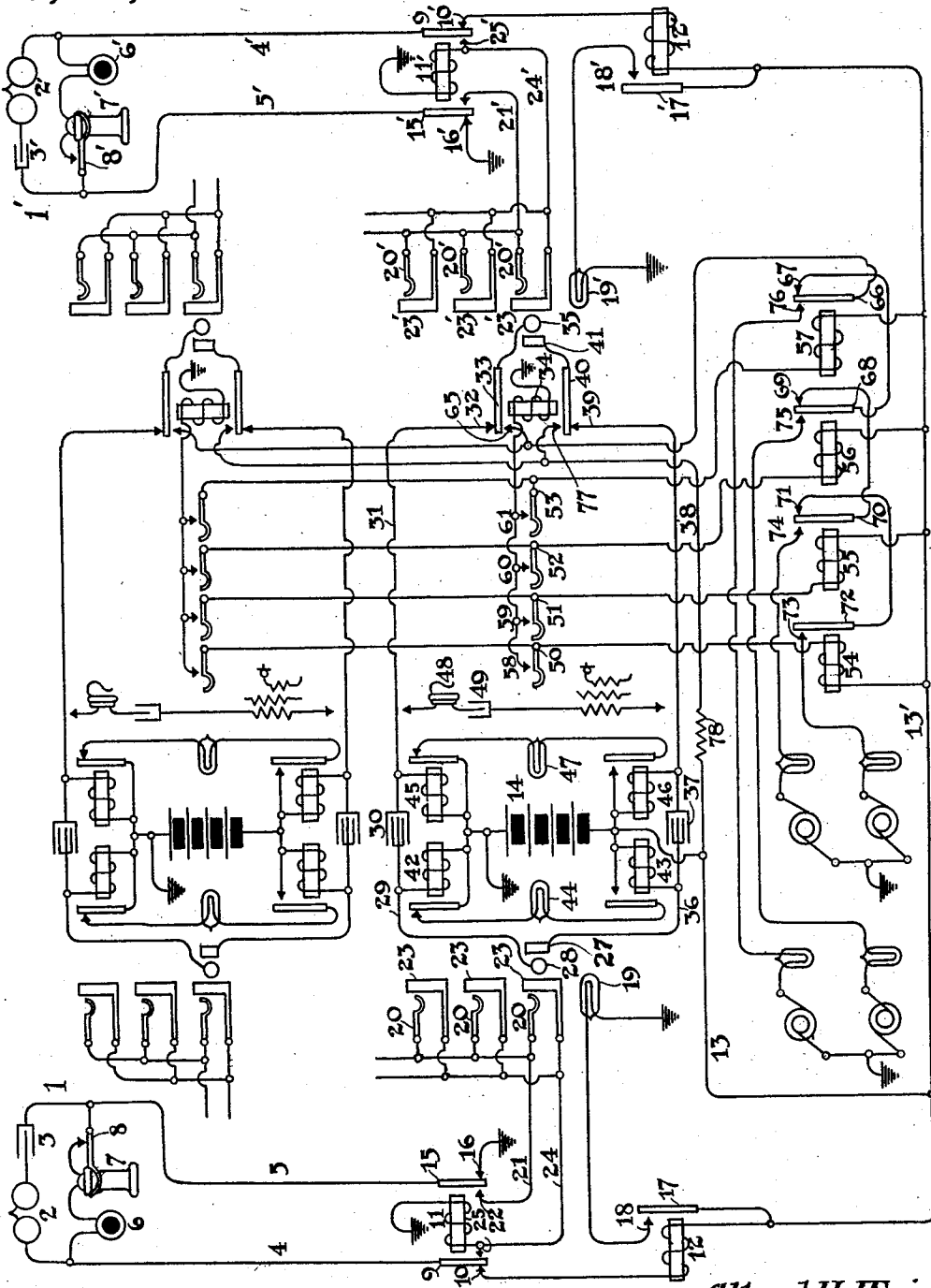


A. H. WEISS.
TELEPHONE SYSTEM.
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To all whom it may concern:

Be it known that I, ALFRED H. WEISS, 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, and particularly to a simplified method of wiring for the switchboard key shelf. It has been customary in the past to connect the generator current for ringing purposes directly with the strands of the cord circuit by means of a ringing key, the generator current being carried to the contacts of the ringing key through conductors which are usually closely associated with one another and bound into a cable. Such systems become especially complicated when the telephone system is equipped with selective party line ringing apparatus, because, in this case a number of different conductors carrying generator currents of different characters to the key are bound in the cable. In systems of this character the ringing keys are usually provided with series contacts through which the voice currents must pass, and it is customary also to bind the cord conductors carrying the voice currents into the same cable with the generator conductors. In order to eliminate inductive effects caused by the oscillation of the generator current it has been necessary to very carefully twist the cord conductors together so that the inductive effect of this key shelf cable will be balanced and will not be heard upon the lines connected for conversation. A slight leakage, however, upon one side of the telephone line will often disturb the balanced condition so that even with the most careful twisting of the pairs in the key shelf the inductive effect is heard by the subscribers during conversation.

By my present invention, I greatly simplify the wiring of the key shelf, eliminating entirely therefrom the cord or voice current conductors, and so simplify the key construction that bare wires strapped from one key to another may be used in place of the formerly complicated cable arrangement.

My invention is illustrated in the accompanying drawing in which two cord or connecting circuits are shown, and in which

calling and answering subscribers' lines 1 and 1' are adapted to be placed in conversational connection by one of said cord circuits.

Substation 1 is equipped with the usual annunciator 2 and condenser 3 in a permanent bridge between line conductors 4 and 5, and with the transmitter 6 and receiver 7 in a bridge maintained normally open by contacts of the switch hook 8. At the central office, line conductor 4 is connected through contacts 9 and 10 of cut-off relay 11, the coil of line relay 12, and conductor 13 with the live pole of battery 14, and line conductor 5 is connected through contacts 15 and 16 of cut-off relay 11 with earth. Line relay 12 controls the normally open contacts 17 and 18 in the circuit of the line lamp 19. The tip contacts 20 of the answering and multiple jacks are connected through conductor 21 with the normally open contact 22 of cut-off relay 11, and the sleeve contacts 23 of the answering and multiple jacks are connected through conductor 24 with the normally open contact 25 of cut-off relay 11, and also with the coil of that relay, the other terminal of the coil being connected with earth. The answering subscriber's line is similarly equipped, the corresponding apparatus associated with this line being designated by like figures with the suffix " ' ".

Two cord or connecting circuits are illustrated, the two circuits having identical apparatus, that of the lower circuit only being designated by figures. Each cord circuit has tip and sleeve talking strands, the tip extending from the tip 28 of the answering plug through conductor 29, condenser 30, conductor 31, series contacts 32 and 33 of ringing relay 34 to the tip contact 35 of the calling plug, and the sleeve conductor extending from the sleeve contact 27 of the answering plug through conductor 36, condenser 37, conductor 38, and series contacts 39 and 40 of ringing relay 34 to the sleeve contact 41 of the calling plug. The answering supervisory relays 42 and 43 are connected in a bridge between the answering tip and sleeve conductors 29 and 36, this bridge containing the battery 14. Relay 43 controls normally open and relay 42 normally closed contacts in the circuit of the answering supervisory signal 44. The call-

ing supervisory relays 45 and 46 are similarly connected in a bridge between the tip and sleeve calling conductors 31 and 38, this bridge also containing the central battery 14.

5 Relay 46 controls normally open and relay 45 normally closed contacts in the circuit of the calling supervisory signal 47. The operator's receiver 48, condenser 49 and secondary of the operator's induction coil are adapted to be placed in a bridge between the talking strands of the cord circuit by the actuation of the listening key, which is not shown in the drawing.

10 In the system here illustrated, each cord circuit is equipped with a four party ringing key, this key being provided with four lever contacts 50, 51, 52 and 53, these contacts being connected in multiple with all of the corresponding contacts of the keys at the same operator's position, and being connected respectively with the coils of the master relays 54, 55, 56 and 57. Each key also has the contacts 58, 59, 60 and 61, which contacts in each key are connected in multiple and with the coils of the various ringing relays 34, the other terminals of these relays being connected with earth. The one terminal of the coils of each of the master relays 54, 55, 56 and 57 is connected with the live pole of battery 14. The inside tip contacts 65 of ringing relays 34 are all connected in multiple, and with the spring contact 66 of master relay 57. The normally closed contact 67 of relay 57 is connected with the spring contact 68 of relay 56. The normally closed contact 69 of relay 56 is connected with the spring contact 70 of relay 55, and the normally closed contact 71 of relay 55 is connected with the spring contact 72 of relay 54, thus placing the normally closed contacts of relays 54, 55, 56 and 57 in a series circuit. These relays each have normally open contacts 73, 74, 75 and 76 connecting through resistance lamps with four sources of ringing current, these sources being adapted to supply current of a distinctive character for the selective operation of annunciators at different subscribers' stations on the same line. The normally open contacts 77 of ringing relays 34 are connected in multiple and with the live pole of battery 14 through non-inductive resistance 78.

15 In the operation of my invention, the subscriber in charge of substation 1 removes his receiver 7 from the switch-hook 8, and thus completes a path for current from the live pole of battery 14 through conductor 13, the coil of line relay 12, contacts 10 and 9 of cut-off relay 11, line conductor 4, transmitter 6, receiver 7, contacts of switch hook 8, line conductor 5, and contacts 15 and 16 of cut-off relay 11 to ground. The current in this path actuates line relay 12 closing its contacts 17 and 18 and completing the circuit of the line lamp 19.

Upon the display of the signal 19 the operator inserts the answering plug of one of her cord circuits into the answering jack of the line designated by the signal, and thereby completes a circuit from the live pole of battery 14 through the coil of relay 43, conductor 36, sleeve contacts 27 and 23 of the plug and jack, conductor 24, and the coil of cut-off relay 11 to ground. The current in this path actuates relays 43 and 11, the actuation of relay 11 interrupting the circuit of line relay 12 and effacing the line signal 19, and also connecting the limbs of the telephone line directly with the tip and sleeve contacts of the jack, whereupon a second circuit is completed from the contact 25 of cut-off relay 11, through the contact 9, line conductor 4, transmitter 6, receiver 7, contacts of switch hook 8, line conductor 5, contacts 15 and 22 of cut-off relay 11, conductor 21, tip contacts 20 and 28 of the jack and plug, conductor 29, and the coil of supervisory relay 42 to earth. The current in this path actuates relay 42 which prevents the display of answering supervisory signal 44 which would otherwise have been displayed by the actuation of relay 43. The operator now actuates her listening key, not shown, and inquires the desired number. Finding this to be that of one of the subscribers upon the line 1', the operator tests one of the multiple jacks of this line, and finding the line idle, inserts her calling plug into the jack, and immediately actuates the proper button of her ringing key to selectively call the desired subscriber. Suppose the operator, to actuate the button which closes contacts 51 and 59 of her ringing key. A circuit is thereby completed from the live pole of battery 14 through conductors 13 and 13', the coil of relay 55, contacts 51 and 59 of the ringing key, and the coil of ringing relay 34 to earth. The current in this path actuates relays 55 and 34. The actuation of relay 34 connects its springs 33 and 40 with their inside contacts 65 and 77. The connection of contacts 40 and 77 completes a circuit from the live pole of battery 14 through the non-inductive resistance 78, contacts 77 and 40 of ringing relay 34, sleeve contacts 41 and 23' of the plug and jack, conductors 24' and the coil of cut-off relay 11' to ground. This actuates relay 11' connecting line conductors 5' and 4' directly with the contacts of the jack. The connection of contacts 33 and 65 of relay 34 completes a circuit from one of the ringing current sources through its resistance lamp contacts 74 and 70 of the now actuated relay 55, contacts 69 and 68 of relay 56, contacts 67 and 66 of relay 57, contacts 65 and 33 of relay 34, tip contacts 35 and 20' of the plug and jack, conductor 21', contacts 22' and 15' of cut-off relay 11', line conductor 5', condenser 3', annunciator 2', line conductor 4', 130

contacts 9' and 25' of cut-off relay 11', conductor 24', sleeve contacts 23' and 41 of the jack and plug, contacts 40 and 77 of ringing relay 34 and through the non-inductive resistance 78 and the battery 14 back to the ground pole of the ringing generator. The current in this path being of an alternating character passes through the condenser 3' and sounds the annunciator 2'.

It will be seen that if the operator had actuated a button controlling, for example, contacts 53 and 61 of her ringing key, the master relay 57 would have been actuated in series with the ringing relay 34 and a different source of ringing current would have been connected with the line, thus sounding the annunciator at another station. When the ringing relay 34 resumes its normal position a path for current is completed from the live pole of battery 14 through the coil of relay 46, conductor 38, contacts 39 and 40 of ringing relay 34, sleeve contacts 41 and 23' of the plug and jack, conductor 24' and the coil of relay 11' to ground. This maintains the actuation of relay 11' and actuates the sleeve supervisory relay 46. The actuation of relay 46 completes the circuit of the calling supervisory signal 47 which is displayed to indicate to the operator that the called subscriber has not yet answered his call.

When the called subscriber answers his call by removing his receiver from the switch hook, current flows through contacts 25' and 9' of cut-off relay 11', line conductor 4', transmitter 6', receiver 7', switch hook 8', line conductor 5', contacts 15' and 22' of cut-off relay 11', tip contacts 20' and 35 of the jack and plug, contacts 33 and 32 of ringing relay 34, conductor 31 and the coil of supervisory relay 45 to earth. The current in this path actuates relay 45 which opens the circuit of calling supervisory signal 47 effacing that signal to indicate to the operator that the called subscriber has answered his call.

It will be seen that by this invention I have entirely eliminated the possibility of inductive disturbances in the key shelf cable, due to the association of the ringing current leads with the cord circuit strands and have greatly simplified the construction of the ringing key itself. I have further eliminated the series contacts usually found in the cord conductors where they pass through the ringing key and have substituted therefor the single contacts of the ringing relay 34. My system is therefore more efficient from the operating standpoint and much more simple and economical from the maintenance standpoint since the element of key shelf trouble is practically eliminated.

It will be understood that the master relays 54, 55, 56 and 57 are preferably dupli-

cated for each separate operator's position so that they will be under the control of but one operator.

While my invention has been here described with reference to a specific telephone system, it is to be understood that I do not wish to be limited thereto, the arrangement being equally applicable to any system of the manual type using either indicating or non-indicating keys. Other modifications may also be made without departing from the spirit or scope of my invention.

I claim:

1. In a telephone system, the combination with a plurality of connecting circuits, of relays common to said circuits, each relay controlling a distinctive signaling current, and a relay individual to each of said circuits, and means for simultaneously actuating one of the common and one of the individual relays for connecting ringing current with the cord circuit with which the individual relay is associated, substantially as described.

2. In a telephone system, the combination with a plurality of connecting circuits, of ringing relays, one for each of said cord circuits, ringing relays common to all of said cord circuits, and means to actuate one of said common and one of said individual relays in series to connect ringing current with the connecting circuit with which the individual relay is associated, substantially as described.

3. In a telephone system, the combination with a plurality of connecting circuits, a party line ringing key for each circuit, a ringing relay for each circuit, a relay common to said circuits, the actuation of one of said ringing keys being adapted to complete the circuits of its associated individual relay, and a common relay to connect ringing current with the associated connecting circuit, substantially as described.

4. In a telephone system, the combination with a plurality of cord circuits, of a plurality of sources of distinctive ringing current, a relay for each source common to all of the connecting circuits, a relay individual to each of said connecting circuits, and means to simultaneously actuate the individual and one of the common relays to connect a particular source of current with the calling end of the connecting circuit with which the individual relay is associated, substantially as described.

5. In a telephone system, the combination with a plurality of cord circuits, of a plurality of sources of distinctive ringing current, a plurality of relays common to said connecting circuits, one individual to each of said sources, a plurality of ringing relays one individual to each of said cord circuits, and means under the control of the operator to simultaneously actuate the individual re-

lay of a connecting circuit, and any desired one of the relays individual to the sources to connect the particular source with the calling end of that particular connecting circuit, substantially as described.

6. In a telephone system, the combination with a plurality of cord circuits, of a plurality of ringing keys, one for each cord circuit, a plurality of ringing relays, one for each of said cord circuits, a plurality of sources of distinctive current all common to all of said cord circuits, a plurality of relays, one individual to each of said sources of ringing current and all common to all of said cord circuits, the actuation of a particular switch of one of the operator's ringing keys being adapted to connect its associated individual relay in series with one of the common relays, and the actuation of the common and individual relays being adapted to connect a particular source of ringing current with the calling plug of the cord circuit with which the ringing key is associated, substantially as described.

7. In a telephone system, the combination with a plurality of cord circuits, of a plurality of party line ringing keys, one for each cord circuit, a plurality of ringing relays, one for each cord circuit, contacts of each key connected in multiple through the key and with the coil of the associated ringing relay, a plurality of ringing relays, one corresponding with each of the distinctive parties and all common to all of the cord circuits, the corresponding contacts of all of the ringing keys being connected in multiple and with the coils of the associated common relays, a source of current, one associated with each of the common relays, the actuation of a particular switch of any of said ringing keys being adapted to complete the circuit of its associated individual relay and its associated common relay, whereby a distinctive source of current is connected with the calling end of the associated cord circuit, substantially as described.

8. In a telephone system, the combination with a cord circuit, of a ringing key therefor, a source of direct current, and sources of ringing current, a plurality of relays, the actuation of the ringing key being adapted to complete a path for current from said direct current source including a pair of said relays, said pair of relays being actuated by the current in said path for connecting one of said ringing current sources with the calling end of the cord circuit, substantially as described.

9. In a telephone system, the combination with a cord circuit, of a ringing relay therefor adapted when actuated to connect ringing current with the calling end of the cord circuit, a party line ringing key, the said ringing key being adapted when actuated to complete the circuit of said ringing relay,

the contacts of said key being independent of the conductors carrying the ringing current, substantially as described.

10. In a telephone system, the combination with a cord circuit, a plurality of sources of ringing current, of a ringing relay therefor adapted when actuated to connect ringing current from one of said sources with the calling end of the cord circuit, a party line ringing key, the said ringing key being adapted when actuated to complete the circuit of said ringing relay and select a ringing source according to the actuated key, the contacts of said key controlling the circuit of said relay but being free from ringing current, substantially as described.

11. In a telephone system, the combination with a plurality of cord circuits, of a pair of conductors common to all of said cord circuits, a plurality of relays, one for each of said cord circuits, each adapted when actuated to connect said conductors with the calling end of the associated cord circuit, a plurality of sources of distinctive ringing current, and means to connect one of said sources with said conductors simultaneously with the actuation of one said relays, substantially as described.

12. In a telephone system, the combination with a plurality of cord circuits, a source of direct current, a plurality of sources of ringing current, of a pair of conductors common to all of said cord circuits, one of said conductors being permanently connected with the live pole of said source of direct current, the other of said conductors being adapted to be connected with any one of said ringing current sources, and means to simultaneously connect said conductor with one of said sources and with the calling end of a cord circuit, substantially as described.

13. In a telephone system, the combination with a plurality of cord circuits, of a conductor common to all of said cord circuits, a plurality of relays common to all of said cord circuits, said conductor being normally connected through series contacts of said relays, a plurality of sources of ringing current, one source connected with a contact of each of said relays, the actuation of any one of said relays being adapted to connect its associated source of ringing current with said conductor, the series contacts of said relays being adapted to prevent more than one source being connected with said conductor simultaneously, and means to connect the calling end of a cord circuit with said conductor while one of said sources is connected thereto, substantially as described.

14. In a telephone system, the combination with a plurality of cord circuits, of a conductor common to all of said cord cir-

cuits, a plurality of relays common to all of said cord circuits, said conductor being normally connected through series contacts of said relays, a plurality of sources of ringing current, one source connected with a contact of each of said relays, the actuation of any one of said relays being adapted to connect its associated source of ringing current with said conductor, the series contacts of said relays being adapted to prevent more than one source being connected with said conductor simultaneously, and a plurality of relays, one for each of said cord circuits adapted to be actuated simultaneously with one of said common relays for completing the connection of one of said ringing current sources with the calling end of a cord circuit, substantially as described.

15. In a telephone system, the combination with a connecting circuit, of a party line ringing key therefor, and means responsive to the selective operation of said key for connecting selective ringing current

with the cord circuit, the contacts of said key being free from ringing current but included in a circuit for controlling said means, substantially as described.

16. In a telephone system, the combination with a connecting circuit, of a selective party line ringing key therefor having normally open contacts, a pair of relays, and a conductor, one of said relays being adapted to connect said conductor with the calling end of the cord circuit, and the other of said relays being adapted to connect the selected ringing current with said conductor, said relays being actuated by current through the contacts of said key when the key is closed, substantially as described.

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

ALFRED H. WEISS.

Witnesses:

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Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."