R. S. WILBUR AND C. G. SPENCER.

TELEPHONE SYSTEM.

APPLICATION FILED DEC. 27, 1918.

1,364,909.

Patented Jan. 11, 1921.

2 SHEETS—SHEET 1.

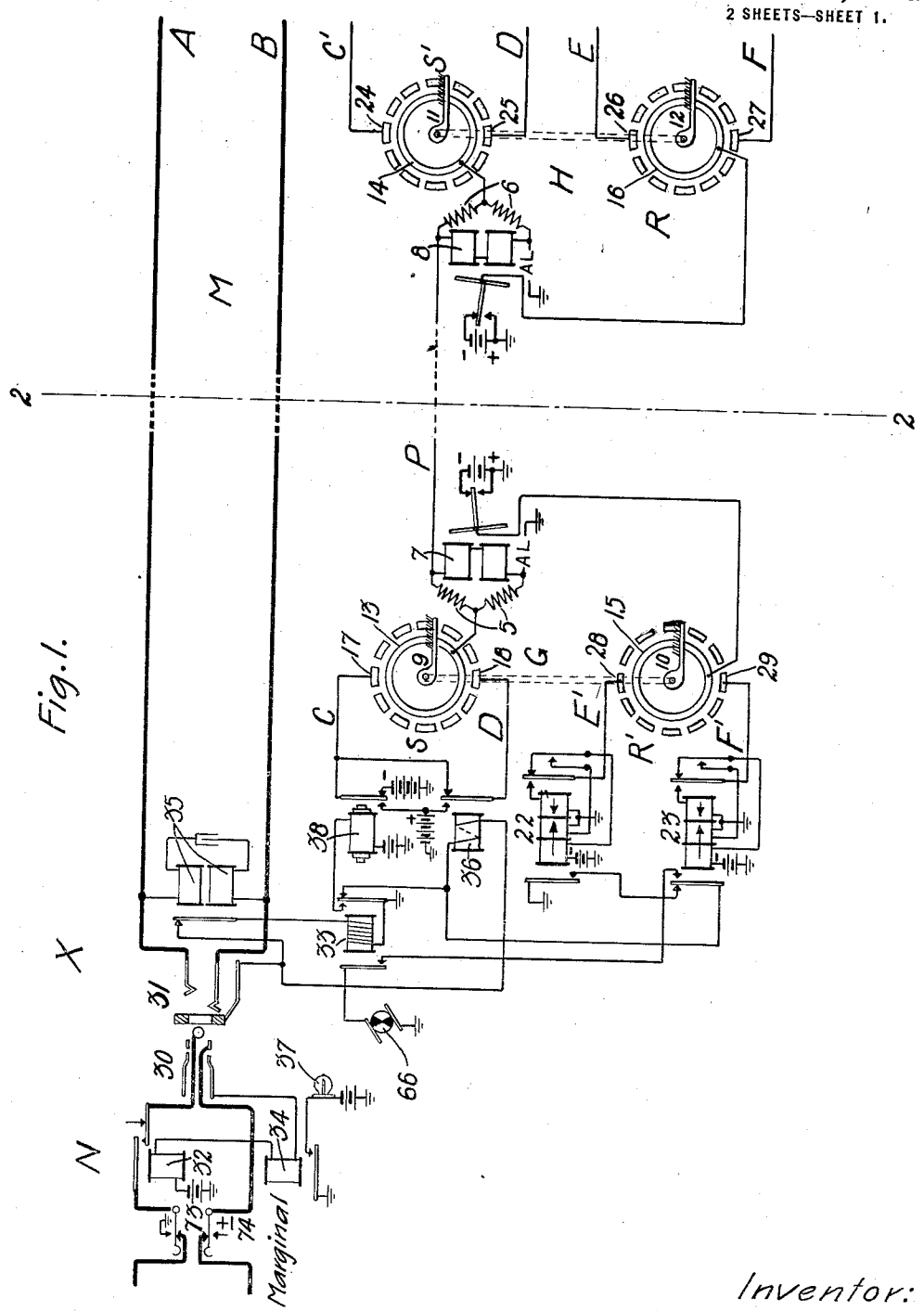

Fig. 1.

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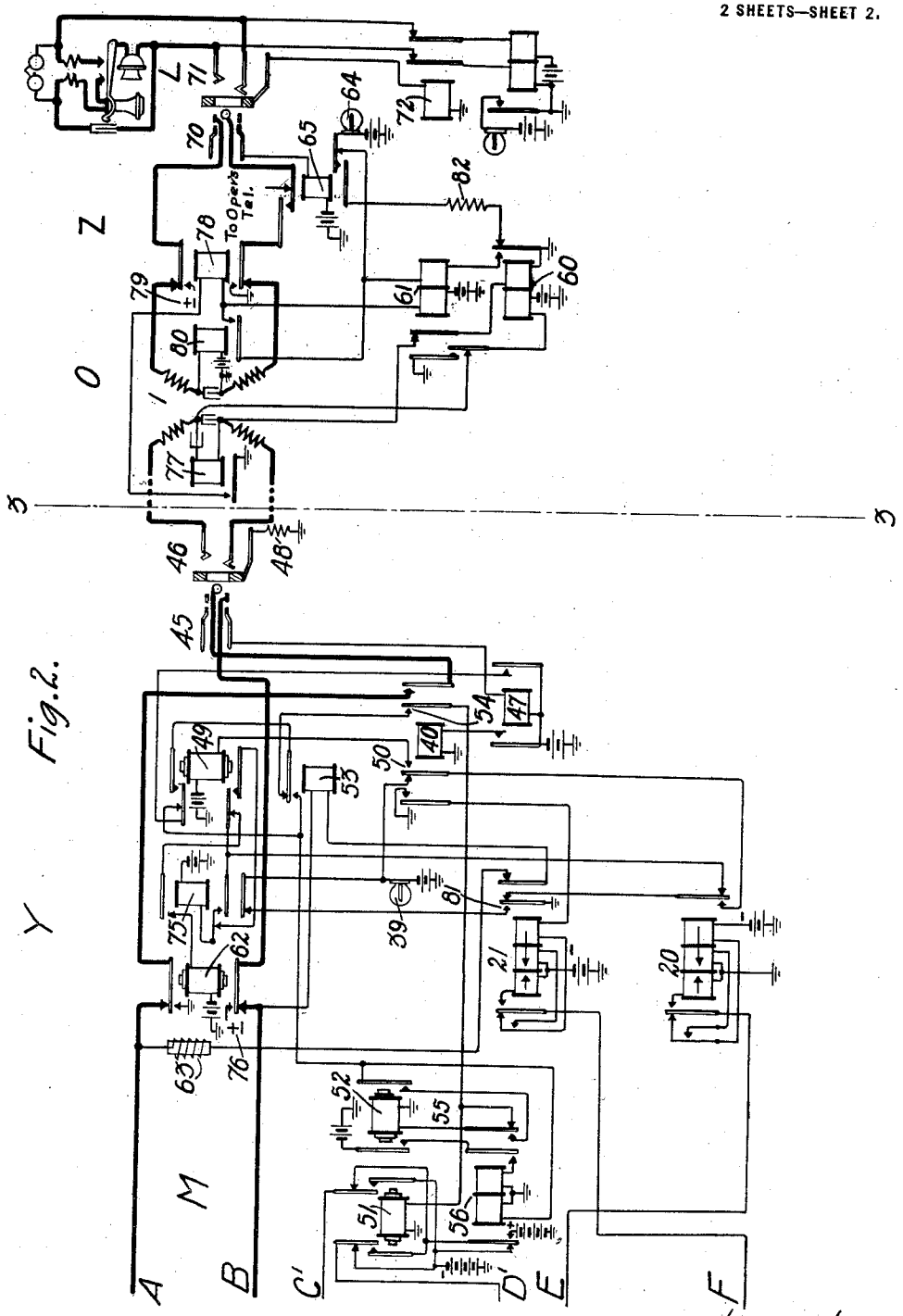

Fig. 2.

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by [signature] Atty.

UNITED STATES PATENT OFFICE.

RAY S. WILBUR, OF LYNDHURST, AND CHARLES G. SPENCER, OF EAST ORANGE, NEW JERSEY, ASSIGNORS TO WESTERN ELECTRIC COMPANY, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

TELEPHONE SYSTEM.

1,364,909. Specification of Letters Patent. Patented Jan. 11, 1921.

Application filed December 27, 1918. Serial No. 268,454.

To all whom it may concern:

Be it known that we, RAY S. WILBUR and CHARLES G. SPENCER, citizens of the United States, residing at Lyndhurst, in the county of Bergen and State of New Jersey, and at East Orange, in the county of Essex and State of New Jersey, respectively, have invented certain new and useful Improvements in Telephone Systems, of which the following is a full, clear, concise, and exact description.

This invention relates to telephone systems and more particularly to such systems in which the telephone lines terminating at widely separated centers are connected together by means of toll trunk lines extending therebetween.

In systems of this character it has been proposed in the Gherardi Patent No. 1,251,363, to employ a signaling path between the two centers which is common to the toll trunk lines and over which may be controlled signals between the operators located at the centers, and between the subscribers' stations of the telephone lines and the operators. It is therefore the object of this invention to provide for systems of this character improved signaling means which are in the nature of improvements over the signaling means disclosed in the Gherardi patent. These improvements reside in part in rendering the system more positive in operation and in providing for controlling, over the common signaling path, all of the signals incident to the establishing of connections between the telephone lines over the toll trunk lines.

The invention may be more readily understood by reference to the following description considered in connection with the accompanying drawings, in which Figures 1 and 2, when placed end to end with Fig. 1 at the left, represent one embodiment of the invention.

Referring to the drawings, there is shown a toll trunk line M comprising talking conductors A and B extending from a central office X to a central office Y. At the central office X there is located a toll cord circuit N by means of which connection is established with the toll trunk line M. The toll trunk line M may be connected with a toll switching trunk circuit O extending from the central office Y to a central office Z at which terminates a subscriber's telephone line L with which the toll switching trunk circuit O may be connected. While only one toll cord circuit, one toll trunk line, one toll switching trunk and one subscriber's telephone line are shown, it is to be understood that this is for the purpose of convenience only and that many such circuits and lines may be and usually are provided in actual service.

The signals for a plurality of toll trunk lines M may be controlled over a signaling path common to the trunk lines and comprising a conductor P extending from the central office X to the central office Y, which conductor as shown has a grounded return. The signaling conductor is arranged in a well-known manner for duplex operation, for which purpose there is provided at the ends of the conductor, artificial balancing lines AL and retardation coils 5 and 6. Across the ends of each set of retardation coils are bridged polarized relays 7 and 8. The two ends of the signaling conductor P are connected with commutators G and H respectively, the commutator G having a transmitting section S and a receiving section R′, and the commutator H having corresponding sending and receiving sections S′ and R. The commutators are preferably of the well-known multiplex type of distributers, employed in connection with multiplex printing telegraph systems and are, it will be understood, provided with a synchronizing device (not shown) by means of which synchronism is automatically maintained between brushes 9, 10 and 11, 12, respectively, of the distributers G and H. The opposite ends of the signaling conductor P are respectively connected with common sending segments 13 and 14 of the two distributers, while the armatures of the polarized relays 7 and 8 are respectively connected to the common receiving segments 15 and 16 of the distributers.

The apparatus shown to the left of the dotted line 2—2 of Fig. 1 is located at the central office X, and that shown to the right of the dotted line 2—2 of Fig. 1 and that shown to the left of the dotted line 3—3 of Fig. 2 is located at the central office Y, while the apparatus shown to the right of the dotted line 3—3 in Fig. 2 is located at the central office Z.

For controlling the sending of signals

over the common signaling conductor P from the office X to the office Y, each trunk line is provided with a plurality of relays which, through individual sending conductors C and D, control the polarity connected with two individual sending segments 17 and 18 of the distributer G located 180 degrees apart. Likewise, for controlling the sending of signals over the common signaling conductor P from the office Y to the office X, there is provided for each trunk line a plurality of relays which, through individual sending conductors C′ and D′, control the polarities connected with two individual sending segments 24 and 25 of the distributer H located 180 degrees apart. Signals transmitted over the signaling path P from the sending section S of the distributer G, are received on the receiving section R of the distributer H, while those transmitted by the sending section S′ of the distributer H are received on the receiving section R′ of the distributer G. For the purpose of utilizing the signals transmitted over the common signaling conductor P and received at office Y, each trunk line is provided with individual receiving conductors E and F, connected with individual receiving segments 26 and 27 of the distributer H located 180 degrees apart and controlling signal receiving relays 20 and 21 respectively. In order that the signals transmitted over the common signaling conductor P to the office X may be utilized, each trunk line is provided with individual receiving conductors E′ and F′ connected with individual receiving segments 28 and 29 of the distributer G located 180 degrees apart and controlling signal receiving relays 22 and 23 respectively.

The signal receiving relays 20, 21, 22 and 23 are of the same construction, each having three windings. Each of these relays is energized over one winding and when energized locks up through its energizing and middle windings, these two being connected in series aiding. The third winding may be termed a deënergizing winding since when a circuit is closed therethrough the relay releases its armatures. The windings of each relay are so proportioned that when the energizing and middle windings are connected in series aiding, the combined ampere turns thereof are equal to the ampere turns of the deënergizing winding. Furthermore, the windings of each relay are so connected in circuit that the effect of the deënergizing winding upon the core of the relay is equal and opposite to the combined effect of the energizing and middle windings, so that, when the circuits including the three windings are closed, the relay becomes differentialized and releases its armatures opening its controlling circuits.

Having in mind this brief description of the apparatus of the system, it is thought that the system will be more thoroughly understood from a description of its operation.

Cord circuit N is connected with trunk line M.

The operator at office X desiring to establish connection with the telephone line L which terminates at office Z, and connection with which must be established through the office Y, communicates with the operator at office Y over an order wire circuit (not shown). The operator at the office X, ascertaining that connection with telephone line L is to be completed by way of the trunk line M, inserts calling plug 30 of the toll cord circuit N into jack 31 of the toll trunk line M. Relays 32 and 33 are thereupon operated over a circuit from battery through the windings of relays 32 and 34, sleeve contacts of the plug 30 and the jack 31, contact of ringing response relay 35 and the winding of high resistance relay 33 to ground. Relay 34 is marginal and does not operate when included in circuit with the high resistance winding of relay 33. The winding of relay 36 is normally connected in parallel with the winding of relay 33 but relay 36 does not have time to operate before its circuit is opened upon the operation of relay 33. The winding of relay 36 is of low resistance so that when connected in parallel with the winding of relay 33, it permits the operation of marginal relay 34 to control the lighting of supervisory lamp 37.

Relay 33 in operating causes the operation of slow-release relay 38 which disconnects negative battery from the individual sending conductors C and D and connects positive battery therewith. When the brush 9 reaches the individual sending segment 17, polarized relay 8 at the distant end of the signaling path P operates to connect ground with the common receiving segment 16 of the distributer H. The brush 12 rotating in synchronism with brush 9, connects common receiving segment 16 with the individual receiving segment 26, thereupon causing the operation of the signal receiving relay 20 over a circuit from battery through the right-hand winding and left-hand normal contact of relay 20, conductor E, segment 26, brush 12, common receiving segment 16 and the alternate contact of polarized relay 8 to ground. Signal receiving relay 20 in operating, completes a locking circuit for itself from battery through its right-hand winding, left-hand alternate contact and middle winding to ground. The closure of the middle alternate contact of signal receiving relay 20 prepares a circuit for its deënergizing (left-hand) winding. The closure of the right-hand alternate contact of receiving relay 20 causes lamp 39 asso-

ciated with the trunk line M to be lighted over a circuit from battery through the lamp 39, left-hand normal contact of relay 40, right-hand alternate contact of signal receiving relay 20 and the middle normal contact of signal receiving relay 21 to ground. The lighting of this lamp serves as an indication to the operator at office Y that the operator at office X has made connection with the proper toll trunk line. The connection of positive battery with conductor D, while causing the operation of the polarized relay 8 when brush 9 engages the individual sending segment 18 to which this conductor D is connected, does not operate the signal receiving relay 21 because a negative impulse is required for operating this relay and because its circuit is open at the outer left-hand armature of relay 40.

Connection of trunk line M with toll switching trunk circuit O.

The operator at office Y, observing the lighted condition of lamp 39, knows that the operator at office X has connected with the proper toll trunk line, and thereupon inserts plug 45 of the toll trunk line M into jack 46 of the toll switching trunk circuit O, whereupon relay 47 operates over a circuit from battery through the winding of this relay, sleeve contacts of the plug 45 and the jack 46 and resistance 48 to ground. Relay 47 in operating causes the operation of relay 40 which opens the circuit of and extinguishes the lamp 39. The operation of relay 40 also causes the operation of a fast-operating and slow-releasing relay 49 over a circuit from battery through the winding of relay 49, contact 50 of relay 40, right-hand alternate contact of the signal receiving relay 20 and the middle normal contact of the signal receiving relay 21 to ground.

Relay 49 in operating causes the energization of two fast-operating and slow-releasing relays 51 and 52 over a circuit from battery through the right-hand contact of relay 47, upper alternate contact of relay 49, normal contact of relay 53, contact 54 of relay 40, to the point 55, from thence over one path through the winding of relay 51 to ground, and over another path through the right-hand normal contact of relay 56 and the winding of relay 52 to ground.

The operation of relay 52 does not at this time affect any other apparatus, and the operation of relay 51, while interrupting its normal and closing its alternate contacts, does not alter the polarities connected with the individual sending conductors C′ and D′.

While, upon the operation of relay 47 and before the operation of relay 49, a circuit is momentarily completed through the left-hand winding of relay 56 over a circuit from battery through the right hand contact of relay 47, upper normal contact of relay 49 and the left-hand winding of relay 56 to ground, still this circuit is not completed long enough to cause the operation of this relay. However, should this circuit for any reason be closed long enough to cause the operation of relay 56, positive battery will be connected with the individual sending conductor C′ and polarized relay 7 will be operated. The operation of polarized relay 7 then causes the energization of the signal receiving relay 22 over a circuit from battery through the left-hand winding and right-hand normal contact of relay 22, conductor E′, segment 28, brush 10 and common segment 15 of distributer G and the alternate contact of polarized relay 7 to ground. Relay 22 thereupon locks up through its left-hand winding, right-hand alternate contact and middle winding. The operation of the signal receiving relay 22 connects relay 36 in parallel with relay 33 to permit the operation of marginal relay 34 to close the circuit of the lamp 37. This lamp circuit can be closed but for an instant, for as soon as relay 49 operates relay 56 releases to connect negative battery with the individual sending conductor C′. Then when brush 11 engages segment 24 of the distributer H, polarized relay 7 will not operate, so that the signal receiving relay 22 will be deënergized by the closure of the circuit from battery, through the normal contact of polarized relay 7, common segment 15, brush 10 and individual segment 28 of distributer G, conductor E′, and the middle alternate contact and right-hand (deënergizing) winding of the signal receiving relay 22 to ground. Marginal relay 34 thereupon releases its armature to open the circuit of the lamp 37.

At the time of inserting the plug 45 into the jack 46, relay 60 in the toll switching trunk circuit operates over a circuit from battery through the left-hand winding ot relay 60, left-hand normal contact of relay 61, tip contacts of the jack 46 and the plug 45, right-hand alternate contact of relay 40, upper normal contact of slow-operating ringing relay 62, impedance coil 63, right-hand normal contact of receiving relay 21, winding of relay 53, lower normal contact of slow-operating ringing relay 62, ring contacts of the plug 45 and the jack 46, right-hand normal contact of relay 61 and the right-hand winding of relay 60 to ground. Relay 60 immediately operates, causing the lighting of lamp 64 and the operation of relay 61 over a circuit from battery through the lamp 64, lower normal contact of relay 65, right-hand winding of relay 61 and the alternate contact of relay 60 to ground. The lighting of the lamp 64 serves as a signal to the operator at office Z that the connection has been set up as far as the toll switching trunk circuit O. The operation of relay 61 first closes its alternate

contact to maintain a holding circuit through the left-hand winding of relay 60, then opens its normal contacts interrupting the circuit through relay 53. While the circuit through relay 53 is completed upon the connection of the plug 45 with the jack 46, still it is immediately released upon the operation of relays 60 and 61.

Should this relay 53 operate, before relay 49 operates, no other apparatus is affected but, should it operate after the operation of relay 49, and before the operation of relays 51 and 52, then signal receiving relay 22 may be momentarily energized in the manner previously described in connection with the possible operation of relay 56 prior to the operation of relay 49. However, should relay 53 operate after the operation of the three relays 49, 51 and 52, relay 56 then operates, and in operating completes a locking circuit for itself through the left-hand contact of relay 52, middle alternate contact and right-hand winding of relay 56 to ground. The opening of the right-hand normal contact of relay 56 opens the energizing circuit of slow-release relay 52, which circuit is immediately reëstablished upon the closure of the right-hand alternate contact of relay 56 so that relays 52 and 56 are locked up under control of relay 53. The opening of the normal contact of relay 53 opens the energizing circuit of slow-release relay 51. While relays 56 and 51 are energized, positive battery is connected with the individual sending conductor D′ through the left-hand alternate contacts of relays 56 and 51, which may cause the operation of the polarized relay 7 and the energization and locking up of the signal receiving relay 23 at the office X, if the brush 11 engages segment 25 before the release of slow-release relay 51. Signal receiving relay 23 can remain locked up for but an instant, for as soon as relay 51 fully releases, negative battery is connected with the individual sending conductor D′, and when brush 11 engages segment 25, causes the differentiation and release of signal receiving relay 23. As previously explained, relay 53, if it should be fully energized, remains so for a very short length of time, so that if relay 53 releases before relay 51 releases its armatures, the energizing circuit of relay 51 is reëstablished and signal receiving relay 23 will remain locked up. Upon the release of this relay 53, the locking circuits for relays 52 and 56 are opened, whereupon these relays release their armatures, the release of relay 56 reëstablishing, at its right-hand normal contact, the original energizing circuit for relay 52 and connecting through its left-hand normal contact negative battery to the individual sending conductor D′, whereupon polarized relay 7 at office X remains in its normal position when brush 11 connects the common sending segment 14 with the individual sending segment 25 to which conductor D′ is connected. Consequently, the signal receiving relay 23 will be differentialized and will release its armatures. In either event, the signal receiving relay 23 would not be energized long enough to permit more than the mere flicker of the supervisory lamp 37.

Connection of toll switching trunk circuit O with telephone line L.

Having been previously advised that the toll switching trunk circuit O is to be connected with the telephone line L, the operator at office Z, upon observing the lighted condition of the lamp 64, inserts plug 70 of the toll switching trunk circuit O into jack 71 of the telephone line L, thereby causing the operation of relay 65 and cut-off relay 72. The operation of relay 65 opens the circuit including the right-hand winding of relay 61 and the lamp 64, whereby the relay 61 is released and the lamp 64 is extinguished. The release of relay 61 by connecting the windings of relay 60 in circuit with the winding of relay 53, causes the energization of relay 53. The energization of relay 53 opens the circuit of slow-release relay 51 causing the release thereof. Upon the closure of the alternate contact of relay 53, relay 56 is operated and locks up under the control of relay 52, the latter also locking up under the control of relays 53 and 56. The release of relay 51 and the operation of relay 56 connects positive battery to the individual sending conductor C′, whereupon polarized relay 7 operates when the brush engages the individual sending segment 24. The operation of polarized relay 7 causes the signal receiving relay 22 to energize through its left-hand winding, and to lock up through its left-hand and middle windings. The operation of the signal receiving relay 22 connects the winding of relay 36 in parallel with the winding of relay 33, whereupon marginal relay 34 operates to light the supervisory lamp 37. The lighting of this lamp serves as a ringing signal to the operator at office X. Relay 36 also operates but does not change the polarity on sending lead D, for relay 38 is energized and positive battery is connected to the alternate contacts of both relays 36 and 38.

If the toll switching trunk circuit O is connected with the telephone line L before the connection of the toll trunk line M with the toll switching trunk circuit O, upon the insertion of the plug 45 into the jack 46, relay 53 operates and remains operated. Relay 53 may operate before or after the operation of relay 49, but in either event, relay 56 operates to connect positive battery with the individual sending conductor C′.

Therefore when the brush 11 engages the individual sending segment 24, positive battery on conductor C' causes the operation of polarized relay 7. Signal receiving relay 22 thereupon operates to cause the lighting of the supervisory lamp 37 to furnish a ringing signal. The toll switching trunk circuit O and the telephone line L when connected, may be considered an extension circuit which connects the telephone station of line L with the second office Y.

Operator at office X actuates ringing key.

The operator at office X observing the lighted condition of the supervisory lamp 37, actuates ringing key 73 to connect a source of ringing current 74 with the toll trunk line M for operating the ringing response relay 35. The operation of this relay 35 opens the circuit of relay 33 which releases its armatures, causing the release of slow-release relay 38. A holding circuit for relay 36 is established at the normal contact of relay 33. The release of relay 38 connects negative battery with the individual sending conductor C, whereupon when brush 9 engages the individual segment 17 of the distributer G, polarized relay 8 remains in its normal position, whereby negative battery is connected through the common receiving segment 16, brush 12 and individual receiving segment 26 of the distributer H with the individual receiving lead E for differentializing and releasing the signal receiving relay 20. Upon the release of this receiving relay 20, slow-release relay 49 begins to releaes its armatures but before its armatures are fully released, relay 75 operates over a circuit from battery through the winding of relay 75, upper normal contact thereof, lower alternate contact of relay 49, right-hand normal contact of signal receiving relay 20 and middle normal contact of receiving relay 21 to ground. Relay 75 in operating establishes a locking circuit for itself through its lower alternate contact and the right-hand, and middle normal contacts of the respective signal receiving relays 20 and 21. Upon the full release of relay 49, slow-operating ringing relay 62 operates over a circuit from battery through the winding of relay 62, upper alternate contact of relay 75, lower normal contact of relay 49 and right-hand and middle normal contacts of the respective signal receiving relays 20 and 21 to ground. Relay 49 in releasing closes its upper normal contact before opening its upper alternate contact, so that relays 52 and 56 remain operated upon the release of relay 49.

The operation of relay 62 connects a source of ringing current 76 with the talking strands of the trunk line for operating ringing response relay 77 in the toll switching trunk circuit O. The operation of ringing relay 62 also opens the circuit of relays 53 and 60, releasing relay 53, but this does not affect relays 52 and 56 since they are held operated through the upper normal contact of the deënergized relay 49. The energization of ringing response relay 77 in the toll switching trunk circuit O causes the operation of relays 61 and 78 over a circuit from battery through the left-hand winding of relay 61, winding of relay 78 and contact of relay 77 to ground. The operation of relay 61 takes place before relay 60 can release so that relay 60 is held operated to prevent the lighting of the supervisory lamp 64. The operation of relay 78 connects a source of ringing current 79 with telephone line L for operating the usual call bell at the subscriber's station connected with the line.

Operator at office X restores ringing key.

Upon the release of the ringing key 73 by the operator at office X, ringing response relay 35 deënergizes, whereupon relay 33 operates causing the energization of relay 38. The operation of relay 38 connects positive battery with the individual sending conductor C so that when brush 9 connects the individual sending segment 17 with the common sending segment 13, polarized relay 8 operates. Signal receiving relay 20 thereupon energizes over a circuit from battery through the right-hand winding of relay 20, left-hand normal contact thereof, individual receiving conductor E, individual receiving segment 26, brush 12 and common receiving segment 16 of the distributer H and the alternate contact of polarized relay 8 to ground.

Signal receiving relay 20 upon being energized, locks up through its right-hand and middle windings, and in opening its right-hand normal contact, interrupts the locking circuit of relay 75, which in releasing deenergizes ringing relay 62 to disconnect ringing current from the toll switching trunk circuit O. The closure of the right-hand alternate contact of signal receiving relay 20 operates relay 49. The disconnection of the source of ringing current 76 from the toll switching trunk circuit O causes the release of relay 77, which in turn releases ringing relay 78, thereby disconnecting ringing current from the called line. Relay 61 is also deënergized at the time of the deënergization of relay 78 and in closing its normal contacts causes the operation of relay 53. Upon the operation of relay 53, the apparatus is restored to the same condition as before the actuation of the ringing key 73.

Subscriber of telephone line L responds.

The subscriber at the station on telephone line L, in responding to the operation of the

call bell thereat, removes the receiver from the switch hook, causing the operation of a supervisory relay 80 over a circuit from battery through the winding of relay 80, upper normal contact of ringing relay 78, ring contacts of the plug 70 and the jack 71, out over one side of the line, through the switchhook contacts, back over the other side of the line, tip contacts of the jack 71 and plug 70, upper alternate contact of relay 65 and lower normal contact of ringing relay 78 to ground. The operation of supervisory relay 80 causes the energization of relay 61 over a circuit from battery through the left-hand winding of relay 61, contact of supervisory relay 80, right-hand winding of relay 61 and the alternate contact of relay 60 to ground.

Relay 61 in operating establishes a holding circuit through the left-hand winding of relay 60 to prevent the lighting of the lamp 64, and disconnects the relay 60 from the outgoing end of the toll switching trunk circuit O. Relay 53 thereupon releases its armature. The opening of the alternate contact of relay 53 releases relays 56 and 52, and the closure of the normal contact thereof energizes relay 51. The energization of relay 51 connects negative battery with the sending lead C′, whereupon signal receiving relay 22 is differentialized and releases its armatures. The release of the signal receiving relay 22 disconnects relay 36 from parallel relation with relay 33, causing the release of marginal relay 34 which extinguishes the supervisory lamp 37.

Subscriber restores receiver to switchhook.

At the conclusion of the conversation, the subscriber at the station on telephone line L restores the receiver to the switchhook, thereby releasing supervisory relay 80 which opens the circuit of and releases relay 61. Relay 60 is thereupon connected in circuit with relay 53 causing this relay to operate. Relays 51, 52 and 56 now function in the same manner as previously described in connection with the connection of the plug 70 with the jack 71, and in so functioning causes the operation and locking up of the signal receiving relay 22. Marginal relay 34 thereupon operates to light the supervisory lamp 37 which now serves as a disconnect signal to the operator at office X.

Operator at office X disconnects toll cord circuit N from trunk line M.

The operator at office X, upon observing the lighted condition of the supervisory lamp 37, withdraws the plug 30 from the jack 31, causing relays 33, 36, and 38 to release. Upon the release of the relays 36 and 38, negative battery is connected to the individual sending conductors C and D. Negative battery on the individual sending conductor C causes the differentiation and release of the signal receiving relay 20, and negative battery on the individual sending conductor D causes the energization and locking up of receiving relay 21. Signal receiving relay 21, being operated at the time signal receiving relay 20 is released, prevents the operation of locking relay 75 and ringing relay 62. The release of the signal receiving relay 20 causes the deënergization of relay 49, and the energization of receiving relay 21 opens its right-hand normal contact, releasing relay 53. Relay 53 is fast in releasing while relay 49 is slow in releasing, so that after relay 53 releases and before relay 49 releases, relay 51 is operated from battery through the right-hand contact of relay 47, upper alternate contact of relay 49, normal contact of relay 53, contact 54 of relay 40 and the winding of relay 51 to ground.

Relay 51 in operating, connects negative battery to the individual sending conductor C′. Negative battery on conductor C′ causes the differentiation and release of the signal receiving relay 22. The energization of the signal receiving relay 21 at the office Y causes the lamp 39 to be lighted over a circuit from battery through the lamp 39, lower normal contact of relay 75 and contact 81 of receiving relay 21 to ground. The lighting of this lamp serves as a disconnect signal to the operator at the office Y. Signal receiving relay 21 in opening its right-hand normal contact, in addition to releasing relay 53, causes the deënergization of relay 60 at office Z. The lamp 64 is thereupon lighted over a circuit from battery through the lamp 64, lower alternate contact of relay 65, resistance 82 and the normal contact of relay 60 to ground. The lighting of this lamp 64 serves as a disconnect signal to the operator at office Z. The operators at offices Y and Z may thereupon withdraw the plugs 45 and 70 from the respective jacks 46 and 71. The withdrawal of the plug 45 from the jack 46 causes relays 47 and 40 to release, the release of the latter by opening its extreme left-hand alternate contact, causing the release of the signal receiving relay 21. The withdrawal of these plugs from the jacks therefore restores all apparatus to normal position.

Should the operator at office X, while the connection between cord circuit N and telephone line L is set up, remove the plug 30 from the jack 31, relays 33 and 38 release (and if previously operated, relay 36 releases), thereby connecting negative battery with the individual sending conductor D, whereupon polarized relay 8 does not operate when brush 9 is passing over the individual sending segment 18 of the distributer G. Therefore signal receiving relay 21 operates and locks up to light the supervisory lamp 39. If this removal of the plug 30

from the jack 31 is accidental, it will be reinserted therein almost immediately, and when reinserted, relays 33 and 38 operate; the operation of relay 38 (or if relay 36 operates then the operation of this relay connects positive battery with the individual sending conductor D, whereupon polarized relay 8 operates upon the engagement of brush 9 with the individual sending segment 18. Signal receiving relay 21 is thereupon differentialized and releases its armature, opening the circuit of and extinguishing the supervisory lamp 39.

Should the subscriber at the station on telephone line L, after answering a call when connection is established between the cord circuit N and the telephone line L, wish to signal the operator at office X, this may be done by repeatedly opening and closing the switchhook contact. The first opening of this switchhook contact causes the release of relays 80 and 61 of the toll switching trunk circuit O and the operation of relay 53 of the toll trunk line M. The energization of relay 53 opens the circuit of relay 51 and causes the operation of relay 56 which connects positive battery to the individual sending conductor D′ before relay 51 can release its armatures. Relay 56 thereupon locks up under the control of relay 52 and the latter under control of relay 53. The connection of positive battery with the individual sending conductor D′, when brush 11 engages the individual sending segments 25 of the distributer H, causes the operation of polarized relay 7 which then causes the energization of the signal receiving relay 23. This signal receiving relay 23 then locks up through its left-hand and middle windings, and at its left-hand alternate contact connects interrupter 66 in circuit with the winding of relay 36. The winding of this relay 36 will therefore be intermittently connected in parallel with the winding of relay 33; the intermittent operation of marginal relay 34 results and supervisory lamp 37 is intermittently lighted.

As previously described, the energization of relay 53 causes the opening of the energizing circuit of slow-release relay 51. The release of relay 53, upon the closure of the switchhook contact at the station on telephone line L, closes the energizing circuit of relay 51. It will be seen, therefore, that during this signaling operation on the part of the subscriber, the circuit of relay 51 is opened while that of 52 is closed and the circuit of relay 52 is opened while that of 51 is closed. The relays 51 and 52 are so constructed and adjusted, and these two relays and relay 56 and the circuits therefor are so organized, that these three relays will remain locked up while the subscriber at the station on the telephone line L is repeatedly opening and closing the switchhook contact to signal the operator at office X. It will be evident therefore that throughthe coöperation of relays 51, 52 and 56, the repeated opening and closing of the switchhook contact by the subscriber causes the intermittent lighting of the supervisory lamp 37 at a definite constant rate.

If, at the end of this signaling operation, the subscriber leaves the receiver off the switchhook, thereby maintaining the switchhook contact closed, relays 80 and 61 operate, causing the release of relay 53. Relay 51 remains operated and relays 52 and 56 release, relay 52 operating again upon the release of relay 56. The release of relay 56, while relay 51 is operated, connects negative battery to the individual sending conductor D′, whereupon signal receiving relay 23, at the office X, is differentialized and releases its armatures, disconnecting the interrupter from circuit relation with the relay 36. The supervisory lamp 37 is thereupon extinguished.

Should the subscriber at the end of the signaling operation leave the receiver on the switchhook with the switchhook contact open, relays 80 and 61 are released and relay 53 operated. Relay 53 being operated, relay 51 releases while relays 56 and 52 remain operated. The release of relay 51 connects negative battery with the individual sending conductor D′ so that the signal receiving relay 23 at the office X becomes differentialized and releases its armatures to stop the flashing of the supervisory lamp 37, positive battery is connected with the individual sending conductor C′ through the left-hand alternate contact of relay 56 and the right-hand normal contact of relay 51. This causes the energization and locking up of the signal receiving relay 22 at the office X, which connects relay 36 in parallel with relay 33 to permit the operation of marginal relay 34. Supervisory lamp 37 is thereupon lighted to furnish a disconnect signal.

What is claimed is:

1. In a telephone system, in combination, a plurality of telephone trunk lines, and a common signaling path therefor, extending from a first to a second office, switching apparatus at the opposite ends of the signaling path for individually associating the trunk lines with the signaling path, a link circuit at the first office connected with one trunk line, a signaling device in the link circuit, a telephone station, an extension circuit connecting the telephone station with the other end of the engaged trunk line, apparatus at the first office controlled over the signaling path and adapted when rendered effective to cause the signaling device to be operated intermittently at a definite rate, and electromagnetic means at the second office responsive to the open-

ing and closing of the extension circuit to render the last-mentioned apparatus effective.

2. In a telephone system, in combination, a plurality of telephone trunk lines and a common signaling path therefor extending from a first to a second office, switching apparatus at the opposite ends of the signaling path for individually associating the trunk lines with the signaling path, a link circuit at the first office connected with one trunk line, a signaling device in the link circuit, a telephone station, an extension circuit connecting the telephone station with the other end of the engaged trunk line, an interrupter at the first office, apparatus thereat operated over the signaling path and adapted when rendered effective to operatively associate the interrupter with the signaling device, and electromagnetic means at the second office responsive to the opening and closing of the extension circuit to render the signal control apparatus effective.

3. In a telephone system, in combination, a plurality of telephone trunk lines and a common signaling path therefor extending from a first to a second office, switching apparatus at the opposite ends of the signaling path for individually associating the trunk lines with the signaling path, a link circuit at the first office connected with one trunk line, a signaling device in the link circuit, a telephone station, an extension circuit connecting the telephone station with the other end of the engaged trunk line, an interrupter at the first office, a signal receiving relay thereat controlled over the signaling path and adapted when energized to cause the operative association of the signaling device and the interrupter, and electromagnetic means at the second office responsive to the opening and closing of the extension circuit to transmit a signal over the signaling path for causing the energization of the signal receiving relay.

4. In a telephone system, in combination, a plurality of telephone trunk lines and a common signaling path therefor extending from a first to a second office, switching apparatus at the opposite ends of the signaling path for individually associating the trunk lines with the signaling path, a link circuit at the first office connected with one trunk line, a signaling device in the link circuit, a telephone station, an extension circuit connecting the telephone station with the other end of the engaged trunk line, an interrupter at the first office, a signal receiving relay thereat adapted when operated to cause the operative association of the signaling device and the interrupter, a pair of relays at the second office, energized upon the closure of the extension circuit, and another relay thereat energized upon the subsequent opening of the extension circuit and coöperating with the pair of relays during the continued closing and opening of the extension circuit to transmit a signal over the signaling path for causing the operation of the signal receiving relay.

5. In a telephone system, in combination, a plurality of telephone trunk lines, and a common signaling path therefor extending from a first to a second office, switching apparatus at the opposite ends of the signaling path for individually associating the trunk lines with the signaling path, a link circuit at the first office connected with one trunk line, a signaling device in the link circuit, a telephone station, an extension circuit connecting the telephone station with the other end of the engaged trunk line, means responsive to the continued opening and closing of the extension circuit to transmit a signal over the signaling path, and a signal receiving relay at the first office responsive to the signal for causing the signaling device to operate intermittently at a definite rate.

6. In a telephone system, in combination, a plurality of telephone trunk lines, and a common signaling path therefor extending from a first to a second office, switching apparatus at the opposite ends of the signaling path for individually associating the trunk lines with the signaling path, a link circuit at the first office connected with one trunk line, a signaling device in the link circuit, a telephone station, an extension circuit connecting the telephone station with the other end of the engaged trunk line, means responsive to the continued opening and closing of the extension circuit to transmit a signal over the signaling path, interrupter mechanism, and a signal receiving relay at the first office responsive to the signal to operatively associate the interrupter mechanism with the signaling device.

7. In a telephone system, in combination, a plurality of telephone trunk lines and a common signaling path therefor extending from a first to a second office, switching apparatus at the opposite ends of the signaling path for individually associating the trunk lines with the signaling path, a link circuit at the first office connected with one trunk line, a signaling device in the link circuit, a telephone station, an extension circuit connecting the telephone station with the engaged trunk line, a plurality of relays at the second office coöperating upon the opening of the extension circuit to transmit a signal over the signaling path, upon the continued opening and closing of the extension circuit to transmit a second signal over the signaling path, a signal receiving relay at the first office responsive to the first signal for causing the continuous operation of the signaling device, and a second signal

receiving relay thereat responsive to the second signal for causing the intermittent operation of the signaling device.

8. In a telephone system, in combination, a plurality of telephone trunk lines and a common signaling path therefor extending from a first to a second office, switching apparatus at the opposite ends of the signaling path for individually associating the trunk lines with the signaling path, a link circuit at the first office connected with one trunk line, a signaling device in the link circuit, a telephone station, an extension circuit connecting the telephone station with the engaged trunk line, interrupter mechanism at the first office, a plurality of relays at the second office coöperating upon the opening of the extension circuit to transmit a signal over the signaling path upon the continued opening and closing of the extension circuit to transmit a second signal over the signaling path, a signal receiving relay at the first office responsive to the first signal for causing the continuous operation of the signaling device, and a second signal receiving relay thereat responsive to the second signal for operatively associating the interrupter mechanism with the signaling device.

9. In a telephone system, in combination, a plurality of telephone trunk lines and a common signaling path therefor extending from a first to a second office, switching apparatus at the opposite ends of the signaling path for individually associating the trunk lines with the signaling path, a link circuit at the first office connected with one trunk line, a signaling device in the link circuit, a telephone station, an extension circuit connecting the telephone station with the engaged trunk line, a plurality of relays at the second office coöperating upon the continued successive opening and closing of the extension circuit to transmit a signal over the signaling path and upon the subsequent continued closure of the extension circuit to transmit a second and a third signal over the signaling path, a signal receiving relay at the first office responsive to the first signal for causing the intermittent operation of the signaling device and to the second signal for stopping such operation, and a second signal receiving relay thereat responsive to the third signal for causing the continuous operation of the signaling device.

10. In a telephone system, in combination, a plurality of telephone trunk lines and a common signaling path therefor extending from a first to a second office, switching apparatus at the opposite ends of the signaling path for individually associating the trunk lines therewith, a link circuit at the first office connected with one trunk line, a signaling device in the link circuit, an extension circuit extending from the second office to a telephone station, a relay responsive to the connection of the engaged trunk line with the extension circuit for transmitting a signal over the signaling path, another relay coöperating with the first relay upon the subsequent continued opening and closing of the extension circuit to transmit a second signal over the signaling path, a signal receiving relay at the first office responsive to the first signal for causing the continuous operation of the signaling device, and a second signal receiving relay at the first office responsive to the second signal for causing the intermittent operation of the signaling device.

11. In a telephone system, in combination, a plurality of telephone trunk lines and a common signaling path therefor extending from a first to a second office, switching apparatus at the opposite ends of the signaling path for individually associating the trunk lines with the signaling path, a link circuit at the first office connected with one trunk line, a signaling device in the link circuit, a circuit extending from the second office to a telephone station, a plurality of relays at the second office cooperating upon the connection of the engaged trunk line with the extension circuit to send a signal over the signaling path and coöperating in a different manner upon the subsequent continued opening and closing of the extension circuit to send a second signal over the signaling path, a signal receiving relay at the first office responsive to the first signal for causing the continuous operation of the signaling device, and a second signal receiving relay at the first office responsive to the second signal for causing the intermittent operation of the signaling device.

12. In a telephone system, in combination, a plurality of telephone trunk lines and a common signaling path therefor extending from a first to a second office, switching apparatus at the opposite ends of the signaling path for individually associating the trunk lines with the signaling path, a link circuit at the first office connected with one trunk line, a signaling device in the link circuit, a circuit extending from the second office to a telephone station, a plurality of relays at the second office cooperating upon the connection of the engaged trunk line with the extension circuit to send a signal over the signaling path and coöperating in a different manner upon the subsequent continued opening and closing of the extension circuit to send a second signal over the signaling path, a signal receiving relay at the first office responsive to the first signal for causing the continuous operation of the signaling device, interrupter mechanism at the first office, and a second signal receiving relay thereat respon-

sive to the second signal for operatively associating the interrupter mechanism with the signaling device.

13. In a telephone system, in combination, a plurality of telephone trunk lines and a common signaling path therefor extending from a first to a second office, switching apparatus at the opposite ends of the signaling path for individually associating the trunk lines with the signaling path, a link circuit at the first office, means thereat responsive to the connection of the link circuit with one trunk line for transmitting a signal over the signaling path and differently responsive to the disconnection of the link circuit from the trunk circuit to send a second signal over the signaling path, a signaling device at the second office, means thereat responsive to the first signal for operating the signaling device, a circuit extending from the second office to a telephone station subsequently connected with the engaged trunk line, and means at the second office thereafter responsive to the second signal for controlling the signaling device.

14. In a telephone system, in combination, a plurality of telephone trunk lines and a common signaling path therefor extending from a first to a second office, switching apparatus at the opposite ends of the signaling path for individually associating the trunk lines with the signaling path, a link circuit at the first office, means thereat responsive to the connection of the link circuit with one trunk line for transmitting a signal over the signaling path and differently responsive to the disconnection of the link circuit from the trunk circuit to send a second signal over the signaling path, a circuit extending from the second office to a telephone station, a signaling device at the second office for the one trunk line, a signal receiving relay responsive to the first signal for operating the signaling device, and a second signal receiving relay responsive to the second signal when the engaged trunk line is connected with the extension circuit for controlling the signaling device.

15. In a telephone system, in combination, a plurality of telephone trunk lines and a common signaling path therefor extending from a first to a second office, switching apparatus at the opposite ends of the signaling path for individually associating the trunk lines with the signaling path, a link circuit at the first office, means thereat responsive to the connection of the link circuit with one trunk line for transmitting a signal over the signaling path and differently responsive to the disconnection of the link circuit from the trunk circuit to send a second signal over the signaling path, an extension circuit connecting a telephone station with the second office, a signaling device associated with the engaged trunk line, a signal receiving relay responsive to the first signal, an operating circuit for the signaling device closed thereby, a relay responsive to the connection of the engaged trunk line with the extension circuit for opening the operating circuit, and a second signal receiving relay thereafter responsive to the second signal for again causing the operation of the signaling device.

16. In a telephone system, in combination, a plurality of telephone trunk lines and a common signaling path therefor extending from a first to a second office, switching apparatus at the opposite ends of the signaling path for individually associating the trunk lines with the signaling path, a link circuit at the first office, means thereat responsive to the connection of the link circuit with one trunk line for transmitting a signal over the signaling path and differently responsive to the disconnection of the link circuit from the trunk circuit to send a second signal over the signaling path, an extension circuit connecting a telephone station with the second office, a signaling device for the engaged trunk line, two signal receiving relays at the second office, one responsive to the first signal before the engaged trunk line is connected with the extension circuit and the second responsive to the second signal after the engaged trunk line is connected with the extension circuit, an operating circuit for the signaling device completed upon the response of the first signal receiving relay while the second signal receiving relay is deenergized, a relay responsive to the connection of the engaged trunk line with the extension circuit for interrupting the operating circuit, and a second operating circuit for the signaling device completed upon the subsequent energization of the second signal receiving relay in response to the second signal.

17. In a telephone system, in combination, a plurality of telephone trunk lines and a common signaling path therefor extending from a first to a second office, switching apparatus at the opposite ends of the signaling path for individually associating the trunk lines with the signaling path, a link circuit at the first office, means thereat responsive to the connection of the link circuit with one trunk line for transmitting a signal over the signaling path and differently responsive to the disconnection of the link circuit from the trunk line to send a second signal over the signaling path, a signaling device at the second office for the engaged trunk line, two mutually independent signal receiving relays for completing operating circuits for the signaling device, the first receiving relay being responsive to the first signal and the second receiving relay being responsive to the second signal transmitted from the first office for causing the operation of the

second office signaling device, an extension circuit joining a telephone station with the second office, a relay responsive to the connection of the engaged trunk line with the extension circuit for interrupting the operating circuit and for causing a signal to be sent over the signaling path to the first office, a signal-receiving relay thereat responsive to the signal from the second office, and a signaling device in the link circuit operated upon the response of the last mentioned signal-receiving relay.

18. In a telephone system, in combination, a plurality of telephone trunk lines and a common signaling path therefor extending from a first to a second office, switching apparatus at the opposite ends of the signaling path for individually associating the trunk lines with the signaling path, a link circuit at the first office connected with one trunk line, an extension circuit connecting a telephone station with the second office, a relay responsive to the connection of the one trunk line with the extension circuit for transmitting a signal over the signaling path to the first office, a signaling receiving relay thereat responsive to this signal, a signaling device in the link circuit, a circuit controlling the signaling device, a relay connected in the controlling circuit upon the response of the signal receiving relay to cause the operation of the signaling device and responsive to the subsequent disconnection of the link circuit from the trunk line to send a signal over the signaling path to the second office, a signaling device at the second office, and a signal receiving relay thereat responsive to the signal from the first office for causing the operation of the second office signaling device.

19. In a telephone system, in combination, a plurality of telephone trunk lines and a common signaling path therefor extending from a first to a second office, switching apparatus at the opposite ends of the signaling path for individually associating the trunk lines therewith, a link circuit and a switch at the first office, means responsive to the connection of the link circuit with one trunk line to send a signal over the signaling path and responsive to the actuation of the switch to send a second signal over the signaling path, a signaling device for the engaged trunk line, a circuit extending from the second office to a telephone station subsequently connected with the engaged trunk line, a signaling device associated with the extension circuit, and a signal receiving relay at the second office differently responsive to the two signals for controlling the operation of the signaling devices.

20. In a telephone system, in combination, a plurality of telephone trunk lines and a common signaling path therefor extending from a first to a second office, switching apparatus at the opposite ends of the signaling path for individually associating the trunk lines therewith, a link circuit and a switch at the first office, means responsive to the connection of the link circuit with one trunk line to send a signal over the signaling path and responsive to the actuation of the switch to send a second signal over the signaling path, a signal receiving relay at the second office energized in response to the first signal and deënergized in response to the second signal, a signaling device for the engaged trunk line controlled by the signal receiving relay when energized, a circuit extending from the second office to a telephone station subsequently connected with the engaged trunk line, and a signaling device associated with the extension circuit whose operation is controlled by the signal receiving relay when deënergized.

21. In a telephone system, in combination, a plurality of telephone trunk lines and a common signaling path therefor extending from a first to a second office, switching apparatus at the opposite ends of the signaling path for indivdually associating the trunk lines therewith, a link circuit at the first office, means responsive to the connection of the link circuit with one trunk line to send a signal over the signaling path to the second office, a ringing key at the first office and means responsive to the actuation thereof to send a second signal over the signaling path, a signal receiving relay at the second office differently responsive to the two signals, a signaling device for the engaged trunk line controlled by the signal receiving relay, a circuit extending from the second office to a telephone station subsequently connected with the engaged trunk line, and a source of ringing current whose connection with the extension circuit is controlled by the signal receiving relay when responding to the second signal over the signaling path.

22. In a telephone system, in combination, a plurality of telephone trunk lines and a common signaling path therefor extending from a first to a second office, switching apparatus at the opposite ends of the signaling path for individually associating the trunk lines therewith, a link circuit at the first office, means responsive to the connection of the link circuit with one trunk line for transmitting a signal over the signaling path, a ringing key at the first office, means responsive to the actuation thereof for transmitting a second signal over the signaling path, a signal receiving relay at the second office energized in response to the first signal and deënergized in response to the second signal, a signaling device operated upon the energization of the signal receiving relay, a circuit connecting a telephone station with the second office and subsequently con-

nected with the engaged trunk line, a ringing relay responsive to the subsequent deenergization of the signal receiving relay, and a source of ringing current connected with the extension circuit upon the response of the ringing relay.

23. In a telephone system, in combination, a plurality of telephone trunk lines and a common signaling path therefor extending from a first to a second office, switching apparatus at the opposite ends of the signaling path for individually associating the trunk lines therewith, a link circuit at the first office, means responsive to the connection thereof with one trunk line for transmitting a signal over the signaling path, a ringing key at the first office, means responsive to the actuation of the ringing key for transmitting a second signal over the signaling path, a signal receiving relay at the second office energized in response to the first signal and deënergized in response to the second signal, a signaling device operated upon the energization of the signal receiving relay, an extension circuit joining a telephone station with the second office, a relay responsive to the connection of the engaged trunk line with the extension circuit for transmitting a signal over the signaling path to the first office, a signal receiving relay thereat responsive to the last-mentioned signal, a signaling device in the link circuit operated upon the response of the signal reciving relay at the first office, a source of ringing current at the second office, and a ringing relay energized upon the deënergization of the second office signal receiving relay to connect the source of ringing current with the extension circuit.

24. In a telephone system, in combination, a plurality of telephone trunk lines and a common signaling path therefor extending from a first to a second office, switching apparatus at the opposite ends of the signaling path for individually associating the trunk lines therewith, a link circuit at the first office connected with one trunk line, a trunk circuit connected with the engaged trunk line at the second office and extending to a third office, a telephone line thereat connected with the trunk circuit, means responsive to the disconnection of the link circuit from the one trunk line for sending a signal over the signaling path, a signal receiving relay at the second office responsive to the signal, and a signaling device at the third office operated upon the response of the signal receiving relay.

25. In a telephone system, in combination, a plurality of telephone trunk lines and a common signaling path therefor extending from a first to a second office, switching apparatus at the opposite ends of the signaling path for individually associating the trunk lines therewith, a link circuit at the first office connected with one trunk line, a trunk circuit connected with the engaged trunk line at the second office and extending to a third office, a telephone line thereat connected with the trunk circuit, means responsive to the disconnection of the link circuit from the one trunk line for sending a signal over the signaling path, a signal receiving relay at the second office energized in response to the signal, a signaling device at the second office. a signaling device at the third office, and operating circuits therefor completed upon the energization of the signal receiving relays.

26. In a telephone system, in combination, a plurality of telephone trunk lines and a common signaling path therefor extending from a first to a second office, switching apparatus at the opposite ends of the signaling path for individually associating the trunk lines therewith, a link circuit at the first office connected with one trunk line, a trunk circuit connected with the engaged trunk line at the second office and extending to a third office, a telephone line thereat connected with the trunk circuit, means responsive to the disconnection of the link circuit from the one trunk line for sending a signal over the signaling path, a signal receiving relay at the second office energized in response to the signal, a signaling device at the third office, and a normally closed bridge of the engaged trunk line interrupted by the energization of the signal receiving relay to cause the operation of the signaling device at the third office.

27. In a telephone system, in combination, a plurality of telephone trunk lines and a common signaling path therefor extending from a first to a second office, switching apparatus at the opposite ends of the signaling path for individually associating the trunk lines therewith, a link circuit at the first office, a local circuit relay energized upon the connection of the link circuit with one trunk line for transmitting a signal over the signaling path, a signaling device at the second office, means responsive to the signal to cause the operation of the signaling device, a circuit extending from the second office to a telephone station subsequently connected with the engaged trunk line, a ringing key at the first office which when actuated causes the deënergization of the local circuit relay whereby a second signal is transmitted over the signaling path, a source of ringing current at the second office, and means responsive to the second signal for connecting the source of ringing current with the extension circuit.

28. In a telephone system. in combination, a plurality of telephone trunk lines and a common signaling path therefor extending

from a first to a second office, switching apparatus at opposite ends of the signaling path for individually associating the trunk lines therewith, a link circuit at the first office, a ringing key thereat, a local circuit relay at the first office energized upon the connection of the link circuit with one trunk line for transmitting a signal over the signaling path and deënergized upon the actuation of the ringing key to transmit a second signal over the signaling path, a signal receiving relay at the second office energized in response to the first signal and deënergized in response to the second signal, a signaling device associated with the engaged trunk line operated upon the energization of the signal receiving relay, a circuit extending from the second office to a telephone station and subsequently connected with the engaged trunk line, a source of ringing current, and a ringing relay operating upon deenergization of the signal response relay for connecting the source of ringing current with the connected extension circuit.

29. In combination, a plurality of individual lines, a common signaling path therefor, switching apparatus at the opposite ends of the signaling path for individually associating the individual lines with the signaling path, a signaling device associated with an individual line, apparatus at one end of and controlled over the signaling path adapted when rendered effective to cause the signaling device to be operated intermittently at a definite rate, and means at the other end of the signaling path for rendering the last-mentioned apparatus effective.

30. In combination, a plurality of individual lines, a common signaling path therefor, switching apparatus at the opposite ends of the signaling path for individually associating the individual lines with the signaling path, a signaling device associated with an individual line, interrupter mechanism, apparatus at one end of and controlled over the signaling path adapted when rendered effective to operatively associate the interrupter mechanism with the signaling device, and means at the other end of the signaling path for rendering the last-mentioned apparatus effective.

31. In combination, a plurality of individual lines, a common signaling path therefor, switching apparatus at the opposite ends of the signaling path for individually associating the individual lines with the signaling path, a signaling device associated with an individual line, signal control means at one end of and controlled over the signaling path adapted when rendered effective to cause the signaling device to operate continuously or intermittently at a definite rate and means at the other end of the signaling path for determining whether the signaling device shall operate continuously or intermittently and for rendering the signal control means effective.

32. In combination, a plurality of individual lines, a common signaling path therefor, switching apparatus at the opposite ends of the signaling path for individually associating the individual lines with the signaling path, means at one end of the signaling path for transmitting thereover a first and a second signal, a signaling device at the other end of the signaling path associated with an individual line, an operating circuit for the signaling device, signal receiving apparatus at said other end of the signaling path responsive to the first signal to complete the operating circuit, means for interrupting the operating circuit, and other signal receiving apparatus responsive to the second signal for again completing the operating circuit.

33. In combination, a plurality of individual lines, a common signaling path therefor, switching apparatus at the opposite ends of the signaling path for individually associating the individual lines with the signaling path, means at one end of the signaling path for transmitting thereover a first and a second signal, a signal receiving relay at the other end of the signaling path responsive to the first signal and differently responsive to the second signal, a signaling device associated with an individual line operated upon the first response of the signal receiving relay, and a second signaling device subsequently associated with the one individual line and operated upon the second response of the signal receiving relay.

34. In a telephone system, in combination, a transmission circuit and a signaling path independent thereof extending between two stations, a signaling device at one station, means at the other station responsive to a change in the condition of the transmission circuit to transmit a signal over the signaling path, and means responsive to the transmitted signal to cause the intermittent operation of the signaling device.

35. In a telephone system, in combination, a transmission circuit and a signaling path extending between two stations, means at one station responsive to a change in the condition of the transmission circuit to transmit a signal of one polarity and responsive to a succeeding change to transmit a signal of opposite polarity over the signaling path, a relay at the other station having a plurality of windings, means responsive to the first transmitted signal for completing an energizing circuit including one winding of the relay, a locking circuit for the relay established upon the energization thereof, a circuit including a winding of the relay established in response to the

transmission of the second signal for causing the deënergization of the relay, and a signaling device controlled by the relay.

36. In a telephone system, in combination, a transmission circuit and a signaling path extending between two stations, means at one station responsive to a change in the condition of the transmission circuit to transmit a signal of one polarity and responsive to a succeeding change to transmit a signal of opposite polarity over the signaling path, a relay at the other station having a plurality of windings, a circuit including one winding established in response to the first transmitted signal for causing the energization of the relay, a locking circuit including a second winding established upon the energization of the relay, another circuit including a third winding established in response to the second transmitted signal for differentializing and causing the release of the relay, and a signaling device at said other station individual to the transmission circuit controlled by the relay.

In witness whereof we hereunto subscribe our names this 23rd day of December A. D., 1918.

RAY S. WILBUR.
CHARLES G. SPENCER.