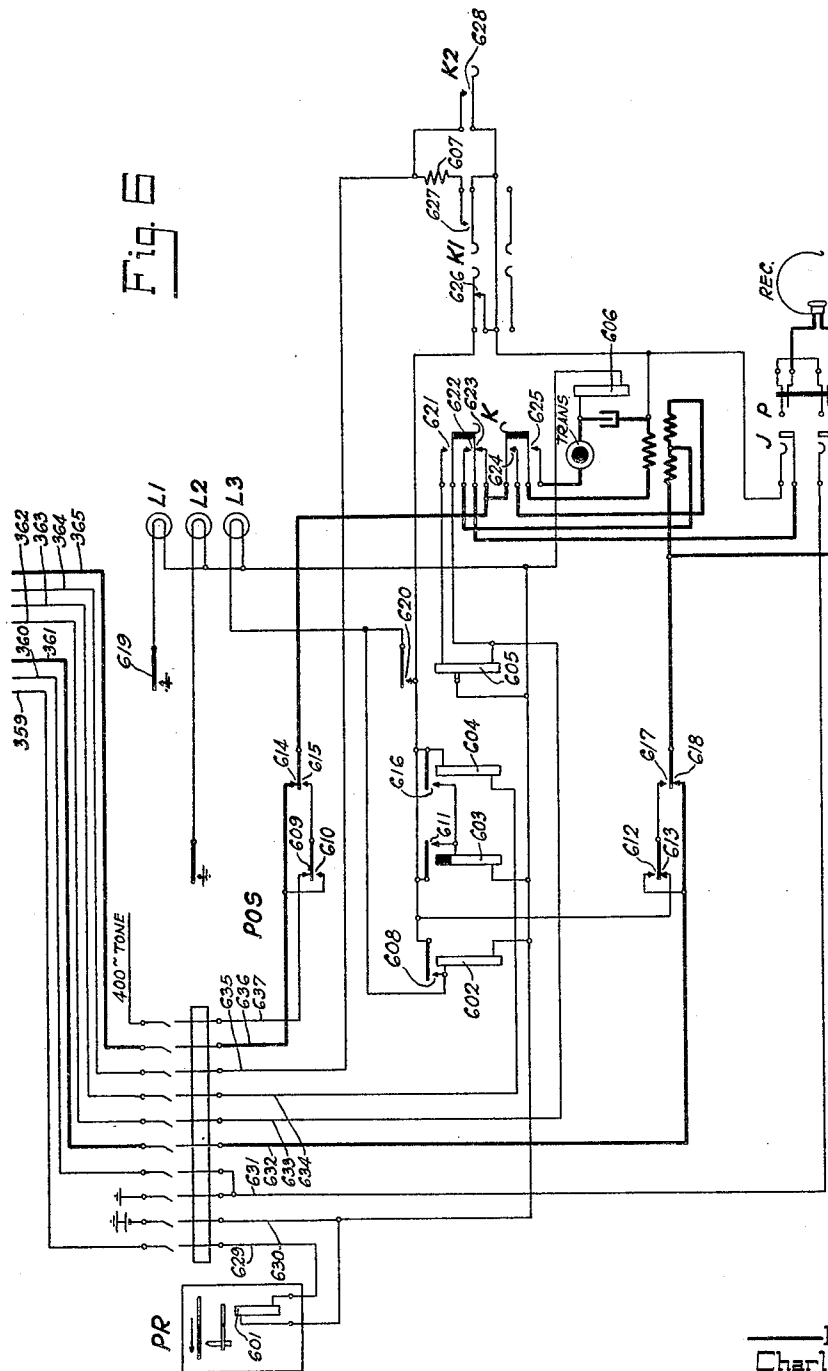
C. R. BROOKS ET AL

1,907,240

SERVICE OBSERVING EQUIPMENT

Filed Sept. 21, 1931

6 Sheets-Sheet 6



Inventors
Charles R. Brooks
John E. Ostline

RB Richardson
Att'y.

UNITED STATES PATENT OFFICE

CHARLES R. BROOKS, OF CHICAGO, AND JOHN E. OSTLINE, OF BERWYN, ILLINOIS, ASSIGNORS, BY MESNE ASSIGNMENTS, TO ASSOCIATED ELECTRIC LABORATORIES, INC., OF CHICAGO, ILLINOIS, A CORPORATION OF DELAWARE

SERVICE OBSERVING EQUIPMENT

Application filed September 21, 1931. Serial No. 563,950.

This invention relates to telephone systems in general, and particularly to arrangements for observing the quality of service afforded subscriber's lines in such systems. The invention has for its object the provision of new and improved circuits and apparatus for the centralized observation of connections established in the various offices of a multi-office telephone system.

General description

In telephone systems employing automatic switching apparatus for the establishment of connections, it is particularly desirable to observe connections from time to time in order to ascertain that the switching apparatus is functioning properly and that the subscribers are thoroughly familiar with the operations necessary for calling. When there are a number of offices in the system, it is ordinarily most economical to conduct the observing operations from a central switchboard. The centralization of observing facilities results in a considerable saving of equipment, and also permits the observing operator to work in the most efficient manner.

A centralized service observing system consists generally of a central switchboard located at some convenient point in the telephone exchange system. In each office of the exchange system there are a number of observation trunks which can be connected to the subscriber's lines or service trunks to be supervised. Switching apparatus at the offices associate the various observation trunks with inter-office trunks extending to the central switchboard, and other switching apparatus associates the various inter-office trunks with the observing equipment at the switchboard. The various switching apparatus units are coordinated to prevent interference from lines calling simultaneously.

A service observing system of the above general type is shown in United States Patent No. 1,641,453, granted September 6, 1927, to John E. Ostline, on which the present invention is an improvement. In prior systems, including that shown in the patent, it has been the practice to arrange the observing equipment for connection to a service trunk rather

than directly to a subscriber's line. This arrangement has been generally satisfactory, although obviously it does not permit observation of the service of the primary line switches or finder switches which operate upon the initiation of a call. The present system is arranged so that the observation trunks may be connected directly to subscribers' lines as well as to trunk lines, and thus provides for the observation of the service afforded by the non-numerical switches of the system. This is of particular importance in systems employing finder switches, as it enables the operator to determine the time required for the finder switches to connect with the calling line after a call has been initiated. This arrangement constitutes one of the main features of the invention.

Another feature of the present invention is the arrangement for reducing the transmission loss in a talking connection due to the connection of the observation equipment thereto. The talking conductors of the observation trunk are bridged across the talking conductors of the line in series with a condenser of low capacity and the high impedance primary winding of a transformer. The shunting effect of this bridge on the talking connection is relatively small, and, of course, the current flow in the bridge is feeble. This feeble current is amplified to the level necessary for the accurate supervision of the call by means of a vacuum tube amplifier associated with the observation equipment.

A further feature of the invention is the provision of a designation sender which transmits designating impulses to identify a particular line or trunk under observation. The sender is so arranged that in a new call arriving before the sending apparatus has had time to restore to normal, there will be no interference with the transmission of the proper trunk identifying digits.

Various other features of the invention relate to improvements in circuits and apparatus tending to make the operation of the system more efficient and reliable. The features of the invention, including those specifically referred to and others, will be described in more detail hereinafter in connection with

the description of the operation of the apparatus in a system embodying the invention which is shown in the accompanying drawings comprising Figs. 1 to 7, inclusive.

Description of drawings

Referring now to the drawings, Fig. 1 shows a subscriber's line and a part of the switching apparatus in the office in which the line terminates. Figs. 2 and 3 show that part of the service observing equipment located in the automatic office. Figs. 4 and 5 show service observing equipment located at the central observing office. Fig. 6 shows a portable observation set for use with the equipment shown in Figs. 2 and 3. Fig. 7 is a layout diagram showing the manner in which the various figures of drawings should be assembled to show the complete circuits of a service observing system embodying the present invention.

Switching apparatus in the outlying office

Referring now to Fig. 1, the subscriber's line from substation S terminates at an automatic office on the main distributing frame MDF and is cross-connected to the usual line and cut-off relays. A group of lines, including the one shown, are accessible to the finder switch FA, which, together with other similar finders, is controlled by the distributor switch DA. Selector EA is individual to the finder switch FA and has access to the second selectors of the exchange. The finder switch, selector, and distributor switch shown are similar to those disclosed in United States Patent No. 1,688,588, granted October 23, 1928, to Clarence E. Lomax and Norman H. Saunders. The reference characters used in designating the various parts of these switches correspond, as far as practical, to the reference characters used to designate corresponding parts in the patent. One observation trunk is shown terminating on the equipment side of the distributing frame and is temporarily connected with a line to be observed by means of jumpers or a cord and shoe of any suitable type. While only one observation trunk has been shown in the drawings, it will be understood that there will be as many of these trunks as traffic conditions require, one trunk being supplied for each line to be observed.

Service observing equipment in the outlying office

In Fig. 2 there is shown a number of observation trunks and their associated relays. The trunks are arranged in groups of ten for convenient identification. Relays TR1 are associated with the first trunk in the first group and the relays TR10 are associated with the tenth trunk of the first group. Relays TR11 are associated with the first trunk of the second group and relays TR20 are associated with the tenth trunk of the

second group. There may be as many additional groups of trunks as traffic conditions require and these will be connected up in the manner indicated. Each group of trunks is provided with a pair of common relays of which relays CR1 are associated with the first group and relays CR2 with the second group.

To the right of the common relays is shown two groups of lamps. The lamps of the first group identify the position of the trunks in their respective groups, and the lamps of the second group identify the particular group in which a trunk in use is located. These lamps serve to identify the line and trunk under observation and are provided for use when the observation is made by means of the portable set shown in Fig. 6, as will be explained subsequently. When calls are observed from the central observation switchboard the line or trunk under observation is identified by impulses transmitted over the interoffice trunk. These impulses are sent by the sender switch DS and its associated relays SR whose operation is controlled by conductors extending from the trunk and group relays to the lamps shown in Fig. 2 and to the banks of the rotary switch.

Fig. 3 shows the common control relays CR associated with the trunk and group relays shown in Fig. 2. These relays terminate an interoffice trunk T over which all connections at the automatic exchange are observed from the central switchboard. The relays associated with this trunk are also adapted to operate with the portable observation set shown in Fig. 6. In this figure there is also shown an amplifier A which is an ordinary vacuum tube audio frequency amplifier and is used only when observing calls from the central switchboard.

Included in the common relay group is a sensitive polarized relay which operates in synchronism with the impulse relay of a line under observation. The relay is connected to the line through a condenser and does not interfere in any way with the operation of the regular exchange switching apparatus. Impulses dialled by a calling subscriber are thus repeated to the observation switchboard and recorded by means of a pen register.

Service observing equipment in the central office

Fig. 4 shows the interoffice trunk relays located in the same office as the centralized observing equipment. The relay group OTR is associated with the trunk T which extends to the automatic office in which the equipment shown in Figs. 1-3 is located. The relay group OTR1 is associated with the observation trunk T1 which extends to another automatic office provided with equipment similar to that shown in Figs. 1-3. Both of these relay groups are adapted to associate their

respective trunks with the trunk TO which extends to the first position of the observation switchboard. Relay groups OTR2 and OTR3 are associated respectively with trunks T and T1 and are adapted to associate these trunks with the trunk TO1 which extends to the second position of the observation switchboard. Additional relay groups may be provided in case more than two switchboard positions are required.

Fig. 5 shows the equipment at the first position of the centralized service observing switchboard. This includes an operator's telephone circuit and various supervisory lamps and controlling keys, the pen register PR1, a receiving switch RS, and a bank of lamps arranged in the same manner as those shown in Fig. 2 for identifying the trunk on which a call is being observed. The equipment at the other position of the observation switchboard will be exactly the same as that shown in this figure.

Portable observation set

Fig. 6 shows the circuit of a portable observation set which can be associated with the apparatus in any of the automatic offices for the purpose of observing traffic solely in that office. This set includes the usual lamps and keys, an operator's telephone set, and a pen register PR. The trunk and group lamps for this particular equipment are associated with the exchange apparatus itself as shown in Fig. 2.

Detailed description

The invention having been described generally, a detailed description of the operation of the apparatus shown will now be given. For this purpose it will be assumed that the subscriber's line terminating in substation S is the line to be observed.

Operation of the switching apparatus in the outlying office

Before proceeding with the detailed description of the operation of the service observing equipment the operation of the switching apparatus in the outlying exchange will be considered briefly. This apparatus as previously stated is similar to that shown in the Lomax and Saunders patent, and is described in detail in the patent. It will be assumed first that the subscriber at substation S initiates a call at a time when the service observing switchboard is not in service. The calling subscriber on lifting his receiver completes a circuit from battery, upper winding of relay 19, contacts 20, terminal 4, line conductor 2, through the loop at the substation S, line conductor 1, terminal 6, and contacts 22, to ground. Relay 19 operates and marks the line as calling in the banks of the finder switches by closing contacts 23 and opening contacts 25, and at contacts 24 connects ground by way of contacts

21 and conductor 30 to relay 52 of the distributor switch. Assuming that no other calls are in progress at this time, relay 52, on operating, completes a circuit at contacts 55 for relay 53 and stepping magnet 51 in series. The wipers of the switch DA will be standing on the contacts associated with an idle finder, such as the finder FA, due to circuit conditions which will be described subsequently, and, upon the closure of the above-mentioned circuit, relay 53 will operate and open the stepping circuit at contacts 57. Magnet 51 does not operate at this time due to the high resistance of relay 53. As a result of the operation of relay 53 a circuit is completed by way of contacts 65 and 58, wiper 63, conductors 163 and 150, contacts 117, upper winding of line relay 102 of selector EA, to battery. Relay 102 operates and at contacts 116 completes a circuit for release relay 101. Relay 101 operates, connects ground to release trunk conductor 151 at contacts 113, and prepares the impulsing circuit of the selector at contacts 114. Relay 53 at contacts 59 also closes a circuit over wiper 64 and conductor 162, which extends by way of contacts 125, 121, and 120 to relay 107. Relay 107 operates and at contacts 129 extends the ground on conductor 162 to vertical magnet 105 of the finder switch. Magnet 105 operates to raise the wipers of the switch one step, at the same time opening the circuit of relay 107 at contacts 121. On the first vertical step of the wipers vertical test wiper 175 will engage a bank contact corresponding to the first level of the bank and will test this level for the presence of a calling line. If the calling line is not in this level there will be no further action until magnet 105 restores after the release of relay 107, whereupon the circuit for relay 107 will be again closed at contacts 121 and relay 107 will again complete a circuit for the magnet. These operations will be repeated until such time as test wiper 175 engages the contact corresponding to the level in which the calling line is accessible. When this level is reached, and while magnet 105 is still energized, a circuit will be completed from ground applied to conductor 30 at contacts 24 of the calling line, bank contact 29, wiper 175, conductor 158, upper winding of relay 106, contacts 120, winding of relay 107, to battery. Relay 106, on operating, prepares the rotary test circuit at contacts 122, completes a locking circuit for itself at contacts 123, prepares a circuit for rotary magnet 104 at contacts 147, and at contacts 148 prepares the automatic stopping circuit. Magnet 104 operates immediately upon the closure of the above circuit, opens the circuit of relay 107, and steps the wipers of the finder in upon the first set of contacts in the selected level. It will be noted that the finder switch is provided with two separate sets of wipers. These wipers

have access to two different groups of lines appearing in the corresponding levels of their respective banks and the lines in these levels are tested alternately until the calling line is found. Assuming that the calling line is not the one terminating in the first set of contacts of either bank, the following operations will take place: The contacts engaged by the wipers at this time are marked non-calling by ground applied to the test contact 27 via contacts corresponding to contacts 25 of the associated lines. This ground, by way of wiper 173, conductor 157, contacts 122 and 132, energizes relay 109. Relay 109 thereupon connects test wiper 170 via contacts 143 and 131 to the stepping circuit which includes relay 107. Since this set of contacts is marked non-calling, wiper 170 will accordingly find ground and relay 107 will energize. Relay 107 again completes a circuit for magnet 104 at contacts 129, thereby operating the magnet to step the wipers ahead to the next set of contacts of the level. When the calling line is reached, for example, the line from substation S, test wiper 173 will find battery on contact 27 instead of ground and as a result relay 109 will not energize. A circuit may now be traced from ground, contacts 113, conductor 151, winding of relay 108, contacts 131, 138, and 128, conductor 157, test wiper 173, test contact 27, contacts 23, lower winding of relay 19, winding of relay 18, to battery. Relay 19 will remain operated over this circuit and relays 18 and 108 will energize. Relay 18 opens the starting circuit at contacts 21, and at contacts 20 and 22 disconnects relay 19 and ground from the line conductors. Relay 108 is the switching relay of the finder and has numerous functions to perform. Upon the operation of this relay the calling line is extended through to the line relay of the selector by the closure of contacts 130 and 136. Wiper switching relay 109 is disconnected from the test circuit at contacts 132. The opening of contacts 131 disconnects relay 108 from the test wiper, and the closure of contacts 146 connects ground to this wiper to maintain the line cut-off relay of the line in operated condition. Discriminating tone is applied to release trunk conductor 121 at contacts 133. A new holding circuit for relay 108, including the winding of relay 107, is completed at contacts 134. Relay 107 does not operate in series with relay 108, due to the high resistance of the latter relay. A circuit is closed at contacts 135 by way of conductor 164 and wiper 62 for relay 54 of the distributing switch. This relay on operating opens the circuit of relay 53, which restores, and at contacts 57 completes a circuit for stepping magnet 51. Since the finder switch has been operated to an off-normal position, off-normal contacts 166 will be closed, and ground by way of these contacts, conductor 165, wiper 61, contacts 57 and 56, energizes magnet 51 to step the distributor wipers to the next set of contacts. If the next set of contacts is also busy, a similar operation will take place and in this manner the wipers of the distributor will be stepped until an idle finder switch is found. The movement of the wipers of the distributor switch opens the previously described energizing circuit for line relay 102 of the selector. This relay is now held operated over the calling subscriber's loop. The calling subscriber may thereupon complete the connection by dialling in the usual manner.

Since it has been assumed that the centralized observation switchboard is unattended at this time, the group relays 210, 212, etc., will be in normal condition, as will be explained in more detail hereinafter. The initiation of the call as above described will be without effect on the observation equipment at this time due to the normal condition of these relays. When the finder switch connects with the calling line, as above described, ground is applied over test contact 27 and relay contacts 23 to maintain relay 19 operated and to mark the line busy in the banks of the various connector switches. The test contact is connected by way of conductor 16 to relay 201, and this relay energizes upon the seizure of the calling line by the line finder. Relay 201, upon operating, opens a point in the circuit of relay 202 at contacts 223, the utility of which will be apparent as the description proceeds.

Observation of calls from the central office

The operation of the service observing circuits will now be described, first consideration being given to the observation from the central observing position of calls originating on lines terminating in the automatic office, such as the line for substation S.

Observing equipment placed in service

In order to place the observation equipment in operating condition, the operator at one of the central switchboard positions, for example the first position as shown in Fig. 5, will insert the plug P1 of her receiver set into the jack J1. A circuit is thereby completed from ground, contacts 541, lower tip spring and lower tip of the double jack and plug, upper tip and upper tip spring of the plug and jack, contacts 536 of release key K4, conductor 472, through normally closed contacts 419 of relay 401, and through similar portion of conductor 483, contacts 430, conductor 478, contacts 463, and relay 409, to battery. Relay 409 operates, closes a circuit from ground at contacts 461, conductor 477, normally closed contacts 514 and 515 of keys K6 and K7, thence over two branch circuits, one of which includes conductor 467, contacts 414, conductor 356, upper right-hand winding

of repeating coil R, Fig. 3, contacts 348, conductor 268, contacts 237 of relay 213 (Fig. 2), conductor 267, contacts 329, high resistance lower winding of relay 305, to battery. In multiple with the above described circuit is a circuit including conductor 475, contacts 426, conductor 356' of the trunk T1 and thence over a path similar to that above traced in the service observing circuit in the exchange in which the trunk line T1 terminates. While only two circuits of this have been shown, it will be understood that there will be as many of the circuits as there are observing trunks coming in to the position under consideration. There will, of course, be a key such as keys K6 and K7 for each trunk, and there will be a corresponding lamp L7 or L8 for each trunk. When it is desired to observe connections only in a particular office or offices, the trunk keys corresponding to the other offices will be operated. This will prevent calls originating in these other offices from being trunked to the position under consideration.

As a further result of the operation of relay 409, a circuit is closed from battery, resistance 411, contacts 462, thence over two parallel circuits, one by way of conductor 482, upper windings of relays 402 and 401, contacts 417, conductor 357, lower right-hand winding of repeating coil R (Fig. 3), contacts 347, winding of relay 311, conductor 255, to open contacts of relays 202, 204, 206, etc. A multiple circuit extends through the upper windings of relays 404 and 403, contacts 428, and conductor 357' of the trunk line T1 to the observing equipment in the office in which the trunk line T1 terminates. Only two of these circuits have been shown, but it will be understood that there is a circuit of this type for each trunk extending to an outlying office.

Referring now to Fig. 3, it will be recalled that relay 305 operated upon the insertion of the receiver plug in the jack as just described. This relay completes a holding circuit for itself at contacts 330, which renders it independent of the contacts 237. Ground is applied at contacts 328 to conductor 258, which extends by way of contacts 229 of relay 203 and the chained contact of similar relays of the group to contacts 277 of relay 204, and thence through the chained contacts of the corresponding relays in all other groups, the last contact group being connected to conductor 260 which extends to relay 301. Relay 301 accordingly operates, opens the alarm signal circuit at contact 319, and closes a circuit from ground at contacts 328 by way of contacts 320, conductor 254, to relays 210, 212, and corresponding group relays of other groups. The group relays operate, and at their contacts 233, 279, 282, and 283, etc., connect the upper windings of the various trunk relays 202, 204, 206, 208, and other sim-

ilar relays to conductors of the respective observation trunks. As a further result of the operation of relay 305, a circuit is completed for relay 310, which relay prepares the amplifier A for operation by closing contacts 338. A circuit is closed by way of contacts 339 and 351 for relay 309, and this relay operates. Relay 309 closes a circuit for relay 308 at contacts 337. Relay 308 operates and prepares various circuits concerned with the repeating of the impulses dialled by a calling subscriber. The observation equipment is now in condition to receive calls from any of the exchanges equipped according to the arrangement shown in the drawings.

The condition of the apparatus at this time may be summarized briefly, as follows: The group relays 210, 212, etc., in each office will be in operated condition and the trunk relays 202, 204, 206, 208, etc., of the various trunks will be connected up on all trunks in which calls are not in progress. In the case of trunks which are busy at the time the observation equipment is placed in service, the cut-off relays 201, 203, 205, 207, etc., of the trunks will be operated, and at contacts 223, 271, etc., will open the circuits of the trunk relays. This arrangement prevents the extension to the observation switchboard of calls that are in progress when the equipment is placed in service. In the common relay group CR (Fig. 3), relays 301, 305, 308, 309, and 310 are operated, and relay 302 has been connected through to the normally open upper contacts of the various trunk relays. Impulse repeating relay 314 has its lower right-hand polarizing winding energized in series with resistances 369 and 370 and the upper windings of this relay are bridged across the operating conductors 256 and 257 in series with condenser 367. The filament of vacuum tube 318 of amplifier A is lighted in series with the ballast resistance lamp BL. The equipment is now in readiness to intercept the first call initiated on any of the observation trunks.

Second position of the switchboard placed in service

The foregoing operations are those which take place when the first position of the observation switchboard is placed in service. In the event that the second position had been placed in service instead of the first position, the operations involved would be substantially the same, except that in this case, since the position apparatus is connected to the trunk TO1, ground is extended over conductor 472' instead of conductor 472. This ground, by way of chained contacts 442, 454, etc., conductor 480, and contacts 412, energizes relay 410. Relay 410 opens the circuit for relay 409 at contacts 463, and connects ground by way of contacts 464, conductor 477' and the interoffice trunk to the group

relays of the observation equipment of the various offices in the manner previously described. The trunk relays 405, 406, 407, 408, etc., associated with the second position, will be placed in operating condition by the connection of battery through resistance 413 and contacts 464, to the upper windings of the respective relays.

It will be seen from the foregoing that the first position to be placed in series will be assigned the first intercepted cell due to the operation of its associated relay, such as 409 or 410. It will also appear presently that when two positions are in service at the same time the intercepted calls will be assigned to the respective positions alternately.

Call initiated on a subscriber's line

The description of an intercepted call will now proceed on the basis of both observation positions having been placed in service with the first position having precedence as regards the first call. Assuming that the subscriber at substation S initiates the first call after the observation equipment is placed in service, the line relay equipment, finder switch, distributor, and selector will operate in exactly the same manner as previously described for calls made with the service observing equipment out of service. Under these conditions, however, relay 202 of the trunk relays TR1 is connected in parallel with the upper winding of line relay 19, the circuit extending by way of contacts 233 and 223 and conductor 17, which is jumpered to terminal 4 in multiple with line conductor 2. Relay 202 will accordingly energize in parallel with the line relay immediately upon the initiation of the call. The talking conductors 14 and 17 of the observation trunk are accordingly extended through to the common equipment at contacts 225 and 226 and the metering conductor 15 is extended to conductor 259 at contacts 230. At contacts 227, relay 202 completes a locking circuit for its lower winding in series with group relay 209, which circuit extends over conductor 258 to ground at contacts 328. The previously traced chain circuit over which the group relays 210, etc., were energized is opened at contacts 229 and the circuit for the associated trunk lamp is closed at contacts 228. Relay 202 remains energized over the above-traced holding circuit, and relay 209 energizes and closes a circuit for the associated group lamp at contacts 232. Relay 209 also closes a circuit from ground at contacts 231, conductor 253, winding of relay 302, to battery. The opening of the chain circuit permits the group relays to restore, thereby disconnecting the various observation trunk relays 204, 206, 208, etc., from their associated trunks so that calls over the lines to which these trunks are connected will not be intercepted. The group and trunk lamps, in this case the trunk

lamp 1 and the group lamp 1, are lighted, although this is without any particular utility in the present instance since the call is to be observed at the central office. The conductors over which these lamps are energized, however, extend, respectively, to the second and tenth contacts of the banks of switch DS and identify the observation trunk, as will be explained hereinafter.

Referring now to the common relay circuit of Fig. 3, relay 302 operates upon the closure of the above-traced circuit, opens a further point in the alarm signalling circuit at contacts 321, closes a point in the starting circuit of the designation sending switch at contacts 322, and at contacts 323 closes an obvious circuit for slow-to-operate relay 303. During the slight interval required for relay 303 to operate a circuit is closed from ground at contacts 323, contacts 326, winding of relay 311, contacts 347, lower right-hand winding of repeating coil R, conductor 357, contacts 417, upper windings of relays 401 and 402, contacts 462, and resistance 411, to battery. Relays 401 and 402 operate and lock to ground by way of contacts 420 and conductor 472. Relays 401 and 402 are so adjusted that contacts 422 are closed before contacts 416 are opened, and as a result an impulse ground is transmitted by way of these contacts, lower left-hand winding of repeating coil R1, conductor 470, lower high-resistance winding of relay 505, to battery. Relay 505 energizes momentarily and at contacts 530 connects ground through the release key contacts 536 to relay 502. Relay 502 operates, locks by way of contacts 516, and opens a point in the release circuit of the receiving switch RS at contacts 517. Guard lamp L6 is connected in parallel with relay 502 and lights at this time to indicate that a call has been initiated on one of the observation trunks. Upon the energization of relays 401 and 402, conductors 356 and 357 of trunk T are extended by way of contacts 415, 418, and 423 to the left-hand windings of repeating coil R1. As the ground connected to conductor 357 upon the operation of relay 302 is only temporary, this conductor will be clear by the time the connection is extended through, and consequently relay 505 will restore and open the original energizing circuit of relay 502. The latter relay, however, will remain energized over the previously-traced locking circuit and lamp L6 will continue to glow. As a further result of the operation of relay 401 the chain circuit indicated by the dotted section of conductor 483 is opened at contacts 419, thereby permitting relay 409 to restore and at contacts 462 disconnect battery from the upper windings of the various trunk relays associated with the first position. The release of relay 409 also completes a circuit at contacts 412 for trunk relay 410 associated with the trunk of the

second position, and this relay operates to prepare the trunks for extending intercepted calls to the second position.

To proceed with the intercepted call under consideration, a further result of the operation of relay 402 is the closure at contacts 421 of a circuit for the office identifying lamp L7. This lamp glows to indicate to the operator that the intercepted call is from the particular office designated by the lamp, in this case the office in which the subscriber's line from substation S terminates. The supervisory conductors 355 and 358 of the trunk T are extended by way of contacts 424 and 425 to conductors 473 and 474 of the trunk TO. The condition obtaining at this time may be summarized as follows: The calling subscriber has initiated a call and the finder switch FA has started in search of the calling line. A momentary signal has been transmitted over the trunk T to switch the trunk through to the first position of the observation switchboard and guard lamp L6 has been lighted to indicate the interception of a call upon initiation. The operator at this position will accordingly note the time at which lamp L6 operated.

When the finder switch FA connects with the calling line, ground will be applied to test conductor 3 of the called line, and this conductor, being multiplied with conductor 16, relay 201 of the trunk relay group will operate in the usual way. Relay 201 closes a circuit which may be traced from ground at contacts 222, contacts 224, conductor 255, thence over the previously traced circuit to relay 505, which relay will again operate and close a circuit at contacts 529 for lighting the subscriber's pilot lamp L4. The interval between the lighting of lamps L6 and L4 represents the time taken by the finder to connect with the calling line after the initiation of the call. Relay 311, which is connected in series with the lower winding of relay 505, is not operated at this time due to the high resistance of the latter relay. As a result of relay 311 remaining in normal condition, the amplifier A will be connected in operating condition between the observation trunk TR1 and the interoffice trunk T. The circuits over which the voice current from the calling and called lines are transmitted will be described subsequently.

53 *Trunk designation transmitted to the observation switchboard*

Referring back to the operation of relay 202 upon the initiation of a call, as above described, we find the following starting circuit completed for the sender switch. Relay 301 having restored upon the opening of the chain circuit by relay 202, ground at contacts 328 by way of contacts 319, 322, and 324, conductor 269, contacts 234 and 244, pulsing relay 216 and magnet 218, to battery energizes the relay

and magnet. Relay 216, on operating, connects the grounded starting circuit to the pulsing circuit which may be traced from contacts 242 and 240, conductor 266, contacts 350, conductor 358, contacts 425, conductor 474, contacts 538, conductor 540, and relay 509, to battery. Magnet 218, on operating, steps wipers 219—221 ahead one step and, by opening contacts 245, removes the short circuit from the winding of relay 217. Relay 217 operates and opens the circuit of relay 216 and the magnet at contacts 244. The relay and magnet restore, the former removes ground from the pulsing circuit, and the latter again closes the short circuit for relay 217. Relay 217 releases slowly, due to the short circuit of its winding, and after an interval recloses the circuit for the pulsing relay and magnet. Upon the switch wipers reaching the second position a circuit for relay 213 is completed from ground on the bank contact engaged by wiper 220. It may be noted that all contacts accessible to wiper 220, except the normal position or home contact, are multiplied and connected to ground for purposes which will be apparent as the description proceeds. Relay 213 operates and disconnects the pulsing relay from the original starting circuit at contacts 234 and connects it instead to wiper 220 at contacts 235. The continued operation of the pulsing relay and stepping magnet is now independent of the maintenance of the original starting circuit and is controlled by wiper 220, as long as the same is away from its normal position. Relay 213 also completes a holding circuit for its lower winding at contacts 236 to maintain the relay operated until the observing operator releases the connection. The original energizing circuit of relay 305 of the common relay equipment is opened at contacts 237 to prevent the reoperation of this relay in case the observing operator releases one connection and a new call arrives before the sender switch has returned to normal position.

With relay 213 operated, it is obvious that the pulsing relay and stepping magnet will continue to operate until the switch wipers return to their normal positions. Relay 216 will accordingly close the pulsing circuit at contacts 242 for each step of the wipers. Wiper 221, on encountering the contact associated with the group in which an engaged trunk is located, will find ground on the contact to energize relay 214. Relay 214 operates and locks to the off-normal ground circuit at contacts 239 and opens the pulsing circuit at contacts 240. In the present case it is assumed that the first trunk of the first group is the one in use, and consequently conductor 221 will find ground on contact 261, and relay 214 will operate after the first impulse has been transmitted over the pulsing circuit. As relay 214 is locked up, the energization and deenergization of relay 216 will be ineffective

to transmit any further impulses until wiper 219 engages the ninth contact of its bank, whereupon a circuit is completed for relay 215. Relay 215 operates and opens the circuit to relay 214 at contacts 241. Relay 214 restores, and again closes the pulsing circuit at contact 240. The next step of the wipers brings them into engagement with the contacts associated with the first trunk designating contact, and relay 216 will again transmit impulses until wiper 221 engages a contact marked by ground. In the present-assumed connection, the first trunk contact is the one marked, and consequently relay 214 will again operate following the transmission of one impulse by relay 216. Relay 214 will remain locked up until the wipers of the switch reach their normal position, and consequently no further impulses will be sent during the present connection. When the wipers reach normal position the off-normal ground circuit is opened and the stepping operation of the switch ceases. Relay 214 releases and extends the previously-described pulsing circuit by way of contacts 240 and 243 and conductor 265 to relays 306, 307, in series. Relay 213 will remain energized over its lower winding to ground on the original starting circuit of the sender. Thus the sender is prevented from further operation as long as the connection between the observation trunk and the central switchboard is maintained.

It will be noted that three vacant contacts appear between the group designating contacts and the trunk designating contacts. These vacant contacts are for the purpose of creating a pause between the two series of impulses of sufficient length to allow the necessary switching operations in the receiving switch. It will be apparent that in case more than five groups of trunks are required, additional contacts will be allotted to these groups and the trunk designating contacts will be moved over to later positions in the switch bank. A twenty-five point switch of the type shown can be arranged to handle ten groups of ten trunks each in this manner. When more than ten groups of trunks are required it is only necessary to provide a double set of banks containing the necessary additional contacts.

Referring now to the receiving switch RS, Fig. 5, relay 509 operates in response to each impulse transmitted by pulsing relay 216 of the sender. The first series of impulses, i. e., the series designating the trunk group, are repeated by way of contacts 547, relay 510, magnet 513, to battery. Relay 510 and the magnet operate in response to the impulses and relay 510, being slow to release, remains operated throughout the series of impulses. Magnet 513 advances wiper 559 step-by-step in accordance with the impulses received. In the case under consideration it is assumed

that the sender switch transmitted a single impulse to identify the group, and, therefore, wiper 559 is operated into engagement with contact 562. During the pause which follows the transmission of the group-identifying impulses, relay 510 restores and a circuit is completed from off-normal contacts 555, which operated on the first step of the wiper 559, contacts 548, relay 511, to battery. Relay 511 operates, completes a locking circuit for itself at contacts 553, and switches the impulsing circuit over to magnet 512 at contacts 552. Relay 509 repeats the next series of impulses as in the preceding case, and magnet 512 responds and advances wiper 558 step by step in accordance with the number of impulses received. In the present instance it has been assumed that the trunk-identifying digit consists of a single impulse, and wiper 558 accordingly engages contact 560. Relay 510 again operates in series with the stepping magnet, and, shortly after the last impulse of the series, this relay releases and completes a circuit for the selected lamps. This circuit may be traced from ground on contacts 546, contacts 549, wiper 559, contact 562, conductor 565, group lamp 1, to battery, and also by way of wiper 558, contact 560, conductor 563, and trunk lamp 1, to battery. The selected lamps are now lighted to indicate to the operator the particular group and trunk to which the observing equipment is connected, and office lamp L7 is likewise lighted to indicate the office in which the connected trunk is located. Guard lamp L6 and subscriber's pilot lamp L4 are both lighted and the operator is awaiting the dialling of the called number by the calling subscriber.

The calling subscriber dials

The progress of the connection has been described up to the point at which the calling line has been connected through to the first selector, an observing connection has been extended to the first position of the observing switchboard, and the trunk-identifying digits have been sent over the observation trunk to light the trunk-identifying lamps at the central switchboard. These operations take place very rapidly and will ordinarily be completed before the subscriber starts to dial the called number, although there will be no interference even though the subscriber turns the dial before the sender switch has completed its sending operation.

The calling subscriber dials the first digit of the called number by interrupting the loop circuit for line relay 102 of selector EA in accordance with the value of the called digit. Condenser 367 (Fig. 3), which is bridged across the line conductors in series with the upper winding of polarized relay 314, as previously described, is charged during the interval that the loop circuit is closed and dis-

charges at each interruption of that circuit. Upon the first interruption of the line circuit and consequent discharge of the condenser a current flow is set up in the upper winding of relay 314, which opposes the current flow normally existing in the lower right-hand winding of the relay, and the relay moves its armature to close contacts 352 and open contacts 351. A circuit is now closed by way of contacts 339, 352, and 333, resistance 371, lower-left-hand winding of relay 314, to battery. The left-hand winding of the relay is energized in this circuit and tends to maintain the armature of the relay in its operated position. An impulse is also transmitted by way of contacts 339, 352, and 324, resistance 368, contacts 346, conductor 355, contacts 424, conductor 473, to magnet 501 of the pen register PR1 (Fig. 5). The impulse is accordingly recorded on the tape by the pen register in the usual manner. At the end of the impulse the impulse contacts of the subscriber's dial again complete the loop circuit and condenser 367 is re-charged. During the re-charging of the condenser current will flow in the opposite direction in the upper windings of the polarized relay, thereby causing the armature of the relay to be moved to its normal position, as shown in the drawings. The circuit for relay 309 is opened at contacts 351 during the impulsing, but due to the slow-acting characteristics of this relay its armatures are maintained in operated position throughout the series of impulses. Subsequent impulses to the calling subscriber's dial are repeated in the manner previously described until all of the called digits are recorded on the tape at the pen register.

The observing operator will now listen in on the connection to determine whether or not the called subscriber answers, and also to ascertain the quality of the transmission. The voice currents to the calling line are amplified by amplifier A which is connected between the observation trunk and the inter-office trunk. It will be noted that the left-hand winding of the transformer 316 is bridged across conductors 256 and 257 in series with condensers 373 and 367. The above conductors, as previously described, are connected to the talking conductors of the line under observation, and voice currents impressed on this line are accordingly transmitted through the transformer and condenser. Transformer 316 is coupled with transformer 317, the latter of which is connected to the grid of vacuum tube 318. The plate of this vacuum tube is connected through the primary winding of transformer 366 and to the grounded positive side of the exchange battery. The secondary winding of transformer 366 is connected in the loop circuit including contacts 340 and 344, contacts 345 and 349, and the left-hand winding of the repeating coil R. A further loop cir-

cuit may be traced from the condenser and right-hand windings of repeating coil R, conductors 356 and 357, contacts 415, 418, and 423, to the left-hand windings and condenser of repeating coil R1. The right-hand windings to this repeating coil are connected by way of conductors 468 and 469, contacts 524 and 528, contacts 533 of the key K3, contacts of the jack and plug of the operator's receiver set to the receiver. The operator is enabled to clearly overhear the conversation between the calling and called subscriber over the connection just described; while, due to the low capacity of condensers 367 and 373 and the high impedance of the transformer winding, relatively little current is taken from the talking connection.

Observing operator intercepts a call

In case the calling subscriber fails to get the called subscriber, due either to errors in calling or to faulty operation of the switching apparatus, the observing operator upon noting this condition may enter the connection and converse with the subscriber. The operator may hold up a partially extended connection independent of the calling subscriber and may signal the attendant in the outlying exchange in order to call his attention to the condition. By way of example, it will be assumed that a call from substation S to another subscriber in the same office has failed to get through while under observation, as described in preceding paragraphs. On noting the subscriber's difficulty, the observing operator will actuate key K3, thereby connecting her transmitter in talking relation with the observation trunk by closing contacts 532, 534, and 535, and opening contacts 533. The closure of contacts 531 shunts the lower high resistance winding of relay 505 by its upper low resistance winding, and relay 311 of the common relay equipment (Fig. 3) operates due to the increased current flow in the circuit. Relay 311 completes an obvious circuit to relay 312 at contacts 342, and the latter relay operates to connect the talking conductors 256 and 257 of the observation trunk through to repeating coil R independent of the amplifier by closing contacts 341 and 343.

The operator may now converse with the calling subscriber and call his attention to the improper manner in which the calling device was operated, if such was the cause of the trouble, or, in case the switching apparatus operated in a faulty manner the operator may advise the subscriber that this condition will be corrected and that he may call the wanted subscriber after a short interval. The operator will then actuate key K4 to the right, thereby connecting ground through contacts 541 and the release circuit of the position equipment, resistance 507, contacts 537, conductor 474, contacts 425, con-

ductor 358, contacts 350, conductor 266, contacts 240 and 243, conductor 265, relays 306 and 307 in series, to battery. Relay 306 will operate in this circuit, but due to the inclusion of resistance 507 in the circuit relay 307, which is marginally adjusted, will not operate. Relay 306 bridges impedance 315 across the talking conductors of the observation trunk at contacts 331, thereby completing a holding loop for the exchange switching apparatus which will be effective to maintain this apparatus in operated condition after the calling subscriber hangs up. In order to call the attendant at the outlying office the observing operator will now momentarily actuate key K5, thereby short-circuiting resistance 507 by the closure of contacts 539. Relay 307 now operates due to the increased current flow in the circuit, and at contacts 332 closes a circuit for the buzzer which audibly signals the office attendant. The attendant on noting the alarm signal will plug into the test jack TJ with the usual test telephone and may then converse with the observing operator to ascertain the cause of the signal. The attendant may then trace the call over the exchange switching apparatus and repair the faulty condition as required.

Release of the observation connection

When the operator has satisfied herself that a connection has been completed satisfactorily, or after having called the office attendant's attention to an unstandard condition, she will release the observation connection and thus condition the observing equipment for receiving a new connection. In the case of an intercepted call, the operator will first restore the talking key K3 to normal position, thereby removing the shunt from the lower winding of relay 505 with the consequent release of relay 311. Relay 311 will restore and open the circuit of relay 312, which will also restore. The operator will then restore key K4 to normal position, opening the circuit of relays 306 and 307, and these relays will restore. Relay 306 opens the bridge across the talking conductor of the trunk at contacts 331, which permits the switching apparatus of the outlying office to release, providing the calling subscriber has restored his receiver. If the calling subscriber has not yet hung up, the switching apparatus will remain operated and the condition of the observing equipment will be exactly the same as it was when the observation of the connection was started. The release of the observing equipment will be the same from this point on regardless of whether the subscriber has hung up or remained in connection with the calling subscriber. This release is brought about by the operation of key K4 to the left, thereby opening the holding ground circuit at con-

tacts 536. At the observation position this permits relay 502 to restore and close a circuit for relay 508 at contacts 517. Relay 508 operates and locks to ground by way of its own contacts 544 and off-normal contacts 555 of the lower receiving switch. Stepping circuits are now completed for the magnets of those receiving switches, that for magnet 512 extending from ground at off-normal contacts 554, contacts 517, 543, and 556 to the magnet, and that for magnet 513 extending from ground at off-normal contacts 555, contacts 545 and 557, to the magnet. The magnets accordingly operate buzzer-like, and advance the wipers step by step to their home positions, whereupon the off-normal contacts open and relay 508 restores. Relay 511 also restores and switches over the impulsing circuit to the magnet of the lower receiving switch.

As a further result of the removal of ground from the release circuit upon the operation of key K4, trunk relays 401 and 402 restore and again close the chain circuit for the trunk group relays 409, 410, etc. In case the second position of the switchboard has been placed in service, relay 410 will be operated and relay 409 will be prevented from operating so that the next call received will be routed to the second position. In the common relay equipment CR, relay 305 restores upon the opening of the release circuit, and at contact 328 removes ground from the circuit over which relays 303, 310, 202, and 209 have been held operated. These relays restore, followed by the restoration of relays 308 and 309. Relay 209 on restoring opens the circuit of relay 302, which restores and opens the circuit of relay 213 of the sender switch. The latter relay restores and the observing equipment is now in condition to receive the next call.

In case the line under observation has not been released, trunk relay 201 will remain operated so that upon the subsequent operation of relay 210, which occurs upon the closure of the chain circuit by the trunk relays, the trunk relay 202 will not be connected to the trunk. This condition will prevail likewise on trunks connected to lines on which calls were initiated when the service observing equipment was in use in the preceding connection. These lines, therefore, will be barred from connection to the observing switchboard at this time, but the next line on which the call is initiated will be connected to the switchboard in the manner described for the above call.

Metering operations

The observation equipment of the present application is arranged for the supervision of the two classes of metering commonly used, i. e., the so-called booster battery metering in which the metering current is applied

to the release trunk or holding conductor of a connection, and for metering over a separate metering conductor. The observation trunks are accordingly provided with a fourth conductor, which, in the present instance, is shown connected to the holding conductor by a strap at the distributing frame. When observing calls on lines arranged for the separate wire metering, this fourth conductor will be connected to the metering conductor of the line, and resistance 353 (Fig. 3) will be short circuited by a strap 354. In this case, the relay 204 will be operated upon the application of ground to the metering conductor, which takes place upon the call being answered by the called subscriber. In the arrangement shown in the drawings, however, the metering conductor of the observation trunk is tied to the holding conductor which is grounded upon the seizure of the calling line by a line finder. Under these conditions, relay 304 is prevented from operating due to resistance 353 in the circuit, but when the high voltage metering current is applied to the holding conductor of the line the relay operates.

It will be recalled that when the service observing equipment was placed in service relay 305 of the common relay equipment was operated and locked over a circuit which may be traced from battery, lower high resistance winding of relay 305, contacts 330 and 348, upper right-hand winding of repeating coil R, conductor 356, contacts 415, upper left-hand winding of repeating coil R1, conductor 471, relay 504, through contacts of the release key to ground at contacts 541. It will also be recalled that relay 504 was not operated in the above circuit due to the high resistance of the lower winding of relay 305. It will be apparent that upon the operation of relay 304 as the result of the application of metering current to the metering conductor of the line under observation the lower high resistance winding of relay 305 will be shunted by the upper low resistance winding of the relay, upon the closure of contacts 327. Relay 504 operates due to the increased current flow in its circuit, connects metering tone to the operator's telephone circuit by way of contacts 518 and 525, closes a circuit for slow-to-operate relay 503 at contacts 526, and connects the tone return ground to the operator's receiver circuit by way of contacts 523 and 527. Relay 503 operates after a short delay and reestablishes the connection of the receiver to the talking conductors of the observation trunk by closing contacts 519 and 522, and at contacts 518 and 523 disconnects the metering tone from the receiver circuit. Relay 503 also completes a locking circuit for itself at contacts 521, and at contacts 520 closes a circuit for metering lamp L5. The lamp glows to give the operator a visual in-

dication that the metering operation was completed successfully.

Observation of calls with the portable observation set

The portable observation set provided for observing connections in the outlying offices is substantially the same as that provided at the central observation switchboard. As this set is adapted for supervising in a single office only, the office designating lamps and office keys have been omitted, and the receiving switch and associated lamp bank has also been omitted. Identification of the trunk in use is made by means of the lamp bank which is provided with the observing equipment in each outlying exchange, as shown in Fig. 2 of the drawings. Reference to Fig. 6 of the drawings which shows the portable observation set for use with the observation equipment comprising the present invention will show that the various parts of this set have been designated with reference characters similar to those used to designate corresponding parts in the centralized equipment shown in Fig. 5. For example, relays 602, 603, 604, and 605 correspond to relays 502, 503, 504, and 505, respectively, and have exactly the same functions to perform. Keys K, K1, and K2 correspond to keys K3, K4, and K5 of the centralized equipment. Lamps L1, L2, and L3 correspond to lamps L4, L5, and L6, etc.

The portable observation set is connected with the observation equipment of an exchange by means of a terminal strip and jack of the type commonly used for connecting selector and connector switches of the Strowger type with their associated self-wiring. The service observing equipment is placed in service by connecting up the portable set and inserting the plug P of the operator's receiver set into the jack J. Upon connecting up the portable set, a circuit is completed from ground on the jack contact, conductor 360, relay 313, to battery. Relay 313 operates and disconnects the observing equipment of the outlying office from the interoffice trunk T by opening contacts 345—350. A circuit is closed from ground by way of conductor 631, springs and contacts of the jack and plug, release key contacts 626, relay 604, conductor 634, jack contact, conductor 363, and thence to the lower winding of relay 305 as previously described for calls observed at the central switchboard. Battery is normally connected to the two windings of relay 605 so that this relay will operate in the same manner in which relay 505, previously described, operated upon the initiation of a call on a line equipped for observation. The talking conductors of the observation trunk are extended to the portable set by way of conductors 361 and 365 which are permanently connected with the trunk conductors at the common re-

lay equipment. The pulsing circuit over which dial impulses are repeated to the pen register is connected to the portable set by way of conductor 359. A circuit over which relay 306 is operated to hold up a connection is connected to the portable set by way of conductor 364. A momentary application of ground to conductor 362 upon the initiation of a call energizes relay 602, and the seizure of the calling line by a line finder energizes relay 605 to light the respective supervisory lamps L3 and L1. The various operations, such as establishing a talking connection with a calling subscriber, holding of a connection, and release thereof is obtained by the operation of keys K, K1, and K2 in the same manner as previously described for the central observation switchboard. With the foregoing explanation in mind, it will be readily seen that the operations involved for observing and supervising a call by means of a portable set is the same as that described for observing calls at the central switchboard.

What is claimed is:

1. In a multi-office telephone system, a central office, an outlying office, an observation switchboard at the central office, a subscriber's line terminating at the outlying office, non-numerical switching apparatus for connecting the line with an automatic switch, an observation trunk connected with said line, an interoffice trunk connecting said two offices, means responsive to the initiation of a call on said line for starting the operation of said switching apparatus and for extending a connection from the line to said switchboard via the interoffice trunk, and means responsive to the completion of the operation of said switching apparatus for operating a signal at the switchboard.

2. In a multi-office telephone system, a central office, an outlying office, an observation switchboard at the central office, a subscriber's line terminating at the outlying office, non-numerical switching apparatus for connecting the line with an automatic switch, an observation trunk connected with said line, an interoffice trunk connecting said two offices, means responsive to the initiation of a call on said line for starting the operation of said switching apparatus and for operating a signal at the switchboard via said observation trunk and said interoffice trunk, and means responsive to the completion of the operation of said switching apparatus for operating a second signal at the switchboard.

3. In a multi-office telephone system, a central office, an outlying office, an observation switchboard at the central office, a subscriber's line terminating at the outlying office, a finder switch having access to said line, an observation trunk associated with said line, an interoffice trunk connecting said two offices, means responsive to the initiation of a call in said line for starting said finder to

hunt for the line and for establishing a connection from the line to said switchboard via said observation trunk and said interoffice trunk, and means responsive to said finder connecting with the line for operating a signal at the switchboard.

4. In a telephone system, a central office, a plurality of outlying offices, a plurality of observation trunks in each outlying office, each of said trunks being directly connected to a subscriber's line terminating at the office, a trunk line extending from each outlying office to the central office, an observation switchboard at the central office, means responsive to the initiation of a call on a subscriber's line terminating at any of the outlying offices for connecting the associated observation trunk with one of said trunk lines and for connecting the trunk line to said switchboard, and means thereafter effective to prevent any further connections to the switchboard as long as said first connection is maintained.

5. In a multi-office telephone system comprising a central office and a plurality of outlying offices, an operator's position at the central office, means for extending said lines, means for connecting any one of said lines to said position, and means at said position for indicating the time between the initiation of a call on a line and the instant when the same is extended to a further point.

6. In a multi-office telephone system comprising a central office and a plurality of outlying offices, an operator's position at the central office, lines terminating at the outlying offices, means controlled by the operator for rendering said position connectable to any of said lines, means for connecting one of said lines to the position, means controlled by an operator for disconnecting said line from the position, means responsive to the initiation of a call on another line for connecting that line to the position, and means for rendering said last connecting means ineffective in case the first line is disconnected from the position subsequent to the initiation of the call on said other line.

7. In a telephone system, a line, means for extending a talking connection from the line, an operator's position, a voice current amplifier, means for establishing a monitoring connection from said first connection to said position via said amplifier, and means controlled by the operator for excluding said amplifier from the connection.

8. In a telephone system, a line, means for extending a talking connection from the line, a local operator's position, a remote operator's position, a voice current amplifier, and means responsive to the establishment of said talking connection for extending a monitoring connection either to said local position independent of said amplifier or to said remote position via said amplifier.

9. In a telephone system, a line, means of extending talking connections from the line, an operator's position, a voice current amplifier, means responsive to the establishment of said talking connection for extending a monitoring connection to said position via said amplifier, and means controlled by the operator for converting said monitoring connection into a talking connection and for excluding said amplifier therefrom.

10. In a telephone system, lines, a local observation position for observing calls on said lines, a remote observation position for observing calls on said lines, means for rendering either position connectable to said lines, an amplifying device, and means for rendering said device effective only when said remote position is connectable to the lines.

11. In a telephone system, a line, means for extending a talking connection from the line, an operator's position, a transmitter and a receiver at the position, an amplifier, means for establishing a monitoring circuit from said connection to said receiver via said amplifier, and means controlled by the operator for connecting the transmitter to said circuit and for excluding said amplifier therefrom.

12. In a telephone system, a plurality of branch offices, subscriber's lines terminating at said offices, line indicating and supervisory equipment common to said office, common means and means individual to each of said lines for associating the same with said equipment responsive to the initiation of a call on the line, and means for preventing a second line from being associated with said equipment while the first line is still associated therewith.

13. In a telephone system, a plurality of outlying offices, a central office, a plurality of subscriber's lines at each outlying office, means for extending connections from said lines, a trunk line extending from each outlying office to the central office, means at each outlying office responsive to the initiation of a call on a line for connecting the line with the trunk extending to the central office and for signalling an observing operator, and means responsive to the extension of a connection from the calling line to a further point for signalling the observing operator.

14. In combination, a trunk line, subscriber's lines and means for connecting them to the trunk line, an indicator at the originating end of said trunk line for indicating in any given case which of said lines is connected to the trunk line, a similar indicator at the distant end of said trunk, an impulse sending switch at the originating end of the trunk line operating from normal position to transmit impulses over the trunk line to control the distant indicator, common apparatus for controlling said first indicator and said sending switch, and means controlled by the sending switch for preventing the connection of a line

to the trunk line unless the sender switch is in normal position.

15. In a service observing system, service observing equipment, service observation trunks normally disconnected from said equipment, lines to be observed, means responsive to the initiation of a call on any one of said lines for connecting the same to an observation trunk and for connecting the trunk to said equipment, an impulse sender operated from normal position responsive to the operation of said connecting means for transmitting impulses over the observation trunk to identify the particular line connected thereto, and means for preventing the reoperation of said connecting means until said sender returns to normal position.

In witness whereof, I hereunto subscribe my name this 15th day of September, A. D. 1931.

CHARLES R. BROOKS.

In witness whereof, I hereunto subscribe my name this 15th day of September, A. D. 1931.

JOHN E. OSTLINE.

95

100

105

110

115

120

125

130

DISCLAIMER

1,907,240.—*Charles R. Brooks and John E. Ostline*, Chicago and Berwyn, Ill. SERVICE OBSERVING EQUIPMENT. Patent dated May 2, 1933. Disclaimer filed December 13, 1934, by the patentees, the assignee, *Associated Electric Laboratories, Inc.*, consenting.

Hereby enter this disclaimer to claims 4, 6, 7, 9, 11, 12, and 13 of said specification which are in the following words, to-wit:

"4. In a telephone system, a central office, a plurality of outlying offices, a plurality of observation trunks in each outlying office, each of said trunks being directly connected to a subscriber's line terminating at the office, a trunk line extending from each outlying office to the central office, an observation switchboard at the central office, means responsive to the initiation of a call on a subscriber's line terminating at any of the outlying offices for connecting the associated observation trunk with one of said trunk lines and for connecting the trunk line to said switchboard, and means thereafter effective to prevent any further connections to the switchboard as long as said first connection is maintained."

"6. In a multi-office telephone system comprising a central office and a plurality of outlying offices, an operator's position at the central office, lines terminating at the outlying offices, means controlled by the operator for rendering said position connectible to any of said lines, means for connecting one of said lines to the position, means controlled by an operator for disconnecting said line from the position, means responsive to the initiation of a call on another line for connecting that line to the position, and means for rendering said last connecting means ineffective in case the first line is disconnected from the position subsequent to the initiation of the call on said other line."

"7. In a telephone system, a line, means for extending a talking connection from the line, an operator's position, a voice current amplifier, means for establishing a monitoring connection from said first connection to said position via said amplifier, and means controlled by the operator for excluding said amplifier from the connection."

"9. In a telephone system, a line, means for extending talking connections from the line, an operator's position, a voice current amplifier, means responsive to the establishment of said talking connection for extending a monitoring connection to said position via said amplifier, and means controlled by the operator for converting said monitoring connection into a talking connection and for excluding said amplifier therefrom."

"11. In a telephone system, a line, means for extending a talking connection from the line, an operator's position, a transmitter and a receiver at the position, an amplifier, means for establishing a monitoring circuit from said connection to said receiver via said amplifier, and means controlled by the operator for connecting the transmitter to said circuit and for excluding said amplifier therefrom."

"12. In a telephone system, a plurality of branch offices, subscriber's lines terminating at said offices, line indicating and supervisory equipment common to said office, common means and means individual to each of said lines for associating the same with said equipment responsive to the initiation of a call on the line, and means for preventing a second line from being associated with said equipment while the first line is still associated therewith."

"13. In a telephone system, a plurality of outlying offices, a central office, a plurality of subscriber's lines at each outlying office, means for extending connections from said lines, a trunk line extending from each outlying office to the central office, means at each outlying office responsive to the initiation of a call on a line for connecting the line with the trunk extending to the central office and for signalling an observing operator, and means responsive to the extension of a connection from the calling line to a further point for signalling the observing operator."

[*Official Gazette January 8, 1935.*]