

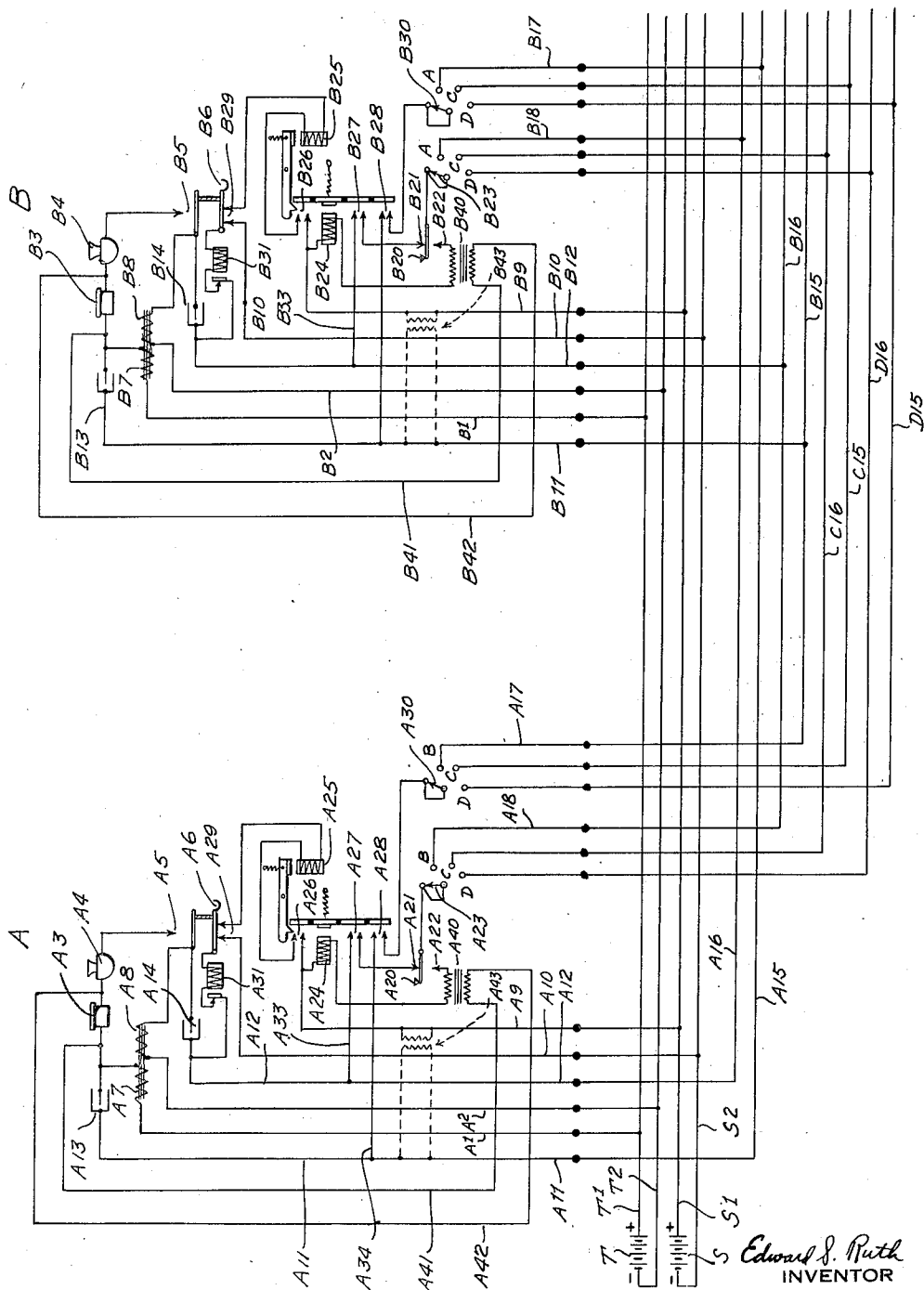
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TELEPHONE SYSTEM

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TELEPHONE SYSTEM

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This invention relates to telephone systems, more particularly of the kind where the party at one station can himself connect his instrument or circuits to the line or lines of any other station in the system and signal such other station and converse with it.

One of the objects of this invention is to provide a system of the above-mentioned character which will be simple in construction and arrangement, in which the apparatus and circuits of the individual station can be simple and compactly arranged, and all of which will be of dependable, simple and foolproof manipulation and operation. Another object is to provide a system and apparatus of the above-mentioned character in which the initial calling or signaling of one station or to another will be improved in a simple and dependable manner over prior practice and, more particularly, in which the calling station, though its calling apparatus is made operative for such signaling, cannot interfere with a busy or operating station and in which the condition or availability or unavailability of the called station will be indicated to the calling station in a simple yet thoroughly practical and dependable way. Another object is to provide a system and circuit arrangement, in a telephone system of the above-mentioned character, for effecting calling or signaling of a remote station but also to indicate or signal to the calling station the fact that the called station is or is not busy. Other objects include the improvement in general of telephone systems of the above-mentioned character. Other objects will be in part obvious or in part pointed out hereinafter.

The invention accordingly consists in the features of construction, combinations of elements, and arrangements of parts as will be exemplified in the structure to be hereinafter described and the scope of the application of which will be indicated in the following claims.

In the accompanying drawing in which is shown one of various possible embodiments of my invention, the single figure is a diagrammatic representation of a system embodying my invention.

Referring again to the drawing, I have there shown so much of a multi-station system as comprises two stations, that being adequate to illustrate my invention, and it may at this point be noted, also, that I have illustrated my invention as applied to a so-called full metallic system in which any two connected stations of the plurality of stations in the system operate over

a complete metallic talking circuit that is of two conductors and independent of the conductors over which any other two stations of the system might be connected or in communication with each other; but it is to be understood that my invention is adaptable to other types of systems, such as, for example, the type having a so-called common conductor or return wire, the latter being usually common to all talking circuits. For convenience let one station be called station A and the other station B and let it also be assumed that station A is calling station B. For convenience and for greater facility in description and understanding of the invention, all parts of station A are designated by the reference character A modified by a suitable numerical exponent while all parts of station B will be designated by the reference character B modified by numerical exponents, identity of numerical exponent indicating identity of parts in the two stations. The system is preferably provided with preferably separate or independent sources of energy, preferably direct current, one for supplying energy to the station-signaling circuits and the other to supply energy to the talking circuits. Thus, there is a battery S from which the various stations receive energy for ringing or signaling, preferably by way of lines S—1 and S—2 which extend throughout the system and are common to all of the stations. A battery T provides energy for the various talking circuits by way of lines T—1 and T—2 which are also common throughout the system.

Each station is provided with suitable connections to these battery lines. Thus, station A taps battery lines T—1 and T—2 by conductors A—1 and A—2 which lead to the serially connected receiver A—3 and transmitter A—4 by way of contact A—5 of the hook switch A—6 which normally, with the receiver on the hook, interrupts this connection of receiver and transmitter to the battery lines T—1, T—2; in this circuit I preferably provide suitable inductance means, preferably in the form of a winding A—7 in conductor A—1 and a winding A—8 in conductor A—2, preferably wound on the same iron core and appropriately proportioned to permit the passage therethrough of the direct current from the battery T to the receiver and transmitter but to block the passage of alternating or audio frequency current from the transmitter and receiver to the common battery lines T—1 and T—2, thus to insure against interference with any of the other stations of the system whose receiver and transmitter receive direct

current energization in like manner from the battery lines T—1, T—2.

Also, each station has connections to the lines S—1, S—2 of the signaling battery S. Thus, as to station A, conductors A—9 and A—10 are connected to lines S—1 and S—2, respectively, and likewise conductors B—9, B—10 of station B.

At each station a pair of conductors leads from the local transmitter and receiver to two line conductors which are individual to the particular station and extend each to the remaining stations. Thus, as to station A conductors A—11, A—12, connected respectively through condensers A—13 and A—14 to the local receiver and transmitter circuit as shown, are connected or extended to the pair of line conductors A—15 and A—16 to all of the remaining stations on the system and at each station these line conductors A—15, A—16, individual to station A, are extended or tapped to a pair of contacts of a double pole selector switch. Thus, at station B, for example, conductors B—17 and B—18 to the two contacts marked A, thus to identify them as the contacts through which station B may make connection to station A. In like manner, conductors B—11 and B—12 of station B are connected to line conductors B—15 and B—16, respectively, the latter extending to all of the remaining stations where, as at station A, they are connected to the two contacts B, B of a double pole selector switch, these contacts being thus identified at station A to indicate those through which station A may make connection to station B. The selector switches may be provided with as many pairs of such contacts as there are remaining stations; thus, the selector switch at station A may have a pair of contacts C, C and another pair of contacts D, D connected respectively by conductors C—17 and C—18 and conductors D—17 and D—18 to the line wires C—15 and C—16 that run to station C where they are connected to the telephone and transmitter circuit and conductors D—15 and D—16 that run to the transmitter and receiver circuit of station D, the selector switch contacts C, C and D, D of the remaining stations, like station B, being connected, respectively, to these line conductors C—15, C—16 and D—15, D—16.

Each station is provided with a manually operable key or switch by which a station selected by the selector switch may be signaled or called. Thus, station A has a calling key or button A—20 which is single pole, double throw, having two contacts A—21 and A—22, the normal position of the switch being to close a circuit at contact A—21; the switch member of key A—20 leads to one of the switch arms, namely, A—23 of the selector switch.

Contact A—22 leads to the winding A—24 of a relay preferably so constructed, as indicated in the drawing, that when winding 24 is energized, the relay armature is pulled up and automatically latched, as by the mechanical latch indicated, in that position so that subsequent deenergization of winding A—24 will not effect return of the armature, as under the action of a biasing spring, to its normal position. The latch may, however, be released, so as to cause the return of the armature to normal, upon energization of a winding A—25, which acts to trip the latch, thus to release the armature. The latter is constructed in any suitable way to provide for the independent bridging of several pairs of contacts, illustratively and preferably three pairs

A—26, A—27 and A—28, as shown, these contacts having circuit connections preferably as indicated.

Assuming that station A is to call station B, the receiver A—3, normally resting on the hook A—6, thus bridging the contacts A—29, is removed, whence the circuit of contacts A—29 is interrupted but the circuit of contact A—5 is closed. Closing the circuit at contact A—5 completes the bridging of the serially connected receiver and transmitter across the battery line wires T—1, T—2, throughout the inductances A—7, A—8, and also effects connection of receiver and transmitter, through the condensers A—13 and A—14 (which block the passage of direct current but permit the passage of varying or alternating currents, such as the audio frequency or voice currents), to the line wires A—15, A—16. The selector switch at station A is then set so that its joined but insulated switch arms A—23 and A—30 contact the two contacts individual to station B and hence designated B, B. Thereby, the circuits of switch arms A—23 and A—30 are extended or connected by conductors A—18 and A—17 to the line conductors B—16 and B—15, respectively, the latter being, at station B, connected by conductors B—12 and B—11 to the transmitter and receiver circuit and other circuits, as shown. The calling key A—20 is now actuated.

A signaling or calling circuit is thereby completed between station A and station B and may be traced as follows: From battery line S—1, conductor A—9, relay winding A—24, thus pulling up the armature which becomes latched and closes the circuits at the pairs of contacts A—26, A—27 and A—28, calling key contact A—22, selector switch arm A—23, contact B, conductor A—18, line wire B—16, conductor B—12 at station B, buzzer or bell B—31 (since the condenser B—14 blocks the passage of this direct current from the battery S), hook switch contacts B—29 (the receiver being on the hook), conductor B—10, to the other battery line S—2. Thus, the signaling instrument B—31 is actuated.

The above described actuation of the armature of the relay at station A makes the latch operative to hold the armature in actuated position, thus to hold bridged the contacts A—26, A—27 and A—28. Thereby, the talking or telephone and transmitter circuits of stations A and B become connected, over a complete circuit which may be traced as follows:

The receiver at station A being off the hook, the circuit is closed at contact A—5, so that the receiver A—3 and transmitter A—4 have their circuit extended through closed contact A—5, condenser A—14, conductor A—12, conductor A—33, bridged contacts A—27, contact A—21 of the key A—20, now released when the calling is completed, selector switch arm A—23, contact B, conductor A—18, line B—16, conductor B—12, condenser B—14, closed contact B—5, assuming that station B has responded and taken the receiver B—3 off its hook, transmitter B—4, receiver B—3, condenser B—13, conductor B—11 to line B—15, then conductor A—17, contact B, switch arm A—30, closed contacts A—28, conductor A—34, conductor A—11, and then by condenser A—13 to the other side of receiver A—3. Talking may now be carried on.

At station B, the contacts B—26, B—27 and B—28 remain open or unbridged, since at that station the relay is not actuated, and hence the above-described talking circuit between stations

A and B remains individual and uninterfered with even though at station B the switch arms B—23 and B—30 of the selector switch may have been left in a set position with respect to the contacts through which circuits are extended to other stations.

Upon completion of talking, the receivers are replaced on the hook and at station A a circuit is completed through the winding A—25 of the release magnet or relay to cause the mechanically latched armature to be released and restored to normal. That circuit extends from battery line S—2, conductor A—10, bridged contacts A—29, winding A—25, bridged contacts A—26, and by way of conductor A—9 to the other battery line S—1.

The restoration of the armature open-circuits the contacts A—26 and thus breaks the circuit of the release relay A—25 so that the latter does not remain energized and does not thereafter prevent a subsequent automatic latching of the armature by the mechanical latch. The selector switch arms A—23 and A—30 may be left in position and need not be restored.

Recurring to the above-described initial actuation of the calling key A—20 to call or signal the station B that has been selected, the circuit arrangement and apparatus provided are such that the condition of station B is indicated to the calling station A, preferably through the receiver of the latter. Thus, if station B is not "busy" so that its receiver is on the hook, and the buzzer or bell B—31 is in operation, the latter or the initial source of energy employed being preferably such that a variable or pulsating or alternating E. M. F. is effective, the receiver A—3 at the calling station responds to that E. M. F., thus to indicate that the calling station is available and is being called, but if the called station is "busy" and hence has its receiver off the hook so as to interrupt the calling circuit at the contacts B—29, no response occurs in the receiver A—3 of the calling station, thus to indicate that the called station is not available.

A preferred arrangement for giving such indications is as shown in the drawing, where the signaling device B—31 is preferably of the type that has a circuit interrupter in circuit with it or as part of it, as in an ordinary buzzer or bell, and hence as the device B—31 is energized, as by the direct current from the battery S, the interrupter or vibrating contact makes and breaks the circuit through which the magnet windings of the device B—31 are energized. Included in that circuit is also the winding A—24 of the relay at station A, and there is thus sufficient inductance in that circuit to cause rapidly varying or rapidly pulsating current changes in the circuit as the interrupter or vibrating contact continues to make and break the circuit; such current changes in the circuit are of audio frequency and may have audio frequency harmonics or components.

This circuit I couple in an appropriate way so that the effects produced in it are made effective to actuate the receiver at the calling station, as at calling station A. Illustratively, I may provide an inductive coupling in the form of an appropriate transformer A—40 whose one winding is connected in the above described circuit in which the pulsating current or rapidly varying current changes are effective and whose other winding is connected by conductors A—41 and A—42 in parallel with the receiver A—3. The receiver A—3 is thus made to respond and is

sounded if the called station is not busy and is available. If it is busy the signaling device B—31 at the called station B is not effective to bring about the inductive effects above described, its circuit being interrupted at the contacts B—29, and thus no signal is produced in the receiver A—3 at the calling station.

I may and preferably do, however, simplify the above-described arrangement, particularly where the current changes in the above-described calling circuit are of sufficient rapidity or magnitude and in such case I may effect, at the calling station, a coupling between the receiver and transmitter circuit and the above-described calling circuit by simply and appropriately paralleling, in suitable proximity, appropriate conductors of the two circuits. Thus, conductor A—9, which is in the calling circuit in which the current changes take place, may be run parallel and in close proximity to conductor A—12 or conductor A—11, or both, at or within the instrument at the calling station A, and through a sufficient length, say, for example, several inches, and thus effect a coupling which may act both inductively and capacitatively to transfer pulsating energy at audio frequency from the calling circuit in which the interrupter of the signaling device B—31 is effective to the circuit of receiver A—3 and transmitter A—4, the latter circuit being closed at contact A—5 and being connected to the conductors A—11, A—12 through the condensers A—13 and A—14, respectively. This inductive coupling is indicated in broken lines at A—43. I have found in practice that such a phantom coupling operates satisfactorily.

I may, however, in practice, employ both of the above-described arrangements, and in such case the phantom coupling may also be made effective to reduce the magnitude or size of the transformer that forms the other coupling.

The system and apparatus provide also additional safeguards. Thus, in the preferred arrangement, I make it dependably certain that the calling station, even though it sets its selector switch for a particular called station, cannot connect itself thereto if the called station is already busy or talking, thus insuring privacy and preventing interruption of or confusion with an existing circuit. Thus, in the above-outlined illustrative calling of station B by station A, if station B is busy so that its receiver is off the hook, the calling circuit closed at contact A—22 by the calling key A—20, as earlier above described in detail, cannot be completed for it is interrupted at contact B—29 which remains unengaged by the hook switch member which is in upper position, the receiver being off the hook. Accordingly, relay winding A—24 cannot be energized, its armature therefore is not actuated, and contacts A—27 and A—28 remain unbridged so that, even though the selector switch is positioned at the B contacts, the talking circuit of station A remains interrupted at open contacts A—27 and A—28 which, as will be seen from what is earlier above set forth, have to be bridged to extend that talking circuit to the talking circuit of the called station.

Thus, any station that is operating is dependably protected against being interfered with by some other station of the system, such other station, moreover, being given a signal, preferably by way of its own receiver, as to the condition or availability of the called station.

Thus, it will be seen that there has been provided in this invention a system and apparatus

in which the various objects hereinbefore noted, together with many thoroughly practical advantages, are successfully achieved.

As many possible embodiments may be made of the above invention and as many changes might be made in the embodiment above set forth, it is to be understood that all matter hereinbefore set forth, or shown in the accompanying drawing, is to be interpreted as illustrative and not in a limiting sense.

I claim:

1. A selective intercommunicating telephone system comprising a plurality of stations each having a transmitter and receiver circuit and a selector switch with connecting lines extending to the selector switch of each station from the remaining stations, switch means at each station interposed between its own selector switch and its own receiver and transmitter circuit, said switch means being normally open, each station having a calling key and a signaling means with connections including the selector switch whereby the key at the calling station may be placed in circuit with the signaling device at the called station, each station having means dependent upon whether it is busy or is not busy for preventing or permitting the flow of current to its signaling means by a calling station key, and means at the calling station dependent upon and responsive to the flow of current to the signaling means at the called station according as flow of current is permitted or prevented as aforesaid for operating said switch means.

2. A selective intercommunicating telephone system comprising a plurality of stations each having a transmitter and receiver circuit and a selector switch with connecting lines extending to the selector switch of each station from the remaining stations, switch means at each station interposed between its own selector switch and its own receiver and transmitter circuit, said switch means being normally open, each station having a signaling device and a calling key, said calling key being in circuit with the selector switch, whereby throughout the setting of the latter and the actuation of said calling key a calling circuit to a called station and through the signaling device of the latter may be completed, and means responsive to the flow of current in said calling circuit for actuating said switch into closed position.

3. A selective intercommunicating telephone system comprising a plurality of stations each having a transmitter and receiver circuit and a selector switch with connecting lines extending to the selector switch of each station from the remaining stations, switch means at each station interposed between its own selector switch and its own receiver and transmitter circuit, said switch means being normally open, each station having a signaling device and a calling key, said calling key being in circuit with the selector switch, whereby throughout the setting of the latter and the actuation of said calling key a calling circuit to a called station and through the signaling device of the latter may be completed, each station having means such as a hook switch whereby, when it is a called station, the circuit of its signaling device is open if the receiver is off the hook and is closed if the receiver is on the hook, and means dependent upon the presence or absence of energization of such a calling circuit for controlling said switch at the calling station.

4. A selective intercommunicating telephone

system comprising a plurality of stations each having a transmitter and receiver circuit and a selector switch with connecting lines extending to the selector switch of each station from the remaining stations, switch means at each station interposed between its own selector switch and its own receiver and transmitter circuit, said switch means being normally open, each station having a signaling device and a calling key, said calling key being in circuit with the selector switch, whereby throughout the setting of the latter and the actuation of said calling key a calling circuit to a called station and through the signaling device of the latter may be completed, each station having a hook switch in accordance with whose position its signaling device may or may not be actuated from a calling station, each station having in said calling circuit and hence also in circuit with its calling key electromagnetic means for controlling said switch when the station is a calling station in accordance with whether or not the hook switch at the selected called station permits or prevents energization of its signaling device.

5. A selective intercommunicating telephone system comprising a plurality of stations each having a selector switch and a receiver and transmitter talking circuit with line conductors leading from each station to the contacts of the selector switches at the remaining stations, whereby one station may selectively connect itself through its selector switch to any selected station, and means for preventing a calling station from connecting itself to a selected station that is busy, said means comprising a switch at the calling station in circuit with its selector switch, an electro-responsive device at the selected station having means controlling its responsiveness in accordance with whether the selected station is or is not busy, means at the calling station for energizing said translating device at the selected station in accordance with whether the means associated with the latter permits it to be or not to be responsive, and means at the calling station acting in accordance with the response or lack of response of said translating device at the selected station for controlling said switch.

6. A selective intercommunicating telephone system comprising a plurality of stations each having a selector switch and a receiver and transmitter talking circuit with line conductors leading from each station to the contacts of the selector switches at the remaining stations, whereby one station may selectively connect itself through its selector switch to any selected station, a calling key at a calling station, a source of current controlled by said calling key, a signaling device at the called station, said signaling device comprising a circuit interrupter and reactance means which, when energized, cause the current flow to vary, means at the called station for preventing energization of said signaling device if the called station is busy, and circuit connections comprising reactance coupling means for making the varying current flow caused by said signaling device at a called station effective upon the receiver at the calling station to give an audible signal at the latter if the called station is in such condition as to permit actuation of said signaling device.

7. A selective intercommunicating telephone system comprising a plurality of stations each having a selector switch and a receiver and transmitter talking circuit with line conductors leading from each station to the contacts of the

selector switches at the remaining stations, whereby one station may selectively connect itself through its selector switch to any selected station, and means for preventing a calling station from connecting itself to a selected station that is busy, said means comprising a switch at the calling station in circuit with its selector switch, an electro-responsive device at the selected station having means controlling its responsiveness in accordance with whether the selected station is or is not busy, means at the calling station for energizing said translating device at the selected station in accordance with whether the means associated with the latter permits it to be or not to be responsive, and means at the calling station energized in response to the flow of current to said translating device at the called station for moving said switch in position to complete the connecting circuit of the two talking circuits through the selector switch if the called station is not busy, means for holding said switch when moved in said position, and manually controlled means at the calling station operable upon the completion of the conversation for making said holding means ineffective and thereby to effect restoration of said switch.

8. A telephone system as claimed in claim 6 in which the reactance coupling means of said circuit connections for making the varying current flow effective upon the receiver at the calling station comprise means inductively coupling the circuit of said calling key and signaling device to the circuit of said receiver.

9. A telephone system as claimed in claim 6 in which the reactance coupling means of said circuit connections for making the varying current flow effective upon the receiver at the calling station forms a coupling between the circuit of said calling key and signaling device and the circuit of said receiver, said coupling means being formed by paralleling suitable portions of the conductors of said two circuits.

10. A telephone system as claimed in claim 6 in which the reactance coupling means of said circuit connections for making the varying current flow effective upon the receiver at the calling station comprise a transformer at the calling station having its one winding connected to be responsive to current variations in the circuit of said calling key and said signaling device and having its other winding connected to have its output effective upon said receiver.

11. A telephone system as claimed in claim 7 in which the means for holding said switch comprises a latch means coacting, in response to movement of said switch into said position, to engage it and hold it against movement out of said position, and in which said manually controlled means comprises electromagnetic means acting, when energized, upon said latch means to move it into switch-releasing position and switch means for effecting energization of said electromagnetic means in response to a manual operation at the calling station.

12. A telephone system as claimed in claim 7 in which said manually controlled means comprises electromagnetic means operable upon said switch-holding means and a hook switch actuated in response to replacement of the receiver at the calling station for controlling said electromagnetic means.

13. A telephone system as claimed in claim 7 in which said manually controlled means comprises electromagnetic means operable upon said switch-holding means and a hook switch actuated in response to replacement of the receiver at the calling station for controlling said electromagnetic means and additional switch means operable in response to said means for moving said first-mentioned switch in position to complete the connecting circuit of said two talking circuits, for conditioning the circuit of said electromagnetic means for subsequent control by said hook switch.

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