

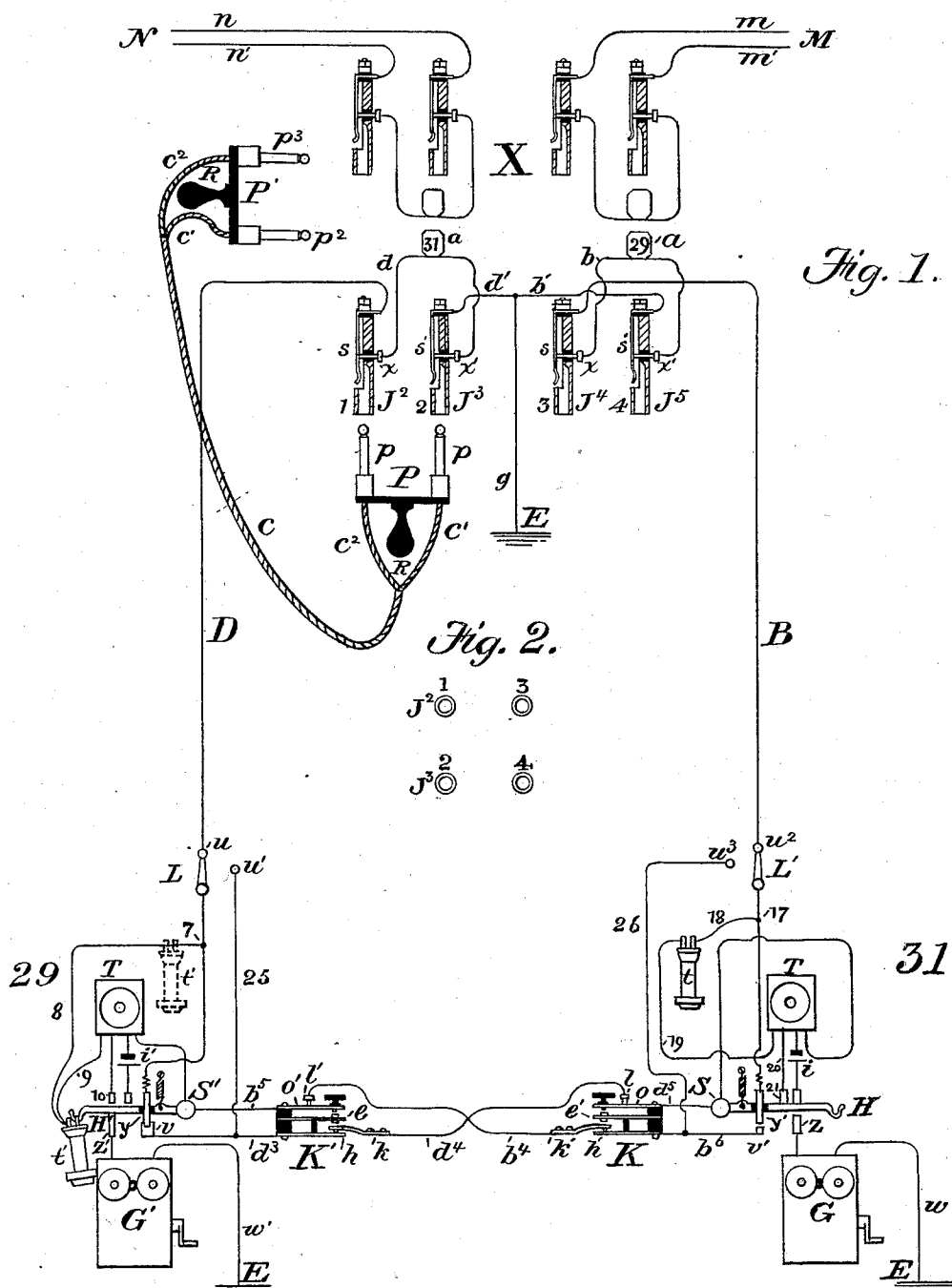
(No Model.)

F. A. PICKERNELL.

TELEPHONE COMBINATION CIRCUIT.

No. 405,677.

Patented June 18, 1889.



Witnesses.

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UNITED STATES PATENT OFFICE.

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TELEPHONE COMBINATION-CIRCUIT.

SPECIFICATION forming part of Letters Patent No. 405,677, dated June 18, 1889.

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To all whom it may concern:

Be it known that I, FRANK A. PICKERNELL, residing at East Orange, in the county of Essex and State of New Jersey, have invented certain Improvements in Telephone Combination-Circuits, of which the following is a specification.

For the more perfect and undisturbed transmission of speech it is a well-known practice to provide a return-wire for the telephone-circuit instead of utilizing the earth therefor. A metallic or double-wire circuit is thus formed, the direct and return wires whereof are substantially equidistant from any external electric wire. Disturbing induced currents are in this way neutralized and earth-currents avoided. For long distances—for example, between large cities—this, so far as I am aware, is the only practically satisfactory plan of construction; but since metallic circuits require twice as much wire as earth-return circuits, it is clear that they are very expensive; moreover, in the majority of cases the sub-station lines are ready in operation upon the single-wire plan, and for these reasons the lines extending between different centers of population should in all cases be constructed as metallic circuits, as the major part of the disturbance originates upon the said long stretches of line. In many cases it is also desirable to utilize for telephone-exchange sub-station circuits, if feasible, the single-wire or earth-return plan of construction, and thereby to keep the cost down, provided that this can be done without sacrificing materially the advantages accruing from the use of metallic circuit.

My invention accomplishes this, and its object is to arrange single-wire telephone-circuits in such a way that each one may be enabled to utilize some other as a return-wire for itself extending to the same central station, the two together constituting a temporary metallic telephone-circuit. Any number of ground-return or single-wire circuits may thus be enabled at an inconsiderable expense to participate in the benefits of a non-inductive parallel metallic circuit, and in case any sub-station on a single line is to be connected

with a sub-station at a distance by means of a metallic trunk-circuit, my invention furnishes a means whereby this may be done, and whereby the two wires of the said trunk-circuit may be made practically continuous through the said sub-station directly and without the intermediation of repeating-coils.

My invention is shown in the drawings as being embodied in two ordinary single-line telephone-circuits, which are paired with each other to form a metallic circuit when either sub-station desires to use the line for conversation; but it is obvious that any number of such lines may be so arranged.

The several sub-station earth-return circuits are arranged in pairs; but each is capable of being connected singly at the central station with any other similar circuit, as usual, while the two wires of the said pair running to two subscribers' stations near to one another are used together by either of the said stations as a metallic circuit. This arrangement provides that either party while talking has a metallic circuit; that the central station can ring one subscriber without ringing the other; that when one subscriber is using the circuit in conversation, the other one, should he attempt to ring, is at once apprised that the joint-talking line is already in use; that the telephonic service is absolutely private; that the circuit does not include electro-magnets with their well-known retarding effect, while it does not necessitate any complication or material difference in the operation of the central station.

To these ends my invention comprises a circuit arrangement of a pair, and necessarily therefore of any number of pairs, of single-wire circuits, in which each wire of the said pair or pairs is when quiescent terminated at the earth at its own sub-station, as usual, and is capable of being united at a central station with other single-wire circuits, while, however, it is also capable of being employed as one member of a metallic circuit of which the other wire of the pair constitutes the other member, the two lines then forming a metallic circuit adapted to be used at will, albeit separately, by the sub-station of either of the said lines which are respectively its compo-

nent parts, the said metallic circuit being also adapted to be united at the central station with any other metallic circuit similarly or otherwise formed.

5 It furthermore consists in two lines, each extending from a central station to its own sub-station and there normally grounded, but each passing first through a contact controlled by the automatic switch device of the other, 10 whereby each sub-station may obtain the control of both lines for conversational purposes and at the same time break the continuity of the calling-circuit of the other, thus preventing either station from sending call-signals 15 while the other is using the line and affording an indication also at the station essaying to call by the refusal of its bell to ring that the said other station is already using the line. It consists, also, in establishing the 20 telephones at one of the said sub-stations in a normally-open branch circuit permanently attached to the line leading to the other station. At a point before the said line reaches the controlling automatic switch contact, 25 whereby, when the said switch at either sub-station is, by the removal of the receiving-telephone, permitted to act, the said telephones may be and are included in a circuit composed of both lines, the normal circuit of 30 the line leading to the other station being broken and the said other station being thereby disabled from sending call-signals until the receiving-telephone is replaced.

It also comprises suitable means for enabling the two sub-stations of two lines so 35 paired to signal and communicate telephonically with each other, and in certain other details in the arrangement of the spring-jacks and central-station devices, to be hereinafter 40 more fully specified.

In the drawings, which accompany and form a part of this specification, Figure 1 is a general electrical diagram indicating an arrangement of circuits and instrumentalities in 45 which I have actually embodied my invention, and Fig. 2 shows the actual position of the four spring-jacks sockets of two paired grounded circuits.

Referring now more specifically to the said 50 drawings, X represents a central station and 29 and 31 are sub-stations at some distance therefrom and near to one another.

B is a line-wire normally connecting sub-station 29, and D a line-wire normally connecting sub-station 31, with the central station. 55 At the said central station both lines, after passing their appropriate and necessary apparatus, terminate at the earth E.

The apparatus of each line when constructed 60 in accordance with my invention consists of two ordinary spring-jacks and a call-receiving annunciator. The spring-jacks J may be constructed as usual, each comprising a socket and frame piece 1, 2, 3, and 4, a resting contact-screw *x*, insulated from said frame, and a 65 contact-spring, also insulated, affixed to the said frame and resting near its free end upon

the said contact-screw, but so disposed that it may be lifted out of contact therewith by the insertion of a properly-conformed plug in the 70 socket. The annunciators are also of the ordinary character. Now, considering the line B, the circuit may be traced from the point where it enters the central station, as follows: Line B, spring *s*, and contact-screw *x* of spring-jack J⁴, wire *b*, including the electro-magnet 75 of the annunciator *a* of station 29, contact-screw *x'*, and spring *s'* of spring-jack J⁵, wire *b'*, and ground-wire *g* to earth E. Similarly, line D, entering the central station, may be traced by way of spring *s* and contact-screw 80 *x* of spring-jack J², wire *d*, including annunciator *a* of station 31, contact-screw *x'* and spring *s'* of jack J³ and ground-wire *d'* to earth at E. 85

The spring-jacks of each pair of lines are mechanically disposed, as shown in Fig. 2, where the plug-sockets 1 and 2 of jacks J² and J³ are at a determinate distance in a vertical plane, while the sockets 3 and 4 of the 90 second line of the pair are disposed in a like vertical plane immediately adjacent to the sockets of the first line. Furthermore, it is required that the distance between 1 and 2 and between 3 and 4 shall be equal to that 95 between 1 and 3, because the same double-plug connector that is adapted to fit a pair of sockets—say 1 and 2—vertically mounted must be also capable of being thrust into 1 and 3, for the purpose of operating the two 100 lines together as a metallic circuit. This plug-connector P is shown as consisting of two simple conducting-plugs *p*, having a common non-conducting handle R. This may, as shown, be affixed to one end of a double-conducting 105 cord *c*, provided at its other end with a similar compound plug P', having twin plugs *p*² *p*³ for insertion in adjacent plug-sockets, the main cord *c* at both ends being bifurcated to the several simple plugs by branches *c'* and *c*². 110 Such a compound plug and cord conductor may be used either, as shown, to connect one of the lines of a pair with a metallic circuit, or it may be employed to connect the two lines of a pair in the same way with a metallic 115 circuit.

It is not absolutely necessary to employ two spring-jacks for each line, but it is useful in mixed systems of metallic and single-wire 120 circuits, because when they are present the double-conductor cords and plugs can be used for all circuits alike and two classes of cords dispensed with. The cord *c* can of course be fitted to unite the several lines D or B with calling apparatus and operators' telephones in 125 a manner well understood, the said calling apparatus being, if desired, included in the circuit of said cord.

M and N represent two metallic trunk-line circuits terminating at central station X and 130 adapted to be there united with any sub-station line or with each other. The two wires of each *m m'* and *n n'* are respectively connected with connecting and calling devices

of the same character as those already described.

Passing now to the arrangements of the sub-stations 29 and 31, it is to be borne in mind, as before stated, that B is the individual line of station 29, and D that of station 31.

T and T' are transmitting and *t* and *t'* receiving telephones.

H and H' are the automatic switch-hooks, operated, as usual, by the removal and replacement of the receiver.

G and G' are the bells and generators, *i* *i'* the respective transmitter-batteries, and K and K' keys, the object whereof will presently be stated.

Suppose, first, the receivers to be in place and resting upon the hooks H and H'. Each line coming from the central station is run first to the station of the other. There it passes through a pair of contacts (preferably sliding) *y* *v*, controlled by the movement of the automatic switch at the said station of the other line, but carefully insulated from the said switch. From the contact *v* it continues to its own station, where it connects in the ordinary way at S with the automatic telephone-switch H. The receivers being in place upon their hooks, the circuit continues through the substance of said hooks to the resting-contacts thereof *z*, and then through the bells and generators G to earth. Under these conditions the central station can of course by means of the ordinary calling apparatus signal either sub-station over its own earth-circuit, and each sub-station can also in like manner signal the central station.

Although the letters in the drawings referring to like parts are distinguished from one another by being at one station provided with indices, I have not thought it necessary to refer to the said index letters or figures, since both lines are constructed identically.

Now, suppose one of the sub-stations (say 31) to be using the two lines as a metallic circuit, the telephone-receiver, is of course removed from its support, as shown. The circuit from the central station, by way of wire D, is then the same as before until the point S on the switch H at station 31 is reached; but the said switch now being in position for talking, the circuit continues, by contact-spring 21, wire 20, transmitter T, wire 19, receiver *t*, wire 18, to a point 17, where the telephone branch, normally open at 21, is permanently united with the main line B of the other station, and from this point the circuit returns over said line B to the central station, the resting or calling circuit of said line being broken at *y'* by the elevation of switch H. Now, as the plug-sockets at the central station are arranged, as in Fig. 2, in the form of a square, the operator can by inserting his twin plug-in sockets 1 and 3 connect the two lines B and D with any other metallic circuit, thus constituting a compound metallic circuit extending to station 31.

Both stations of course have the same facilities; and either can get possession of the line for use as a metallic circuit at any time except when the other is actually so using it. The stations of grounded lines can thus at low cost be furnished with metallic circuit facilities, and when so working no earth branch at all is in connection with the said metallic circuit.

It is impossible that either sub-station can interfere by sending a call-signal while the other is conversing; because the calling-circuit of the second station is broken in the switch of the first, and it is equally impossible that one station can overhear the conversation of the other, because when one is already using the line, should the other remove his receiver and attempt to listen, the only result thereby attained is that the circuit of the first is broken in the switch of the second.

Another advantage is that by this arrangement no electro-magnets are left in the talking-circuit to retard and interfere with the voice-currents.

The central station rings each independently by using the plug-sockets 1 and 2 to ring station 31, and sockets 3 and 4 to ring station 29. Neither station is therefore disturbed by hearing call-signals intended for the other.

When it is desired to connect either line as a single circuit with other single lines at the central station, this can readily be done by employing the spring-jack J² of line D or J⁴ of line B only. The talking-circuit for station 29 would in that case start at the central-station earth terminal, and passing over line D would continue over line D, telephones and switch-hook at station 29, contacts *v'* and *y'* at station 31, and then over line B to spring-jack J⁴, which, by means of any suitable single cord and plug connector, can be united to a like jack of the line desired. I have thus shown the adaptability of my system of combined circuits to metallic or single-wire circuit work. It is only requisite now to describe the means whereby the two sub-stations of any pair can signal and converse with each other. K is a compound key located at station 31, and K' is a similar key located at station 29, both being arranged to control both circuits. A portion of each line traverses the space between the two stations. Line B, after passing the contacts *y'* *v'* controlled by but insulated from switch H at station 31, is led on its way to station 29 through the lower contacts *h'* *k'* of key K, then by wire *b*⁴ to back contact of the key K', to the upper strap *o'* thereof, and from thence to the switch H' at S'. Line D in the same way reaches the switch H at station 31 by way of wires *d*³, *d*⁴, and *d*⁵, the lower contacts *h* and *k* of key K', and the upper contacts *l* and *o* of key K. The telephones of both stations being at rest, either station can ring the other by first pressing the key, thus breaking both normal con-

tacts and forming a new one between the upper strap of the key and that member of the original lower contact which leads to the other station. Let station 31, for example, signal station 29. The operator presses the key K and turns the crank of his generator. The ringing-circuit is now from E at station 31, through wire *w*, generator and bell G, spring-contact *z*, hook-switch H, wire *d*⁵, upper key-strap *o*, middle key-strap *e'*, fixed key contact-piece *k'*, wire *b*⁴, back contact *l'* of key K', upper strap of said key, wire *b*⁵, switch H', bell-contact spring *z'*, and bell G' to earth. Each subscriber can thus signal the station on the other line of his pair without first calling the central station, and the operator at the other station 29, hearing the call, may press his key K', take his receiver from the hook, and talk, station 31 now leaving key K undepressed. A local talking-circuit is thus formed, extending from earth at the central station through spring-jack J³, annunciator *a*, wire *d*, jack J², line-wire D, junction-point 7, receiver *t'*, and transmitter T', at station 29, wires 8 and 9, contact-spring 10, switch-bar H', wire *b*⁵, upper key-strap O', central key-strap *e*, fixed contact-piece *k*, wire *d*⁴, contacts *l* and *o* of key K, switch-bar H, contact-spring 21, wire 20, transmitter T, wire 19, receiver *t*, wire 18, junction-point 17, and then by line B back to earth at the central station. It is sometimes undesirable to form a circuit of this length simply for telephonic communication between these sub-stations, and other modes of arranging the circuits may be substituted. For example, I have indicated one which is very convenient.

A switch L or L' may be introduced into the circuit of each main line external to the junction of the telephone branches. Normally these switches may rest on the points *u* *u*², and thus maintain the continuity of said lines; but if private telephonic communication be desired, the switches may be turned onto points *u'* and *u*³, which are respectively the terminals of normally-discontinuous branches 25 and 26, extending from the wires *d*³ and *b*⁶, and a short telephonic circuit may thus be formed, which is completed when both receivers are taken from their holders. Neither key need now be pressed during conversation.

Keys with back and front contacts may of course be substituted for the switches L and L'.

Having now described my invention and its operation, I claim—

1. In a telephone-exchange system, two single-line or earth-return circuits, each extending from a central to a sub station and each normally grounded through signaling apparatus at its own sub-station, combined with automatic switches at each sub-station controlling the earth terminals of both lines and operated by the removal and replacement of the receiving-telephones, whereby when the said receiving-telephone at either sub-station

is removed from its position of rest it is connected in a metallic circuit formed of the said two lines, and whereby the normal earth terminals of both lines are automatically disconnected by the operation of the switch at either station.

2. In a telephone-exchange system, the combination, substantially as hereinbefore described, of two single-line or earth-return main circuits, each extending from a central station to an earth terminal at an independent sub-station, and signal sending and receiving appliances at each sub-station included in said circuit, with telephones at each sub-station, and means also at each sub-station for disconnecting the earth terminals and signaling appliances of both circuits, and for automatically uniting the said two single lines to establish a metallic circuit including the said telephones, whereby each sub-station may be provided with an individual ringing-line, and with an exclusive metallic talking-circuit, for the purposes specified.

3. In a telephone system, two single-line or earth-return circuits, each extending from a central station to a sub-station, where it normally terminates in the earth, each line constituting a distinct and independent signaling-circuit, automatic devices at each sub-station operated by the removal and replacement of the telephone, whereby the said two distinct lines may be united through the telephones of said sub-station in metallic circuit, and spring-jacks at the central station arranged in pairs, as shown and described herein, the terminals of both lines at said central station being in close proximity to each other, whereby both terminals may by the same movement be connected with the terminals of any other line, substantially as described.

4. The combination, substantially as hereinbefore described, of two single-line or earth-return circuits, each extending from a central station to its own sub-station, and there normally grounded after passing through signaling devices, but each passing first through a circuit-breaker or movable contact controlled by the automatic switch of the other sub-station, for the purposes specified.

5. In a telephone-exchange system, the combination of two lines, each extending from a central station through the sub-station of the other to a normal earth terminal at its own sub-station, a normally-open branch circuit at each sub-station, including the telephones of the said sub-station, the said branch being in permanent connection at one end with the line of the other sub-station, as described, and automatically-operated means at each station for disconnecting the earth terminals of both lines, and for connecting the disconnected terminal of its own line with the normally-open end of the telephone branch, whereby a metallic circuit including the telephones is established, substantially as hereinbefore described.

6. In combination with two telephone-lines,

each extending, as described herein, through
the station of the other to earth at its own
station, signaling appliances and telephones
at each sub-station, and an automatic tele-
5 phone-switch at each sub-station adapted to
transfer the main line of said station from its
signaling-instruments to the telephones, and
vice versa, and to disconnect the earth ter-
10 minals of both lines, of circuit-changing keys
or switches at each station controlling con-
tacts in both lines, as described, whereby the
said two sub-stations are enabled to signal

and converse with each other without the in-
termediation of the central station, substan-
tially as specified.

15 In testimony whereof I have signed my name
to this specification, in the presence of two sub-
scribing witnesses, this 6th day of March,
1889.

F. A. PICKERNELL.

Witnesses:

JOHN A. BARRETT,
GEORGE E. COMYNS.