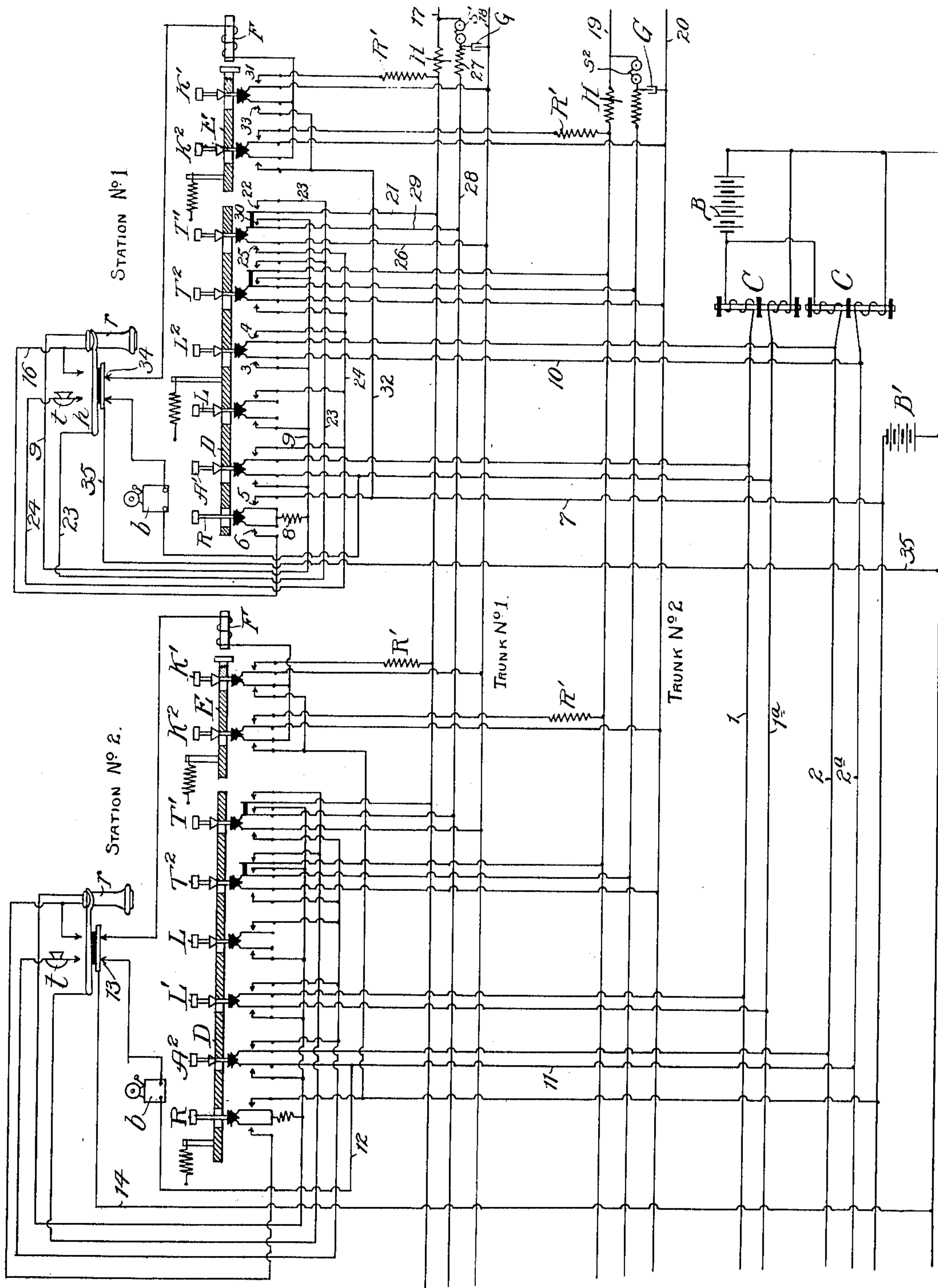


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PRIVATE BRANCH INTERCOMMUNICATING TELEPHONE SYSTEM.
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UNITED STATES PATENT OFFICE.

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PRIVATE-BRANCH INTERCOMMUNICATING TELEPHONE SYSTEM.

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To all whom it may concern:

Be it known that I, JAMES L. McQUARRIE, citizen of the United States, residing at Oak Park, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Private-Branch Intercommunicating Telephone Systems, of which the following is a full, clear, concise, and exact description.

My invention relates to a private branch exchange telephone system, embodying an intercommunicating system, and also providing for outside connections with the central office exchange. Its object is to provide an arrangement whereby local communication may be had between the parties at the several stations in the private exchange without the intervention of an operator, and whereby the telephone used for answering an outside call may be utilized for communicating with another local station without causing a disconnect signal at the central office during the interval of such use.

A further object is to provide for secret communication between the station of the intercommunicating system at which the call over the trunk line is received and any other local station, without the central office operator hearing the conversation.

My invention consists in the provision of means at two or more stations of an intercommunicating system for maintaining the circuit continuity of a line leading to said system from the central office exchange, said means being in addition to and in substitution of the telephone set at said stations.

My invention thus provides means for holding a calling line while the telephone set which was used in answering the call is being utilized for communicating with another local station.

My invention further provides means whereby said call may be transferred to another station without the act of transferring establishing conditions at the central office causing the display of a disconnect signal.

My invention also provides means for holding a trunk line while the station at which the call is received has communication with another local station, without the central office operator hearing the connection.

In the preferred embodiment of my invention, the trunk line from the central office terminates in an intercommunicating

system and is multiplied with the several stations of such system. Means are provided at each station for connecting that station with the trunk line, and a circuit closing device is also located at each station for completing the circuit continuity of said trunk line irrespective of the telephone set, thus permitting the disconnection of the telephone set from the trunk line without affecting the central office signals. Communication may then be had from that station to another over their local lines, without the central office operator hearing the conversation, while said circuit closing device is maintaining the continuity of the trunk line to prevent the display of the disconnect signal to the central office.

My invention may be more readily understood by reference to the accompanying drawing, which is a diagram of circuits and apparatus which may be employed.

For sake of clearness, only two stations of the intercommunicating system and two trunk lines terminating therein are shown, it being obvious that as many trunk lines may be employed as may be deemed necessary and that the stations of the system may be duplicated within the usual limits.

Considering first merely the intercommunicating feature of the system illustrated in the drawing, each station, as shown for example at station No. 1 and station No. 2, is equipped with the usual telephone set comprising a transmitter *t* and a receiver *r*. Corresponding with each station is a local line 1, 1^a and 2, 2^a, respectively, connected with a common battery *B* through the usual retardation coils *C*. Each station is provided with local keys associated with the local lines of every other station, those at station No. 1 being designated *L*², and those at station No. 2 as *L*¹. For sake of uniformity, the panels of local keys are identical in structure, which, of course, leaves at each station an idle key *L* corresponding to that station. Each station is also provided with an answering key associated with its own local line, as shown at *A*¹ and *A*², of stations No. 1 and No. 2, respectively. Each station is further provided with a ringing key *R* for applying ringing current to the line selected by the operation of the local key. At each station is the usual call bell *b*, the circuit through which is closed at the switch contacts when the receiver is on its

hook. The battery B' furnishes the source of ringing current.

It will be noted that with the exception of the ringing key R , all the keys at a station are held locked down when depressed by means of a plate D , and the depression of one key releases any key already locked down. The manipulation of key R , however, has no effect on any other key.

The manner in which a subscriber at one station may call up another station is obvious. For example, if the subscriber at station No. 1 desires to communicate with station No. 2, he will remove his receiver r from its switch hook h , and depress key L^2 , thus closing contacts 3, 4 and connecting his telephone set with local line 2, 2^a . He will then depress his ringing key R , thereby closing contacts 5 and 6, whereupon, if the called line is not in use, current will flow from battery B' through conductor 7, contact 5, resistance 8, conductor 9, contact 3 of key L^2 , conductors 10, 2^a , 11, 12, bell b , contact 13, conductor 14, back to battery B' . The subscriber at station No. 2 will respond by depressing his answering key A^2 and by removing his receiver r from its hook. Stations 1 and 2 are now in telephonic communication, their telephone sets being connected to local line 2, 2^a , through local key L^2 and answering key A^2 , respectively.

The circuit arrangement just described provides means whereby the calling party is informed whether or not the station called is busy. At the time the party at station No. 1 depressed his ringing key R , current was supplied for ringing the bell b at station No. 2, said current flowing through resistance 8. The terminals of the receiver r are connected through conductors 9, 16 to each side of said resistance. The ringing of the bell b at station No. 2 causes a buzz in the receiver r , due to the difference in potential across the terminals of resistance 8, this resistance being in series with the bell at station No. 2. The current flowing through resistance 8 is intermittent, owing to the opening and closing of the circuit in the usual manner in the contact of the bell b . The buzz denotes to the party at station No. 1 that the telephone at station No. 2 is not in use, since if it were, contact 13 would be open, the bell b at station No. 2 would not ring, and consequently the party at station No. 1 would not hear a buzz in his receiver.

It will be observed that the arrangement thus far described in detail provides what is commonly designated as an intercommunicating system. I will now describe the circuits and arrangement whereby such a system may be connected to a central office exchange to provide for outside communication, and means permitting transferring of

calls and maintaining central office signals unchanged during the interval of transfer.

Conductors 17, 18 and 19, 20 are trunk lines No. 1 and No. 2, respectively, extending from the central office exchange to the intercommunicating system. Each trunk is multiplied, as shown, with each station of the intercommunicating system. Each station is provided with trunk keys T' , T^2 , associated with trunk No. 1 and trunk No. 2, respectively, and adapted when depressed to connect the telephone set of that station with the corresponding trunk line. Each station is also provided with a transfer key associated with each trunk line, those for trunk lines No. 1 and No. 2, being indicated at K' and K^2 , respectively. The function of said keys is to maintain the continuity of the signaling circuit established over the trunk line in substitution of the telephone set, thus enabling that station to call up and communicate with any other station without giving a disconnect signal at the central office. Said transfer keys are held down when depressed by means of a plate E , and are released by a magnet F which is energized at the time the receiver at that station is returned to its hook, providing a transfer key had been previously depressed. By pressing down transfer key K' or K^2 , a bridge is placed across the corresponding trunk line. Such bridge preferably includes a resistance R' and acts as a holding coil in substitution of the telephone set for preventing a disconnect signal from being displayed at the central office.

Signal bells s' and s^2 may be associated with the trunk lines in any manner to give a signal at the station or stations at which it is desired to answer an incoming call. These bells may be located at some point, for example, where they can be heard from any station.

It is apparent that a call over any one of the trunk lines may be answered at any station, and the answering station may thereafter secretly communicate with any other station without giving a disconnect signal at the central office. Furthermore, the answering station may then either renew the conversation with the calling party, or request the called local party to answer over the trunk line.

The operation of the system as a whole is as follows: Assume that a call is received over trunk line No. 1, and is answered at station No. 1. The party at said station removes his receiver from its hook and depresses trunk key T' . Current then flows from the central office over conductor 17 of the trunk line, through the conductor 21, contact 22 of the key T' , conductor 23, switch hook h , transmitter t , conductor 24, contact 25 of key T' , conductor 26 and conductor 18 of the trunk line to central office.

This completes the circuit continuity of the trunk line and establishes conditions at the central office which show, in the usual manner, that the call has been answered. At the same time a path for telephonic currents, in which is included the telephone receiver, has been established, which path is local to the private branch exchange and is secondary to the main line circuit. Such path may be traced as follows: From conductor 18, through condenser G, winding 27 of induction coil H, conductors 28, 29, contact 30 of key T', conductor 9, receiver r, switch hook h, transmitter t, conductor 24, contact 25 of key T', conductors 26 and 18 back to the point where condenser G connects to conductor 18. Station No. 1 is now so connected to trunk line No. 1 that conversation can take place between the private branch exchange party and the calling party, connected through the central exchange, the party at station No. 1 controlling the central office signals in the usual manner, that is, by means of his switch hook. If the party at station No. 1 now wishes to call up any other station of the intercommunicating system for any purpose, as for example to receive instructions, or to transfer the call, he presses down the transfer key K', which key is then held down by the plate E. The closing of contact 31 of the key K' places a bridge across the trunk line conductors 17, 18, thus maintaining the continuity of the signaling circuit of that line, and leaving the party at station No. 1 at liberty to use his telephone for calling up any other station of the private branch exchange. For example, he may call up station No. 2 in the manner hereinbefore described. In so doing, he depresses local key L², thereby releasing trunk key T' and completely disconnecting his telephone set from the trunk line, but leaving, as before stated, the bridge closed by key K' in substitution thereof. By again pressing down trunk key T', he may at any time resume his conversation with the outside calling party. Let us assume, however, that the party at station No. 1 desires to transfer the call to station No. 2. After pressing down transfer key K' and calling up station No. 2 in the usual manner, he instructs the party at that station to answer over trunk line No. 1. The party at station No. 2 then depresses his trunk key T' and in so doing releases his answering key, leaving his telephone set connected only with the trunk line. The party at station No. 2 is now in position to talk with the outside calling party. The circuits established through the connections of station No. 2 are substantially the same as those hereinbefore traced from the trunk line through station No. 1 and may be readily followed without further description. The party at station No. 1, after requesting

the party at station No. 2 to answer over trunk No. 1, replaces his receiver on its hook, thereby causing the automatic release of his transfer key K', which is effected by the electromagnet F becoming momentarily energized and attracting the plate E, moving it so as to release said key. Said magnet is energized by current flowing from battery B' through conductor 7, conductor 32, contact 33 of key K', winding of magnet F, contact 34 closed by the switch hook, and conductor 35 back to battery B'. As soon as the key K' is released, the contact 33 in the circuit just traced is opened and current ceases to flow in said circuit. As before stated, the bridge of the trunk line closed by the transfer key preferably includes a resistance R'; for otherwise such bridge would practically short-circuit the telephone set at station No. 2 and prevent conversation between that station and the central station operator until after the party at station No. 1 had hung up his receiver. When the party at station No. 2 hangs up the receiver at the end of the conversation, the contacts which had been closed by the switch hook are opened, thereby giving the usual disconnect signal to the central office operator.

It will be noted that the arrangement of the keys at each station is as follows: The ringing key R does not lock down nor does its operation release any other keys. The remaining keys associated with the plate D release each other, and a key when depressed locks in that position. The transfer keys K' K² release each other and the depressed key remains locked down. The magnet F attracts the plate E and releases any transfer key that may be down at the time the telephone at that station is restored to its hook.

It will be observed that substantially the same conditions apply whether a call received over the trunk line is actually transferred from the station answering the call to another one of the local stations or whether the answering station, without losing connection with the trunk line, merely talks with another station, as for example, for the purpose of obtaining information. Hence it will be understood the terms "transfer" and "transfer-key", in their broad sense, are applicable to both of the above-mentioned conditions.

I claim:—

1. The combination with an intercommunicating telephone system, of a trunk line leading from a central office exchange to said intercommunicating system and multiplied with two or more stations thereof, and means at each of said stations, additional to and in substitution of the telephone set thereof, for maintaining the circuit continuity of said trunk line.

2. The combination with an intercommu-

nicating telephone system, of a trunk line leading from a central office exchange to said intercommunicating system and multiplied with two or more stations thereof, switching means at each of said stations for connecting the telephone set thereof either to said trunk line or to the local circuits of the intercommunicating system, and means at each of said stations, in substitution of the telephone set, for maintaining the circuit continuity of the trunk line while the connection of the telephone set is transferred from the trunk line to a local circuit of the intercommunicating system.

3. The combination with an intercommunicating telephone system, of a trunk line leading from a central office to said intercommunicating system and multiplied with two or more stations thereof, switching mechanism at said stations for placing the telephone set thereof into telephonic communication over said trunk line, additional means associated with said trunk line for maintaining the circuit continuity of the trunk line, and switching means at each station for substituting said additional means for the telephone set to maintain the central office signals unchanged.

4. The combination with an intercommunicating telephone system, of a trunk line leading from a central office exchange to said intercommunicating system and multiplied with two or more stations thereof, and means at said stations for transferring a call over the trunk line, said means including a circuit closing device individual to the trunk line for maintaining the circuit continuity of said trunk line during the intervals of the transfer.

5. The combination with an intercommunicating telephone system, of a trunk line leading from a central office exchange to said intercommunicating system and multiplied with two or more stations thereof, and a circuit closing device at said stations associated with said trunk line and adapted to be substituted for the telephone set of the station for maintaining the circuit continuity of the trunk line.

6. In a telephone system, the combination with an intercommunicating system, of a trunk line leading from an outside exchange and multiplied with each station of the intercommunicating system, means at said stations for answering a call over said trunk line, and means for transferring a call from the answering station to any other of the stations, said means including means for maintaining the circuit continuity of the trunk line during the interval of transfer.

7. A telephone system, comprising a trunk line terminating in an intercommunicating system and multiplied with two or more stations thereof, means for connecting any of said stations with the trunk line, and a circuit closing device located at each station and having connection with said trunk line, said circuit closing device when operated maintaining the continuity of said trunk line, thereby permitting the disconnection of the telephone set at that station from the trunk line and its use for communication from that station to another independent of said trunk line while holding the call over said trunk line.

8. The combination with an intercommunicating telephone system, of a trunk line leading from a central office exchange to said intercommunicating system and multiplied with two or more stations thereof, switching mechanism at said stations for connecting the telephone set at each station with the trunk line, means at each of said stations additional to and in substitution of the telephone set thereof, for closing the circuit of said trunk line.

9. In an intercommunicating telephone system, a main exchange, trunk lines connecting said main exchange with a plurality of groups of local substations connected by local lines, each substation having a set of push keys controlling said trunk and local lines and one of said stations of each group serving as an attendant's station and being provided with a signal bell adapted to be rung from the main exchange, means for ringing up any one station of the group on the manipulation of a key at the attendant's station, means operating at the attendant's station for holding the trunk line until the called station responds, automatic means operating to disconnect the trunk holding circuit whenever the attendant hangs up her receiver, and means for establishing talking communication between any two substations of different groups in the system by the manipulation of the trunk keys at said stations.

10. In an intercommunicating telephone system, a main exchange, trunk lines connecting said main exchange with a plurality of groups of local substations each having a set of push keys, one station of each group being an attendant's station, means operating on the manipulation of a key at the attendant's station for ringing up any one station of a group, means for holding the trunk line until the called station responds, and automatic means for disconnecting the holding circuit whenever the attendant's receiver is replaced on the hook.

11. An intercommunicating telephone system having a plurality of stations, a trunk line associated with the system, and means at two or more of the stations for establishing a bridge across the trunk line to hold the latter while calling the desired station to answer a trunk call.

12. The combination with an intercommunicating telephone system, of a trunk line

leading from the central office exchange to said intercommunicating system and multiplied with the several stations thereof, and means at two or more of said stations additional to and in substitution of the telephone set thereof for establishing a bridge across the trunk line for maintaining the circuit continuity of said trunk line.

13. An intercommunicating telephone system having a plurality of stations, a trunk line associated with the system, means at one of the stations for establishing a bridge across the trunk line to hold the latter while calling the desired station to answer a trunk call, and automatic means operating to disconnect the trunk holding circuit whenever the attendant at that station hangs up the receiver; whereby when the desired station is connected for conversation over the trunk line the disconnect signal is under the control of the latter station.

14. In an intercommunicating telephone system, a main exchange, a trunk line connecting said main exchange with a plurality of local substations connected by local lines, each substation having a set of push keys controlling said trunk and local lines, and each of said stations serving as an answering station over the trunk line, means at each of the stations for ringing up any other station of the intercommunicating system, means at each of the stations for holding the trunk line until the called station responds, and automatic means operating to disconnect the trunk holding circuit upon the hanging up of the telephone receiver at the station which initially answers over the trunk line.

15. In an intercommunicating telephone system, a main exchange, a trunk line connecting said main exchange with a plurality of local intercommunicating substations each having a set of push keys, means operating on the manipulation of a key at any one of said stations for ringing up any other of the local substations, means at each of the substations for answering on the trunk line and for holding the trunk line while the call is being transferred to another station, and automatic means for disconnecting the holding circuit when the receiver at the station which initially answered the call is replaced on the hook.

16. The combination with an intercommunicating telephone system, keys at each of said stations for connecting the telephone set thereof with the trunk line, a transfer key at each station for establishing a temporary bridge across the trunk line to maintain the central office signals unchanged, means at each of said stations for establishing talking communication between that station and any other station of the system, whereby a call over the trunk line answered at one station may be transferred to another station, and automatic means operating to

disconnect the trunk holding circuit when the receiver at the station which initially answered the call over the trunk line is replaced on the hook.

17. The combination with an intercommunicating telephone system, of a trunk line leading from a central exchange to said intercommunicating system and multiplied to two or more stations thereof, holding means for said trunk line at each of said stations independent of the telephone set thereof, switching apparatus for associating the holding means individual to a station with said trunk line, and means for rendering said holding means ineffective controlled by the station to which it is individual.

18. In an intercommunicating telephone system, the combination with a plurality of stations and conductors extending between said stations, of a trunk line leading to said stations from a central exchange, a holding bridge associated with one of said stations adapted to be connected to said trunk line, and means for removing said holding bridge from said trunk line under the exclusive control of the associated station.

19. In an intercommunicating telephone system, the combination with a plurality of stations and conductors extending between said stations, of a trunk line leading to said stations from a central exchange, a holding bridge associated with one of said stations adapted to be connected to said trunk line, and means for removing said holding bridge from said trunk line under the control of the receiver hook switch at the associated station.

20. In an intercommunicating telephone system, the combination with a main exchange, of trunk lines connecting said main exchange with a plurality of groups of local substations connected by local lines, each substation having a set of push keys controlling said trunk and local lines, and one of said stations for each group serving as an attendant's station and being provided with a signal bell adapted to be rung from the main exchange, means for ringing up any one station of the group on the manipulation of a key at the attendant's station, an additional key at the attendant's station for closing the trunk circuit and thus holding the trunk line until the called station responds, automatic means operating to disconnect the trunk holding circuit whenever the attendant hangs up her receiver, and means for establishing talking communication between any two substations of different groups in the system by the manipulation of a trunk key at said stations.

21. In an intercommunicating telephone system, the combination with a plurality of stations, of conductors extending between said stations, means at each station for signaling a desired one of the remaining sta-

tions, means for establishing a talking condition between such two stations of the intercommunicating system, a trunk line extending from an outside station to the stations of the intercommunicating system, signaling means at a first one of the intercommunicating stations adapted to be operated from the outside station, a holding bridge at such first station for holding the trunk connection while signaling from such first station to a second station of the intercommunicating system and while the connection between such second station and the trunk line is being effected, such holding bridge being released whenever the receiver at such first station is returned to the receiver hook thereat.

22. In an intercommunicating telephone system, the combination with a plurality of stations, of conductors extending between such stations, means at each station for signaling a desired one of the remaining stations, means for establishing a talking condition between such two stations, a trunk line extending from an outside station to the stations of the intercommunicating system, signaling means at a first one of the intercommunicating stations adapted to be operated from the outside station, a holding bridge at such first station for holding the trunk line connection as desired during the

calling and connecting to the trunk line of a second station of the intercommunicating system, such holding bridge being released whenever the receiver at such first station is returned to the receiver hook thereat.

23. In an intercommunicating telephone system, the combination with a plurality of stations, of conductors extending between such stations, means at each station for signaling a desired one of the remaining stations, means for establishing a talking condition between such two stations, a common battery trunk line extending from an exchange to such stations, signaling means at one of the stations adapted to be operated from such exchange and a holding bridge at such station for holding the trunk line connection as desired during the calling and connecting to the trunk line of a second station of the intercommunicating system, such holding bridge being released from such holding condition whenever the receiver at such first station is returned to the receiver hook thereat.

In witness whereof, I, hereunto subscribe my name this ninth day of November A. D., 1907.

JAMES L. McQUARRIE.

Witnesses:

WILLIAM MC. A. SMITH,
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