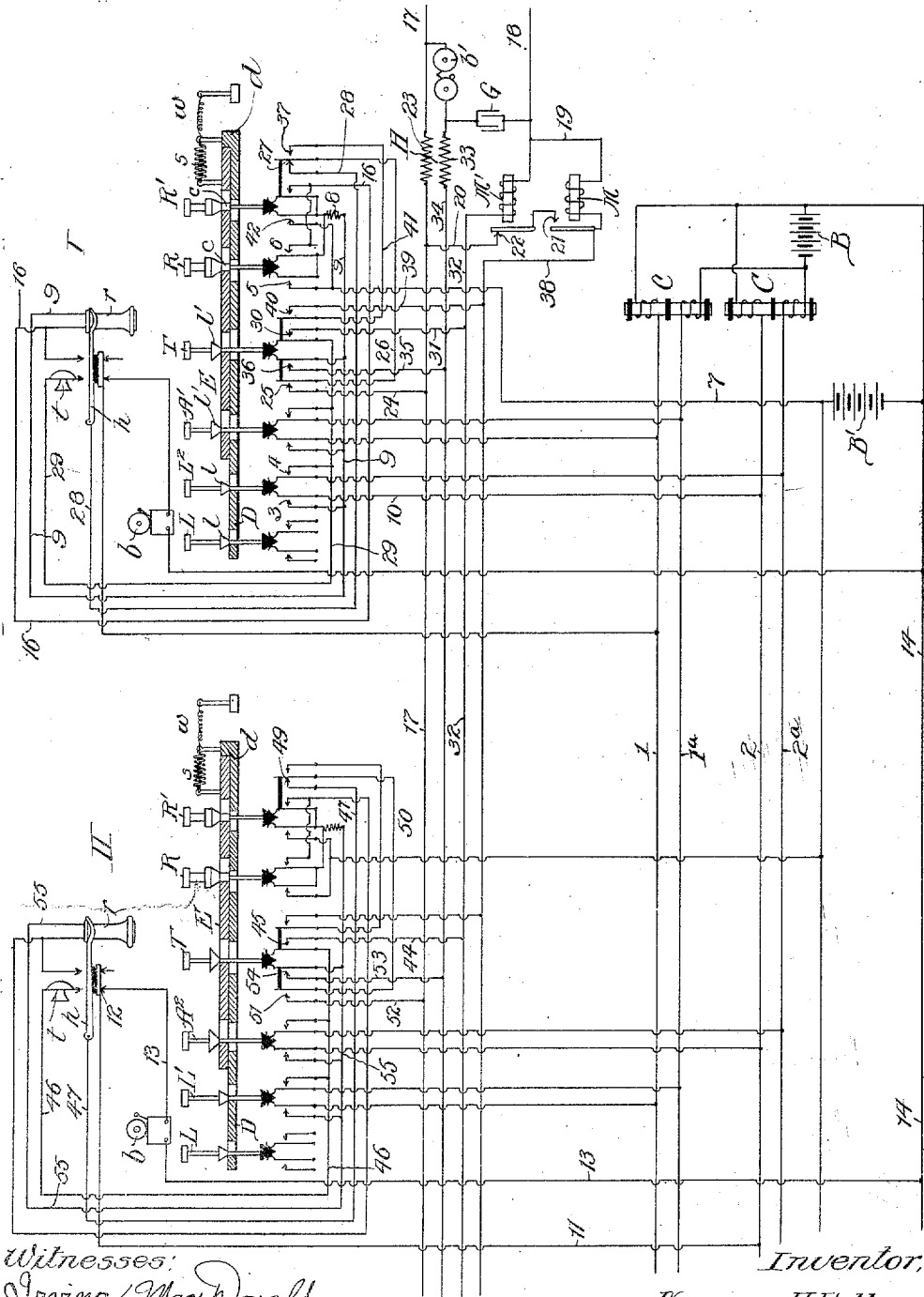


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PRIVATE BRANCH INTERCOMMUNICATING TELEPHONE SYSTEM.
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UNITED STATES PATENT OFFICE.

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PRIVATE BRANCH INTERCOMMUNICATING TELEPHONE SYSTEM.

967,773.

Specification of Letters Patent.

Patented Aug. 16, 1910.

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To all whom it may concern:

Be it known that I, NEWMAN H. HOLLAND, citizen of the United States, residing at Chicago, 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.

My invention relates more particularly to an arrangement whereby a call over a trunk line may be answered at any one of several stations in the private exchange, 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.

The object of my invention is to reduce the number of operations involved in transferring a call received over a trunk line from one station to another, and to otherwise simplify the operation of the system.

My invention provides means at two or more stations of an intercommunicating system for maintaining the circuit continuity of a trunk line leading to said intercommunicating system from the central office exchange, said means being in addition to and in substitution of the telephone set at said stations. By such arrangement, means are provided 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. Likewise, my invention provides means whereby said call may be transferred to another station without the act of transferring causing a disconnect signal at the central office. Likewise 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 conversation.

My invention consists in an arrangement

of circuits and apparatus whereby the operations required of the party in transferring a call received over a trunk line from one local station to another are simplified.

One feature of my invention consists in the provision of two ringing keys one of which is for use where local intercommunication only is involved, and the other where a party after receiving a call over the trunk line desires to communicate with some other local station, as for example, to transfer the call. Said second key in addition to its function as a ringing key acts to establish conditions which will maintain the circuit continuity of the trunk line by closing a path in substitution of the circuit closed through the telephone set.

Other features of my invention relate to the particular structure and arrangement of the switch keys at the local stations, and the circuits controlled by said keys.

These and other features of 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 one trunk line 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.

Each station is provided with local keys associated with the local lines of every other station, those at station I being designated L^1 , and those at station II as L^2 . 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 I and II respectively. Each station is further provided with two ringing keys R and R' , either of which will, when operated, apply 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. The ringing key R is used in ordinary intercommunication from one station to another. The ringing key R' is a combined transfer and ringing key and is employed whenever a call is received over a trunk line and the answering station wishes, in order to transfer the call or for any other purpose, to call up another local station. The function of the transfer ringing key R' will be hereinafter more fully set forth. Each station is also provided with a trunk key T associated with the trunk line, and adapted when depressed to connect the telephone set of that station with the corresponding trunk line.

The local keys at each station are provided with conical shoulders *l* which engage with a sliding plate D, moving the same in opposition to a retractile spring *w*. Said keys when depressed are held locked down by said plate D. In a like manner the trunk keys T and the answering keys are associated with a plate E. The plate E overlies the plate D and is connected thereto by a comparatively stiff spring *s*, in order that the movement of the plate E by the keys will effect the movement of plate D. The plate D has a shoulder *d*, which engages the end of the plate E. The ringing keys R and R' are adapted to move the plate E but are constructed so that they do not lock down when depressed. Said ringing keys are also provided with an enlarged collar *c* forming a stop which prevents the plate D being moved by the act of depressing either of said ringing keys.

The structure of the keys at each station is the same. Referring to station I, it will be noted that the trunk key T or the answering key A' will move both plates D and E and will release any key which may be depressed. The local keys L and L² will move both plates and will release each other, but owing to the fact that the collar *l* of said local keys is smaller than the collars *l'* of the keys A' and T, the local keys will not release the trunk key T or the answering key A'. Both of the ringing keys R, R', move the top plate E only, thus releasing any trunk key T or answering key A' which may be depressed. The stops *c* of said ringing keys prevent the ringing keys from operating the lower plate D, and hence said ringing keys do not release any of the local keys.

It will be noted that the key arrangement of my invention permits the transferring of calls received over the trunk from one station to another with comparatively few operations on the part of the person answering the trunk call. For example, when a trunk call is answered by depressing key T, it is desired to have this key remain in a de-

pressed position, and, therefore, plate E 65 locks said key down. The same is true as applied to the local keys L² when a station is placed in connection with any one of the local lines, and hence plate D is provided for locking said local keys down. When 70 key T is depressed and locked under the control of plate E, and the call is to be transferred to the line associated, for example, with key L², it is desired not to cause the releasing of key T when the key L² is 75 depressed and locked, for otherwise the continuity of the trunk line would be broken. However, after key L² is locked down, and the ringing key R' is used to ring the local party, it is desired to automatically release 80 the key T to disconnect the telephone set at station I from the trunk line, and to maintain the key L² in the locked position. Therefore, since key T is released by key R', other means are provided, by the act of de- 85 pressing the key R', to automatically establish a locking circuit for the trunk line in substitution of the telephone set, as will hereinafter be more fully described.

It is evident that should a local key L² 90 be depressed at the time the party removed the telephone from the hook and such party desires communication with the trunk line, the act of depressing key T will cause a release of the local key L², resultant from 95 the movement of plates E and D, the spring S being enough greater in tension than the spring W to permit such movement. The converse of this condition would be when a trunk key was depressed at the time the 100 telephone is to be used for communicating over one of the local lines. Though the depression of the local key L² will not cause a releasing of the trunk key, that key will be released at the time the ringing key R is 105 used in calling the local party. It can readily be seen that the two keys R and R' enable a party to differentiate between when it is, or is not desired to lock or hold the trunk line at the time a local party is called. 110 The answering key A' is associated with plate E so that any key which the party may find depressed at his station may be released at the time the answering key is depressed. 115

Considering first merely the intercommunicating feature of the system illustrated in the drawing, each local station, as shown for example at station I and station II, is 120 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. 125

The manner in which a subscriber at one station may call up another station is obvious. For example, if the subscriber at

station I desires to communicate with station II, 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, 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, 11, contact 12, conductor 13, including bell b , conductor 14, back to battery B' . The subscriber at station II will respond by depressing his answering key A^2 and by removing his receiver r from its hook. Stations I and II are now in telephonic communication, the telephone sets thereof 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 I depresses his ringing key R , current was supplied for ringing the bell b at station II, said current flowing through resistance 8. One terminal of receiver r is connected through conductor 9 to one side of said resistance, and the other terminal of the receiver is connected to the other side of said resistance through conductor 16 and the closed contact 6 of the key R . The ringing of the bell b at station II 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 II. 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 I that the telephone at station II is not in use, since if it were, contact 12 would be open, the bell b at station II would not ring, and the party at station I 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 for permitting transferring of calls without causing a disconnect signal to be displayed during the interval of transfer.

Conductors 17 and 18 constitute a trunk line extending from the central office exchange to the intercommunicating system. Said trunk line is multiplied as shown, with each station of the intercommunicating system. Each station is provided, as hereinbefore stated, with a trunk key T associated

with the trunk line, and adapted when depressed to connect the telephone set of that station with the trunk line.

Each station is provided, as before described, with a transfer ringing key R^1 , said key being used when it is desired to transfer, from one local station to another, a call received over a trunk line. The function of said transfer ringing key, as far as the ringing circuit is concerned, is the same as the local ringing key R . But the transfer ringing key R^1 has additional contacts associated with it, which serve to operate a relay holding device M . Said holding relay M is placed in a bridge 19, 20, adapted to maintain the continuity of the signaling circuit established over the trunk line in substitution of the telephone set, thus enabling the station at which the trunk call is answered to call up and communicate with any other local station without giving a disconnect signal at the central office. By pressing down transfer ringing key R^1 , therefore, current is applied to the ringing circuit in the same manner as previously described in connection with the operation of key R , and a bridge is placed across the trunk line, said bridge including relay M . The relay M in said bridge acts as a holding coil in substitution of the telephone set for preventing the display of a disconnect signal at the central office. It will be noted that the bridge 19, 20, has a normally open contact 21 controlled by relay M and a normally closed contact 22 controlled by relay M^1 . The relay M^1 is in series with the trunk line, and therefore, the called party in making connection with the trunk line after the bridge including relay M aforementioned has been established, will cause the relay M at this time held up through its contact 21, to become deenergized. It will thus be seen that the trunk line is directly under the control of the switch hook contacts of the particular station which has made connection with the trunk line.

A signal bell b^1 may be associated with the trunk line in any manner to give a signal at the station or stations at which it is desired to answer an incoming call. The signal bell may be located at some point, for example, where it can be heard from any station.

A call over the trunk line may be answered at any station with which the trunk line is multiplied, and the answering station may thereafter communicate with any other station without the central office operator learning the conversation or causing 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 the trunk line, and is answered at station I. The party at said station removes his receiver from its hook and depresses trunk key T. Key T will remain locked down by means of plate E. Current then flows from the central office over conductor 17 of the trunk line, winding 23 of induction coil H, through conductor 24, contact 25 of the key T, conductor 26, normally closed contact 27 of key R¹, conductor 28, switch hook h, transmitter t, conductor 29, contact 30 of key T, conductor 31, conductor 32 including relay M¹, 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 ranch exchange and is secondary to the main line circuit. Such path may be traced as follows: from conductor 18, through condenser G, winding 33 of induction coil H, conductors 34, 35, contact 36 of key T, conductor 9, receiver r, contacts of switch hook h, transmitter t conductor 29, contact 30 of key T, conductors 31 and 32 back to the point where condenser G connects to conductor 18. Station I is now so connected to the trunk line that conversation can take place between the private branch exchange party and the calling party, connected through the central exchange, the party at station I controlling the central office signals in the usual manner, that is, by means of his switch hook. If the party at station I 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 may readily do so. For instance, to call up station II, the party at station I would depress local key L² corresponding to station II, and then ring that station by depressing the transfer ringing key R¹. It will be noted that the first effect of pressing down key R¹ is to open the contact 27 of said key. Since the circuit of relay M¹ is thus opened at contact 27, said relay becomes deenergized and contact 22 of said relay closes. It will be further noted that the keys are so adjusted that, though key R¹ releases key T, the contacts 25 and 40 of key T do not open until after contact 37 of key R¹ is closed.

The substitute path established for current on the trunk line by the depression of transfer ringing key R¹ may now be traced as follows: from conductor 18, through conductor 19, relay M, conductors 38, 39, contact 40 of key T, conductor 41, contact 37 of key R¹, conductor 26, contact 25, conductor

24 to conductor 17. Due to the closing of this circuit, the relay M becomes energized, closing contact 21, and remains locked up by current flowing in the bridge closed from conductor 18 through conductor 19, relay M, contacts 21, 22, conductor 20 to conductor 17. The bridge thus placed across the trunk line maintains the continuity of the signaling circuit of said trunk line. The release of key T at station I disconnects the telephone set from the trunk line and permits of secret communication between stations I and II.

The ringing circuit closed by key R¹ is the same as that previously described in connection with the operation of key R, the circuit in one instance being closed at contact 5 of ringing key R, and in the other at contact 42 of ringing key R¹. When the party at station II responds by depressing the answering key A² and taking the receiver r from the switch hook, telephone communication is established between stations I and II, in the manner hereinbefore described in connection with the intercommunicating features of the system. After communicating with station II, the party at station I may resume conversation over the trunk line with the outside calling party, or he may instruct the party at station II to answer over the trunk line. In fact either the party at station I or the party at station II can by depressing the trunk key T at his station connect his telephone set to the trunk line, the resulting operations being the same in either case.

Let us assume that the party at station I desires to transfer the call to station II. After calling up station II in the manner just described, he instructs the party at that station to answer over the trunk line. The party at station II 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 II is now in position to talk with the outside calling party. When the party at station II answers over the trunk line, as above described, by pressing the key T, the following circuit conditions are established: Current flows from the central office over conductor 18, through relay M¹, conductor 32, conductor 44, contact 45, conductor 46, transmitter T, switch hook h, conductor 47, contact 49 of key R¹, conductor 50, contact 51, conductor 52, conductor 17 back to the central office exchange. Relay M¹ being in the circuit thus completed is energized and operates to open contact 22. The bridge of the trunk line over conductors 19, 20, being thus open at contact 22, the relay M becomes deenergized, thus also opening contact 21 in said bridge.

The receiver circuit at station II is as follows: from the conductor 18, through con-

denser G, winding 33 of the induction coil H, conductors 34, 53, contact 54 of key T, conductor 55, receiver r, switch hook z, transmitter t, conductor 46, contact 45 of key T, conductors 44, 32, relay M', conductor 18 back to the point where condenser G connects with conductor 18.

It will be noted that the bridge 19, 20, across the trunk line was removed as a result of the party at station II depressing the trunk key T, and therefore the continuity of the trunk line is maintained during the conversation only by the contacts of the switch hooks. When the party at station II hangs up the receiver at the end of the conversation this continuity is thereby destroyed and the usual disconnect signals given at the central office. 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 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 common to said stations and associated with said trunk line for maintaining the circuit continuity of the trunk line, and switching means at each of said stations for substituting said additional means for the telephone set to prevent the display of a disconnect signal at the central office.

2. 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, a bridge of the trunk line common to said stations, and circuit closing devices at each of said stations for substituting said bridge for the telephone set of that station to maintain the circuit continuity of said trunk line.

3. 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 combined ringing and transfer key at each of said stations for transferring a call received over the trunk line, said key in

its operation producing circuit conditions for maintaining the circuit continuity of said trunk line during the interval of the transfer.

4. In an intercommunicating telephone system having a trunk line leading to said intercommunicating system and multiplied with two or more stations thereof, switching mechanism at each of said stations for connecting the telephone set of that station to the trunk line, a circuit in substitute of the circuit of the telephone set, for maintaining the continuity of the trunk line, and a combined ringing and transfer key having contacts controlling the local ringing circuit of said intercommunicating system, and also having contacts adapted by the operation of said key to produce circuit conditions for completing the continuity of the trunk line through said substitute circuit.

5. In an intercommunicating telephone system having a trunk line leading to said intercommunicating system and multiplied with two or more stations thereof, switching mechanism at each of said stations for connecting the telephone set of that station to a trunk line, a circuit in substitute of the circuit of the telephone set, for maintaining the continuity of the trunk line, a combined ringing and transfer key having contacts controlling the local ringing circuit of said intercommunicating system, and also having contacts adapted by the operation of said key to produce circuit conditions for completing the continuity of the trunk line through said substitute circuit, and a trunk key at each of said stations having contacts adapted, when said trunk key is depressed, to connect the telephone set of that station to the trunk line whereby circuit conditions are established which will cause the substitute circuit to be opened providing the receiver is off its hook.

6. In an intercommunicating telephone system having a trunk line leading from a central office exchange to said intercommunicating system and multiplied with two or more stations thereof, a trunk key at each of said stations having contacts controlling the connection of the telephone set of that station to the trunk line, a transfer key at each of said stations having contacts controlling the transfer from one of said stations to another of a call received over the trunk line, a holding relay for maintaining the circuit continuity of the trunk line, said relay having a circuit including a serial arrangement of contacts of said keys, a locking circuit for said relay closed upon the energization thereof, and means whereby the operation of said transfer key releases said trunk key subsequent to the closure of said locking circuit.

7. In an intercommunicating telephone system having a trunk line leading from a

central office exchange to said intercommunicating system and multiplied with two or more stations thereof, a trunk key at each of said stations having contacts controlling the connection of the telephone set of that station to the trunk line, a transfer key at each of said stations having contacts controlling the transfer from one of said stations to another of a call received over the trunk line, a bridge of said trunk line for maintaining the continuity of the trunk line during the interval of transfer, and a relay for controlling the continuity of said bridge, the circuit of said relay including a normally closed contact of said transfer key and a normally open contact of said trunk key.

8. In an intercommunicating telephone system having a trunk line leading from a central office exchange to said intercommunicating system and multiplied with two or more stations thereof, a trunk key at each of said stations having contacts controlling the connection of the telephone set of that station to the trunk line, a transfer key at each of said stations having contacts controlling the transfer from one of said stations to another of a call received over the trunk line, a holding relay for maintaining the circuit continuity of the trunk line, said relay having a circuit including a serial arrangement of contacts of said keys, a locking circuit for said relay closed upon the energization thereof, means whereby the operation of said transfer key releases said trunk key subsequent to the closure of said locking circuit, and a second relay controlling the continuity of said locking circuit, the circuit of said second relay including a normally closed contact of said transfer key and a normally open contact of said trunk key.

9. In an intercommunicating telephone system having a trunk line leading from a central office exchange to said intercommunicating system and multiplied with two or more stations thereof, a trunk key at each of said stations having contacts controlling the connection of the telephone set of that station to the trunk line, a transfer key at each of said stations having contacts controlling the transfer from one of said stations to another of a call received over the trunk line, a holding relay for maintaining the circuit continuity of the trunk line, said relay having a circuit including a serial arrangement of contacts of said keys, a locking circuit for said relay closed upon the energization thereof, means whereby the operation of said transfer key releases said trunk key subsequent to the closure of said locking circuit, and a second relay adapted when energized to open said locking circuit, the circuit of said second relay being multiplied with each of said stations and includ-

ing a normally closed contact of the transfer key and a normally open contact of the trunk key at each of said stations.

10. In an intercommunicating telephone system having a trunk line leading to said system and multiplied with two or more stations thereof, a trunk key at each of said stations having contacts controlling the connection of the telephone set of that station to the trunk line, a bridge of the trunk line, in substitute of the telephone set, for maintaining the circuit continuity of the trunk line, a holding relay controlling said bridge, and a transfer key at each of said stations for closing a circuit through said holding relay.

11. In an intercommunicating telephone system having a trunk line leading to said system and multiplied with two or more stations thereof, a trunk key at each of said stations having contacts controlling the connection of the telephone set of that station to the trunk line, a bridge of the trunk line, in substitute of the telephone set, for maintaining the circuit continuity of the trunk line, a holding relay controlling said bridge, a transfer key at each of said stations for closing a circuit through said holding relay, and a locking circuit for said relay closed upon the energization thereof.

12. In an intercommunicating telephone system having a trunk line leading to said system and multiplied with two or more stations thereof, a trunk key at each of said stations having contacts controlling the connection of the telephone set of that station to the trunk line, a bridge of the trunk line, in substitute of the telephone set, for maintaining the circuit continuity of the trunk line, a holding relay controlling said bridge, a transfer key at each of said stations for closing a circuit through said holding relay, a locking circuit for said relay closed upon the energization thereof, and a circuit under the control of the trunk key at each of said stations for effecting the deenergization of said holding relay and removing said bridge of the trunk line.

13. In an intercommunicating telephone system having a trunk line leading to said system and multiplied with two or more stations thereof, a telephone set at each station adapted to be connected to the trunk line, a bridge of the trunk line, in substitute of the telephone set, for maintaining the circuit continuity of the trunk line, a holding relay controlling said bridge, and switching mechanism at each of said stations for connecting the telephone set of that station to the trunk line and for controlling the operation of said holding relay.

14. An intercommunicating telephone system having a plurality of local stations, a trunk line connected therewith, switching mechanism at each of said stations for join-

ing its telephone set to the trunk line and to
another local station, a circuit which may
be substituted for a telephone set to main-
tain the continuity of the trunk line, means
5 for effecting such substitution when the sta-
tion with its set connected to the trunk line
seeks communication with another local sta-
tion, and means operable upon the uniting
of a station telephone set with the trunk

line for rendering the substituted circuit in- 10
effective.

In witness whereof, I, hereunto subscribe
my name this 12th day of November A. D.,
1907.

NEWMAN H. HOLLAND.

Witnesses:

RALPH G. JOHANSEN,
E. F. BEAUBIEN.