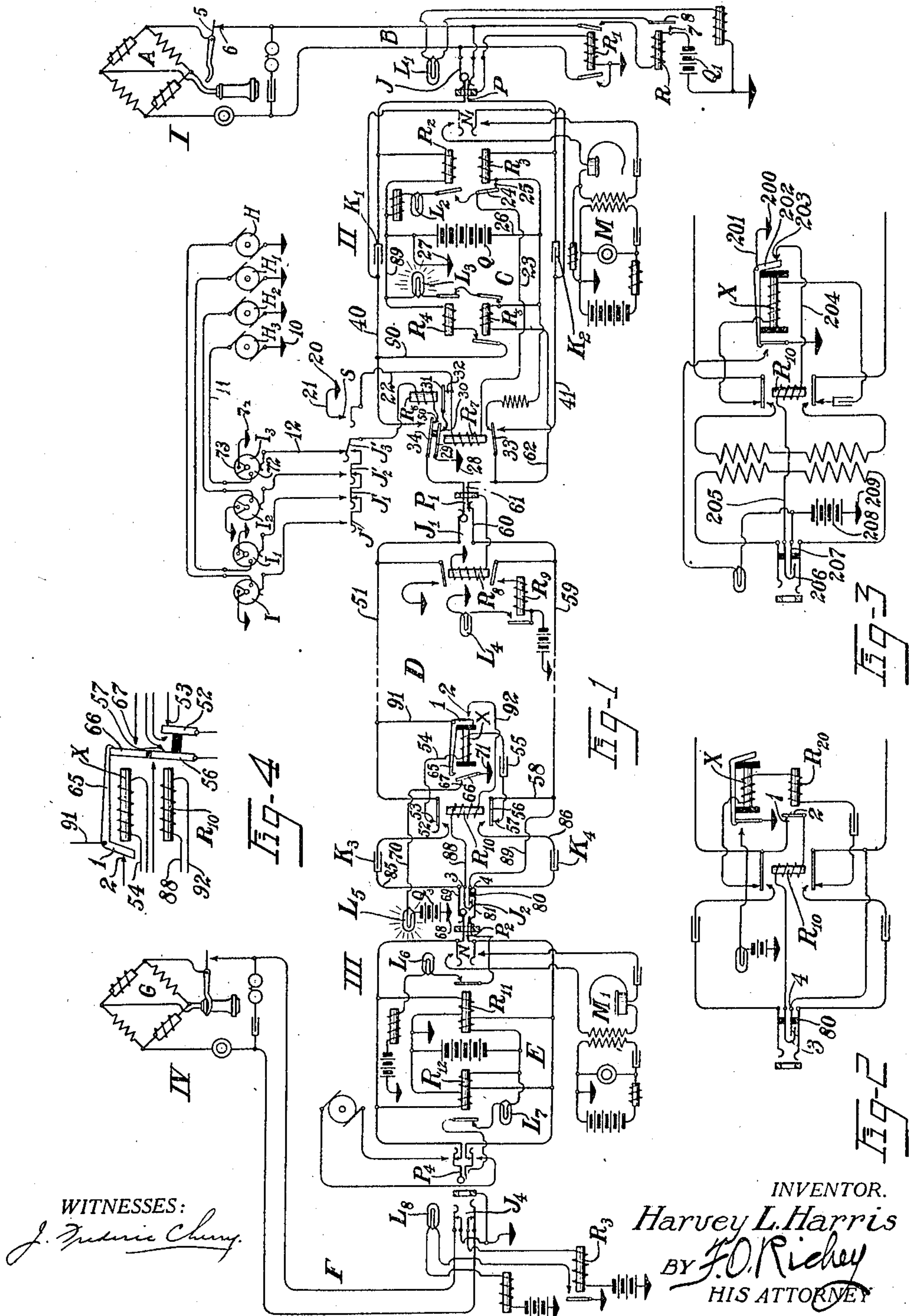


H. L. HARRIS.
TELEPHONE SYSTEM.
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TELEPHONE SYSTEM.

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Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, HARVEY L. HARRIS, a citizen of the United States, residing at Elyria, in the county of Lorain and State of Ohio, have invented certain new and useful Improvements in Telephone Systems; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to improvements in telephone systems. In modern telephone practice, the systems comprise a main or central office, telephone lines leading to the office and means at the central office for connecting the telephone lines together. The party desired is called by the application of what is known as automatic ringing current. In this practice, the operator sets a key, the ringing current is automatically turned on and operates the signal of the party desired, at stated intervals, the intervals during which the current is applied being known as ringing intervals and the intervals when the current is not applied being known as silent intervals. The ringing current used is frequently of high voltage, or otherwise possesses characteristics which would injure the responding party if connected to his receiver, while his receiver is at the ear.

The principal object of my invention is to improve such systems by providing means for preventing the responding party connecting his receiver to the conductors connected to the source of ringing current during the ringing period.

Other objects of my invention and the invention itself will probably be better understood from a description of specific embodiments of the invention.

Figure 1 shows diagrammatically a telephone system which includes a private branch exchange.

Fig. 2 is a diagram showing a modification of the system shown in Fig. 1.

Fig. 3 is a second diagram showing a second modification of the embodiment of the invention illustrated in Fig. 1.

Fig. 4 is a detail of the apparatus shown at X and R₁₀ in Fig. 1.

Referring now first to the embodiment shown in Fig. 1, at I is shown a substation,

at II a main or central station, here illustrated as a private branch exchange central station, which, in the embodiment illustrated in Fig. 1, constitutes the party responding to the call. At IV is shown a substation upon the private branch exchange system, which is connected to the private branch exchange by the telephone line F.

The line B is provided with a substation set and with the usual calling and cut-off apparatus at the main station. Means are provided at the main station for connecting the lines together, here shown as a cord circuit. A circuit is shown for connecting the station II to the station of the responding party, here shown as a trunk circuit D. A second cord circuit E is provided at the private branch exchange for connecting together telephone lines or for connecting the trunk D with a subscriber's line, such as the line F. Mechanism is provided for calling the party at the station III, which in the embodiment illustrated in Fig. 1 consists of ringing machines, commutators, ringing keys and ringing relays. A signal is provided at the station of the party called, here shown as consisting of a lamp L₅.

When the operator at the station II operates the ringing key J₃', ringing current is connected from a ringing generator H₃ through the commutator I₃ and the ringing relay R₆ to the plug P₁, thence through the jack J₁ to the device X, which operates, closing a switch in the circuit of the signal L₅, which is operated to indicate to the party at station III that he is being called. The ringing current is applied at intervals, the periods between these intervals being known as the silent periods, both ringing and silent periods being determined by the commutator I₃. Means are provided for preventing the party at III connecting the receiver of his telephone set M₁ to the circuit D when the ringing current is on the line. These means include a relay R₁₀, a switch 1—2 and associate conductors and switches which will be explained more in detail in the description of the operation.

When the party at III responds, the listening key N will be operated, connecting the telephone set M₁ with the plug P₂, which, when inserted into the jack J₂ will close a switch 3—4 in the circuit of the relay R₁₀. The trunk strands, however, will not be

completed until the relay R_{10} is energized by current over the battery Q , and R_{10} cannot be energized as long as the switch 1—2 is open, and since this relay will be open during each of the ringing periods, it will not be possible to connect the telephone set M_1 through during a ringing period. However, as soon as a ringing period has terminated, the switch 1—2 will be closed, and the relay R_{10} operated. When operated, the relay R_{10} will not only complete the circuit D , but will interrupt the circuit of the device X and automatically disconnect the ringing current from the telephone line.

The operation of the system is as follows: Assuming that the subscriber at station I desires to communicate with the station at IV, the receiver of the substation set at I is removed from the hook in the usual manner, whereupon the switch 5—6 is closed, completing a circuit through the line relay R , which will include the contacts of the cut-off relay R_1 , the limbs of the line B , the substation set at A, the relay R and the battery Q_1 . The relay R will be energized, closing the switch 7—8 in the circuit of the line lamp L_1 and causing the illumination of the lamp L_1 . This lamp is so located as to come under the observation of the operator at the main station II. The operator will answer the call by inserting the plug P into the jack J of the line B .

While I have shown plugs and jacks as a most convenient form for making the connections, it is obvious that any suitable switching means may be employed. The means here shown at the main station II for connecting lines together consists of a cord circuit, though, of course, any suitable connecting means may be employed. I also illustrate suitable supervisory signaling means in the cord circuit, here consisting of relays R_2 , R_3 , R_4 and R_5 and supervisory lamps L_2 and L_3 controlled by said relays in a manner well known. The relay R_3 is controlled over a circuit which includes the cut-off relay R_1 , the contacts of the plug and jack and a portion of one of the strands of the cord circuit and the battery Q . The circuit of the relay R_2 includes the battery Q , portions of the strand of the cord circuit, contacts of the plug P and jack J , the strands of the line B and the telephone set A at the substation I. The further circuit arrangement provided for these relays and the operation of the relays are all well known and constitute no part of my invention, so that their operation will not be described in detail here.

The operator at the station II will connect her telephone set M to the line B through the agency of the listening key N_1 , and on learning that communication is desired with some party at the station III, or connected thereto, the plug P_1 will be in-

serted into the jack J_1 . Ringing current is then placed upon the circuit D , operating one of the series of ringing keys, here shown as J' , J_1' , J_2' and J_3' , which will connect one of a series of generators, here shown as H , H_1 , H_2 and H_3 , each connected with one of a set of commutators I , I_1 , I_2 and I_3 . Assuming that the key J_3' is operated, a master key S will be operated at the same time, completing the circuit of the ringing relay R_7 , which is as follows: ground 20—conductor 21—contacts of the master key S —conductor 22—relay R_7 —conductor 23—contacts 24 and 25—conductor 26—battery Q to ground at 27. The relay R_7 will be energized, completing a locking circuit from ground 28 through the contacts 29 and 30—the contacts 31 and 32 of the relay R_6 . The relay R_7 also attracts its armatures 33 and 34, disconnecting the plug P_1 from the talking strands 40 and 41 of the cord circuit and connecting the plug P_1 to the ringing leads. Ringing current will now operate over the following circuit: ground at 10, generator H_3 —commutator I_3 —conductor 12—key J_3' —relay R_6 —switch 50—34—the tip of the plug P_1 —the tip spring of the jack J_1 —conductor 51—contacts 52—53—conductor 54—device X —condenser 55—contacts 57 and 56—conductor 58—conductor 59—spring 60—plug contact 61—conductor 62—relay R_5 —conductor 26—battery Q to ground 27. The current through this circuit will not be sufficient to operate the relay R_6 , but will operate the device X which will attract its armature 1, raising the catch 65 and releasing the contact 66 which falls back and engages the contact 67, completing a circuit for the lamp L_5 from ground at 68 through battery Q_3 , lamp L_5 , conductor 70, contacts 67 and 66, to ground at 71.

The commutator I_3 is provided with two sections, one shown at 72 adapted to connect the conductor 11 and 12 to permit ringing current to flow through the commutator, and another section shown at 73 grounded at 74 to interrupt the connection of the ringing current and provide what is known as a silent period, during which only the direct current in the battery Q is connected over the ringing circuit. Owing to the presence of the condenser 55 in this circuit, which bars the flow of current from the battery Q , the device X will not be operated during the silent period. The lamp L_5 is in such a position that its operation will be observed by the party at the station III, who will respond to the same, in the form of the invention illustrated by inserting the plug P_2 into the jack J_2 and operating the listening key N . When the plug is inserted into the jack, the switch 3—4 will be operated through a physical connection 80 between the spring 4 and the spring 81 of the jack.

This will close the switch 3—4 in the circuit of the relay R_{10} . Another switch 1—2 is provided in this circuit which will be open, as shown, during the application of the ringing current. The switch 1—2 will be closed during the silent period, so as to complete the circuit of the relay R_{10} . If the receiver of the set M_1 is connected through the key N and the plug P_2 and jack J_2 to the ends 85 and 86 of the trunk during the ringing period, they will not be connected through to the station II because the relay R_{10} will not be operated. If, however, they are connected during the silent period, the relay R_{10} will be operated, or, if so connected to the conductors 85 and 86 during the ringing period, they will be connected through to the station II as soon as the ringing period has been interrupted. The circuit of the relay R_{10} will be as follows: R_{10} —conductor 88—contacts 3 and 4—conductor 89—conductor 59—contacts 60—61—conductor 62—relay R_5 —conductor 26—battery Q , ground at 27—ground at 74, section 73 of the commutator I_3 —12—key J_3 —relay R_6 —contacts 50 and 34, the tip of the plug P_1 —tip spring of jack J_1 —conductor 51—conductor 91—switch 1—2—conductor 92 and back to relay R_{10} . When energized over this circuit, the relay R_{10} attracts its armatures 52 and 56, disconnecting the device X from the conductors 51 and 59 and restoring, through means illustrated in Fig. 4, the member 66 to the catch 65. This will also energize the relay R_6 , which in turn interrupts the circuit of the relay R_7 and completes the talking strands of the cord circuit C , so that the parties at II and III are now placed in communication.

If it is desired to secure a party connected to the private branch exchange, such as the subscriber at IV, the cord circuit E is operated in the usual manner, to effect such a connection, the usual test being made. The plug P_4 is inserted into the jack J_4 and the subscriber at IV rung. At the termination of the use of the system, the operators will be notified, through the use of suitable supervisory signaling apparatus, all of which is old and well known, of the termination of the conversation, whereupon the plugs will be withdrawn from the jacks and the system restored to normal.

In the modification shown in Fig. 2, the contacts 1 and 2 in the circuit of the relay R_{10} , instead of being controlled by the device X , are controlled by a relay R_{20} in the circuit of said device. During the ringing period, both the device X and the relay R_{20} will be operated, and the switch 1—2 will be opened, preventing the energization of the relay R_{10} and the completion of the ringing circuit to the receiver of the set M_1 .

In the modification shown in Fig. 3 the circuit of the relay R_{10} is local to one end

of the circuit D . This circuit is as follows: ground at 200—conductor 201—contacts 202—203—conductor 204—relay R_{10} —conductor 205—contacts 206—207—battery 208—to ground at 209. This circuit is controlled by the device X in the same manner as in the embodiment illustrated in Fig. 1 and it self-controls the connections in the same manner as in the embodiment shown in Fig. 1. In the embodiment shown in Fig. 3 the combination apparatus shown in Fig. 4 is employed.

The operation of the apparatus shown in Fig. 4 will be apparent from the descriptions already given and from the illustration of that device.

While I have illustrated three embodiments of my invention, it will be apparent that it is broader than these modifications, and is capable of being incorporated in other embodiments. These modifications have been shown, not with the intention of limiting the invention thereto, but for the purpose of illustrating this invention, it being apparent to those skilled in the art that many variations may be made from such embodiments, as well as from the details thereof, without departing from the scope of the invention which is set forth in the appended claims.

I claim:—

1. In a telephone system, the combination of a main station, link conductors thereat, a second station, circuit conductors connecting the main and second stations, a signal at the second station, a substation set at the second station normally disconnected from said conductors, a source of current at the main station for causing the operation of the signal at the second station, means to break such current up into silent and active periods, means to automatically disconnect said source from said circuit conductors when said substation set is connected to said circuit conductors and means at the second station permitting said set to be connected to said conductors during a silent period and preventing the connection of said set to said conductors while said ringing current is connected thereto.

2. In a telephone system, the combination of a main station, means at the main station for connecting telephone lines together, a source of signaling current and means to connect said source of signaling current to said connecting means, a second telephone station, a circuit for connecting the main station and the second telephone station, a talking set at the second station, a signal at the second station responsive to currents from the source of signaling current at the main station, apparatus at the main station for breaking the signaling current up into active and silent periods, means at the second telephone station for connecting the

telephone set thereat to the circuit for connecting the two stations together, apparatus for preventing the connection of said telephone set to said circuit during an active period of the ringing current and means for connecting said set to said circuit and for disconnecting the source of signaling current from said circuit at the end of an active period.

3. In a telephone system, the combination of a calling station, a called station, conductors for connecting said stations together, a source of calling current at the calling station, means for automatically connecting said source to said conductors including mechanism for interrupting the calling current and producing ringing and silent periods, a signal at the called station controlled by the ringing current, a substation set at the called station, means preventing the connection of the substation set to said conductors during a ringing period and apparatus for connecting said set to said conductors during a silent period.

4. In a telephone system, the combination of a calling station and a called station, conductors normally interrupted at the outgoing end thereof to connect said stations together, a source of calling current, means for connecting said source to said conductors, including a continuously operating commutator for interrupting the flow of ringing current and breaking the time of its operation up into silent and ringing periods, a telephone set at the called station and means for connecting said set to said conductors, said means being operative during a silent period but inoperative during a ringing period.

5. In a telephone system, the combination of a calling station, a called station, trunk conductors normally interrupted at their outgoing ends connecting said stations, a source of calling current at the calling station, means to apply calling current from said source to said conductors and means to prevent the completion of said conductors while the calling current is applied thereto.

6. In a telephone system, the combination of a calling station, a called station and trunk conductors normally interrupted at their outgoing ends for connecting said stations together, a source of calling current at the calling station, means to apply said current to said conductors, and apparatus for completing said conductors from one of said stations to the other, said means being inoperative to complete said connections while the calling current is applied to said conductors.

7. In a telephone system, the combination of a calling station, a called station, a signal at the called station, a source of calling current at the calling station for causing the operation of said signal, trunk conductors

normally interrupted at their outgoing ends for connecting said stations together, means for applying calling current from said source to said conductors for the operation of said signal and means for preventing the completion of said conductors during the application of calling current to said conductors.

8. In a telephone system, the combination of a calling station and a called station, trunk conductors normally interrupted at their outgoing ends to connect said stations, a signal at the called station, a source of signaling current at the calling station for causing the operation of said signal over said conductors, means to apply current from said source to said conductors to cause the operation of said signal, mechanism for completing said conductors from station to station, said mechanism being operative only when said signaling current is not applied to said conductors.

9. In a telephone system, the combination of a calling station, a called station, conductors connecting said stations, normally interrupted contacts in said conductors, a relay controlling said contacts, a source of calling current at the calling station, means to apply said calling current to said conductors, a lamp signal at the called station controlled by the source of calling current, a circuit for said relay and means controlled by the calling current controlling said circuit.

10. In a telephone system, the combination of a calling station, a called station conductors connecting said stations, normally interrupted contacts in said conductors, a relay controlling the same, a signal at the called station, a source of signaling current at the calling station for causing the operation of said signal, means to apply said signaling current to said conductors, a circuit for said relay, normally open contacts in said circuit and means maintaining said contacts open during the application of signaling current to said conductors, said means being controlled by said signaling current and operable to close the contacts in the relay circuit when the application of signaling current to said conductors is interrupted, and means to interrupt the application of signaling current to said conductors.

11. In a telephone system, the combination of a calling station, a called station, trunk conductors normally interrupted at their outgoing ends for connecting said stations together, a signal at the called station, a source of calling current for causing the operation of said signal, means to connect said source to said conductors including a constantly operating commutator for breaking the application of signaling current to said conductors up into silent periods and ringing periods, and means including an alternating current relay to complete said conductors

from station to station operable during a silent period but inoperative during a ringing period.

12. In a telephone system, the combination of a calling station and a called station, normally interrupted conductors for connecting said stations together, a signal at the called station, a source of signaling current at the calling station for causing the actuation of said signal, means for connecting said source to said conductors including a commutator for interrupting the application of signaling current to said conductors and breaking the same up into silent and active periods, normally open contacts in said conductors, a relay controlling said contacts, a circuit for said relay and means controlled by the signaling current for maintaining said circuit open during the ringing period but closing the same during the silent period.

13. In a telephone system, the combination of a calling station, a called station, conductors connecting said stations, normally open contacts in said conductors, an electromagnet controlling said contacts, a circuit for said electromagnet, a switch in said circuit, a signal at the called station, a source of calling current at the calling station for causing the actuation of said signal, an electromagnet at the called station responsive to the calling current controlling said signal and the switch in the circuit of the first named electromagnet, said second named electromagnet maintaining said switch open during the application of calling current but closing the same when the application of calling current to said conductors is interrupted.

14. In a telephone system, the combination of a main station, a private branch exchange station, a trunk circuit for connecting said stations together, the strands of said trunk being normally interrupted at the outgoing ends thereof, a signal at the private branch exchange station, a source of signaling current at the main exchange station, means to cause the actuation of the signal at the private branch exchange station, including said source, and means to prevent the completion of the strands of the trunk circuit during the application of current from said source to the strands of said trunk circuit.

15. In a telephone system, the combination of a main exchange central station and a private branch exchange central station, a trunk circuit for connecting said stations together, a signal at the private branch exchange main station, a telephone set at the private branch exchange main station, a source of calling current at the main exchange central station, means to apply current from said source to said trunk, a commutator for interrupting the application of current from said source to said trunk, the current from said source controlling the op-

eration of said signal, normally open contacts in said trunk and mechanism including a relay controlling said contacts for preventing the connection of the telephone receiver of said set to said trunk during the application of calling current to the trunk, said means permitting the connecting of said receiver to said trunk when the calling current is interrupted by said commutator.

16. In a telephone system, the combination of a calling station, a called station, conductors for connecting said stations, a source of calling current at the calling station and means to apply the same to said conductors, a commutator for interrupting the application of current from said source to said conductors, a signal at the called station controlled by calling current from said source, a telephone set including a telephone receiver at the called station and mechanism inoperative during the application of the calling current to connect said receiver to said conductors, but operating to make such connection as soon as said commutator interrupts the application of the calling current.

17. In a telephone system, the combination of a main exchange central station, a private branch exchange central station, a trunk circuit for connecting the same, normally open switches in the strands of the trunk circuit, an electromagnet controlling said switches, a telephone set including a telephone receiver at the private branch exchange central station and means to connect said receiver to the strands of the trunk circuit, a signal at the private branch exchange central station, automatic signal current generating means at the main exchange central station, means to connect the same to the strands of the trunk circuit, apparatus for periodically interrupting the flow of current therefrom, a circuit for said first named electromagnet and a second electromagnet governed by the current from said automatic means controlling the circuit of the first named electromagnet and a circuit for said signal controlled by the second named electromagnet.

18. In a telephone system, the combination of a calling station, a called station, conductors for connecting said stations together, a source of calling current at the calling station, means to connect it to said conductors, a telephone set at the called station including a telephone receiver and means to connect said receiver to said conductors, normally open switches in said conductors and apparatus at the called station controlled by the calling current to prevent the closing of said switches while the calling current is applied to said conductors.

19. In a telephone system, the combination of a calling station, a called station, conductors for connecting said stations together, a

source of calling current at the calling station and means for automatically applying current from said source at regular intervals to said conductors, a signal at the called station controlled by the current from said source, normally open switches in said conductors, a telephone set including a telephone receiver at the called station, and means controlled by the current from said source for preventing the closing of said switches during the application of calling

current to said conductors, said means permitting the closing of said switches when current from said source is not applied to said conductors.

In witness whereof, I have signed my name in the presence of two witnesses, this 19 day of April, 1915.

HARVEY L. HARRIS.

Witnesses:

GEO. A. SCOVILLE,
F. L. CLARK.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."