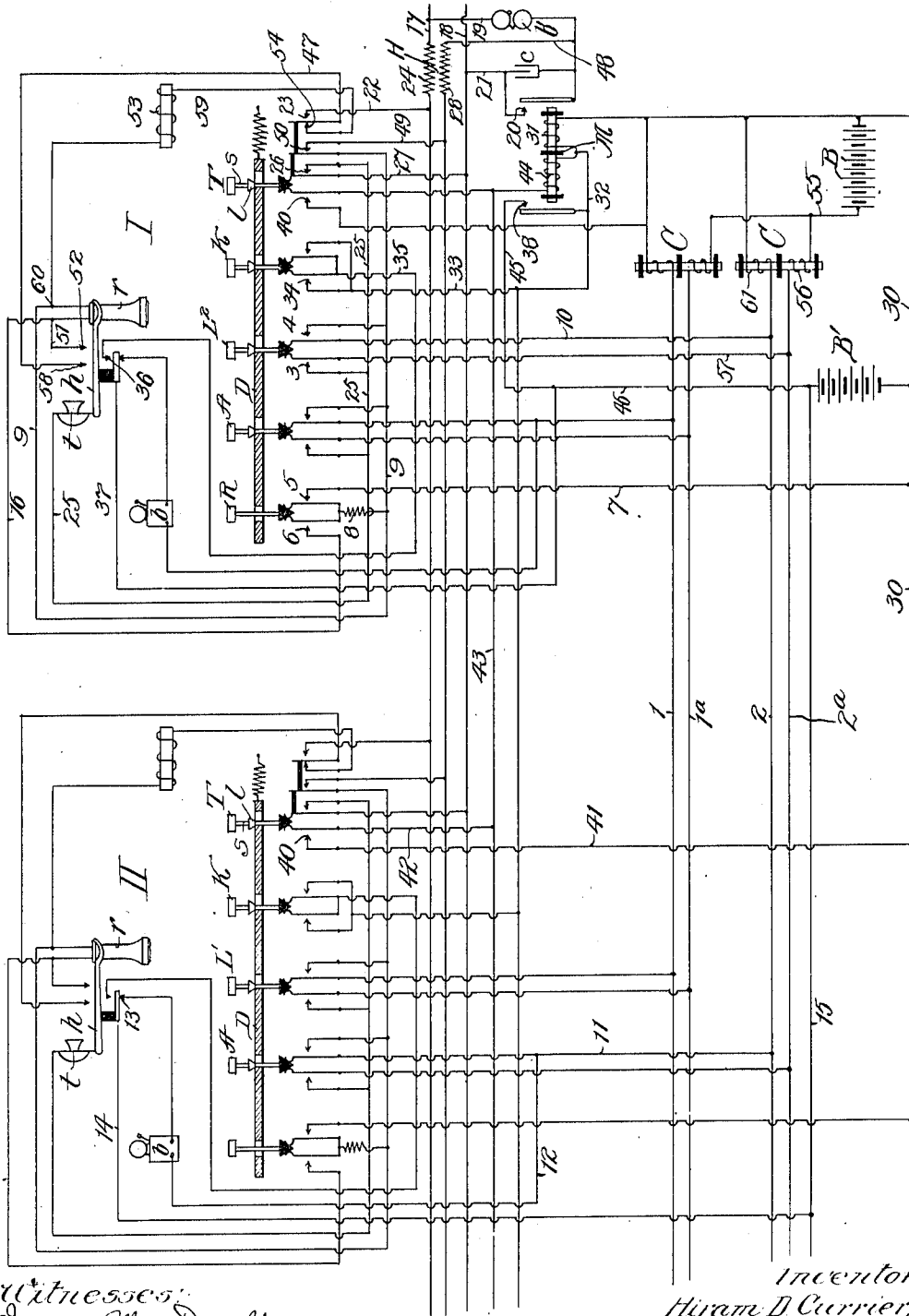


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INTERCOMMUNICATING TELEPHONE SYSTEM.
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UNITED STATES PATENT OFFICE.

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INTERCOMMUNICATING TELEPHONE SYSTEM.

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To all whom it may concern:

Be it known that I, HIRAM D. CURRIER, 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 Intercommunicating Telephone Systems, of which the following is a full, clear, concise, and exact description.

My invention relates to an intercommunicating telephone system, and one feature thereof relates more particularly to an intercommunicating system in which outside communication is provided over a trunk line terminating in such a system and multiplied with two or more stations thereof.

One object of my invention is to provide a system of increased efficiency in transmission.

A further object is to dispense with the induction coil and condenser, usually associated with each telephone set, without impairment of service, and at the same time providing an arrangement which will not result in an unpleasant click in the receiver when ringing current is applied to the local circuits.

A further object of my invention is to obtain the foregoing desirable features of local intercommunication in a system which also provides for communication over a trunk line having an induction coil and condenser individual to the trunk line and common to all the stations of the intercommunicating system that are associated with the trunk line.

My invention consists in an arrangement of circuits and apparatus in which the transmitter and receiver of a station are in series with each other, and in which a retardation coil of low resistance and high impedance is in shunt on the receiver. Said circuit arrangement permits an increased flow of direct current through the transmitter, thereby providing for efficient transmission; and while allowing only a small direct current flow through the receiver, does not appreciably interfere with the flow of currents of telephonic frequency through said receiver.

A further feature of my invention consists in a combination with the above mentioned shunt on a receiver of a ringing circuit in which current is applied through a resistance which is also in shunt on the re-

ceiver. Such arrangement provides means for indicating when the telephone set of the station rung is not in use and at the same time avoids a disagreeable click in the receiver.

A further feature of my invention consists in means for cutting said retardation coil out of circuit when the telephone receiver is associated with a trunk line and for cutting said retardation coil in circuit when the telephone receiver is associated with one of the local lines of the system for local communication.

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 in embodying my invention.

For the 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.

In order to show the several features of my invention, I have shown the same embodied in an intercommunicating system in which means are provided at two or more stations for maintaining the circuit continuity of a trunk line leading to said intercommunicating system and multiplied with said stations, 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 used in answering the call is being utilized for communicating with another local station. Likewise the system shown in the drawing provides means whereby said call may be transferred to another station without the act of transferring causing a disconnect signal at the central office. Such a system also provides means for holding a trunk line while the station at which the call is received may communicate with another local station without the central office party hearing the conversation.

Referring to the drawing, 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 L^1 . Each station is also provided with an answering key A associated with its own local line. Each station is further provided with a ringing key R for applying
 5 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 con-
 10 tacts when the receiver is on its hook. The battery B^1 furnishes the source of ringing current. In addition to said local answering and ringing keys, which provide for
 15 local intercommunication only, each of said stations is provided with a trunk key T and a transfer key K, the function and operation of which will hereinafter be more fully referred to.

It will be noted that with the exception of the ringing key R, all the keys at a station
 20 are held locked down when depressed by means of a plate D, and the depression of one key releases any key already locked down. The manipulation of key R, however, has no effect on any other key, and
 25 said key is not adapted to be locked down by the plate D.

Each local station of the intercommunicating system, as shown, for example, at station I and station II, is equipped with
 30 the usual telephone set comprising a transmitter t and a receiver r . Said transmitter and receiver are here shown in series with each other when the receiver is off its hook h . A shunt on the receiver at each station,
 35 as for example at station I, extends from the switch hook contact 58 at one terminal of the receiver, through the conductor 47, a normally closed contact 54 of the trunk key T, conductor 59, including retardation
 40 coil 53 back to point 60 at the other terminal of said receiver. The retardation coil has a low ohmic resistance and hence largely eliminates direct current flow through the receiver, but the impedance of the retardation
 45 coil is such that the flow of telephonic currents through the receiver is not appreciably lessened. It will be noted that the circuit of the retardation coil 53 is closed through
 50 contact 54 when the key T is in its unoperated position, but is open at said contact when said key is depressed. Means are thus provided for cutting said retardation coil out of circuit when the trunk key is operated to
 55 connect the telephone set with the trunk line as will be hereinafter described.

Corresponding with each local 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.

60 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
 65 its switch hook h , and depress key L^2 , thus

closing contacts 3, 4, and connecting his telephone set with local line 2, 2^a . He will then depress his ringing key R, thereby closing contacts 5 and 6, whereupon, if the
 70 called line is not in use, current will flow from battery B^1 through conductor 7, contact 5, resistance 8, conductor 9, contact 4 of key L^2 , conductors 10, 2, 11, 12, bell b , contact 13, conductors 14, 15, back to battery
 75 B^1 . The subscriber at station II will respond by depressing his answering key A and by removing his receiver r from its hook. Stations I and II are now in telephonic communication, the telephone sets
 80 thereof being connected to local line 2, 2^a , through local key L^2 and answering key A respectively. Bridged across conductors 2, 2^a , as before stated, is the retardation coil C through which current from battery B is
 85 supplied for local communication.

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
 90 depressed his ringing key R, current was supplied for ringing the bell b at station II, said current flowing through resistance 8. One terminal of the receiver r is connected
 95 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
 100 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
 105 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
 110 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 b at station II would not ring, and the party at station I would not hear a buzz in his receiver.

When the telephone receiver r is off the hook h , contacts 52 and 58 are closed and the retardation coil 53 is in shunt on the
 115 receiver, said shunt including the normally closed contact 54 of key T. Therefore with the key L^2 depressed, as above described, current would be applied to station I as
 120 follows: from battery B, conductor 55, winding 56 of retardation coil C, conductor 57, contact 3 of key L^2 , conductor 25, transmitter t , switch hook h , through the shunt of receiver r , extending from contact 58,
 125 through conductor 47, contact 54 of key T, conductor 59, including retardation coil 53, to the point 60, and from thence through conductor 9, contact 4 of key L^2 , conductor 10, through winding 61 of retardation coil
 130 C, back to battery B.

As hereinbefore stated, the resistance of the retardation coil is very low, approximately 2 ohms, while the resistance of the receiver is comparatively high, approximately 70 ohms, and hence there is practically no direct current flow through the receiver. However, the high impedance of coil 53 prevents said shunt seriously impairing the flow of telephone currents through the receiver. It will be observed, therefore, that the shunt on the receiver r permits a greater flow of current for transmission purposes than if the current was supplied solely through the receiver. The above described shunt on the receiver r also performs a further function which may now be described, said function being to prevent an objectionable click in the receiver upon the operation of the ringing key R . As above stated, the receiver r is connected across the resistance 8 in the battery supply. ringing lead in order to produce a tone or buzz in the receiver for indicating to the calling party that the telephone at the station called is not in use. The resistance 8 is low in value in order to produce a low tone in the receiver. Therefore when the key R is depressed, a low shunt is placed on the receiver r , and if such shunt were to result in a marked decrease in the current flow through the receiver, a very objectionable click would be produced. In my invention, however, the retardation coil 53, being in shunt on the receiver at the time the ringing key is operated, practically no current is flowing through the receiver r . The placing of a second low shunt on the receiver, due to the operation of the ringing key R , does not therefore cause a large current change to take place in the receiver, and consequently no objectionable click occurs.

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

Conductors 17, 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. A signal bell b^1 is associated with the trunk line in a manner to give a signal at the stations at which it is desired to answer calls received over the trunk line. The bell b^1 may be located, for example, at some point where it can be heard from any station.

As hereinbefore stated, each of the stations with which the trunk line is multi-

plied is provided with a trunk key T and a transfer key K , associated with the trunk line. The trunk key, when depressed, closes a pair of contacts adapted to connect the telephone set of that station to the trunk line.

The function of the transfer key K is to maintain the continuity of the direct current signaling circuit established over the trunk line in substitution of the telephone set, thus enabling that station to call up and communicate with any other station without giving a disconnect signal at the central office. As shown in the drawing, such continuity of the trunk line is maintained over a bridge of the line extending from conductor 17 to conductor 18 through conductor 19, including the bell b^1 , contact 20 of a differential relay M , and conductor 21, said bridge being normally open at contact 20.

The depression of the transfer key K serves to energize one winding of the relay M and thus cause it to close the contact 20 and to maintain the direct current continuity of the trunk line through the bridge.

Associated with each trunk key T is a way-down contact 40 which is closed when said key is completely depressed by the operator, but which is not closed when the key is merely held down in its usual locked position by the plate D . The stem s of the key T is of such length that said key may be depressed sufficiently to close the way-down contact 40. When the pressure is removed from said key, the key rises in the usual manner until the collar z thereof engages with the underside of the plate D , said plate holding the key locked in this latter position with the trunk line closed but with the way-down contact open. The closing of said way-down contact performs no function unless the relay M is already energized by the prior operation of a transfer key, in the manner hereinbefore described. When a transfer key at any station has been operated so as to energize the relay M , the subsequent operation of a trunk key, in connecting the telephone set at any of the stations to the trunk line, closes a circuit through the other winding of the differential relay, which differential windings thus neutralize the magnetizing effect of each other. The resultant deenergization of relay M opens contact 20 in the bridge across the trunk line. In the drawings, the battery B^1 is shown as the source of current for the differential relay M .

It is apparent that 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, or permitting the central office party to hear the conversation. Furthermore, the

answering station may then either renew the conversation with the calling party, or request the called party to answer over the trunk line.

5 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
10 trunk key T. Current then flows from the central office over conductor 17 of the trunk line, through winding 24 of induction coil H, conductor 22, contact 23 of key T, conductor 47, switch hook *h*, transmitter *t*, conductor 25, contact 26 of key T, conductor 27,
15 and conductor 18 of the trunk line to central office. This completes the direct current circuit continuity of the trunk line and establishes conditions at the central office
20 which show, in the usual manner, that the call has been answered. Station I is now so connected to the trunk line that conversation can take place between the private
25 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
30 up any other station of the intercommunicating system for any purpose, as, for example, to receive instructions, or to transfer the call, he presses down the transfer key K, which key is then held down by the plate D.
35 By depressing key K, the key T is released, and the beforementioned bridge is placed across the trunk line conductors 17, 18, thus maintaining the continuity of the direct current signaling circuit of that line, and leaving
40 the party at station I at liberty to use his telephone for calling up any other station of the private branch exchange.

The circuit conditions brought about by depressing transfer key K are as follows:
45 Current flows from battery B¹, through conductor 30, winding 31 of relay M, conductors 32, 33, contact 34 of key K, conductor 35, contact 36, conductors 37, 46, back to battery B¹. The closure of this circuit causes relay M to become energized,
50 closing contacts 20, 38, thereof. The relay M is now locked up through the closed contact 38. The closure of contact 20 short circuits the condenser *c* and places a bridge across the trunk line permitting the flow of direct current, as hereinbefore described. The act of depressing key K has released the key T, thereby disconnecting the telephone set of station I from the trunk line.
60 It will be seen, therefore, that by operating key K, the party at station I substitutes a bridge of the trunk line for the telephone set, said bridge including contact 20 of the relay M. The party at station I is now
65 free to communicate with any other local

station in the manner hereinbefore described, and in the meantime a disconnect signal at the central office is not displayed. In depressing the key L² to call up station II, for example, the key K at station I is 70 released, opening the contact 34, but not de-energizing relay M, since said relay, as before stated, is locked up through its own contact 38. Assuming the party at station I has communicated with the party at station 75 II, either may then connect with the trunk line by depressing the trunk key T at that station, the conditions brought about being the same in either case. Let us assume, however, that the party at station I desires 80 to transfer the call to station II. After calling up station II in the above manner, he instructs the party at that station to answer over the trunk line. The party at station II then depresses his trunk key T, 85 and in so doing releases his answering key, 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. The circuits established 90 through the connections of station II are substantially the same as those hereinbefore traced from the trunk line through station I and may be readily followed without further description. 95

When the party at station II answers over the trunk line by completely depressing the key T, the contact 40 is closed. Current then flows from battery B¹ through 100 conductor 30, conductor 41, contact 40, conductors 42, 43, winding 44 of relay M, conductor 32, contact 38 of relay M, conductors 45, 46, back to battery B¹. The opposing currents in windings 44 and 31 of relay M will each neutralize the magnetizing effect 105 of the other, and hence relay M will be de-energized. The direct current bridge across the trunk line is now open at contact 20 of relay M. The circuit continuity of the trunk line is maintained, however, through 110 the telephone set at station II. The contact 40 of key T remains closed only so long as the party at station II keeps said key completely depressed. Upon removal of the finger from key T said key moves upward a 115 sufficient distance to open contact 40, but is held locked down by plate D to maintain the other contacts of said key in their closed position. Upon the party at station II hanging up his receiver, the continuity of 120 the circuit of the trunk line is destroyed at the contacts of the switch hook, and the usual disconnect signal is given at the central office exchange.

I claim:—

1. In a telephone system, a transmission circuit, a local circuit including a receiver and transmitter in series with each other, and means for controlling the flow of current in said receiver, comprising a normal 130

shunt around said receiver, a retardation coil in said shunt, a condenser associated with said transmission circuit, and means for simultaneously removing said shunt and placing said condenser in series circuit with said receiver.

2. In a telephone system, the combination with a ringing circuit including a vibrating contact, of a resistance included in said ringing circuit, a telephone receiver in shunt on said resistance, and a retardation coil in shunt on said receiver, said retardation coil being of low ohmic resistance and of high impedance value.

3. In an intercommunicating telephone system, the combination with a telephone circuit including a receiver and transmitter in series with each other and with a source of current for said circuit, of a circuit for ringing current, a resistance included in the ringing circuit, said resistance being in shunt on the telephone receiver, and a second shunt on said receiver, said second shunt including a retardation coil of low ohmic resistance and of high impedance value.

4. In an intercommunicating telephone system having a trunk line leading to said system and multiplied with two or more stations thereof, the combination with an induction coil and condenser individual to the trunk line and common to all of said stations, of a telephone set at each of said stations having the receiver and transmitter in series with each other, means for associating the telephone set with the local circuits of the intercommunicating system and with the trunk line, respectively, a normally closed shunt on said receiver, a retardation coil of low ohmic resistance and of high impedance value included in said shunt, and means for removing said shunt when said telephone receiver is associated with the trunk line.

5. In an intercommunicating telephone system having a trunk line leading to said system and multiplied with two or more

stations thereof, the combination with an induction coil and condenser individual to the trunk line and common to all of said stations, of a telephone receiver at each of said stations, a retardation coil in shunt on said receiver, said retardation coil having a low ohmic resistance and a high impedance value, means for associating said receiver with the local circuits of the intercommunicating system and with the trunk line, respectively, and means for cutting said retardation coil in circuit when said receiver is associated with one of the local lines of the system and for cutting said retardation coil out of circuit when said receiver is associated with the trunk line.

6. In an intercommunicating telephone system having a trunk line leading to said system and multiplied with two or more stations thereof, the combination with an induction coil and condenser individual to the trunk line and common to all of said stations, of a ringing circuit including a vibrating contact, a resistance included in said ringing circuit, a telephone receiver in shunt on said resistance, a retardation coil in shunt on said receiver, said resistance coil having a low ohmic resistance and a high impedance value, means for associating said receiver with the local circuits of the intercommunicating system and with the trunk line, respectively, and means for cutting said retardation coil in circuit when said receiver is associated with one of the local lines of the system and for cutting said retardation coil out of circuit when said receiver is associated with the trunk line.

In witness whereof I, hereunto subscribe my name this 16th day of November A. D., 1907.

HIRAM D. CURRIER.

Witnesses:

RALPH G. JOHANSEN,
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