(No Model.)

T. D. LOCKWOOD.

TELEPHONE CIRCUIT AND APPARATUS.

No. 291,915. Patented Jan. 15, 1884.

Fig. 1.

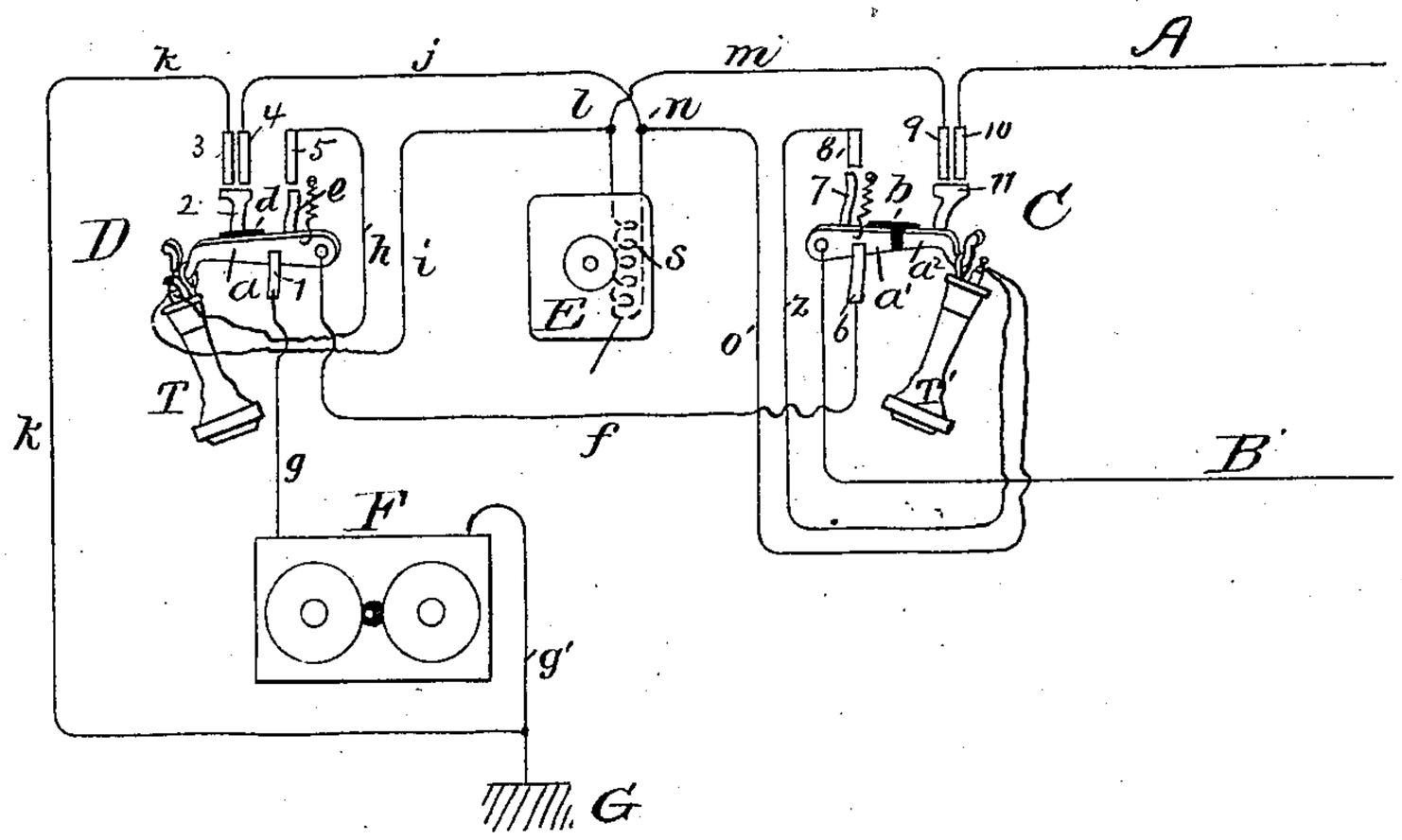
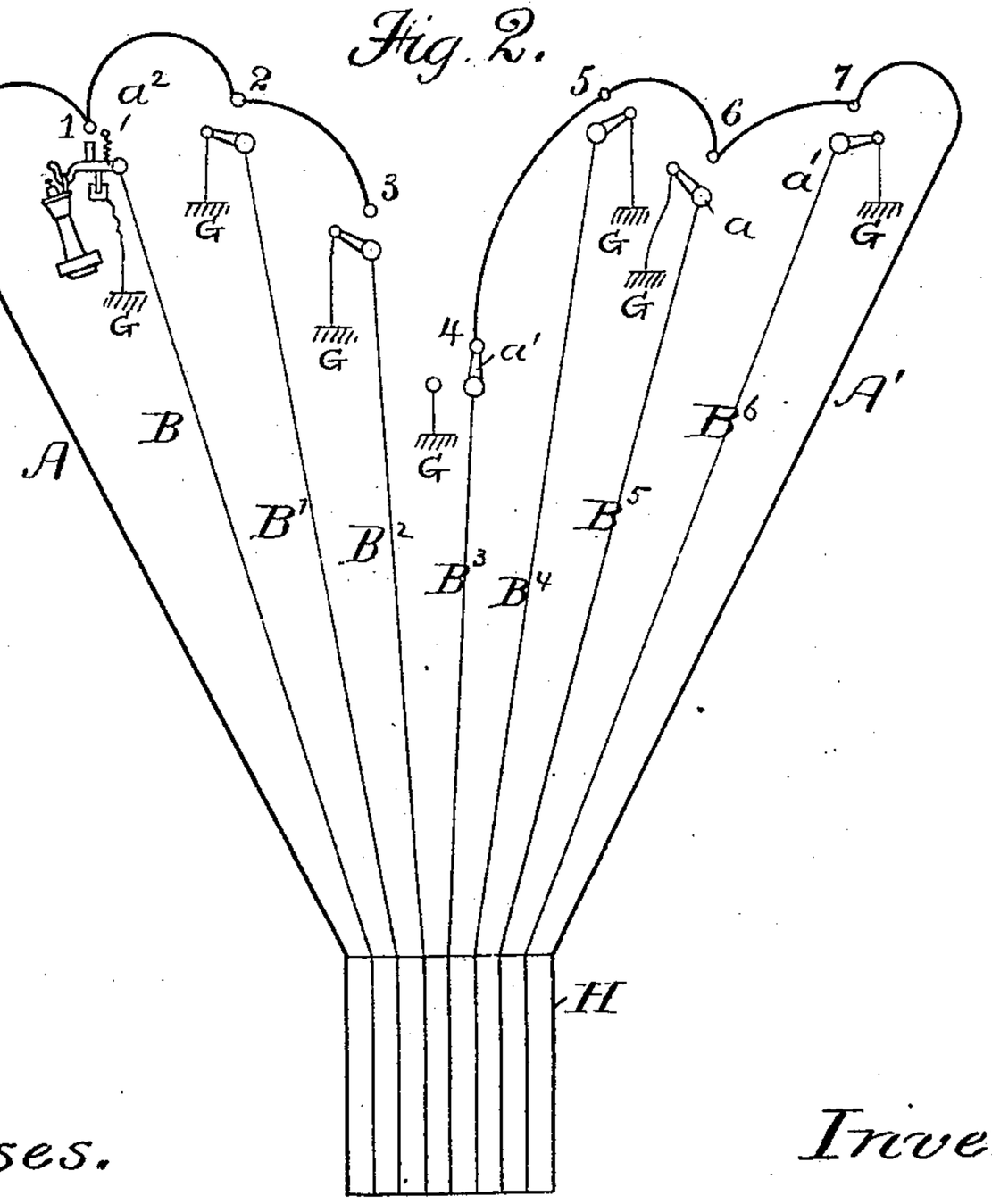


Fig. 2.



Witnesses.

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TELEPHONE CIRCUIT AND APPARATUS.

SPECIFICATION forming part of Letters Patent No. 291,915, dated January 15, 1884.

Application filed April 26, 1883. (No model.)

To all whom it may concern:

Be it known that I, THOMAS D. LOCKWOOD, of Malden, in the county of Middlesex and State of Massachusetts, have invented certain Improvements in Telephone Circuits and Switching Apparatus, of which the following is a specification.

My invention relates to improvements in telephone circuits and apparatus, whereby metallic circuits introduced to diminish the effects of inductive interference may be economically operated in conjunction with the ordinary earth-circuits. Experience has demonstrated that when several line-wires used in the transmission or conveyance of electricity for various purposes are stretched in parallelism to one another, some of them being furnished with telephones and employed in the transmission and reproduction of articulate speech, any variation of the electric force in any of the wires affects the telephone lines adversely, and reproduces in the telephones attached to such lines the signals which may be passing in any or all of the other lines, to the detriment of conversation upon the telephone, lines themselves; and, also, that when two or more separate telephone-lines are supported or laid in close proximity to one another for a considerable distance, the articulate speech transmitted upon one line is reproduced on the others by induction or without actual contact of the several lines involved. To counteract this defect, it has been proposed to provide for each line a parallel return-wire, thus making a metallic circuit, so that the foreign currents induced in one wire of such a metallic circuit will be neutralized by the same current flowing in the opposite direction in the other wire of the circuit, and by such neutralization dissipate or dispense with the extraneous signals; but in a telephone-exchange system it is both impracticable and inconvenient to construct all of the line-circuits with a metallic instead of an earth return, and many circuits must then, as heretofore, terminate at the earth, both at the central and sub stations; and it has been found difficult to construct apparatus at such stations whereby metallic circuits can be conveniently adapted for cross or interconnection with single or ground circuits without losing the advantage gained by the metallic form, inasmuch as if a single line be caused to make contact with a loop it has the effect of reducing that loop virtually to a similar line, unless special arrangements are devised for this contingency; and to this end, the object of my invention is the convenient arrangement of specific apparatus at the several sub-stations with reference to the connecting-lines, whereby any single line-circuit may be used as such, or may be converted into a temporary metallic circuit without the introduction of complex apparatus, or, in fact, without the performance of any operation except that of removing the telephone from its usual support.

My invention is, to a certain extent, based upon that of George H. Bliss, for which he obtained Letters Patent June 13, 1882, No. 259,286. The method adopted therein is to construct, in addition to the regular subscribers' lines, each consisting of a direct line extending between the central and sub station and terminating in a ground-wire at the latter point, one or more other wires extending from the central station and branching into a large number of the sub-stations, each branch, and the main line also, being normally open. A switch is inserted in the circuit of the direct line of each sub-station, whereby the said direct line may be manually transferred from the ground-wire, which forms its normal termination to the branch of the extra wire, thus constituting a metallic loop extending from the central station to the sub-station and return, which loop may of course be connected with any other metallic circuit without losing the advantages resulting from the adoption of this plan.

My invention, which, as I have hereinbefore stated, is based upon and is an improvement upon the foregoing device, consists in the establishment of a second telephone hook-switch, and a telephone normally resting thereon, and in arranging the several circuits and apparatus at the sub-stations in such a manner that when one telephone is removed from its support, the line will remain on a ground-circuit, including the said telephone, and that when the other telephone is removed, the subscriber's line is transferred from its earth terminal to the normally-open branch of the extra wire,

thus forming a metallic loop which includes in its circuit the second telephone and the transmitter, which may be common to either condition.

In the drawings, which illustrate my invention, Figure 1 diagrammatically shows the arrangement of the sub-station apparatus and circuits; and Fig. 2, a general theoretical plan of the main-line circuits, their normal ground-connections, and their alternative metallic return.

I will describe Fig. 2 first, as it is necessary first that it should be understood. H represents the central station or the switch-board thereof. B, B′, B^2, B^3, B^4, B^5, and B^6 are the direct sub-station lines, and A and A′ are the extra lines which, by means of suitable branches extending to each sub-station, may be connected with the direct lines, so that the direct lines instead of terminating at the ground-wires G, may, by means of the switches *a*, be transferred to the branches or terminal points, 1 2 3, &c., of the loop-forming wires A and A′. The return connection of the line B is represented as being made by means of the usual automatic telephone-switch. The small switches, of course, are merely symbols illustrating the fact that the several lines are, at their respective sub-stations, transferable from one terminal to another.

In Fig. 1 the details of the sub-station connections are shown. F represents a magneto-signaling bell; C and D, automatic hook-switches, upon which telephones are, as usual, suspended. A yoke or fork may of course be substituted for the hook as a telephone-support. E is the transmitter, and T and T′ the receiving-telephones. The direct line is represented by B, and the normally-open branch wire extending from the return-wire which enables the metallic circuit system to be used, is indicated by A. The direct subscriber's line B normally terminates at the ground G. The automatic switch-bar C is composed of two metallic parts, *a* and a^2, insulated by a non-conducting partition, *b*. To the portion *a* a contact-spring, 7, is attached, adapted, when the hook passes upward, to slide over and make electrical contact with the plate 8. The substance of the same portion *a* is also adapted to slide under and make contact with the contact-spring 6 when the hook is depressed by the weight of the telephone. The front portion of the hook a^2 carries a contact-spring, 11, which is adapted, as the switch passes upward, to make contact with the two springs 9 and 10, thus uniting them. The switch-lever D is homogeneous, but on its inner surface carries an insulating-plate, *d*, on which is fastened a trailing contact-spring, 2, adapted to pass upward when the telephone is removed, and to make contact with the two plates 3 and 4, uniting them through its substance. A second contact-spring, *e*, is carried by the metal part of the hook *a*, and is adapted to slide over the plate 5, making electrical contact therewith. When the hook-switch is depressed, it slides under and makes normal contact with the plate 1.

To avoid unnecessary complication, I have in the drawings omitted the connections of the transmitter local-battery circuits, as their arrangement forms no part of my present invention.

I will now trace the several circuits through the arrangement, first, as they are normally; second, by means of the direct circuit through the telephones to earth, and, thirdly, through the telephones and metallic return. The direct line-wire B entering proceeds first to the portion *a* of the switch C, passes to contact-spring 6, and by wire *f* to the other switch, D. The circuit is then, by means of the spring 1, directed to the wire *g*, and through the signal-bell F and wire *g′* to the ground G. The branch A of the metallic return is, as shown, open at the plate 10, immediately after entering the station. When the apparatus is in this condition, with both telephones resting upon their respective switch-hooks, the sub-station may be signaled from the central station by means of signal-bell F. When the circuit is to be used as an earth-circuit, terminating at the sub-station, we remove the telephone from its supporting-switch D. The circuits are then established as follows—as in the foregoing arrangement until the switch-lever D is reached; but the telephone T being removed, the switch-lever is now raised by its retracting-spring, and the contact of the metal part *c* of the said lever with the spring 1 is broken, thus disconnecting the bell. Two new contacts are moreover made as follows: The spring *e* carried on and forming part of the metal part *c* of the switch-hook, makes contact with the plate 5, and the spring 2, carried by the insulating-piece of the same hook, in like manner makes contact with the two plates, 3 and 4. The circuit now from the metal part *c* of the hook D proceeds first by spring *e*, the plate 5, thence by wire *h* to the telephone T, and through the helix thereof, returning by wire *i*, and passing to transmitter E. When the wire *i* reaches the point *l*, it will be seen that the circuit apparently splits and two routes present themselves; but following for a short distance the wire *m*, it will be found that it ends in the plate 9 and is not connected with any circuit. There is therefore no complete circuit except through the secondary coil *s* of the transmitter E. Leading out of the transmitter, the circuit again reaches a junction-point, *n*, from which the wires *o* and *j* bifurcate. Again, however, when we trace the former wire, *o*, we find it open, since at present it terminates in the unconnected plate 8. From the point *n* the path of the telephone ground-circuit continues by wire *j* to plate 4, through spring 2 to plate 3, and finally by wire *k* to the ground.

Let us now suppose that the lines are to be used as a metallic circuit. This is accomplished by leaving the telephone T upon the

hook D, and removing instead the telephone T'. As will be seen, a complete change is thus effected in the arrangement of the circuits. The direct line B entering, proceeds, as in all cases, first to the part *a* of the lever-switch C; but since the switch is raised by its retracting-spring, all connection with the second switch is broken by the absence of contact with the spring 6. The line-circuit proceeds *via* spring 7, plate 8, wire *z*, telephone T', wire *o*, point *n*, transmitter-coils *s*, wire *m*, plate 9, spring 11, and plate 10, to the branch A of the metallic return-wire, thus forming a loop from the central station, which includes the common transmitter and one of the receiving-telephones. The entire arrangement in practice would of course be comprised in a single bell-box or case in a manner well understood.

I lay no claim herein to the combination of a direct subscriber's circuit with a normally-open branch of a return-wire, adapted to constitute a metallic return for the said direct subscriber's return-wire, since that is not my invention.

The essence of my invention is the specific arrangement of certain instrumentalities with two separate receiving-telephones, each provided with an independent support when not in use, and by which the removal of one of the telephones from its support introduces the said telephone into the direct earth-circuit, while the removal of the other telephone transfers the direct telephone-circuit from its ground-terminal to the normally-open branch of the metallic return, introducing the telephone thus removed into the compound circuit thus formed.

By my invention one receiving-telephone may always be used for short-line work over the earth-circuit, and the other receiving-telephone may be exclusively devoted to long-line work, and used in connection with the metallic circuit only, and the telephones set apart for either arrangements may be suitably designated in any preferred way.

I claim—

1. In the apparatus of a telephone-station, the combination, with the direct circuit, having a normal earth-terminal and a receiving-telephone for use therein, of a normally-open return-wire and an automatic switch supporting a second receiving-telephone, for transferring said direct-circuit line from its normal earth-terminal to the normally-open return-wire, substantially as described.

2. The combination, substantially as hereinbefore described, of a direct circuit, a normal ground-terminal including a signal-bell, a normally-open telephone ground-terminal, a normally-open return-circuit, and two automatic switches, each constituting the support of a receiving-telephone, one of the said switches being interposed between the main line of the direct circuit and the second switch, and adapted to disconnect the said direct circuit from the said second switch, and to connect it with the return-wire, including in the new circuit one of the receiving-telephones, and the other switch being interposed between the first switch and the normal ground-terminal, and adapted to transfer the direct circuit from the normal ground-terminal to the normally-open ground-terminal, including in the circuit thus formed the other receiving-telephone, whereby the removal of one of the telephones from its support includes the said telephone in an earth-circuit extending to the distant station, and the removal of the other telephones cuts off the earth-terminal and completes a metallic loop to the distant station, and includes the removed telephone in the said loop, for the purposes specified.

3. The combination, in a telephone system, of a direct line-wire, a normal earth-terminal therefor, including a signal-bell, a normally-open telephone earth-terminal, a normally-open return-wire, a transmitting-telephone, two receiving-telephones, and two automatic switches placed in the normal circuit of the said direct line-wire, each constituting a support for one of the said telephones when not in use, one of the said switches being adapted upon the removal of its telephone to transfer the direct circuit from the bell branch to the normally-open earth-terminal, and to include in the said circuit the transmitter and the removed receiving-telephone, and the other being adapted upon the removal of its telephone to transfer the said direct circuit from its normal earth terminal to the normally-open return-wire, and include its own telephone and the transmitter in the loop-circuit thus formed, whereby the removal of one of the telephones connects the same in an earth-circuit with the distant station, and the removal of the other telephone connects the same in metallic circuit with the distant station, the transmitter being common to both, substantially as described.

In testimony whereof I have signed my name to this specifiation, in the presence of two subscribing witnesses, this 23d day of April, 1883.

THOS. D. LOCKWOOD.

Witnesses:

J. H. CHEEVER,

GEO. WILLIS PIERCE.