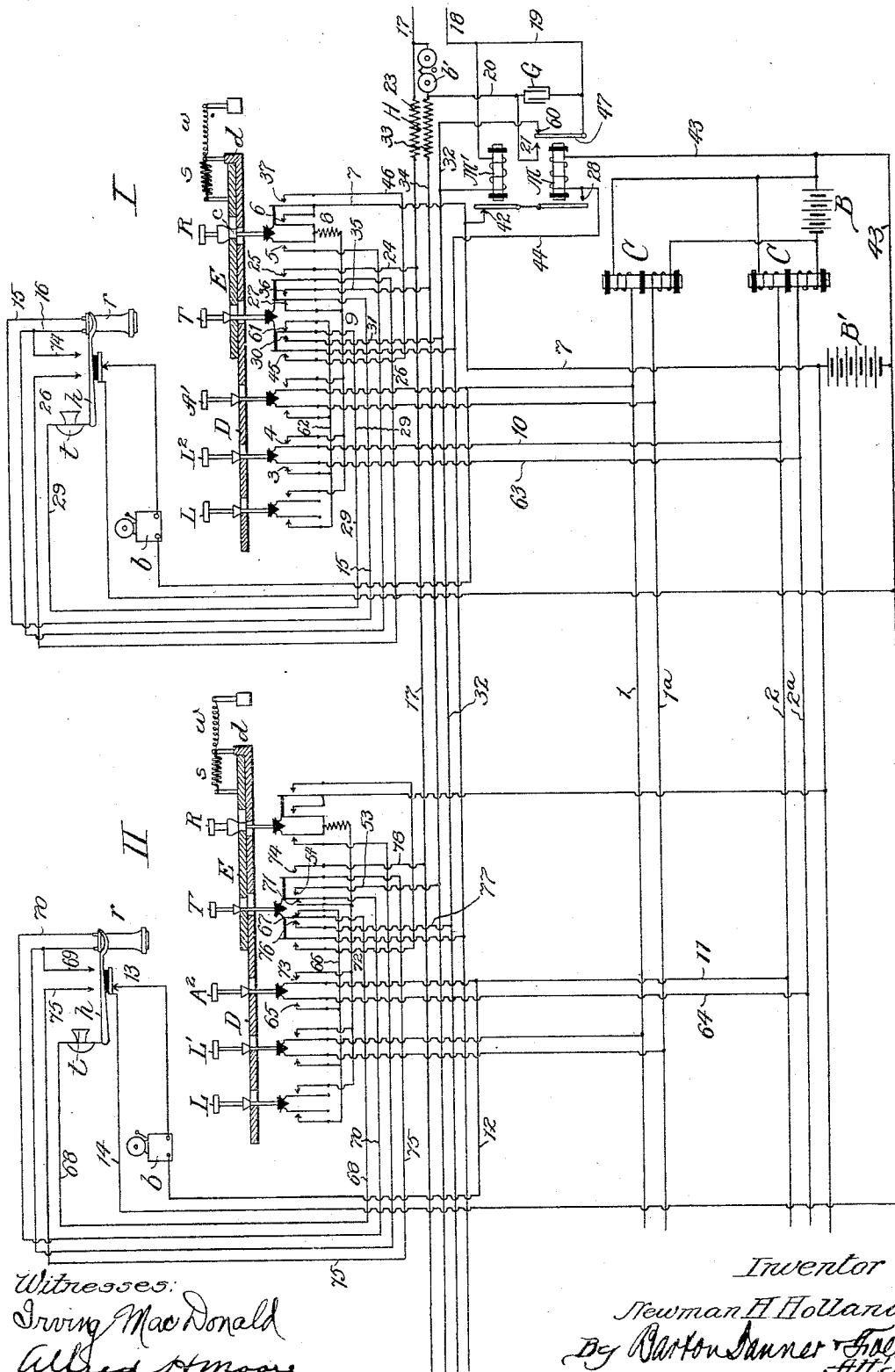


N. H. HOLLAND.
PRIVATE BRANCH INTERCOMMUNICATING TELEPHONE SYSTEM.
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931,307.

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Witnesses:
Irving MacDonald
Alfred H. Moore.

Inventor
Newman H. Holland.
By Barton Tanner Frook
Att'y.

UNITED STATES PATENT OFFICE.

NEWMAN H. HOLLAND, OF CHICAGO, ILLINOIS, ASSIGNOR TO WESTERN ELECTRIC COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

PRIVATE-BRANCH INTERCOMMUNICATING TELEPHONE SYSTEM.

No. 931,307.

Specification of Letters Patent.

Patented Aug. 17, 1909.

Application filed November 23, 1907. Serial No. 403,508.

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.

10 My invention relates to a private branch exchange telephone system, embodying an intercommunicating system, and also providing for outside connection with the central office exchange.

15 My invention relates more particularly to an arrangement whereby a call over a trunk line may be answered at any of the 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.

25 The object of my invention is to provide a simple and efficient system, 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 structure and operation of the system.

30 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.

35 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 party learning the conversation.

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

The present invention contemplates modifi-

cations and improvements of the invention disclosed in my co-pending application, 55 Serial No. 403,507 filed November 23, 1907.

My invention contemplates an arrangement of circuits and apparatus whereby the operations required of the party in transferring a call received over a trunk line 60 from one local station to another are simplified.

One feature of my invention consists in the provision of a single ringing key adapted for use where local intercommunication only 65 is involved, as well as 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 key, under the latter condition of use, 70 in addition to its function as a ringing key, acting 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. 75 My invention thus renders a special transfer key unnecessary, and cuts down the number of operations involved in transferring a call.

A further feature of my invention consists in the provision of means whereby a relay which is in series with the trunk line and which serves to remove the substitute path above mentioned, is itself short circuited after accomplishing its function, 85 thereby removing the impedance due to said relay.

Other features of my invention relate to the particular structure and arrangement of the switch keys at the local stations, and the 90 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 95 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 100 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 105 station, those at station I being designated

L^2 , and those at station II 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 I and II respectively. 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.

Each station is further provided with a ringing key R , 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^1 furnishes the source of ringing current. The ringing key R when used in ordinary signaling from one station to another, merely applies current to the local ringing circuit. However, if the ringing key is operated while the trunk key is depressed, as when a call is received over a trunk line and the answering station, in order to transfer the call or for any other purpose, rings up another local station, conditions are brought about which result in closing a bridge across the trunk line, in substitute of the telephone set, as will be hereinafter more fully set forth.

The local and answering keys at each station are provided, as usual, with conical shoulders which engage with a sliding plate D , moving the same in opposition to a retractile spring w . Said keys when depressed are locked down by said plate D , and release each other. The trunk key T is 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 key R is adapted to move the plate E , but is constructed so that it does not lock down when depressed. Said ringing key is also provided with a collar or shoulder c forming a stop which prevents the plate D being moved by the act of depressing said ringing key.

The structure of the keys at each station is the same. Referring to station I, it will be noted that the trunk key T will move plate E , and owing to the spring connection s , will also move plate D , thereby releasing any key which may be depressed. The local key L^2 and the answering key A^1 will move both plates and will release any key locked down by either plate. The ringing keys R will move the top plate E , thus releasing the trunk key T , but will not move

the plate D , since the stop c of said ringing key prevents the ringing key from operating the lower plate D . Hence said ringing key does not release the local or answering 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 depressed position, and therefore, plate E locks said key down. The same is true as applied to the local key L^2 when a station is placed in connection with a local line, and hence plate D is provided for locking said local key down. When 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 L^2 , it is desired not to cause the releasing of key T when the key L^2 is depressed and locked, for otherwise the continuity of the trunk line would be broken. It will be noted, therefore, that it is necessary to manually hold down the key T while in the act of depressing key L^2 , to allow time for the plates D and E to be retracted by the spring w to lock both of said keys in their operated positions. However, after key L^2 is locked down, and the ringing key R is used to ring the local party, it is desired to automatically release the key T to disconnect the telephone set at station I from the trunk line, and to maintain the key L^2 in the locked position. Therefore, key T is released by key R , and other means are provided, by the act of depressing 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 L^2 be depressed at the time the party removes 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 L^2 . The converse of this condition would be when a trunk key was depressed at the time the telephone is to be used for communicating over one of the local lines, in which case the depression of the local key L^2 will cause the release of the trunk key.

The answering key A^1 is associated with plate D so that any key which the party may find depressed at his station may be released at the time the answering key is depressed.

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

5 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
10 switch hook *h*, and depress key L², 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
15 not in use, current will flow from battery B¹ through conductor 7, contact 6, resistance 8, conductor 9, contact 4 of key L², conductors 10, 2, 11, conductor 12, including bell *b*, contact 13, conductor 14, back to battery B¹.
20 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 the station II,
25 said current flowing through resistance 8. One terminal of receiver *r* is connected through conductor 15, normally closed contact 27 of key T, 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 5 of the key R. The ringing
30 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
40 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 13 would be open, the bell
45 *b* at station II would not ring, and the party at station I would not hear a buzz in his receiver.

The subscriber at station II will respond by depressing his answering key A² and by
50 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 L² and answering key A², respectively,
55 current being supplied from battery B through the retardation coil C, which is bridged across conductors 2, 2^a.

The path for telephone communication between stations I and II may be traced as follows: from the transmitter *t* at station I
60 through conductor 29, normally closed contact 61 of key T, conductor 62, contact 3 of key L², conductors 63, 2^a, 64, contact 65 of key A², conductor 66, normally closed contact 67 of key T, conductor 68, transmitter *t*

of station II, switch hook *h*, conductor 69, receiver *r*, conductor 70, normally closed contact 71 of key T, conductor 72, contact 73 of key A², conductors 11, 2, 10, contact 4 of key L², conductor 9, normally closed contact 27
70 of key T, conductor 15, receiver *r* of station I, conductor 16, conductor 74, and switch *h* back to transmitter *t*.

It will be observed that the arrangement thus far described in detail provides what is
75 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 and preventing the display of a disconnect signal during the interval of transfer.

Conductors 17 and 18 constitute a trunk line extending from the central office exchange to the intercommunicating system.
85 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
90 with the trunk line, and adapted when depressed to connect the telephone set of that station with the trunk line.

The function of the ringing key R, so far as the ringing circuit is concerned, has hereinbefore been fully described. Said ringing
95 key has, however, an additional contact 37 associated with it, which serves to operate a relay holding device M, and thereby to close a bridge of the trunk line, said bridge including conductor 19, a shunt of condenser
100 G, said shunt including a normally open contact 21 of relay M, and conductor 20 including the signal bell *b*¹. Said bridge maintains the continuity of the direct current
105 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
110 with any other local station without giving a disconnect signal at the central office. By pressing down the ringing key R while the trunk key and a local key are depressed, as hereinbefore described, the trunk key is released, current is applied to the ringing
115 circuit in the same manner as previously described in connection with purely local intercommunication, and a bridge is placed across the trunk line. It will be noted that the bridge 19, 20, has a normally open contact
120 21 controlled by relay M. The relay M, when energized, closes a locking circuit for itself, said locking circuit including a normally closed contact 42 of a relay M¹. The relay M¹ is in series with the trunk line, and
125 therefore, the party in making connection with the trunk line after the bridge aforementioned has been established will cause the relay M at this time held up through its contact 28 to become deenergized, thereby re- 130

moving the holding bridge and leaving the trunk line directly under the control of the switch hook contacts of the particular station which has made connection with the trunk line. It should be especially noted that upon the deenergization of relay M, a short circuit of relay M¹ is closed at the back contact 60 of relay M. This short circuiting of relay M¹ after it has accomplished its function is an advantageous feature, since otherwise the impedance of said relay might interfere with speech transmission over the trunk line.

The 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 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 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, releasing any other key that may have been locked down. 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, switch hook *h*, transmitter *t*, conductor 29, contact 30 of key T, conductors 31, 32, contact 60 of relay M, conductor 19, 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 19, through condenser G, conductor 20, winding 33 of induction coil H, conductors 34, 35, contact 36 of key T, conductor 15, receiver *r*, contact of switch hook *h*, transmitter *t*, conductor 29, contact 30 of key T, conductors 31 and 32, contact 60, back to the point where condenser G connects to conductor 19. 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, during the interval of depressing said local key, he would manually hold down key T, until key L² had locked, in order to prevent the release of the trunk key. Both key T and key L² are now locked down. The party at station I would then ring station II by depressing the ringing key R. The depression of key R under these conditions has, as hereinbefore stated, the two distinct results of establishing a path for current across the trunk line in substitute of the telephone set and of applying ringing current for ringing the bell at station II.

I will now describe the manner in which the substitute path across the trunk line is established. Upon depressing key R at station I, the plate E is moved, thereby releasing key T. But prior to the release of key T, contact 37 of key R closes a circuit through relay M. This circuit may be traced as follows: From battery B¹ through conductor 43, relay M, conductor 44, contact 45 of key T, conductor 46, contact 37 of key R, conductor 7 back to battery B¹. Relay M operates and closes a locking circuit for itself as follows: from battery B¹ through conductor 43, relay M, contact 28 of relay M, contact 42 of relay M¹, conductor 7 back to battery B¹. The relay upon being energized also attracts the armature 47, thereupon closing contact 21 in a short circuit about condenser G. Direct current flow is now maintained over the trunk line from conductor 18 through conductor 19, the short circuit of the condenser G closed at contact 21, conductor 20, signal bell *b*¹, 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 by the depressing of key R disconnects the telephone set from the trunk line and permits of conversation between stations I and II without the central office party hearing the same. The ringing circuit closed by key R is the same as that previously described in connection with the intercommunicating features of the system.

When the party at station II responds by depressing the answering key A² and taking the receiver *r* from the switch hook, a telephonic 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 can resume conversation over the trunk line with the outside calling party, or he can 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 the 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 the trunk key T, thereby opening contacts 67 and 71, and also releasing the answering key A², leaving the 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 depressing the key T, the following circuit conditions are established: Current flows from the central office over conductors 17, 78, contact 74 over key T, conductor 75, switch hook h, transmitter t, conductor 68, contact 76 of key T, conductor 77, conductor 32, and (since the short circuit of relay M¹ is open at contact 60 of the energized relay M) through relay M¹ to conductor 18, leading to central office exchange. The closure of the circuit through relay M¹ causes said relay to operate and open the contact 42, thereby opening the circuit of relay M. Relay M becomes deenergized and the armature 47 thereof will fall back opening the substitute bridge of the trunk line at contact 21 and also short circuiting the relay M¹ through contact 60. The short circuiting of relay M¹ removes the impedance of said relay from the circuit of the trunk line, after said relay has performed its required function.

The receiver circuit at station II is as follows: from the conductor 18, through conductor 19, condenser G, conductor 20, winding 33 of the induction coil H, conductors 34, 53, contact 54 of key T, conductor 70, receiver r, conductor 69, switch hook h, transmitter t, conductor 68, contact 76 of key T, conductors 77, 32, contact 60, armature 47 back to the point where condenser G connects with conductor 19.

It will be noted that the substitute bridge 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 conversa-

tion this continuity is thereby destroyed and the usual disconnect signal given at the central office.

I claim:

1. In an intercommunicating telephone system, the combination with a trunk line leading from an outside exchange to said intercommunicating system, and multiplied with two or more stations thereof, switching means for connecting the telephone set of each of said stations with the trunk line or with the local circuits of the intercommunicating system, and a single ringing key at each of said stations for applying ringing current to said local circuits, said key also serving when the telephone set at that station is connected to the trunk line, as a transfer key to produce circuit conditions for maintaining the circuit for direct current on the trunk line.

2. In an intercommunicating telephone system, the combination with a trunk line leading from an outside exchange to said intercommunicating system and multiplied with two or more stations thereof, a local key and a trunk key at each of said stations for controlling the connection of the telephone set of that station with the local circuits of the intercommunicating system and with the trunk line, respectively, and a single ringing key at each of said stations for applying current to the local ringing circuits and also operating as a combined ringing and transfer key when a trunk call answered at that station is transferred to another of said stations.

3. In an intercommunicating telephone system, the combination with a trunk line leading from an outside exchange to said intercommunicating system and multiplied with two or more stations thereof, a local key and a trunk key at each of said stations for controlling the connection of the telephone set of that station with the local circuits of the intercommunicating system and with the trunk line, respectively, a circuit in substitute of the circuit of the telephone set for maintaining the circuit continuity of the trunk line, and a single ringing key having contacts controlling the local ringing circuit of said intercommunicating system, and also having contacts adapted, when the trunk key is in its operated position, to produce circuit conditions for completing the continuity of the trunk line through said substitute circuit.

4. In an intercommunicating telephone system having a trunk line leading from a central office exchange and multiplied with two or more stations of said system, 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, a second relay in series with the trunk line and controlling the continuity of said locking circuit, and a short circuit of said second relay closed upon the deenergization of said other relay.
5. In an intercommunicating telephone system having a trunk line leading from a central office exchange and multiplied with two or more stations of said system, 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, a second relay adapted when energized to open said locking circuit, said second relay being in series with the trunk line, and a normally closed short circuit of said second relay adapted to be opened upon the energization of said other relay.
6. 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 substitution 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, a second relay in series with the trunk line and under the control of the trunk key at each of said stations for effecting the deenergization of said holding relay to remove said bridge of the trunk line, and a short circuit of said second relay closed upon the deenergization of said other relay.

7. 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 continuity of the trunk line, a transfer key at each of said stations for substituting said bridge for the telephone set, a relay in series with the trunk line and adapted when energized to remove said bridge of the trunk line, and a short circuit of said relay closed when said relay has operated to remove said bridge.

8. In an intercommunicating telephone system having a trunk line leading to said system and multiplied with a plurality of the stations of said system, a telephone set at each station, and switching mechanism for connecting said sets with each other and with the trunk line, a bridge for holding said trunk line in substitution for a telephone set, means controlled by said switching mechanism to effect such substitution, and a relay in series with the trunk line operating to remove said bridge and establish a short circuit around its own winding.

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

NEWMAN H. HOLLAND.

Witnesses:

RALPH G. JOHANSEN,
ROY T. ALLOWAY.