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TELEPHONE SYSTEM.

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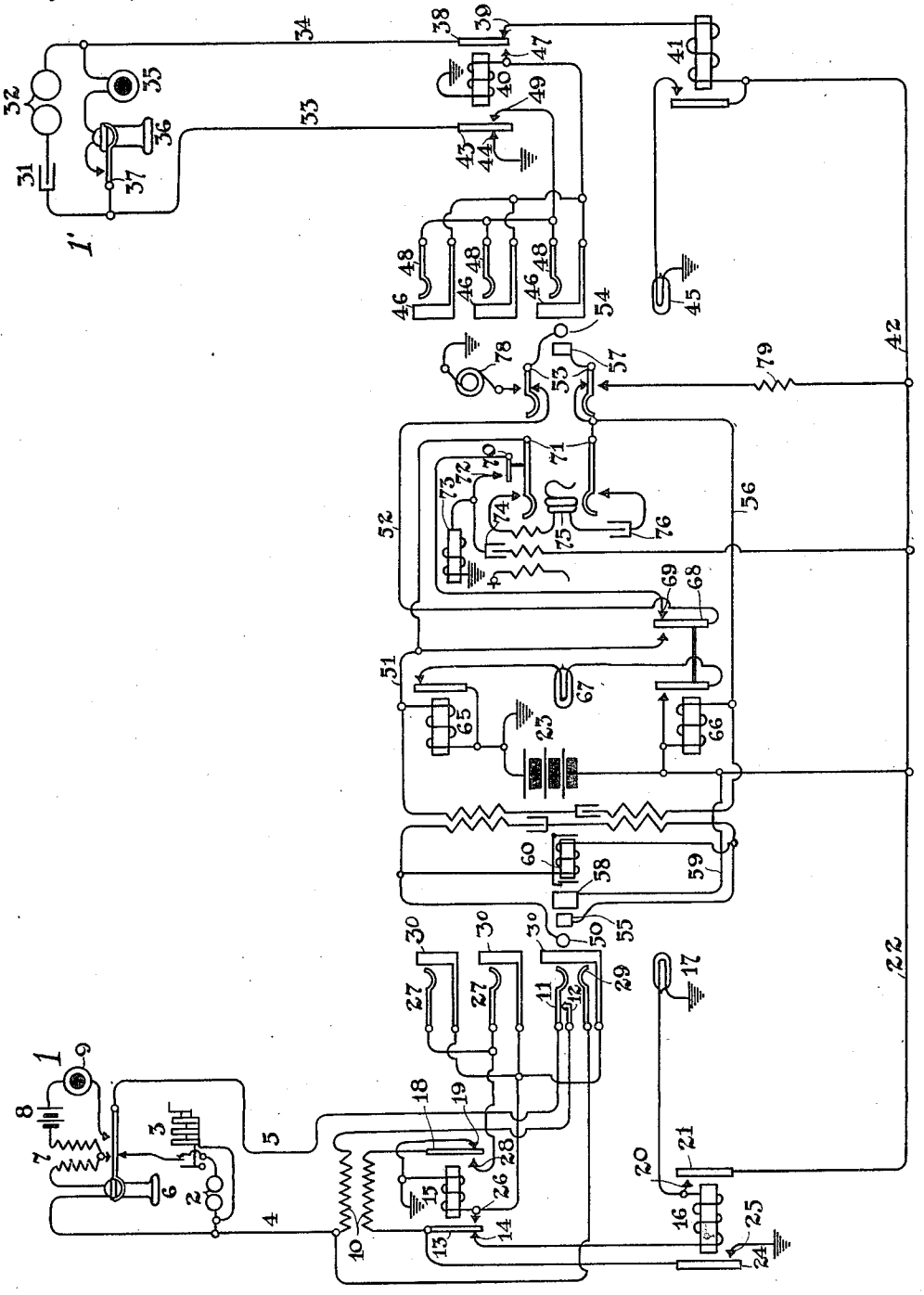

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TELEPHONE SYSTEM.

1,017,085. Specification of Letters Patent. Patented Feb. 13, 1912.

Application filed March 29, 1909. Serial No. 486,300.

To all whom it may concern:

Be it known that I, FRED M. DAVIS, a citizen of the United States, residing in Chicago, county of Cook, and State of Illinois, have invented certain new and useful Improvements in Telephone Systems, of which the following is a specification.

My invention relates to telephone systems of the multiple type in which common battery and local battery telephone lines are adapted to be connected together for conversation.

My invention particularly relates to telephone systems having but two conductors extending through the multiple, and it is the object of my invention to produce an efficient two-wire multiple line circuit for local battery lines which will operate with the form of cord circuit ordinarily used for common battery lines.

It has been found desirable in telephone exchanges of the common battery type to equip certain long lines extending far into the country with local battery telephones, especially when these lines are heavily loaded as is usually the case. In connecting the lines of this character with the central switchboard, it is customary to locate all such lines at one position of the switchboard and to supply that position with cord circuits adapted to connect between local battery lines and common battery lines, and also to supply that operator's position with cords adapted only to connect between local battery lines.

In the accompanying drawing in which all apparatus is shown in its normal or unactuated condition, I have illustrated a local battery telephone line on the left side of the drawing and a common battery telephone line on the right side of the drawing, these lines being adapted to be connected by the special cord circuit here illustrated.

It is to be understood that the same exchange will be equipped with cord circuits of common to common battery type, though these circuits will preferably appear at a different position of the board from the one at which the illustrated cord circuit appears.

The subscriber's station 1 is equipped with the annunciator 2 normally connected in a bridge of the line conductors 4 and 5 by means of the contacts of generator 3, these contacts being adapted to place either the generator coil or the annunciator in said shunt according to whether the generator is in motion or at rest. This subscriber's station is also provided with the receiver 6, repeating coil 7, battery 8 and transmitter 9, all adapted to be connected into operative relation with the line conductors when the receiver 6 is removed from the switch-hook. At the central office, line conductor 4 is connected with one terminal of the external winding of the repeating coil 10, and line conductor 5 is connected through contacts 11 and 12 of the answering jack with the other terminal of said winding, the repeating coil 10 serving to metallically isolate and inductively unite the external and internal lines. One terminal of the internal winding of repeating coil 10 is connected through contacts 13 and 14 of cut-off relay 15, the coil of line relay 16 and the line lamp 17 with earth, the other terminal of repeating coil 10 being connected with earth through contacts 18 and 19 of cut-off relay 15. Line relay 16 has the normally open contacts 20 and 21, contact 20 being connected with the coil of relay 16 and with the line lamp 17, and the contact 21 being connected through conductor 22 with the live pole of battery 23. The line relay 16 also has the normally open contacts 24 and 25, contact 25 being connected with earth and contact 24 being connected with the contact 13 of cut-off relay 15. The sleeve contacts 30 of the answering and multiple jacks are connected with the coil of cut-off relay 15 and with the normally open inside contact 26 of that relay, the other terminal of the coil being connected with ground. The tip contacts 27 of the multiple jacks are connected with the other normally open inside contact 28 of cut-off relay 15. The ring contact 29 of the answering jack is connected directly with line conductor 4.

The common battery line illustrated upon the right of the drawing is equipped at substation 1′ with the usual condenser 31 and annunciator 32 in a permanent bridge between line conductors 33 and 34, and with the transmitter 35 and receiver 36 in a bridge maintained normally open by contacts of the switch hook 37. At the central office, line conductor 34 is connected through contacts 38 and 39 of cut-off relay 40 and the

coil of line relay 41 and conductor 42 with the live pole of battery 21, and line conductor 33 is connected through contacts 43 and 44 of cut-off relay 40 with earth. Line relay 41 controls normally open contacts in the circuit of line lamp 45 adapted when closed to connect this lamp in a circuit with the battery 23. The sleeve contacts 46 of the answering and multiple jacks of this common battery line are connected with the coil of cut-off relay 40 and with the normally open inside contact 47 of that relay, the other terminal of the relay coil being connected with earth. The tip contacts 48 of the answering and multiple jacks of this line are connected with the other normally open inside contact 49 of cut-off relay 40.

The cord circuit for connecting these lines for conversation has a three-conductor plug to connect with the answering jack of the local battery line and a two-conductor plug to connect with a multiple jack of the common battery line. This cord circuit is provided with a repeating coil dividing it into calling and answering ends, the inner terminals of this coil being connected by condensers.

The tip contact 50 of the answering plug is connected with one of the outside tip terminals of said repeating coil. The other outside tip terminal of the repeating coil is connected through conductors 51 and 52, and tip contacts of the ringing key 53 with the tip contact 54 of the calling plug. The ring contact 55 of the answering plug is connected with one of the outside terminals of the repeating coil. The other outside terminal of the repeating coil is connected through conductor 56 and the sleeve contacts of ringing key 53 with the sleeve contact 57 of the calling plug. The answering plug is also provided with the sleeve contact 58 which is connected through conductor 59 with the live pole of battery 23. The clearing out drop or signal 60 is bridged between the talking strands of the answering end of the cord circuit.

The tip and sleeve calling supervisory relays 65 and 66 are connected in a bridge between the tip and sleeve cord conductors 51 and 56, this bridge also containing the battery 23. Supervisory relay 66 controls normally open and supervisory relay 65 normally closed contacts in the circuit of the calling supervisory signal 67.

The calling end of the tip strand of the cord circuit is normally connected through contacts 68 and 69 of relay 66 with the normally open auxiliary contact 70 of the operator's listening key 71, the other normally open auxiliary contact 72 of this key being connected with earth through the impedance coil 73, and also through the condenser 74 and tertiary winding of the operator's induction coil with the live pole of battery 23. The secondary of this induction coil, the operator's receiver 75 and condenser 76 are adapted to be connected in a bridge between the talking strands of the cord circuit by the actuation of the listening key 71.

The operator's ringing key 53 is adapted when actuated to connect the ringing generator 78 with the tip of the calling plug and is adapted to connect the sleeve of the calling plug with the live pole of battery 23 through the non-inductive resistance 79.

In the operation of my system, supposing the call to initiate at substation 1, the subscriber in charge of that substation rotates her ringing generator 3 and thereby sends alternating current over line conductors 4 and 5, through the contacts 11 and 12 of the answering jack and through the external winding of the repeating coil 10. An induced current is thereby generated in the internal winding of repeating coil 10 and flows from earth through contacts 19 and 18 of cut-off relay 15 through the winding of repeating coil 10, contacts 13 and 14 of cut-off relay 15, the coil of line relay 16 and the lamp 17 to earth. The current in this path actuates line relay 16 attracting its armatures and completing a locking circuit for itself over the path from the live pole of battery 23, through conductor 22, contacts 21 and 20 of line relay 16, the coil of that relay, contacts 14 and 13 of cut-off relay 15 and contacts 24 and 25 of line relay 16 to earth. At the same time contacts 24 and 25 of line relay 16 complete a shunt about the coil of that relay, so that a continued operation of the hand generator 3 at the calling subscriber's station will have no tendency to deënergize the line relay 16 and thereby unlock that relay and again efface the line lamp.

When the operator observes the display of line lamp 17, she inserts her answering plug into the answering jack designated thereby and thus completes a circuit from the live pole of battery 23 over the sleeve contacts 58 and 30 of the plug and jack, and the coil of cut-off relay 15 to earth. The current in this path actuates the relay 15, interrupting its contacts 18 and 19, and 13 and 14. The interruption of contacts 13 and 14 severs the locking circuit of line relay 16 allowing that relay to fall back and efface the line lamp 17. The operator now actuates her listening key 71 and obtains the number of the desired line. Finding this to be that of line 2, she touches the tip 54 of her calling plug with the sleeve or test contact 46 of one of the multiple jacks of that line. If the line is busy the sleeve contact of this jack will be connected with the sleeve of some other cord circuit and will therefore be maintained at a potential higher than that of earth. Current will therefore flow over conductor 52, contacts

68 and 69 of relay 66, auxiliary contacts 70 and 72 of listening key 71 and through the impedance coil 73 to earth. The current in this path will disturb the potential of the condenser 74, cause a partial discharge of that condenser, and thereby cause a disturbance in the tertiary winding of the operator's induction coil, the induced current causing a click in the operator's receiver. If the line is found idle, however, no disturbance is heard and the calling plug is inserted into the multiple jack and the ringing key 53 is thrown. When this is done, current flows from the battery 23 through the non-inductive impedance 79, sleeve contacts of the ringing key 53, sleeve contacts 57 and 46 of the plug and jack and through the coil of cut-off relay 40 to earth, actuating that relay and connecting the limbs 33 and 34 of the telephone line directly with the contacts of the jacks. Current therefore flows from the ringing generator 78 through tip contacts 54 and 48 of the plug and jack, contacts 49 and 43 of cut-off relay 40, line conductor 33, condenser 31, annunciator 32, line conductor 34, contacts 38 and 47 of cut-off relay 40, sleeve contacts 46 and 57 of the jack and plug, sleeve contacts of the ringing key and through the non-inductive resistance 79 and the battery 23 to earth and back to the generator 78. Current in this path sounds the annunciator 32 calling the subscriber to his phone.

Before the called subscriber has answered his call and after the ringing key 53 has been released, a circuit is closed from the live pole of battery 23 through the coil of supervisory relay 66, conductor 56, sleeve contacts 57 and 46 of the plug and jack and the coil of cut-off relay 40 to earth. The current in this path actuates relay 66, closing the normal break between conductors 51 and 52 of the cord circuit and completes the circuit of supervisory signal 67. The display of this signal indicates to the operator that the called subscriber has not yet answered his call.

When the called subscriber answers his call, a circuit is completed from the contact 47 of cut-off relay 40, over line conductor 34, through transmitter 35, receiver 36, contacts of switch-hook 37, line conductor 33, contacts 43 and 49 of cut-off relay 40, tip contacts 48 and 54 of the jack and plug, tip conductors 52 and 51 and the coil of supervisory relay 65 to the ground pole of battery 23. Current in this path actuates relay 65 which severs the circuit of supervisory signal 67 indicating to the operator that the called subscriber has answered his call.

When the conversation is terminated, the subscriber in charge of the local battery outfit revolves his generator 3, thus sending an alternating current over line conductor 4, contacts 29 and 55 of the answering jack and plug, the coil of the clearing out signal 60, tip contacts 50 and 11 of the plug and jack and line conductor 5 back to the generator. The current in this path actuates the clearing out drop or signal 60 indicating to the operator that the calling subscriber has terminated his conversation. When the called subscriber replaces his receiver upon the switch-hook he interrupts the circuit through the coil of supervisory relay 65 allowing that relay to resume its normal position, which again closes the circuit of supervisory signal 67 and indicates to the operator that the called subscriber has terminated his conversation. When these two signals are displayed, the operator removes the answering and calling plugs from their connection with the jacks of the lines, thus severing the circuits of the cut-off relays 15 and 40 allowing all apparatus to resume its normal condition.

It is to be understood that when one of the common battery subscribers desires a connection with one of the local battery subscribers a regular common battery cord circuit will be used and the calling end of that cord circuit will be connected with one of the multiple jacks of the local battery telephone line. It will be seen that when used in this way, the operator will only have supervision over the calling subscriber's connection since the circuit through the supervisory relays of the calling end of the cord circuit will be completed through the internal winding of repeating coil 10 as soon as the calling end of the cord is connected with one of the multiple jacks of the local battery line. In carrying on a conversation the repeating coil 10 will be interposed between the local and common battery lines which establishes the ideal condition for that class of service.

It is to be understood that I do not wish to be unduly limited to the particular details of the system here shown and described excepting in so far as those details are essential to the invention, many changes in the portions of the system not directly relating to my invention being possible without departing from the spirit or scope of my invention.

I claim:

1. In a telephone system, the combination with a telephone line having answering and multiple jacks at the central office, of a local battery cord circuit to connect with the answering jack, a common battery cord circuit, the multiple jacks being adapted to be used when a connection is established between said line and a common battery cord circuit, and means associated with said line to prevent battery from the common battery cord circuit flowing over the line when con-

nection is established between said multiple jacks and said common battery cord circuit, substantially as described.

2. In a telephone system, the combination with a telephone line having two types of jacks comprising answering and multiple jacks at the central office, the test contacts of the answering jack being connected with the test contacts of the multiple jacks and the other contacts of the answering jack being connected in a circuit independent of the other contacts of the multiple jacks, a repeating coil for the line, means for including windings of the repeating coil when using one type of jack for establishing a talking connection, and means for excluding windings of the repeating coil when using the other type of jack for establishing a talking connection, substantially as described.

3. In a telephone system, the combination with a telephone line, of an answering jack therefor having contacts directly connected with the limbs of the line, a repeating coil in the line and multiple jacks having contacts inductively connected with the telephone line through said repeating coil during conversation, substantially as described.

4. In a telephone system, the combination with a telephone line, of a line relay therefor adapted to be actuated by current from the substation on the line, a line lamp displayed by the actuation of said relay, a cut-off relay adapted by its actuation to interrupt a locking circuit through said line relay, answering and multiple jacks for the line, the sleeve contacts of said jacks being connected to the coil of said cut-off relay, the other contacts of the answering jack being directly connected with the limbs of the telephone line and being independent of the other contacts of the multiple jacks, substantially as described.

5. In a telephone system, the combination with a telephone line, of a local battery subscriber's station located on the line, a repeating coil permanently associated with the line, answering and multiple jacks for the line, the said repeating coil being adapted to be inductively included in the talking circuit when a connection is established with one of the multiple jacks, and being adapted to be excluded from the talking circuit when a connection is established with the answering jack, substantially as described.

6. In a telephone system, the combination with a telephone line, of a repeating coil for the line, a cut-off relay, answering and multiple jacks for the line, and means to prevent a conversational connection from being established with the multiple jacks of the line while a conversational connection is established with the answering jack, substantially as described.

7. In a telephone system, the combination with a telephone line having answering and multiple jacks, a repeating coil for said line, and means to prevent placing said repeating coil in operative relation with said line, whereby it is impossible to carry on a conversation through the multiple contacts of the jack when a connection is established with the answering jack, and means for placing the repeating coil in operative relation with said line when a connection is established with a multiple jack, substantially as described.

8. In a telephone system, the combination with a telephone line, of a repeating coil for the line having a winding normally bridged between the external limbs of the telephone line, a line relay normally connected with the internal winding of said repeating coil, a cut-off relay, and a locking circuit for the line relay including contacts of the cut-off relay, substantially as described.

9. In a telephone system, the combination with a telephone line, of a repeating coil for the line having a winding normally bridged between the external limbs of the telephone line, a line relay normally connected with the internal winding of said repeating coil, a cut-off relay, and a locking circuit for the line relay including contacts of the cut-off relay, and contacts for said line relay adapted to close a shunt about the coil of the line relay whereby impulses of current over the line will not pass through the coil of the line relay and again deënergize it after its locking circuit has been completed, substantially as described.

10. In a telephone system, the combination with a telephone line, of a local battery subscriber's station located on the line, a repeating coil associated with said line, means for including said repeating coil in the conversational circuit when connection is established with said line by a common battery cord-circuit, and means for excluding said repeating coil from the conversational circuit when connection is established with the said line by a local battery cord-circuit, substantially as described.

Signed by me at Chicago, county of Cook, and State of Illinois, in the presence of two witnesses.

FRED M. DAVIS.

Witnesses:
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