

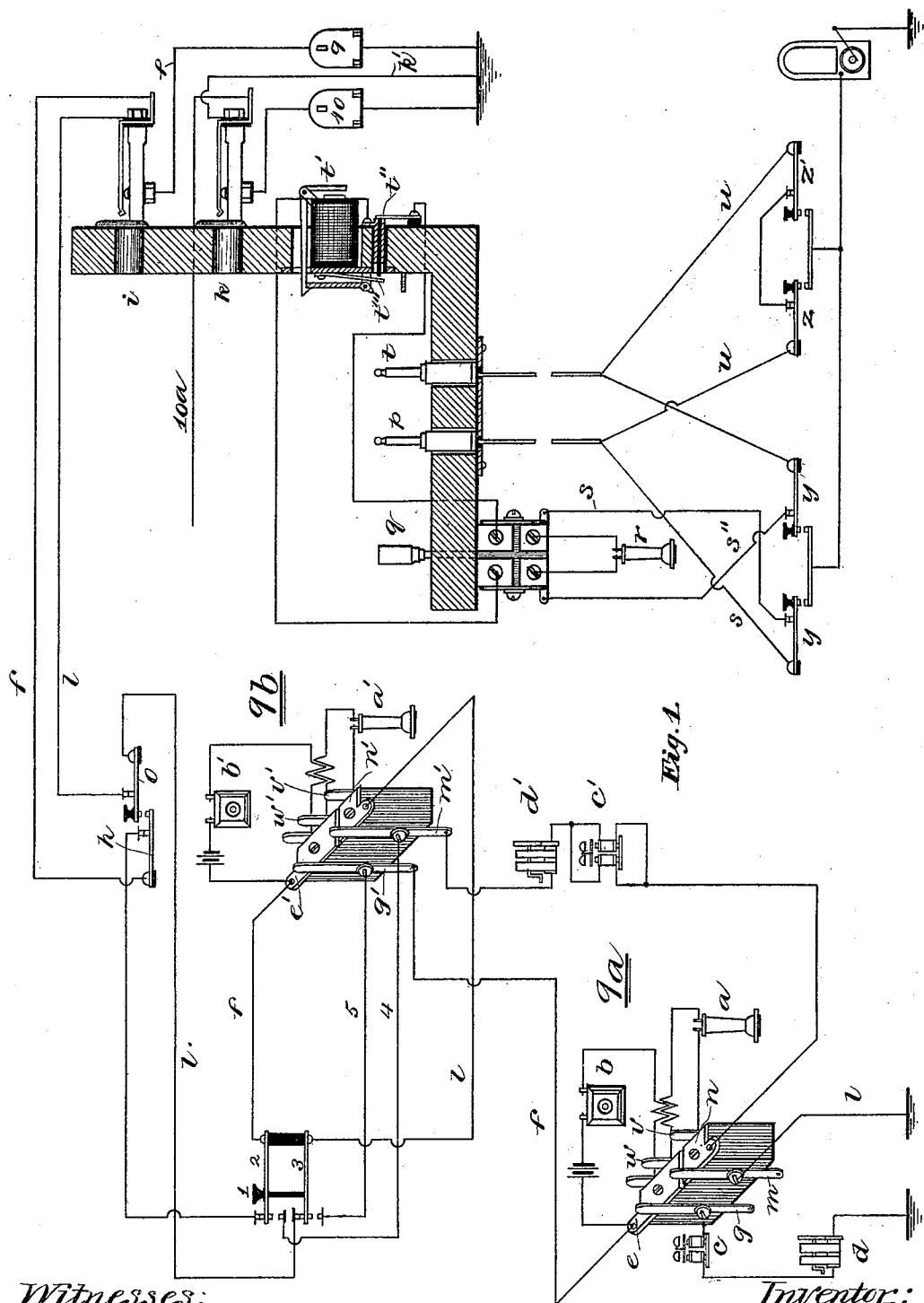
(No Model.)

2 Sheets—Sheet 1.

F. G. BEACH.
TELEPHONE EXCHANGE APPARATUS.

No. 447,485.

Patented Mar. 3, 1891.



Witnesses:

Chas. G. Hawley.
Albert A. Parker

Inventor:

Franklin G. Beach.
By George P. Barton
Attorney.

(No Model.)

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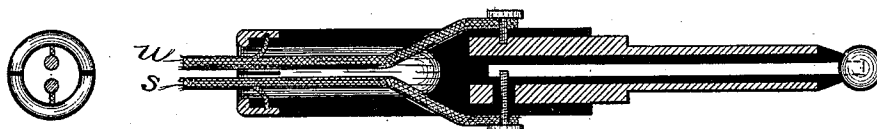
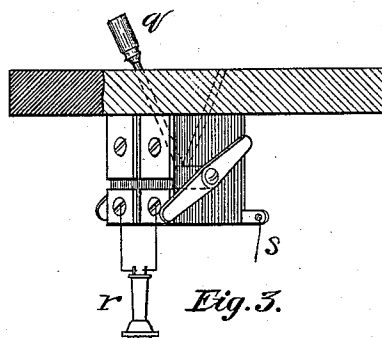
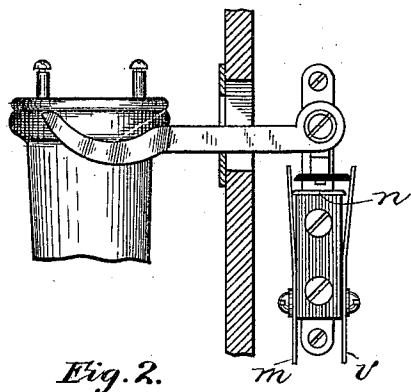
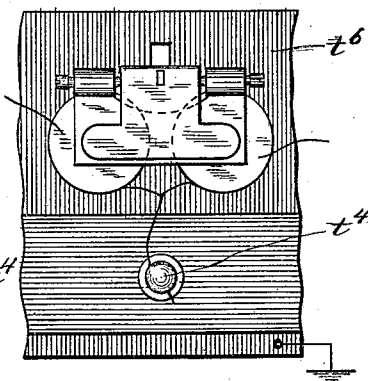
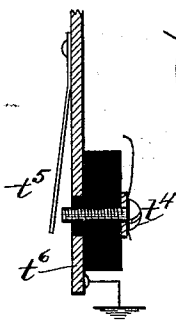
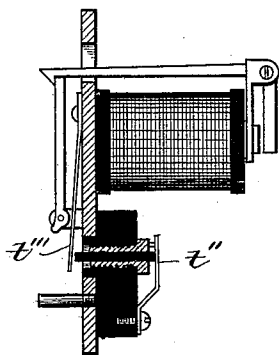


Fig. 5.

Fig. 4.



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By George P. Barton
Attorney.

UNITED STATES PATENT OFFICE.

FRANKLIN G. BEACH, OF CHICAGO, ILLINOIS, ASSIGNOR TO THE AMERICAN BELL TELEPHONE COMPANY, OF BOSTON, MASSACHUSETTS.

TELEPHONE-EXCHANGE APPARATUS.

SPECIFICATION forming part of Letters Patent No. 447,485, dated March 3, 1891.

Application filed February 4, 1888. Serial No. 262,966. (No model.)

To all whom it may concern:

Be it known that I, FRANKLIN G. BEACH, a 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 Telephone-Exchange Apparatus, (Case 6,) of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

My invention relates to a telephone-exchange system in which the lines are run in pairs, each line of every pair being a single circuit. Each line of every pair may have upon it one subscriber's station, which can signal to or receive a signal from the central office independent of the station located on the second line of the same pair. When the subscriber at either station removes his telephone from the automatic switch, the two lines of the pair are disconnected from ground and automatically connected together and make a metallic circuit for talking purposes, the object of such metallic circuits for talking being to overcome inductive disturbances, the advantage of which over single circuits is generally understood by persons skilled in the business.

My invention consists more especially in the circuits and switching apparatus at the station of each subscriber and at the central office. Any two subscribers' stations conveniently located upon or near the same route may be connected with a pair of lines, one station upon each line of each pair.

By the use of my invention in a telephone-exchange single lines can be utilized for metallic circuits without the necessity of furnishing additional wires for the return-circuit, which ordinarily and otherwise would be essential to form such single lines into metallic circuits.

It is of course understood that the two lines chosen to constitute any pair in accordance with the terms of my invention are preferably two, which run substantially together upon their supports or otherwise, or as nearly so as possible, throughout the length of their route from the central to the sub-station, it being well known in the art that inductive neutralization is only attained in any two

paired lines forming a metallic circuit when the said two lines are substantially equidistant from any and all other adjacent and parallel lines. The two lines of each pair are connected with the same spring-jack switch on the switch-board, one line being connected to the spring or lever and the other to the frame or body of the spring-jack. The circuit of the line connecting with the spring passes through the spring and its contact-point to an annunciator, and thence to ground in the usual manner. The other line or limb of the metallic circuit terminates in the insulated frame of the jack.

The apparatus at the different subscribers' stations is arranged so that in signaling both subscribers of the pair use a portion of the same line of the circuit, throwing down the same shutter at the central station. The operator at the central station, seeing a shutter fall, inserts a loop-plug in the corresponding switch and at the same time loops her telephone into the circuit of the cords of the loop-plug. She is thus placed in communication with the subscriber, whoever it may be, who has sent in the signal. Polarized bells adapted to respond to a straight intermittent current in one direction only are provided at the subscribers' stations, and the generators at the different stations are preferably adapted to send current in one direction or the other, accordingly as they are turned to the right or left. The source of electricity at the central office may be a power-generator constructed to send alternating currents or current in reversals or a battery with a pole-changer in circuit. I am thus enabled to prevent false signals at the subscribers' stations when the clearing-out signal is sent, as will be hereinafter described.

As an additional precaution against false signals, I provide for either opening the circuit or for closing the circuit to ground at the central office by the falling of the shutter of the clearing-out annunciator.

By means of suitable connections with the generator or signaling-battery at the central office I am enabled to call up either one of a pair of subscribers' without disturbing the other.

My invention will be understood by refer-

ence to the accompanying drawings, in which—

Figure 1 is a diagram illustrative of a pair of subscribers' stations connected with a switch at the central office and the key-board and signaling apparatus of the switch-board. Fig. 2 is a detail view showing the operation of the telephone-switch at a subscriber's station. Fig. 3 is a view showing the operation of the loop-switch of the key-board apparatus. Fig. 4 is a detail sectional view of a loop-plug provided with a divided metallic heel, one division of the heel being connected with the tip of the plug and the other division being connected with the insulated metallic sleeve upon the shank of the plug. Fig. 5 is a plan of the metallic heel of the plug. Fig. 6 is a detail sectional view of a clearing-out annunciator for opening the circuit by the falling of the shutter. Figs. 7 and 8 are rear and sectional views, respectively, of a clearing-out annunciator closing the line to ground when the shutter falls.

Like parts are indicated by similar letters and figures of reference throughout the different figures.

The spring-jack switch, the loop-plug, and the loop-switch are old in the art, and therefore require no special description. The telephone-switch is in mode of operation similar to the telephone-switch described in United States Letters Patent No. 371,260, granted William M. Goodridge, October 11, 1887.

At the subscriber's station No. 9^a I have shown the usual telephone *a*, transmitter *b*, bell *c*, and generator *d*. At station No. 9^b I have shown also a telephone *a'*, a transmitter *b'*, bell *c'*, and generator *d'*. Beginning at ground at station 9^a, the circuit of the line *f* may be traced through the generator *d*, bell *c*, and spring *g* to plate *e* and thence to the contact-spring *g'* of station 9^b, thence to plate *e'*, and thence to key *h* at said station, and thence to the spring of spring-jack *i* upon the switch-board through the contact of said spring-jack switch, and thence through an annunciator 9 to ground. Beginning at ground at station 9^a, the circuit of limb *l* may be traced to spring *m* and plate *n* of the telephone-switch and thence to station 9^b, where it passes through bell *c'*, the generator *d'*, and spring *m'* to plate *n'*, and thence to key *o*, and thence to the insulated frame of spring-jack *i*. Branch *l* is thus normally open at spring-jack *i*. This is the normal circuit of the lines or limbs *l* and *f* when the telephones *a* and *a'* are hung upon the switch-levers, as illustrated in Fig. 2, in which position the three springs on one side of the rubber heel are lifted from plates *e n*, while the springs *g m* are allowed to close upon plates *e n*, respectively. On removing the telephone from the switch the three springs, pressing in one direction against the rubber heel upon the short arm of the lever of the telephone-support, will close upon their opposing contacts and force the springs *g m* away from their contacts.

I will now describe the manner of sending a signal from station 9^a to the central office, the manner of receiving the call at the central office, and connecting and disconnecting the different stations.

Suppose subscriber 9^a wishes a connection. He turns his generator *d*, sending current over line *f* to annunciator 9, and thereupon takes down his telephone *a*, thus bringing the telephone into circuit, the ground terminals of both limbs of said circuit being at the same time disconnected as springs *g m* are lifted from their normal contacts *e* and *n*, respectively. The operator at the central office, seeing shutter 9 fall, at once picks up plug *p* of her pair of plugs and inserts said plug into spring-jack *i*. The tip of the plug is thus connected with the spring of the switch and the sleeve of the plug with the frame. Thus lines *f l* are looped together in metallic circuit, and the lever *q* of the loop-switch being thrown over to the position shown brings the telephone *r* into this circuit.

I will now trace the metallic circuit between the subscriber's telephone *a* at station 9^a and the operator's telephone *r* at the central office. Beginning at the tip of plug *p*, the circuit may be traced through strand *s* of the cord to a plate of the loop-switch, and thence through the telephone *r*, Fig. 3, and after passing through the loop-switch the circuit may be traced by wire *s''* to the tip of plug *t*. The heel of plug *t* rests upon a metallic support, and hence a connection is established between the different contacts or points of plug *t*. Thus the circuit may be traced through the strand *u*, which connects the sleeves of the two plugs to the frame of switch *i*, and thence by wire *l* through key *o*, plate *n'*, and spring *m'* at station 9^b to the plate *n* of the switch at station 9^a, and thence through spring *v*, telephone *a*, and spring *w* to the terminal plate *e* of the telephone-switch, and thence by line *f*, as heretofore traced, to the spring of switch *i*, and thence to the tip of plug *p*, thus completing the metallic circuit. Subscriber at station 9^b, in order to signal, presses first upon push-key *o*, forcing said key away from its normal contact and closing said key *o* upon key *h* and separating said key *h* from its normal contact. Subscriber 9^b thus brings his generator *d'* into connection with the portion of line *f* leading to the annunciator 9 at the central office, and while holding down said push-key *o* sends current to the central office. The signal-current of subscriber 9^b is thus sent from ground at station 9^a over line *l* to key *o*, and thence from key *h* over line *f* to the central office. The operator, seeing the shutter fall, inserts plug *p*, as before described with respect to subscriber 9^a, and the same connections are formed at the central office. The circuits at stations 9^a and 9^b will be different, however. Subscriber 9^b having signaled, allows keys *h* and *o* to resume their positions, as shown, and at once takes down his telephone, thus opening connections of springs *g' m'* and

closing telephone connections $v'w'$. Telephone a' is thus included in a metallic circuit, which may be traced at station 9^b as follows: From key o to plate or terminal n' , thence to telephone-spring v' , and thence through telephone a' to the other telephone-spring w' , and thence to plate e' , and thence, as indicated by line f , to key h . Thus telephone a' is looped into a metallic circuit with the operator's telephone r when the telephone a' is off the switch and plug p is inserted in spring-jack i . The operator having learned the subscriber wanted, inserts plug t into the proper spring-jack and presses on the proper key to throw current from the signal battery or generator to the particular subscriber asked for. Any key-board apparatus may be used for this purpose. I have shown keys $y y'$ for throwing current to the tip of either plug and the keys $z z'$ for throwing current to the sleeve of either plug.

It will be understood, as shown in Fig. 4, that strand s connects with the tip of the plug and strand u with the sleeve of the plug.

It is seen from the foregoing description that either station of any pair can obtain connection at the central office independent of and without ringing the bell at the other station upon the same pair of lines.

After two subscribers are connected, the clearing-out annunciator t' may be included in the circuit by simply throwing lever q of the listening-key to its other position. Either subscriber may thus clear out by sending current to line. In case current were sent to clear out through the annunciator t' and connections over line f to station 9^b the circuit would be completed through bell c at station 9^a if the telephone a' at station 9^b were upon its support. Bell c , being polarized, would not respond.

In the same telephone-exchange it is often desirable to use different kinds of electric current, as straight current, intermittent currents, and current sent in reversals. It is therefore desirable not to depend entirely upon polarized bells for preventing false signals at station 9^a . This I accomplish either by opening or by grounding the line by the falling of the clearing-out shutter. The clearing-out annunciator t' , Fig. 1, (for detail see Fig. 6,) is constructed so that when the shutter falls its weight or momentum acquired in falling serves to separate spring t'' from its normal contact, thus opening the line at the point of said contact. I have shown an eccentric piece upon the lower part of the shutter which is forced against a spring t''' , resting upon a loose pin of insulating material when the shutter falls. The pin, being thus forced back, serves to lift spring t'' , thus opening the circuit. Instead of opening the circuit, a third leg-connection may be closed directly to ground, as shown in Figs. 7 and 8. The connection t^4 of the line is extended, so that when the shutter falls and spring t^5 is forced back it will close upon contact t^4 . It will be

understood that the plate t^6 of the annunciator is connected to ground, and hence a direct ground-connection is provided when spring t^5 closes upon contact t^4 . Bell c , even if not polarized, could therefore give no signal after the falling of the shutter.

I have thus described my invention without reference to the manner of signaling and making connection between the two stations of a given pair of subscribers.

This feature of my invention I will now describe, it being understood that the principal feature of my invention is not to be considered as in any way limited or restricted by the particular mode of making connections between the two stations of a pair, since this may be accomplished in several different ways in connection with my metallic circuit system.

At station 9^b I have shown a push-key 1, mounted upon two contact springs or keys 2 3. In my previous description I have disregarded these springs and their connections, since they are normally included in the circuits f and l , respectively, and have no special function as keys, except when used for making connections between stations 9^a and 9^b . Suppose now the subscriber at station 9^b wishes to make connection with station 9^a . He presses upon key 1 with one hand, separating springs 2 and 3 from their back contacts and closing them upon their respective front contacts, and with the other hand turns in the proper direction the generator d' , thus sending current through bell c at station 9^a . The circuit thus formed may be traced from ground at station 9^a by wire 1 through the generator d' at station 9^b to spring m' , and thence by wire 4 to contact-spring 2, and thence to plate e' , and thence to spring g' , and thence, as heretofore traced, through the bell c at station 9^a . Having thus signaled subscriber 9^a , subscriber 9^b lets go the generator and takes down his telephone a' . Subscriber 9^a having also taken down his telephone and subscriber 9^b still holding key 1 depressed, the pair of subscribers 9^a and 9^b will be connected together in metallic circuit. This metallic circuit through telephones a and a' may be traced as follows: from plate n' to spring v' , telephone a' , spring w' , and plate e' , thence to key 2, and thence by wire 4 to spring m' , and thence to plate n of the switch at station 9^a , thence by spring v through telephone a to spring w , thence to plate e , and thence back to spring g' at station 9^b , and thence by wire 5 to spring 3, and thence to plate n' , thus completing the metallic circuit between the two subscribers 9^a and 9^b . Subscriber 9^b may thus without assistance from the central office communicate with subscriber 9^a .

It will be understood that when key 1 is depressed the portions of wires $f l$ leading to the central office are cut off at springs 2 and 3.

When subscriber at station 9^a wishes connection with station 9^b , he calls up the cen-

tral office and gives his order and the operator thereupon calls up station 9^b and directs the subscriber at station 9^b to connect with station 9^a, which he does by simply depressing keys 2 and 3, as before described. At station 9^b, I have shown the coils of the bell c' connected in multiple arc, in order that the resistance of the coils when included in the talking-circuit may be as low as possible. I preferably thus connect the coils of all the bells and annunciators in multiple arc. The single circuit 10^a is shown passing through its switch k and its annunciator 10 to ground. The frame of switch k is shown connected by wire k' directly to ground. Thus it appears that any subscriber 9^a or 9^b may be connected with any subscriber 10^a having a single circuit.

Either of two subscribers of a pair may be connected in metallic circuit with either subscriber of any other pair of the exchange without interfering with or disturbing either of the other subscribers of the two pairs—that is to say, subscriber 9^a of the outer station may talk with any subscriber of the exchange without disturbing the intermediate subscriber 9^b, or any other subscriber except the particular one called for, and subscriber 9^b may talk with any other subscriber of the exchange without disturbing subscriber 9^a or any other one except the particular one wanted.

My system as thus described enables me to group the single lines in such manner that the subscribers may each be provided with complete metallic circuits for talking without materially increasing the expense for wire over and above the expense of single circuit-lines, and at the same time the switch-board apparatus is very materially reduced, which latter saving in the case of multiple-switch-board systems would be very large.

Having thus described my invention, I claim as new and desire to secure by Letters Patent—

1. The combination, with two telephone-exchange stations, of two lines, each passing through each of said stations and each to ground at one of said stations, said lines extending to the central office and being there connected with different portions of the same spring-jack, one of said portions of the spring-jack being connected through an annunciator to ground and the other portion being normally insulated, and switching apparatus and generators at the different stations, whereby either subscriber may send current through said annunciator at the central office, substantially as described.

2. The combination, with two telephone-lines, each connected with different portions of the same switching device at the central office and extending through each of said stations and to a separate ground at one of said stations, of telephones, one at each of said stations and one at the central office, and switching apparatus at each of said stations

and at the central office, whereby said lines may be disconnected from ground and the telephone at either station looped in metallic circuit with the telephone at the central office.

3. The combination, with two subscribers' stations, of two lines grounded at one of said stations and passing, respectively, through both of said stations in series to a common switching device at the central office, one of said lines being closed through an annunciator to ground and the other being normally open at the central office, of the generator of the subscriber at the intermediate station included in the normally-open line, and a switching device for closing said generator to the closed line, whereby the subscriber at the said intermediate station may send current from his generator to operate the annunciator included in the circuit grounded at the central office.

4. The combination, with two electric circuits passing each in series through an outer station and an intermediate station to the central office, one of said circuits being normally open and the other being normally grounded through an annunciator at the central office, and both of said circuits being normally grounded at the outer station, of the generator of the intermediate station included in the normally-open circuit, and switching apparatus for connecting said generator to the circuit including the annunciator.

5. Two electric circuits passing each from a separate ground connection at one subscriber's station through said station and another intermediate subscriber's station to the central-office switch-board of a telephone-exchange, one of said lines being normally open at said switch-board and the other passing from said switch-board through an annunciator to ground, of the generator and bell of the different stations, the bell and generator at one station being in one line and the bell and generator of the other station being in the other line, and switching apparatus at the intermediate station, whereby current may be sent from either station to operate the annunciator at the central office without ringing the bell of the other station.

6. Two telephone-lines extending through stations 9^a 9^b normally to the central office, said lines being normally grounded at station 9^a, in combination with switching apparatus at station 9^b for disconnecting both of said lines from the central office and uniting them in a circuit including the signal devices—that is, the bell and generator of each station and automatic telephone-switches, one at each station, and the said subscribers' telephones, whereby current may be sent from the generator at station 9^b to ring the bell at station 9^a, and whereby on taking down the telephones said telephones will be connected in metallic circuit while the signal devices of station 9^a are disconnected therefrom.

7. The combination, with two lines connected with different parts of the same switch

at the central office, and each line including the bell of a different subscriber's station, of a plug with two points or contacts for connecting with the different parts of said switch, respectively, and the strands of the cord of said plug, a key in each strand, and a source of electricity whereby current may be sent from the central office to signal the subscriber at either of the stations.

8. The combination, with the operator's telephone at the central office, of flexible conducting-strands and a loop-plug connected therewith, a loop-switch for bringing the telephone into the circuit of the cords and a switch upon the switch-board, with which two different lines are connected, each line passing through a station 9^b to a station 9^a and to ground, and the polarized bells at said stations included, respectively, in different lines, and a source of electricity for sending current in reversals and keys for closing said source of electricity to either line, whereby the operator's telephone may be looped into a metallic circuit formed between the two lines, or whereby current may be sent to ring the bell at either station at the will of the operator.

9. The combination, with two subscribers' stations, of two lines grounded at one of said stations and passing, respectively, through both of said stations in series to a common switching device at the central office, one of said lines being closed through an annunciator to ground and the other being normally open at the central office, the generator of the subscriber at the intermediate station being included in the normally-open line with a switching device for closing said generator to the closed line, whereby the subscriber at the said intermediate station may send current from his generator to operate the annunciator included in the circuit grounded at the central office.

10. The combination, substantially as specified, of two parallel telephone-lines extending between a central station, an intermediate sub-station, and a terminal sub-station and connected to earth at the latter, signaling appliances at each sub-station, included each in the circuit of one of the said lines, switching devices at each sub-station controlling the outgoing and incoming ends of both lines, operated in one direction by a positive force to unite the two ends of the said two lines leading to the central station and to form thereby a metallic talking-circuit, and oppositely, by the replacement of the telephone on its holder, acting against said positive force to break the said metallic circuit and to re-establish the two independent signaling-circuits, a common switching and signal-receiving appliance at the central station for both lines, and a circuit-changer at the intermediate sub-station, whereby the call-sending appliance at said station may be temporarily transferred from one signaling-line to the other, for the purposes described.

11. Two independent earth return-lines, each extending from a central station through an intermediate sub-station to a terminal sub-station, signaling sending and receiving appliances at each sub-station, those at the intermediate sub-station being in circuit with one of the said lines and those at the terminal sub-station being in the circuit of the other said line, telephones at each sub-station, and an automatic switch at each sub-station, controlled by the removal and replacement of said telephone in its holder and being adapted when the said telephone is removed to disconnect the earth terminals and to unite the central-station ends of both lines, thereby forming a metallic circuit including the sub-station telephones and extending from said sub-station to the central station, substantially as specified.

12. In combination with two subscribers' stations connected with each other and with a central station by means of two electric lines, forming together a metallic or loop talking-circuit, and severally independent circuits, each including the signaling apparatus of one of the said sub-stations, an automatic telephone-switch at each sub-station determining by its position the arrangement at any given moment of said two lines, a telephone at each sub-station, adapted for inclusion in the metallic talking-circuit and mechanically controlling the said automatic switch, an independent circuit-changer at the intermediate station only, acting in its normal position to maintain continuity of the two line-circuits, and two normally-discontinuous branches derived from the lines leading to the outer sub-station and extending to alternative contact-terminals of the said circuit-changer, the said circuit-changer being movable into contact therewith, and being thereby adapted to complete a metallic telephone-circuit between the two sub-stations independent of the central station.

13. In a telephone-exchange system, the combination of a central station, two sub-stations, signaling devices at each sub-station, two electric conducting-lines extending from the central station through the signaling appliances of the two sub-stations, respectively, to earth terminals at the outermost sub-station, thus constituting an independent signaling-circuit for each sub-station, and means, as indicated, at each sub-station for simultaneously disconnecting both lines from their earth-terminal extensions and for uniting the said two lines through the sub-station telephones for the purpose of forming a metallic talking-circuit, substantially as hereinbefore described.

14. In a telephone-exchange system, a central station, two sub-stations, two parallel earth return-lines constituting signal-receiving circuits for the said two sub-stations, respectively, and each passing through both sub-stations serially to ground at the outermost one, and switching devices capable of

two positions at each sub-station, which in
one position maintain continuity of the said
two independent signaling-lines, but in an-
other disconnect the ground terminal there-
5 from and unite the two ends of the portions
of both lines leading to the central station,
thus constituting a metallic talking-circuit,
substantially as specified.

In witness whereof I hereunto subscribe my
name this 13th day of December, A. D. 1887. 10

FRANKLIN G. BEACH.

Witnesses:

CHAS. G. HAWLEY,
GEORGE P. BARTON.