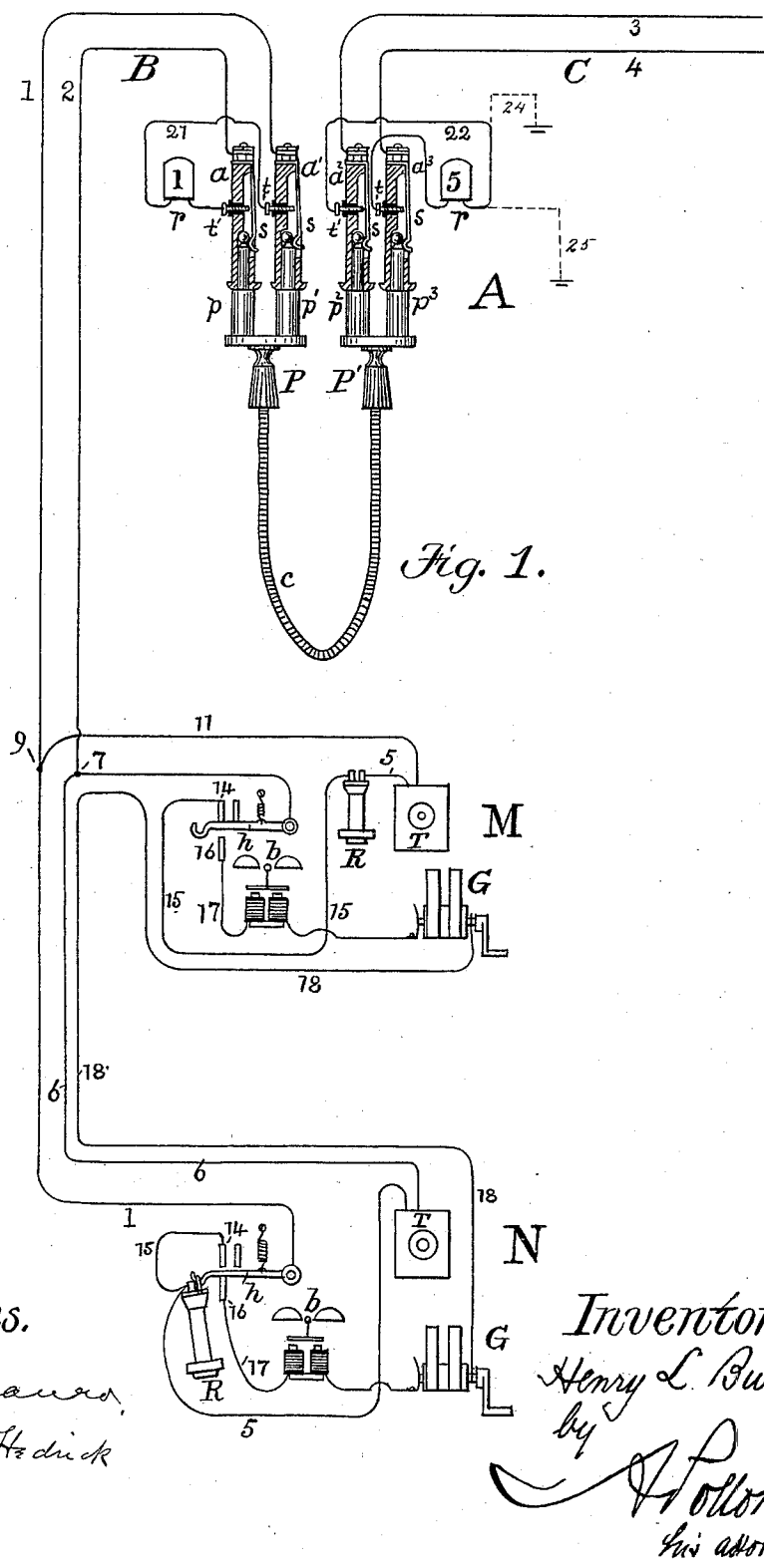


H. L. BURBANK.
METALLIC TELEPHONE CIRCUIT.

No. 405,461.

Patented June 18, 1889.



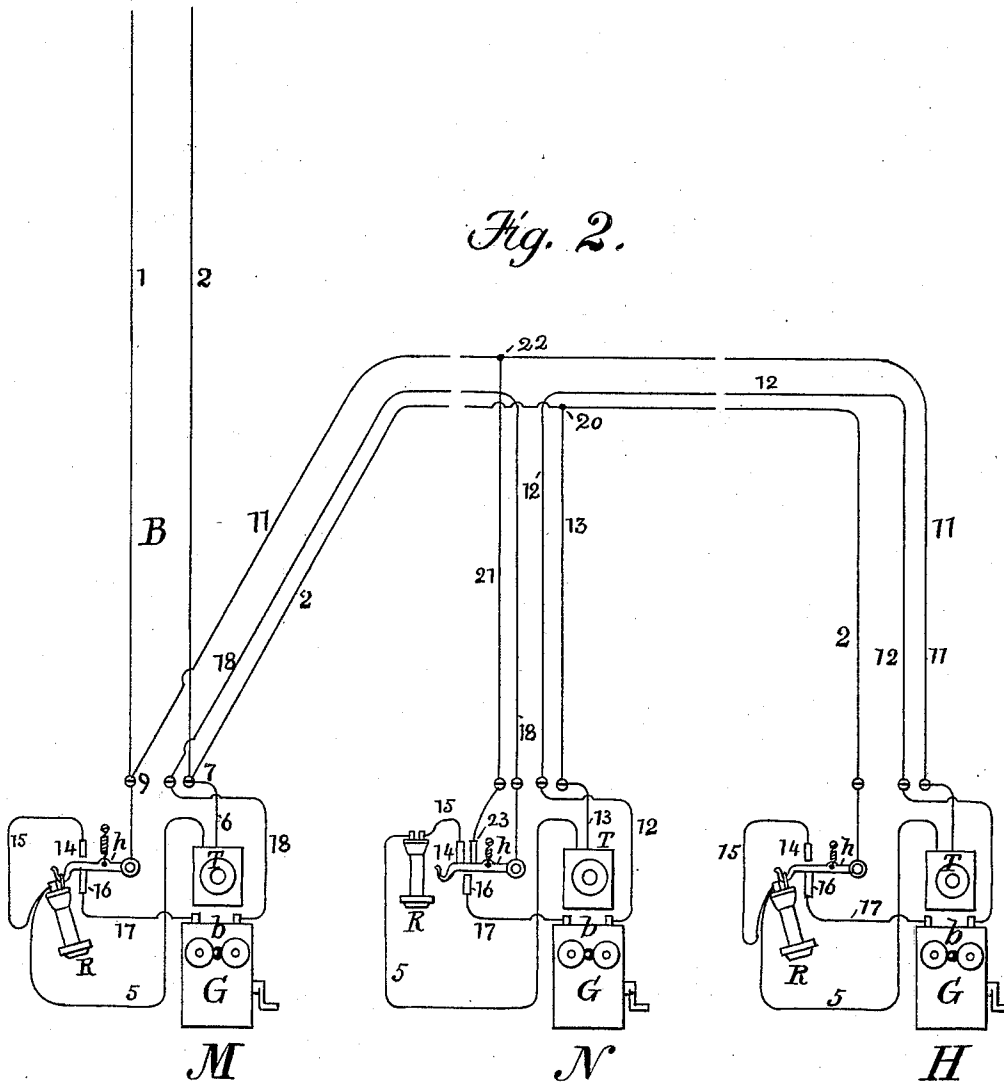
Witnesses.
Philip H. H. H.
Charles J. H. H.

Inventor.
Henry L. Burbank
by
J. H. H.
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Witnesses.

Philip Kanno.

Charles J. Hedrick

Inventor.

Henry L. Burbank
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his attorney.

UNITED STATES PATENT OFFICE.

HENRY L. BURBANK, OF JERSEY CITY, NEW JERSEY, ASSIGNOR TO THE
AMERICAN BELL TELEPHONE COMPANY, OF BOSTON, MASSACHUSETTS.

METALLIC TELEPHONE-CIRCUIT.

SPECIFICATION forming part of Letters Patent No. 405,461, dated June 18, 1889.

Application filed March 13, 1889. Serial No. 303,074. (No model.)

To all whom it may concern:

Be it known that I, HENRY LYMAN BURBANK, residing at Jersey City, in the county of Hudson and State of New Jersey, have invented certain Improvements in Metallic Telephone-Circuits, of which the following is a specification.

My invention relates to the art of telephonic communication, and more especially to systems utilizing metallic circuits.

For the more perfect transmission of speech, and to the end that the voice-currents may not be interfered with by extraneous induced and earth currents, it is now a well-known expedient to provide a return-wire for the telephone-circuit instead of using an earth-return, thus forming a metallic circuit the direct and return wires whereof are practically equidistant from any external electric wire. By this expedient not only are disturbing electric currents due to induction neutralized, but the ordinary earth-connection of the telephone-line being dispensed with earth-currents traceable to that source are also avoided; but since metallic circuits require two wires, and since to obtain the best results one station only should practically be connected with each circuit, this class of construction is very expensive.

The object of my invention is to obtain the benefits accruing from the use of metallic circuits, and to reduce the costliness of such circuits by making each double-wire circuit subservient as the conducting medium for two or more sub-stations, and to do this while providing that each station shall, when using the line for telephonic conversation, have a clear line unencumbered by interposed electromagnets, that each station shall be enabled to ascertain when the circuit is already being used by another, and that while any one station is using the line none of the others shall be able to disturb the conversation by sending a call-signal.

To this end my invention consists in certain arrangements of the circuits with respect to the several appliances at the several stations, whereby, when all the stations are at rest, the several call-bell helices and call-bell generators are serially connected in cir-

cuit, so that each station may receive a call from or send a call to the central station, or exchange calls with each other, and whereby the calling-circuit of both is opened when either station is using the line for conversation. This is effectuated in the simplest embodiment of my invention by causing one of the two main wires to pass directly to the movable member of the automatic telephone-switch of the sub-station most distant from the central station, by causing the other main wire to terminate in the normal or resting contact of said switch at said most distant station after passing successively through the movable member and resting contact of the switch, and the bell and generator helices at the intermediate station, and then through the generator and bell helices at the said most distant station, and by constructing a branch circuit from the telephone or working contact of the switch at the intermediate station, through the telephones at said station to a junction with the first named of said lines, and a similar branch from the telephone-contact of the terminal station to a junction with the second line, both junctions being located between the central station and the movable member of the automatic switches to which the said lines mainly lead. When the system is extended to embrace a larger number of stations, modifications become requisite, which will hereinafter be adverted to; but in both cases shown and in all embodiments of my invention it is required that the calling appliances of all stations shall be (when the circuit is at rest) serially included therein, so that each generator may be in serial circuit with all of the call-bells and with the central station call-receiving appliance. The said circuit thus extends virtually in normally-closed loops to each sub-station, and the said loops include the said call apparatus. Furthermore, in order that each sub-station may have a clear talking-circuit, and that the act of establishing said talking-circuit may disestablish the ringing-circuit, my invention also contemplates in all cases that each station shall also be provided with normally-open talking-loops, one side of each of these being formed of that side of the closed loops

which includes the switch-lever, the other side being formed of the telephone branch circuit extended from the working-contact of said switch through the telephones to a junction with that one of the main lines with which the branch terminating in the said switch-lever is not connected, as herein indicated.

I have illustrated this specification by two diagrams, Figure 1 showing my invention in its simplest form, while Fig. 2 shows the same principles, but extended to three sub-stations.

In Fig. 1, A, is supposed to be a central telephone-station, to which metallic or double-wire telephone-circuits B and C, together with others, converge. My invention is practically disclosed by the consideration of a single circuit, and but one circuit, accordingly, is delineated in full. The said circuit B has two sub-stations M and N. At the central station the two wires 1 and 2 of circuit B, as well as those 3 and 4 of circuit C, are shown as being connected with the spring-contacts *s* of the several spring-jacks *a*, *a'*, *a''*, and *a'''*. Normally these springs rest on the insulated contact-points *t*, the points of the two spring-jacks of each line being united by the wires 21 and 22, in both cases passing through the respective call-annunciators *r*, which are thereby normally included in their respective circuits. The circuits B and C are represented in the drawings as being interconnected by means of the jacks and a flexible cord *c*, which carries two insulated conductors and ends with double connecting-plugs P P', the two members *p* and *p'* of the end P being inserted in the jacks *a* and *a'*, while the two members *p''* and *p'''* of the end P' in like manner are inserted in the jacks *a''* and *a'''* of line C. The springs *s* of all of the jacks are thus raised out of contact with their insulated pins and the annunciator branches are thereby disconnected, while the ends of the two wires 1 and 2 of circuit B are at the same time united to the ends of the two wires 3 and 4 of the circuit C. Instead of normally uniting the two wires of each circuit together through their annunciator-helices, one may be connected directly to earth and the other to earth through the annunciator-helix, as shown by the broken lines 24 and 25, Fig. 1. This would not interfere with or disturb the condition of the two wires of the circuit with respect to the sub-stations.

Each sub-station is, as usual, provided with a call-sending generator G, a call-receiving bell *b*, receiving and transmitting telephone-instruments R and T, and a circuit-changing switch *h*, which in one position, (that of rest,) when controlled by the receiver, directs the main circuit through the calling appliances, and which, when the receiver is removed therefrom, automatically operates and transfers the main circuit to the telephone-instruments.

One of the main wires—say 1—extends outwardly to the terminal station N, and there is united with the switch-bar *h*. Sup-

posing the circuit to be at rest and both receiving-telephones in place, the circuit is continued through the resting-contact 16 at station N by way of the wire 17, bell *b*, call-generator G, and wire 18 back to the intermediate station M. Here it leads successively through call-generator G, call-bell *b*, wire 17, resting-contact 16, and switch *h* to the second main wire 2, which can now be traced back to the central station. When this is the condition of the sub-stations, either station-operator may operate his generator and drop the annunciator at the central station, and may also ring the other sub-station. In like manner the central station may signal either sub-station. The sub-station bells being in series, each will hear the others ring, and will thus be apprised that the line is about to be used. A definite signal must be assigned as the call for each sub-station, or some simple individual call may be employed. From any point 9 on wire 1 between station N and the central station A a branch wire 11 is led to station M, and is there connected with the upper or telephone switch-contact 14. The telephone-instruments T and R are connected in circuit with this branch, of which wire 15 is a continuation. In like manner a similar branch circuit 6 leaves any point 7 on the line-wire 2 between sub-station M and the central station, and, passing through the telephones at station N, terminates in the telephone-contact 14 of the switch-contact there. This construction gives a clear metallic circuit for each sub-station telephone, whereby the telephonic transmission of both remains unobstructed by the call-magnets of the other, and which cannot be broken, disconnected, or disturbed by the operation of the calling apparatus of the other, for, suppose the operator at station M to be talking, his telephone is removed from the switch-holder *h* and the switch makes contact with upper contact 14. The circuit is from the central station through sub-station M and back by way of main wire 1, junction-point 9, branch 11, transmitter T, wire 5, receiver R, wire 15, contact-piece 14, switch-bar *h*, and main wire 2.

Sub-station N cannot disturb the operation by ringing, because, although wire 1 continues to that station and there connects with the calling apparatus, the circuit of the said apparatus continued by wire 18 is open at the resting-contact 16 at station M. Thus though N may actuate his generator he cannot send a signal, and, furthermore, he is immediately informed that M is using the line by the refusal of his own bell to ring. He therefore waits until he hears the disconnecting-ring of M; and in like manner, should N be using the line, M cannot interfere by ringing, because his ringing-circuit is made discontinuous by the disconnection at station N of the switch *h* from its resting-contact 16, and N has a clear metallic circuit by way of wire 1 to station N, switch *h*, telephone-contact 14,

wire 15, receiver R, wire 5, and transmitter T, all at station N, and wire 6 to junction-point 7, and thence back to the central station over wire 2, the main-line continuation of said wire 2 through the calling apparatus of both stations being, as already indicated, open at 16, station N.

The cost of such additional construction as may be required need not be great, as any two stations which are to be operated together on the same circuit will naturally be comparatively close together; and it will be seen that two wires only are required between the central and the nearest sub-station, the third and additional wire being required between the intermediate and terminal sub-station only. Of course the connections of the two lines with respect to the two stations may, if desired, be reversed.

Fig. 2 represents an extension of the principle to three sub-stations M, N, and H. Bearing in mind that all of the calling appliances are in series when the line is at rest, it is not difficult to trace the circuits. The station appliances are unchanged, consisting, as before, at each station of a call-generator G and bell b, transmitting and receiving telephones T and R, and an automatic switch h. The normal or calling circuit extends from the central station over wire 1, successively through sub-stations M, N, and H, and back by wire 2, the route being as follows: wire 1 to station M; there by switch h, contact 16, wire 17, and calling appliances G out; then by wire 18 to station N, there through switch h, contact 16, wire 17, and calling appliance G out; then by wire 12 to station H, and there through bell b, generator G, wire 17, contact 16, and switch h, and then back by wire 2 to the central station.

To complete the telephone-circuit of station M, a branch terminating, as in Fig. 1, at the telephone-contact 14 of the switch h, leads by way of wire 15, receiver R, wire 5, transmitter T, and wire 6 to the junction-point 7 on main line 2. The telephone-circuit of station N extends (normally open, of course) from telephone-contact 14 of the switch h, by way of wire 15, receiver 5, transmitter T, and wire 13, to the junction-point 20 on return-line 2.

The telephonic facilities of station H are, as in Fig. 1, provided by means of a branch circuit extending from the telephone-contact of the switch there through the telephones, and by wire 11 to the junction-point 9 of main line 1. In addition to the above a shunt-wire 21 is required for the intermediate station, this extending from a subsidiary telephone-contact 23 to a junction-point 22 on the branch 11 of main line 1. Were it not for this shunt the telephonic currents to and from station N would be required to traverse the wire 18 and the calling appliances at station M. The results attained in this latter organization are in every respect analogous to those attained in the simpler organization of but two stations. Calls sent to or from the

central station by or for either sub-station are heard by all alike, all having their calling appliances in series.

When either sub-station is using the line for conversation, the others are debarred from sending call-signals, their calling-circuit being thereby made discontinuous, and each sub-station has a clear metallic circuit extending to the central station, no electro-magnets, except those actually appertaining to the telephones in use, being in the said circuit.

It only remains to be stated that when a plurality of stations are connected upon the same circuit in accordance with my invention each can call and converse with any or all of the others, the calling appliances being in series and the several telephones being multiple are with each other.

I claim—

1. The combination, with a metallic telephone-circuit having two or more sub-stations connected thereon, of calling appliances at each sub-station, the said calling appliances being normally included in series in the said circuit, a branch circuit from each of the said sub-stations to one of the said main lines, as indicated herein, the said branch being normally open at the said sub-station, telephones included in said branch circuit, and a switch at each sub-station having its movable element permanently in electrical connection with the main line not connected with the telephone branch of its own station, the said switch being adapted to maintain the continuity of the metallic circuit through the call apparatus of both sub-stations when the line is at rest, and through the telephones of its own station breaking the calling-circuit of both stations when the said telephones are being used, substantially as described.

2. The combination, substantially as hereinbefore set forth, in a metallic-circuit system of telephonic communication, of a central station, two sub-stations, each being provided with telephones, calling appliances, and an automatic telephone-switch actuated by the removal and replacement of the receiving-telephone, two main-line wires, one extending from the central station to the switch-lever of the terminal station, forming one side of a metallic electric circuit, and the other extending from the central station to the switch-lever of the intermediate station and forming a portion of the other side of the said metallic circuit, a continuation line extending from the resting or normal switch-contact of the intermediate station through the calling appliances of both stations to the resting-contact of the terminal station, forming the remainder of the second side of the metallic circuit and normally uniting the two switch-levers, (the receiving-telephone being in place,) whereby the calling appliances of both stations are normally included in circuit, and an independent normally-open branch line for each station extending from the working or

telephone-switch contact through the tele-
phones of said station to a permanent junc-
tion with the main line leading to the switch-
lever of the other station, the said branch be-
5 ing in each case adapted to serve as a substi-
tute for that portion of the metallic circuit
which includes the several calling appliances
of both stations, the removal of the receiving-
telephone from its holder at either station be-
10 ing thereby adapted to close the telephone
branch at said station, and to open the cir-
cuit of the calling apparatus at both stations.

3. The combination, with a main metallic
telephone-circuit extending between a main
15 station and a plurality of sub-stations, and
normally-closed loops, one for each sub-station,
the loops being in series in the said circuit,
and each including the calling apparatus of
its respective sub-stations, of a series of nor-
20 mally-open loops, one for each sub-station, the
said loops being in multiple arc with each
other and each including the telephones of its

respective sub-station, and an automatic
switch at each sub-station connected with one
of the main circuit-wires and adapted to form 25
a part of one side of the loops of either class,
according to its position, the calling appara-
tus and telephones in their several loops be-
ing uniformly upon the other side, whereby the
use of the circuit at either station for teleph- 30
ony is adapted to prevent the other stations
from using their calling apparatus, and where-
by the several stations are enabled to simul-
taneously use their telephones for communi- 35
cation with each other, substantially as here-
inbefore described.

In testimony whereof I have signed my name
to this specification, in the presence of two sub-
scribing witnesses, this 16th day of February,
1889.

HENRY L. BURBANK.

Witnesses:

JAMES W. MANSON,

C. EDRICK SHACKFORD.