Aug. 9, 1932. L. G. ABRAHAM ET AL 1,870,396

TELEPHONE SIGNALING SYSTEM

Filed Nov. 21, 1931 3 Sheets-Sheet 1

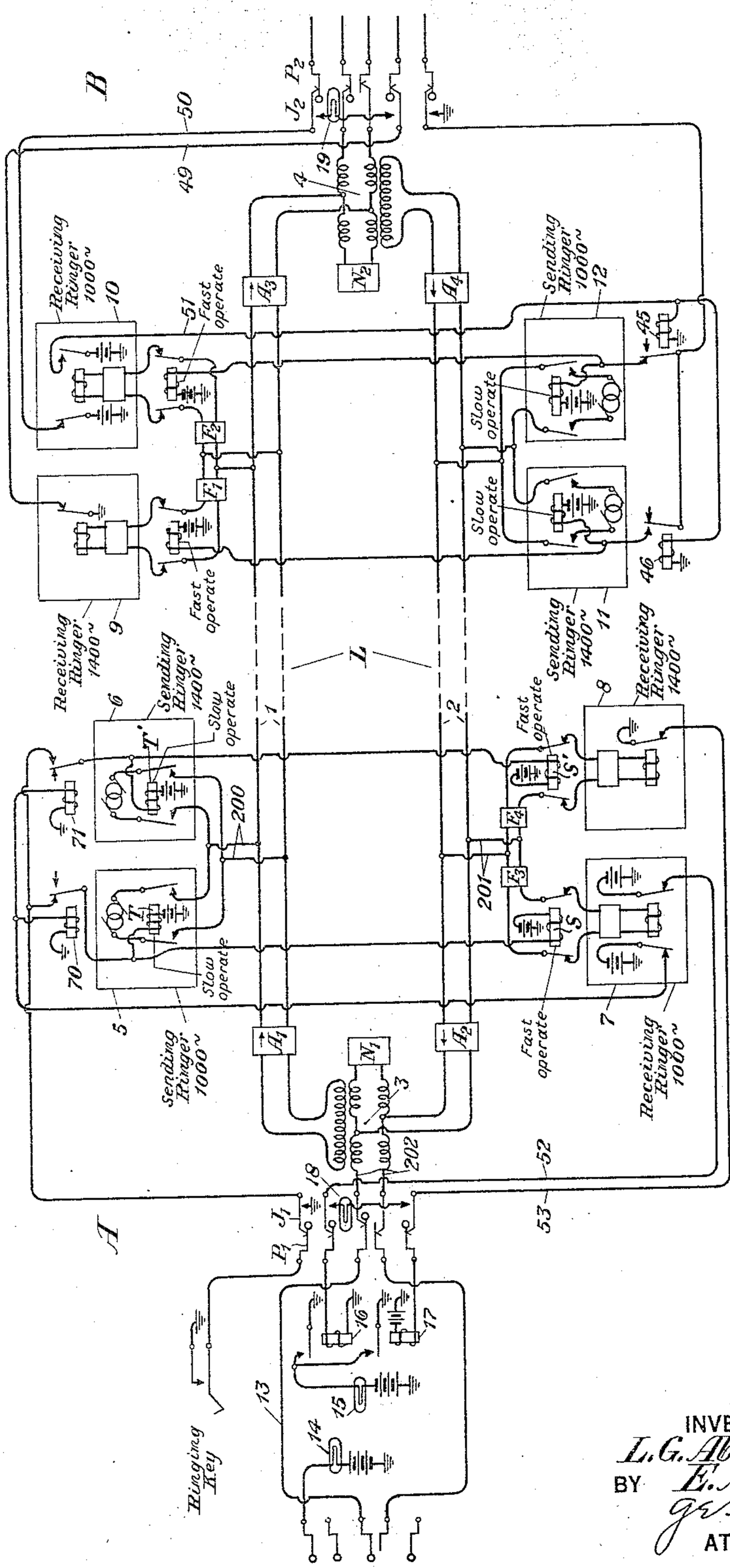

Fig. 1.

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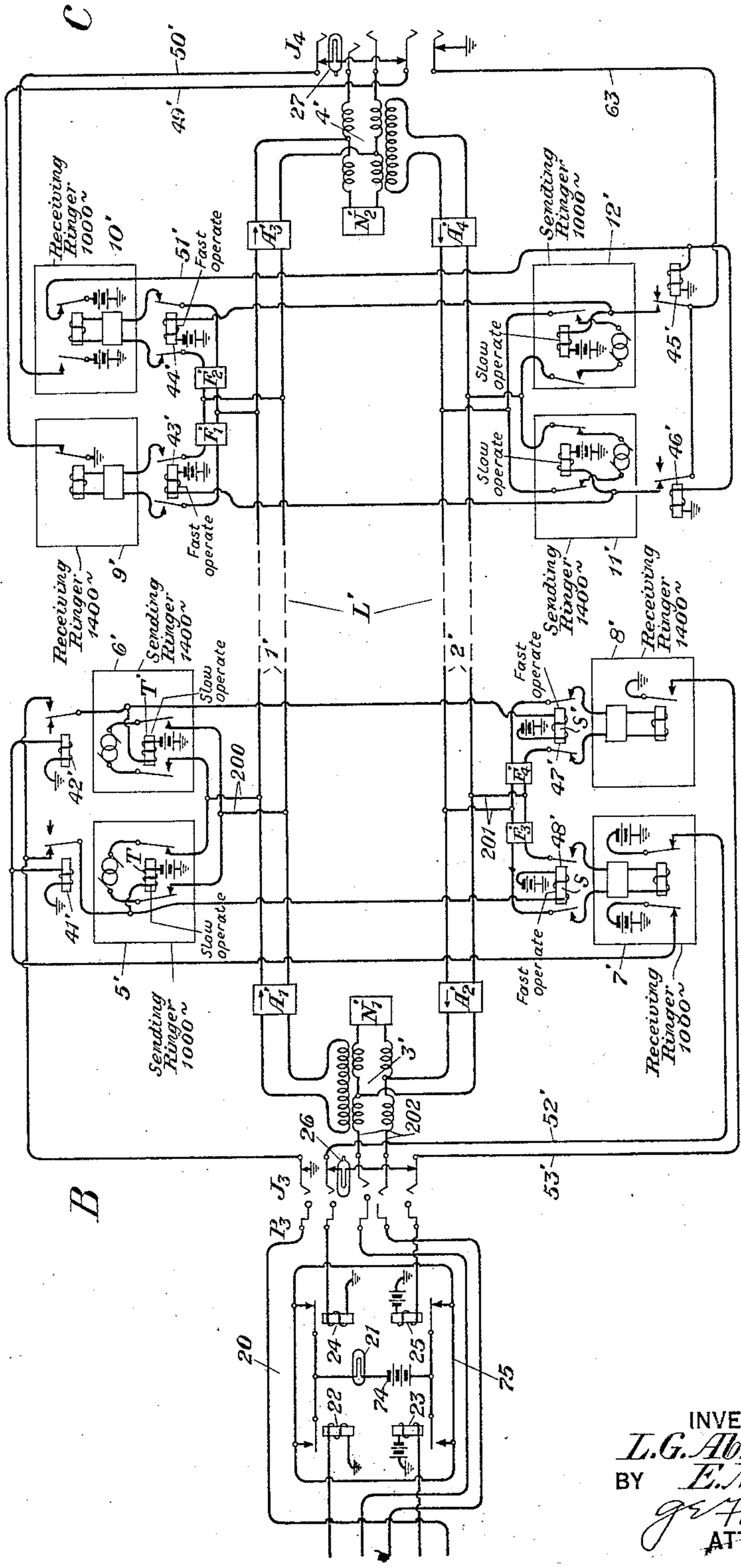

FIG. 2

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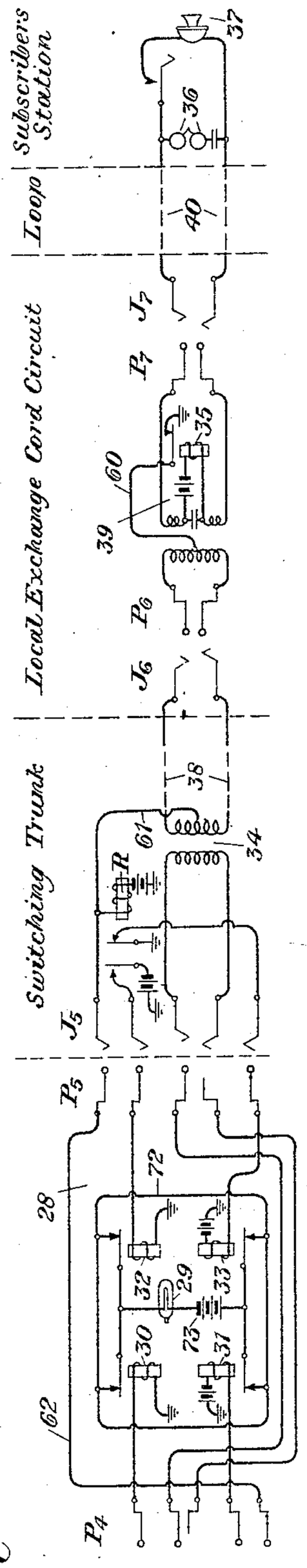

Fig. 3

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UNITED STATES PATENT OFFICE

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TELEPHONE SIGNALING SYSTEM

Application filed November 21, 1931. Serial No. 576,586.

This invention relates to telephone systems and more particularly to improvements in signaling arrangements adapted to be associated with the lines of such systems.

The signaling arrangements of the invention are particularly adapted for toll circuits in a telephone system. When utilized with such circuits they permit any given operator, for example, the operator originating the call, to completely supervise the call. Automatic ringing, switch hook operation, and the completion of the call would all be under the supervision of this one operator. The arrangements of the invention differ from other signaling systems in that they permit the signals to be passed over a circuit in two directions simultaneously when it is not in use. The signaling circuits of the invention may furthermore be used in built-up connections without repeating the signals at the junction points of the lines. Another advantage of the signaling arrangements of the invention consists in the fact that they do not require signals of definite length or lock-up devices. Other objects and features of the invention will appear more fully from the detailed description thereof hereinafter given.

The method of signaling of the arrangements of the invention is accomplished by providing two sending and two receiving ringers at each end of a long distance line. These sending and receiving ringers would utilize signaling currents of different frequencies. For example, one set of ringers might operate with a frequency of 1400 cycles and the other set might operate with a frequency of 1000 cycles. The ringers furthermore are so interconnected that when one frequency is being sent the receiving ringer for that frequency at the same end of the line is disabled before this frequency is applied and only the other frequency may be received at that end of the line. Further details of the system may be more fully understood from the detailed description thereof hereinafter given.

The invention may be more fully understood from the following description together with the accompanying drawings in Figs. 1, 2 and 3 of which the invention is illustrated. Figures 1, 2 and 3 when taken together with Fig. 2 placed to the right of Fig. 1 and Fig. 3 placed to the right of Fig. 2 show a telephone connection embodying the signaling arrangements of the invention.

In the drawings is shown a telephone circuit connecting a subscriber tributary to an exchange A with a subscriber tributary to an exchange C. The individual circuits for completing the connection are as follows: A connection would be established at A with the subscriber's line thereat (not shown) by means of the cord circuit 13. The cord 13 would be connected to the telephone circuit L interconnecting points A and B. At B the circuit might be extended by the cord circuit 20 to the telephone circuit L′ interconnecting points B and C. At C the call would be extended by the cord 28, the switching trunk 38 and the local exchange cord circuit 39 to the subscriber's line 40.

The circuit comprising the line L′ connecting points B and C will first be described as it is shown in the idle condition, or with no connections thereto. The line L′ is of the well known four-wire type comprising two one-way line sections 1′ and 2′ for transmission in opposite directions. These lines would terminate in the hybrid coils 3′ and 4′ and the balancing networks N'_1 and N'_2 and might include the amplifiers A'_1, A'_2, A'_3 and A'_4. Connected with the line 1′ at B would be the sending ringers 5′ and 6′. The operation of ringer 5′ would be controlled by relay 41′ and the ground connected to upper contact of jack J_3 and the ringer 6′ would be controlled by said ground and by relay 42′. Ringer 5′ when operated would apply to line 1′ current of 1000 cycles and ringer 6′ when operated would apply to line 1′ current of 1400 cycles. When the circuit is in idle condition only one of the ringers would be operated at a given time. As shown in the drawings 1000 cycle current is being transmitted over line 1′ from B to C. Connected to line 1′ at C would be the receiving ringers 9′ and 10′. The circuits for these ringers would be controlled by relays 43′ and 44′ and would include the filters F'_1 and F'_2. These filters would make ringer 9′ responsive to 1400 cycle

current and ringer 10′ responsive to 1000 cycle current. With ringer 10′ operated by the 1000 cycle current transmitted from B, battery is removed from conductor 50′ and with ringer 9′ unoperated ground is connected to conductor 49′. Under these conditions the lamp 27 will not be operated. With ringer 10′ operated battery will be connected to conductor 51′ and the relays 45′ and 46′ will be operated as shown. These relays control the operation of the sending ringers 11′ and 12′ connected to line 2′ at C. Ringer 11′ when operated will send 1400 cycle current from C to B and ringer 12 when operated will send 1000 cycle current from C to B. These ringers are controlled by relays 45′ and 46′ and by the ground on the lower contact of jack J_4. As shown the ringer 11′ will be operated and 1400 cycle current will be sent from C to B. At B there would be provided the receiving ringers 7′ and 8′. The 1400 cycle current transmitted from C to B would operate the receiving ringer 8′ and the ringer 7′ would not be operated. This would remove ground from conductor 53′ and allow battery to remain connected to conductor 52′. Under these conditions the signal lamp 26 would not be operated. Thus it will be seen that when the circuit is in idle condition ringing current of one frequency, such for example as 1000 cycle current, will be transmitted from B to C and ringing current of the other frequency, such for example as 1400 cycle current will be transmitted from C to B. Under such conditions the signals associated with the line at each end thereof will not be operated.

The telephone circuit L extending between A and B is substantially similar to the circuit L′ extending between B and C just described. The circuit L is shown with certain connections established therewith and is not in the idle condition. For example, the operator at A may connect her cord circuit 13 with the line L. This will remove the ground from the upper contact of jack J_1 and hence remove the ground from the sending ringer 5. This will stop the application of 1000 cycle ringing current to line 1 and the transmission of such current to B and will release the receiving ringer 10. This will connect battery to conductor 50 and allow ground to remain connected to conductor 49. This will light signal lamp 19 until the B operator plugs in. Before the B operator plugs in and removes the ground from the lower contact of jack J_2 the release of the receiving ringer 10 will remove battery from conductor 51 and release relays 45 and 46. The release of relay 46 will remove 1400 cycle current from line 2 and will cause ringer 12 to apply 1000 cycle current to line 2. This will operate the receiving ringer 7 and release the receiving ringer 8. The operation of receiving ringer 7 will remove battery from conductor 52 and allow relay 16 to release. This will allow the lamp 15 in the cord 13 to remain lighted. When the operator at B in response to the lighting of lamp 19 connects the cord circuit 20 to the line L the ground is removed from the lower contact of jack J_2 and the sending ringer 12 is released as well as the sending ringer 11. Under these conditions no current is transmitted from B to A and both receiving ringers 7 and 8 are released as shown. This will cause both relays 16 and 17 to operate and the lamp 15 will be extinguished thus giving the A operator a signal that the B operator has answered.

If the call is for a subscriber at another point, such as C, the operator at B will connect the cord circuit 20 to the line L′ extending from B to C. This line has heretofore been described in its idle condition with 1000 cycle current being transmitted from B to C and 1400 cycle current being transmitted from C to B. When the plug P_3 of cord 20 is inserted in jack J_3 of line L′ the ground will be removed from the upper contact of jack J_3 and ringer 5′ will be released. This will stop the transmission of 1000 cycle current between B and C and will release the receiving ringer 10′. The release of this ringer will apply battery to conductor 50′. As ground is already connected to conductor 49′ the signal lamp 27 will now be lighted to signal the operator at C. The release of ringer 10′ will also remove battery from conductor 51′ and release relays 45′ and 46′. The release of relay 46′ will stop the transmission of 1400 cycle current from C to B. The release of relay 45′ will operate ringer 12′ and transmit 1000 cycle current from C to B. This will cause the receiving ringer 8′ at B to release and put ground on conductor 53′ and operate relay 25. The receiving ringer 7′ at B will be operated and remove battery from conductor 52′ and allow relay 24 to release. However, with relay 25 operated the signal lamp 21 in the cord 20 will be extinguished even if relay 24 is released. It is pointed out that when the cord 20 was connected to line L′ the battery normally connected to conductor 52′ would operate relay 24 and extinguish lamp 21. Accordingly the 1000 cycle current being transmitted from C to B will not signal the operator at B.

The 1000 cycle current now being transmitted from C to B will be transmitted over the talking conductors of the cord 20 and thence over circuit 2 of line L to point A and will operate the receiving ringer 7 thereat. The operation of ringer 7 at A will remove battery from conductor 52 and release relay 16. This will light the signal lamp 15 in cord 13 and signal the operator at A that the call has reached C.

When the operator at C in response to the signal 27 connects the cord circuit 28 with the line L′ ground will be removed from the lower contact of jack J_4 and the 1000 cycle sending ringer 12′ will be released. This will stop the transmission of 1000 cycle current between C and A and will release the receiving ringer 7 at A. The release of this ringer will restore battery to conductor 52 and operate relay 16 again. This will extinguish lamp 15 in cord 13 and thus notify the operator at A that the operator at C has connected with the line. When the cord 28 is connected to line L′ the relays 30 and 31 will be operated but the light 29 will remain on as a circuit therefore will be closed over the contacts of relays 32 and 33.

If the call is for a subscriber in the region tributary to C, the operator at C may connect her cord circuit 28 to a switching trunk such as 38. A cord circuit, such as 39, at a local exchange will extend the connection from the switching trunk to the called subscriber's line 40. When the cord 28 is connected to the switching trunk 38 the relay 33 will be operated and the lamp 29 at C will be extinguished. When the connection is established as far as the subscriber's line 40 the subscriber may be rung automatically in any well known manner. When the connection is established as far as the subscriber's line and before the subscriber answers the following circuit will be closed,—from ground connected to the contact of relay 35, conductor 60, in parallel over the sides of trunk 38, conductor 61, conductor 62, conductor 63, to battery in the 1000 cycle sending ringer 12′. This will operate the sending ringer 12′ and once again send 1000 cycle current from C to A and will operate the 1000 cycle receiving ringer 7 at A. This will remove battery from conductor 52 and will release relay 16 and light lamp 15 in the cord circuit 13. This will notify the operator at A that the call has been completed to the subscriber's line.

When the subscriber removes the receiver 37 and closes the switchhook contacts a circuit will be completed for the relay 35 in the local exchange cord circuit and said relay will operate. This will remove the ground from the previously traced circuit for the 1000 cycle sending ringer 12′ and cause it to release and stop sending 1000 cycle current from C to A. This will release the receiving ringer 7 at A and cause the relay 16 to be operated again. This will extinguish lamp 15 to notify the operator at A that the subscriber has answered. Obviously, if the subscriber at C flashes his switchhook or if busy signals are applied a signal will be received at A.

When the call is completed and the subscriber at C hangs up the receiver 37, the circuit for relay 35 will be broken and relay 35 will release. This will put ground on the previously traced circuit for the 1000 cycle sending ringer 12′ and operate it so that 1000 cycle current will be transmitted from C to A. This will again operate the receiving ringer 7 at A and remove battery from conductor 52 and release relay 16 and light the signal lamp 15. This will notify the operator at A that the subscriber at C has hung up. The operator at A may now withdraw the cord circuit 13 from the line L. This will put ground on the upper contact of jack J_1 and, as the ringer 7 is in operated condition and the relays 70 and 71 released, the 1400 cycle ringer 6 will be operated and will send 1400 cycle current from A to C.

This 1400 cycle current will operate the receiving ringers 9 at B and 9′ at C, and will remove ground from conductor 49 at B and 49′ at C and release relays 23 and 31. A circuit will then be closed for the lamp 21 at B as follows: from battery 74, armature and contact of relay 23, conductor 75, armature and contact of relay 24, filament of lamp 21, to battery 74. This will light lamp 21 and inform the operator at B that the call is over and to disconnect from lines L and L′. A circuit will also be closed for the lamp 29 at C as follows: from battery 73, armature and contact of relay 31, conductor 72, contact and armature of relay 32, filament of lamp 29, to battery. This will light lamp 29 and notify the operator at C that the call is finished. The operator at C will then remove her cord 28 from the line L′. If the operator at B disconnects from the lines before operator C disconnects, lamp 29 will relight as ringer 6′ will be operated to send out 1400 cycles from B and ringer 9′ will be reoperated. If operator C disconnects before operator B, lamp 21 will relight as ringer 12′ will send 1000 cycles from point C, and ringer 7′ will be reoperated. When the operator at A wishes to disconnect the lines from the subscriber's station at C when the subscriber's receiver is off the hook, she removes cord 13 as before. This operates the 1000 cycle sending ringer as relays 70 and 71 are operated due to the receiving ringer 7 being released. This operates ringers 10 at B and 10′ at C. Lamp 21 at B will not operate at this time as relay 25 will be operated. The circuit will be closed for the lamp 29 as follows: from battery 73, armature and contact of relay 33, conductor 72, contact and armature of relay 30, filament of lamp 29, to battery. Relay 33 will be released and relay 32 operated, as relay R will be released as relay 35 will be operated. The operator at C will disconnect and this will operate sending ringer 11′ and receiving ringer 8′. Lamp 21 will then be lighted by the following connection: from battery 74, to contact and armature of relay 25, to conductor 75, to contact and armature of relay 22, to lamp 21, to battery 74. The

operator at B will now disconnect. A disconnect signal from A to C can also be transmitted when the subscriber at C is flashing his switchbook or when a busy signal is being sent from C.

Accordingly, it will be seen that the method of signaling of the arrangement of the invention is accomplished by means of two sending and two receiving ringers at each end of the circuits. In addition to this the ringers are so connected that when one frequency is being sent the receiving ringer at the same end of the circuit for that frequency is disabled and only the other frequency may be received. Also, if 1000 cycles is being received only 1400 cycles may be sent and if either 1400 cycles or nothing is being received, only 1000 cycles may be sent.

It will also be seen from the foregoing that the operator at B does not receive any signal unless one receiving ringer of each frequency on one or the other of the two circuits is operated, so that signals may be passed in any one direction without giving the operator at B any signal. In addition, if a signal, say of 1000 cycles is passed through the point B operating the 1000 cycle receiving ringer on circuit A—B, and if echoes from circuit B—C are sufficient to operate the receiving 1000 cycle ringer on that circuit, no signal will be received by the operator at B.

If the operator at A wishes to rering the operator at C without disconnecting the cord 13 from the line, she may operate the ringing key shown in Figure 1. The signals are sent and received in the same manner as previously described.

In this description the sending and receiving ringers are shown connected to the four-wire portion of a four-wire circuit. This signaling system will operate equally as well if the ringers are connected to the two-wire portion of the circuit. This would be done by connecting leads 200 and 201 to leads 202 between the hybrid coil and the jack. The ringers at the other points would be connected in the same manner. This signaling system could also be operated on a two-wire circuit.

Obviously, frequencies other than 1000 or 1400 cycles may be used for signaling purposes in the arrangements of the invention and these frequencies have been referred to as desirable for purposes of illustration. Accordingly, while the invention has been disclosed as embodied in certain specific arrangements which are deemed desirable, it is understood that they are capable of embodiment in many and other widely varied forms without departing from the spirit of the invention as defined by the appended claims.

What is claimed is:

1. A signaling system comprising a line adapted for transmission in both directions between two stations, two sending ringers at one of said stations for applying signaling currents of different frequencies to said line for transmission in one direction, two receiving ringers at said same station responsive at said different frequencies to signaling currents transmitted in the opposite direction over said line, and means at said station for interconnecting said sending ringers with said receiving ringers so that when a sending ringer of one frequency is operative the receiving ringer for that frequency will be disabled.

2. A signaling system comprising a line adapted for transmission in both directions between two stations, two sending ringers at the first of said stations for applying signaling currents of different frequencies to said line for transmission from the first to the second of said stations, two receiving ringers at the first station responsive at said different frequencies to signaling currents transmitted from the second to the first of said stations, two sending ringers at the second of said stations for applying signaling currents of said different frequencies to said line for transmission from said second to said first station, two receiving ringers at said second station responsive at said different frequencies to signaling currents transmitted from the first to the second of said stations, and means for interconnecting the sending ringers at each station with the receiving ringers thereat so that when a sending ringer of one of said frequencies is operative the receiving ringer for that frequency at the same station will be disabled.

3. A signaling system comprising a line adapted for transmission in both directions between two stations, two sending ringers at the first of said stations for applying signaling currents of different frequencies to said line for transmission from the first to the second of said stations, two receiving ringers at the first station responsive at said different frequencies to signaling currents transmitted from the second to the first of said stations, two sending ringers at the second of said stations for applying signaling currents of said different frequencies to said line for transmission from said second to said first station, two receiving ringers at said second station responsive at said different frequencies to signaling currents transmitted from the first to the second of said stations, means for interconnecting the sending ringers at each station with the receiving ringers thereat so that when a sending ringer of one of said frequencies is operative the receiving ringer for that frequency at the same station will be disabled, link circuits at each of said stations for extending said line, means controlled by the association and disassociation of said link circuits with said line for controlling said ringers, and signaling means at said stations controlled by said ringers.

4. A signaling system comprising a line adapted for transmission in both directions between stations A and B, means operative when said line is in idle condition for transmitting signaling current of a first frequency between stations A and B and for transmitting signaling current of a second frequency between stations B and A, means responsive to the establishment of a connection with said line at A for cutting off said first signaling frequency, means responsive to the subsequent establishment of a connection with said line at B for cutting off said second signaling frequency, means responsive to the breaking of said connection with said line at B for transmitting signaling current of said first frequency between B and A, means responsive to the subsequent breaking of said connection with said line at A for transmitting signaling current of said second frequency between A and B, and signal responsive devices at said stations controlled by said signaling currents of different frequencies.

5. A signaling system comprising a line adapted for transmission in both directions between stations A and B, means operative when said line is in idle condition for transmitting signaling current of a first frequency between stations A and B and for transmitting signaling current of a second frequency between stations B and A, means responsive to the establishment of a connection with said line at A for cutting off said first signaling frequency, means responsive to the subsequent establishment of a connection with said line at B for cutting off said second signaling frequency, means responsive to the breaking of said connection with said line at B for transmitting signaling current of said first frequency between B and A, means responsive to the subsequent breaking of said connection with said line at A for transmitting signaling current of said second frequency between A and B, means responsive to the subsequent establishment of a connection with said line at A for cutting off said second signaling frequency between A and B, means responsive to the subsequent establishment of a connection with said line at B for cutting off said first signaling frequency between B and A, means responsive to the subsequent breaking of said connection with said line at A for transmitting signaling current of said first frequency between A and B, means responsive to the subsequent breaking of said connection with said line at B for transmitting signaling current of said second frequency between B and A, and signal responsive devices at said stations controlled by said signaling currents of different frequencies.

6. A signaling system comprising a line adapted for transmission in both directions between stations A and B, means operative when said line is in idle condition for transmitting signaling current of a first frequency between stations A and B and for transmitting signaling current of a second frequency between stations B and A, means responsive to the establishment of a connection with said line at A for cutting off said first signaling frequency, means responsive to the subsequent establishment of a connection with said line at B for cutting off said second signaling frequency, signaling means at A responsive to said cutting off of said second signaling frequency between B and A, means responsive to the breaking of said connection with said line at B for transmitting signaling current of said first frequency from B to A, signaling means at A responsive to said transmission of signaling current of said first frequency from B to A, and means responsive to the subsequent breaking of the connection with said line at A for transmitting signaling current of said second frequency between A and B.

7. A signaling system comprising a line adapted for transmission in both directions between stations A and B, means operative when said line is in idle condition for transmitting signaling current of a first frequency between stations A and B and for transmitting signaling current of a second frequency between stations B and A, means responsive to the establishment of a connection with said line at A for cutting off said first signaling frequency, means responsive to the subsequent establishment of a connection with said line at B for cutting off said second signaling frequency, means responsive to the breaking of said connection with said line at B for transmitting signaling current of said first frequency between B and A, means responsive to the subsequent breaking of said connection with said line at A for transmitting signaling current of said second frequency between A and B, a second transmission line adapted for transmission in both directions between stations B and C, said second transmission line being similar to said transmission line between stations A and B, and a link circuit for connecting said transmission lines together at station B, said link circuit comprising signaling means operative when signaling current of one of said frequencies is transmitted from station C to station B and signaling current of the other of said frequencies is being transmitted from station A to station B.

8. A signaling system comprising a line adapted for transmission in both directions between stations A and B, means operative when said line is in idle condition for transmitting signaling current of a first frequency between stations A and B and for transmitting signaling current of a second frequency

between stations B and A, means responsive to the establishment of a connection with said line at A for cutting off said first signaling frequency, means responsive to the subsequent establisment of a connection with said line at B for cutting off said second signaling frequency, means responsive to the breaking of said connection with said line at B for transmitting signaling current of said first frequency between B and A, means responsive to the subsequent breaking of said connection with said line at A for transmitting signaling current of said second frequency between A and B, a second transmission line adapted for transmission in both directions between stations B and C, said second transmission line being similar to said transmission line between stations A and B, and a link circuit for connecting said transmission lines together at station B, said link circuit comprising a signal controlled by circuits over the contacts of four relays, one pair of said relays being controlled by the signaling currents transmitted from station C to station B and the other pair of said relays being controlled by the signaling currents transmitted from station A to station B, the circuits therefor being so arranged that said signal will be responsive when opposite relays of each pair are released or when both relays of a pair are released.

9. A signaling system comprising a line adapted for transmission in both directions between stations A and B, means operative when said line is in idle condition for transmitting signaling current of a first frequency between stations A and B and for transmitting signaling current of a second frequency between stations B and A, means responsive to the establishment of a connection with said line at A for cutting off said first signaling frequency, means responsive to the subsequent establishment of a connection with said line at B for cutting off said second signaling frequency, means responsive to the breaking of said connection with said line at B for transmitting signaling current of said first frequency between B and A, means responsive to the subsequent breaking of said connection with said line at A for transmitting signaling current of said second frequency between A and B, a second transmission line adapted for transmission in both directions between stations B and C, said second transmission line being similar to said transmission line between stations A and B, and a link circuit for connecting said transmission lines together at station B, said link circuit comprising a signal controlled by circuits over the contacts of four relays, one pair of said relays being controlled by the signaling currents transmitted from station C to station B and the other pair of said relays being controlled by the signaling currents transmitted from station A to station B, the circuits therefor being so arranged that said signal will be responsive when opposite relays of each pair are released or when both relays of a pair are released, another link circuit at station A for establishing connection with said line thereat, and a signal in said last mentioned link circuit controlled by circuits over the contacts of two relays, said relays being controlled by the signaling currents transmitted from station B to station A and from station C to station A, said circuits therefor being so arranged that said signal will respond when either of said relays are released.

10. A signaling system comprising a line adapted for transmission in both directions between stations A and B, means operative when said line is in idle condition for transmitting signaling current of a first frequency between stations A and B and for transmitting signaling current of a second frequency between stations B and A, means responsive to the establishment of a connection with said line at A for cutting off said first signaling frequency, means responsive to the subsequent establishment of a connection with said line at B for cutting off said second signaling frequency, means responsive to the breaking of said connection with said line at B for transmitting signaling current of said first frequency between B and A, means responsive to the subsequent breaking of said connection with said line at A for transmitting signaling current of said second frequency between A and B, a second transmission line adapted for transmission in both directions between stations B and C, said second transmission line being similar to said transmission line between stations A and B, and a link circuit for connecting said transmission lines together at station B, said link circuit comprising a signal controlled by circuits over the contacts of four relays, one pair of said relays being controlled by the signaling currents transmitted from station C to station B and the other pair of said relays being controlled by the signaling currents transmitted from station A to station B, the circuits therefor being so arranged that said signal will be responsive when opposite relays of each pair are released or when both relays of a pair are released, a second link circuit at station C for extending the connection, said second link circuit being similar to said link circuit at station B, a switching trunk adapted to be connected to said second link circuit at station C, and means operative when said link circuit is connected to said switching trunk whereby the upper relay of the pair in said link circuit which are associated with said switching trunk will be released and the lower relay of said pair will be operated.

11. A signaling system comprising a line adapted for transmission in both directions between stations A and B, means operative

when said line is in idle condition for transmitting signaling current of a first frequency between stations A and B and for transmitting signaling current of a second frequency between stations B and A, means responsive to the establishment of a connection with said line at A for cutting off said first signaling frequency, means responsive to the subsequent establishment of a connection with said line at B for cutting off said second signaling frequency, means responsive to the breaking of said connection with said line at B for transmitting signaling current of said first frequency between B and A, means responsive to the subsequent breaking of said connection with said line at A for transmitting signaling current of said second frequency between A and B, a second transmission line adapted for transmission in both directions between stations B and C, said second transmission line being similar to said transmission line between stations A and B, and a link circuit for connecting said transmission lines together at station B, said link circuit comprising a signal controlled by circuits over the contacts of four relays, one pair of said relays being controlled by the signaling currents transmitted from station C to station B and the other pair of said relays being controlled by the signaling currents transmitted from station A to station B, the circuits therefor being so arranged that said signal will be responsive when opposite relays of each pair are released or when both relays of a pair are released, another link circuit at station A for establishing connection with said line thereat, and a signal in said last mentioned link circuit controlled by circuits over the contacts of two relays, said relays being controlled by the signaling currents transmitted from station B to station A and from station C to station A, said circuits therefore being so arranged that said signal will respond when either of said relays are released, a link circuit at station C for extending the connection to a subscriber's line, said last mentioned link circuit being similar to said link circuit at station B, and means whereby said subscriber may control the application of signaling currents of said different frequencies from station C to station A.

In testimony whereof, we have signed our names to this specification this 19th day of November, 1931.

LEONARD G. ABRAHAM.
ELLIOT M. STAPLES.