(No Model.) 2 Sheets—Sheet 1.

T. N. VAIL.

TELEPHONE SWITCH APPARATUS.

No. 261,186. Patented July 18, 1882.

Fig. 1.

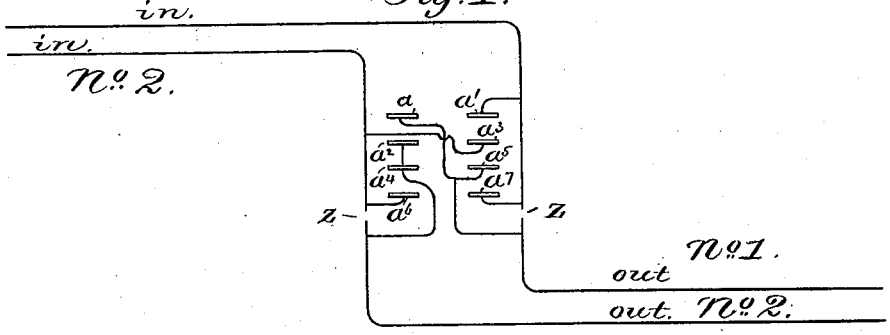


Fig. 2.

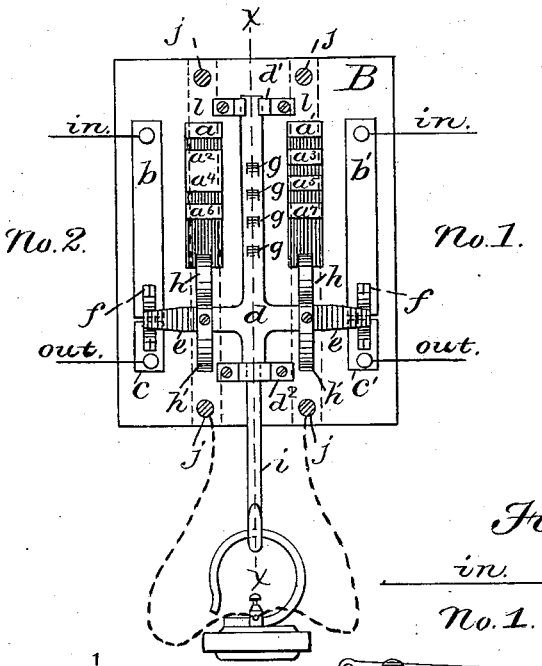


Fig. 3.

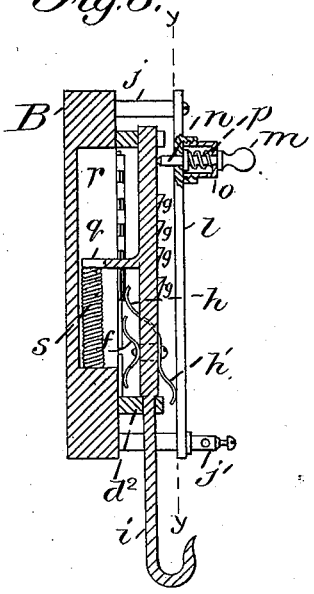
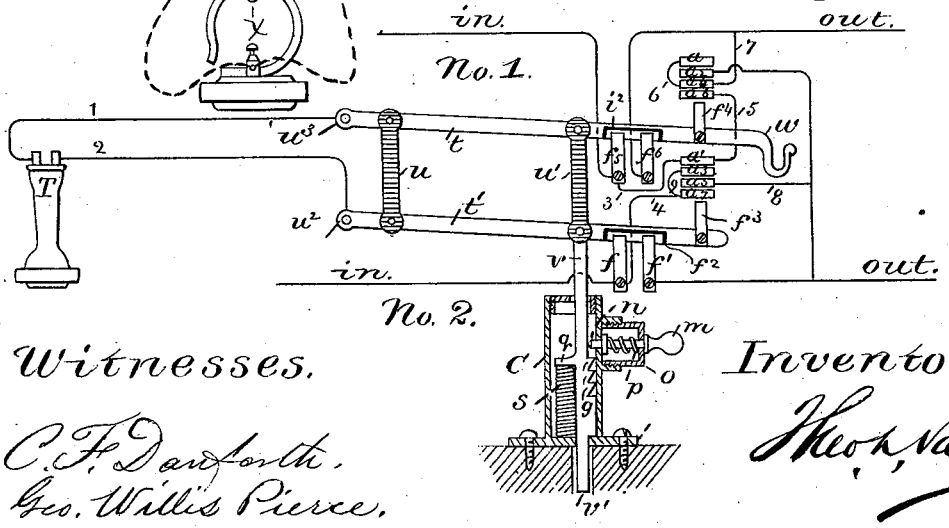


Fig. 4.



Witnesses.

C. F. Danforth.

Geo. Willis Pierce.

Inventor.

Theo. N. Vail

(No Model.) 2 Sheets—Sheet 2.

T. N. VAIL.

TELEPHONE SWITCH APPARATUS.

No. 261,186. Patented July 18, 1882.

Fig. 5.

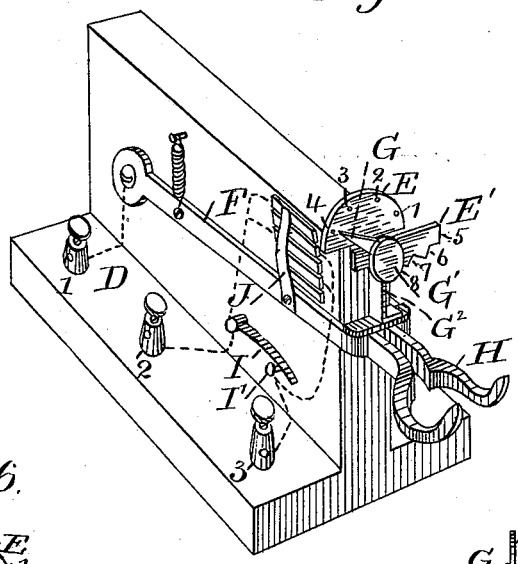


Fig. 6.

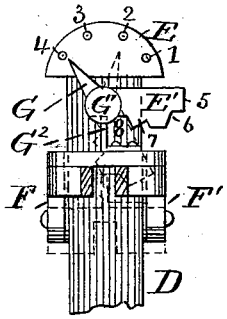


Fig. 7.

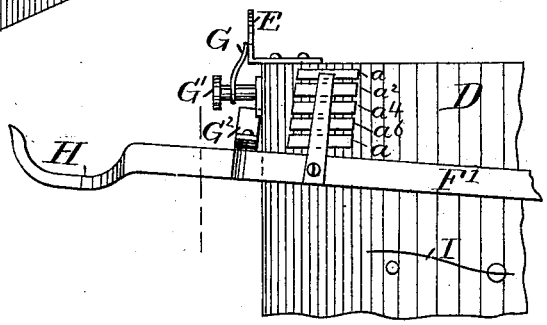


Fig. 8.

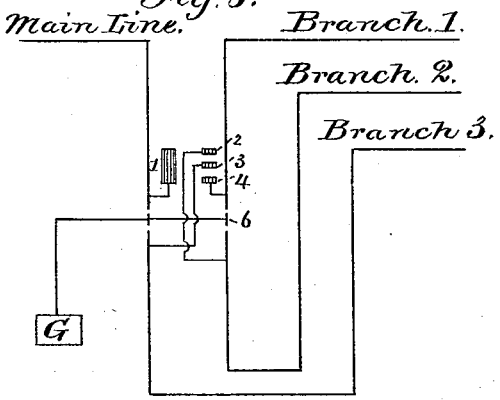
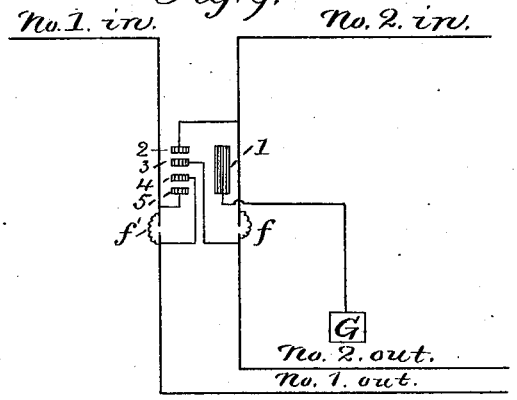


Fig. 9.



Witnesses.

C. F. Donfforth.

Geo. Willis Pierce

Inventor.

Theo Vail

UNITED STATES PATENT OFFICE.

THEODORE N. VAIL, OF BOSTON, MASSACHUSETTS.

TELEPHONE SWITCH APPARATUS.

SPECIFICATION forming part of Letters Patent No. 261,186, dated July 18, 1882.

Application filed December 10, 1881. (No model.)

To all whom it may concern:

Be it known that I, THEO. N. VAIL, of Boston, in the county of Suffolk and State of Massachusetts, have invented certain Improvements in Telephonic Apparatus and Circuits, of which the following is a specification.

My invention relates to circuit changers or controllers, and particularly to that class utilized generally at stations upon telephonic circuits in which the position of a telephone is caused to regulate wholly or partially the position of the circuit-changer and the connections of the main and branch circuits pertaining thereto.

Heretofore circuit changers or switches have been constructed, so far as I am aware, for one of two purposes, either to transfer the main circuit from its ordinary route through the signal-bell to a branch or auxiliary circuit through the telephone, when the telephone is taken from its support, and to restore the bell-connections cutting out the telephone, when the said telephone is replaced on its support or in its original position, or they have been designed and adapted to sever the main line at the way station operating, and at the will of the operator form a new circuit from the earth through the telephones by either fragment of the main line, leaving the other fragment of the said main line open. Switches of the former class have been technically termed "automatic switches," and those of the latter class "secrecy-switches." The automatic switch is typically represented by that patented May 27, 1879, by H. L. Roosevelt, No. 215,837, while the principle of the secrecy-switch is well illustrated in the patent of T. B. Doolittle, No. 209,115, dated October 22, 1878.

My invention to a certain extent combines the features contained in the hereinbefore-mentioned patents, while its scope is more comprehensive. In addition to the performance of similar functions, it is specially adapted to subserve other purposes, which are more particularly hereinafter set forth.

It is well known that when several telephone-wires run for a considerable distance in the same direction and in close proximity to one another the signals transmitted upon one are, by means of leakage, induction, and other agencies, disseminated among the others, and by this dissemination the proper working of the wires is much interfered with, and speech transmitted upon any wire is reproduced in a confused and frequently indistinct manner.

It has been ascertained by experience that the only radical remedy for these troubles is to substitute a metallic return-circuit for the ordinary earth-terminal arrangement at the distant end, the said metallic return-wire being so arranged that it is equally exposed with the direct wire to the inductive influence of the neighboring wires. This method has been considerably resorted to; but there are certain difficulties in practice, which have been prejudicial to and have prevented its general introduction and extended use. Chief among these has been the difficulty of so arranging a telephone at the way station upon such a double circuit that private and exclusive communication may be had in either direction without being subject to intrusion from other way stations beyond.

The objects of my invention are to overcome this difficulty, to provide a means whereby the telephonic instruments at any station on a line consisting of a direct and a return wire may be readily connected to and form the link between the two wires arriving from either direction, which would thus form a loop, leaving in either case the unlinked wires open, or by other simple movements to place the telephone in circuit in either the direct or the return wire.

It is further my object to provide a circuit-changer whereby at a station where four or more wires center the telephone-instruments may be placed in circuit with either.

For the convenient attainment of these objects my invention consists, first, in the combination, with two or more line-wires passing through a station, of a circuit-changer adapted, when properly operated, to include the telephonic instruments in circuit in the loop formed by the two wires on either side of the station; second, in a circuit-changer adapted to include the telephone in either of the single wires, as well as in either loop of the double line, so that the line can be operated either as a metallic or

single-circuit line, as may be most convenient; third, in a circuit-changer or local switch constructed in such a manner that when the telephone is at rest upon its support the several circuits shall be in their normal condition each arranged so that signals may readily pass through while the telephone or telephones are out of the circuit, and that when the telephone is removed from its support the circuit-changer, no longer restrained by its influence, shall automatically break the continuity of the several lines and place the telephone in a predetermined position—usually that position in the circuits where it is most frequently used for oral communication—the said circuit-changer being also furnished with stops, which, when released, will permit it to assume other positions, whereby the telephone is successively interposed in other circuits or other arrangements of circuits, each position being maintained for a long or short period, as required, and so arranged that upon the replacement of the telephone the normal condition of the circuit-changer and that of all the circuits connected therewith shall be automatically restored.

It also consists in special combinations and arrangements of parts, as hereinafter set forth.

I have in the drawings which illustrate and form a part of this specification shown several forms of apparatus embodying my invention. All of these operate substantially upon the same principle. One, however, is dependent upon the dead-weight of the telephone, while the others are operated by the intervention of a lever.

In the drawings, Figure 1 is a diagram which graphically shows the character of changes which by my invention I produce. Fig. 2 is a front view of an instrument constructed in accordance with the invention, the casing being removed to show the construction. Fig. 3 is a sectional view of the same upon the line *x x* of Fig. 2. Fig. 4 is another embodiment of the same principle, showing particularly the connections of the several circuits. Fig. 5 is a perspective view of a practical switch slightly differing from that shown in Fig. 4. Figs. 6 and 7 are details of Fig. 5, and Figs. 8 and 9 are diagrams illustrating the application.

My invention, independently of the peculiar construction of the instrument I use, will be most easily understood by an examination of the diagrams shown in Figs. 1, 8, and 9.

Fig. 1 represents a way station through which two parallel line-circuits are led, each being supposed to be provided with its own signaling-instruments, while the circuit-changer, which is a distinguishing feature of my invention, is common to both of the lines, the telephone being also common to the two. Both lines are continuous through the station, with the exception of a hiatus, *z*. This break in each case is normally bridged over by a metallic connector, consisting of a spring controlled by the telephone-support, and when a telephone is in its support the bridge is kept in place through the influence thereof exerted against a constant force which tends to draw it away, the continuity of both lines being thus maintained.

The respective "in" and "out" wires of each line are also permanently connected to metallic plates properly arranged—as No. 1 "in," for example, is connected to a' and a^7, No. 1 "out" to a and a^5, No. 2 "in" to a^3 and a^6, and No. 2 "out" to a^2 and a^4. These plates are connected to normally-open branches of the lines to which they are attached; but each one is adapted to connect with the opposite plate through the telephone when the latter is removed from its support, and the connections are so arranged that the first working position assumed is that which will be most frequently required, in this case being shown as No. 1 "in" with No. 2 "in," and in that condition the circuit may be traced from No. 1 "in" to plate a^7, through the telephone to plate a^6, and out in the same direction *via* No. 2 "in." This position would be most frequently required in a system of metallic circuits where two wires are always arranged parallel to each other, forming a loop, say from the central station. The next position forms a loop through the telephone of the wires No. 1 "out" and No. 2 "out." The third No. 2 "in" with No. 2 "out," and the fourth No. 1 "in" with No. 1 "out."

Fig. 8 shows a system embodying the same principle, but applied to a station where, instead of each line passing through the station, a main line and branch lines are shown, terminating at a common ground-plate, 6. In this case the connection with the ground-plate is maintained so long as the telephone is at rest on its proper support; but when taken therefrom the constant force breaks the ground-connection of all the lines and forms a new circuit, as in the foregoing case, through the telephone, between the main line and any one of the three branch lines.

It will be observed that the construction of the connection-plates is modified, as the main line is attached to a single plate, 1, of sufficient length to insure a connection with any one of the three branch-line plates 2 3 4, as may be desired.

Fig. 9 is a similar system to that shown in Fig. 1, with the addition of a ground plate and line. In this arrangement all the line-plates are placed at one side, and the ground-plate equal in length to all the line-plates opposite to them, as in Fig. 1. Lines 1 and 2 are normally continuous by means of a bridging-spring or its equivalent, *f f*. When, however, the constant force operating against the restraining influence of the telephone is permitted to act, the continuity of the lines is broken and each line separated into two parts, one of which is then connected *via* the telephone to the ground, while the other three are left open. Secret communication can be thus

maintained. In every case the first position assumed by the circuits, if no action is taken to alter it, will be that which is most frequently required.

As hereinafter more particularly described, I employ in each of the cases indicated a means whereby it is determined which two lines shall be connected together or which line shall be connected to earth.

Proceeding now to the specific instrumentalities whereby I carry out my invention, I show in Figs. 2 and 3 an apparatus in which the several results are effected by the weight of the telephone, when in place, operating vertically in one direction against the force constantly exerted by a spring, *s*, and by the force of the spring itself in the other direction when the telephone is removed.

B is a base board or frame, of wood or other suitable non-conducting material, supporting a vertical bar, *d*, which slides freely through the guides d' d^2. The bar *d* is cruciform, and the cross-bar *e* has depending from its under surface at each extremity, but insulated therefrom, a connecting-bridge, preferably a spring, *f*.

The normal through-connections of the several line-wires No. 1 and No. 2 are formed by the metallic strips *b c* and b' c'. The plate *b* is separated from the plate *c* and b' from c' by a space which is normally bridged over by the spring *f*, carried by the cross-bar *e*, so that when the spring *f* rests upon both of the plates the line is continuous; but when it does not so rest the line is broken by the intervening space.

Two other metallic plates, *l*, run from end to end of the frame, as shown in dotted lines in Fig. 2, and in side view, Fig. 3, and are supported at each end by standards *j*. The two standards *j* at the lower end continue above the metal strip and form binding-screws j' for the telephone-cord. The two metal strips *l* thus are virtually rigid extensions of the telephone-wires.

Immediately below each metal plate *l*, and raised a little from the surface of the base-board B, are a series of metal plates, *a*, a', a^2, a^3, a^4, a^5, a^6, and a^7. These are let into a plate of vulcanite, or of any suitable non-conductor, and are connected by short wires to the several line-plates, as shown in Fig. 1. Thus the line-plate *b* may be connected to the small plates a^3 and a^6, line-plate b' to a' and a^7, and line-plates *c* and c', respectively, to a^2 and a^4 and to *a* and a^5.

The cross-bar *e*, midway between each end and its center, supports an additional spring, *h h'*. This, while firmly fixed to the cross-bar, presses elastically with its end *h* upon the non-conducting surface in which the small plates *a* are set, and with its opposite end, h', as specially shown in Fig. 3, against the upper metallic plate, *l*. A conducting-path is thus established from each terminal of the telephone through the long plates *l* and the spring *h h'* on each side to the non-conducting surface in which are set the plates *a*.

Projecting backward from the vertical slide-bar *d*, and working in a slot between the plates *l*, is a horizontal stud, *q*, attached at its inner end to a spiral spring, *s*, working in a chamber, *r*, which is cut in the base-board B. The spring *s* is compressed by the force exerted by the telephone when hanging on the hook *i*, which forms the end of the vertical bar *d*, and its resilience is such that when the telephone is removed from the hook and the pressure is removed it expands with a tendency to fill the chamber, and thus elevates the vertical bar *d* to the utmost extent of its travel, or until checked by the impingement of one of the projections *g* with the spring-stop *n*. This stop is kept pressing lightly against the board by the spiral spring *p*, which surrounds it, and if upon removing the telephone or other weight from the hook *i* the stop *n* is not changed the bar *d* will only rise until the pin strikes the first projection *g*, and it is clear that by pulling the stop *n* back by its handle *m* any or all of the projections may be permitted to clear the stop *n*, or that any one of them may, at the will of the operator, be permitted to rest against it, while upon the replacement of the telephone, as all the projections *g* have their under surface constructed on a very steep angle, they will slide past the pin or stop *n*, instead of being checked thereby. The projections *g* are so placed as to correspond with the connection-plates *a*, and when the first projection *g* strikes against the pin *n* the telephone-springs will rest upon the lowest connection-plates, a^6 and a^7.

To operate this instrument, let it be supposed that the telephone is in place upon its support. The connectors *f* will then each bridge the break in the lines, and each line will continue through the station, while the telephone, although connected to the springs *h h'*, will be entirely disconnected from any line. Let the telephone now be removed from its support. The vertical bar *d*, under the influence of the spring *s*, will be compelled to ascend, carrying with it the spring-connectors *f*, and thereby severing each line into two parts, and also the springs *h h'*, which, when the bar is stopped by striking the pin *n*, rest on the plates a^6 and a^7, thus forming a link through the telephone, between the plates a^6 and a^7, and, as a consequence, between the lines with which those plates are connected. By withdrawing the stop *n* it is obvious that the telephone may be connected with any two corresponding plates *a*, or with all of them successively. When the telephone is once more restored to its support the bar *d* is caused to descend against the force of the spring *s*, and the connections are restored to their normal condition.

In Fig. 4 I show a means in some respects preferable to that already described, inasmuch as the apparatus is shown in a suitable form for incorporation in a bell-box or other sig-

naling apparatus. t and t' are two metallic levers insulated from each other by the hard-rubber cross-bars u and u', and pivoted at the points u^2 and u^3. Each of the bars is connected to one terminal of a telephone, T, and, in fact, are themselves the actual terminals of the telephonic loop. Let into the surface of each of the lever-bars is a piece of non-conducting material, i^2 f^2, while on that material is fixed a strip of metal. One of the bars, t, terminates in a telephone-hook, w, and is furnished with a traveling spring, f^4. The other bar is also fitted with a corresponding spring, f^3. By means of the insulating cross-bars u u' the two bars are mechanically attached to one another, so as to form one compound lever. Depending from the lower bar, t, is a rod, r, furnished with an arm, q, attached to a spring, s, in the chamber C. The tendency of the spring s is to force the lever upward when the telephone is off its support. As in Figs. 2 and 3, a stop, n, fitted with a spring, p, and handle m, controls the position of the rod in its ascent. Arranged on any suitable base-board are seen for each lever-bar two line-springs, f f', f^5 and f^6. Fixed in a suitable position in the range of the traveling springs f^4 of the bar t are the connection-plates a a^2 a^4 a^6, while the corresponding plates are similarly attached in the range of the traveling springs f^3 of the bar t'. When the telephone is in place the line-circuits may be traced as follows: No. 1 "in" to line-spring f^5, thence by the metallic strip on the insulating-piece i^2 to the second line-spring, f^6, and to the "out" wire direct. A branch wire leads from f^5 to the plates a' and a^6, and from the "out" wire to plates a and a^4. No. 2 line follows substantially a similar course normally connected through by the springs f f' and the metallic connecting-strip. Branch wires run respectively from "line in" wire to a^3 and a^7, and from the "out" wire to a^2 and a^5. The operation of this apparatus, it may be readily seen, is identical with that illustrated by Figs. 2 and 3.

Fig. 5 shows several modifications in the details of construction. In it I employ a base shaped like an inverted T. The two bars F F' of the compound lever are upon the same level, and are insulated and separated from one another by the upright partition forming the shank of the T. The separate terminals of the telephone-wire are connected to the binding-posts 1 on each side of the partition, and are thus normally disconnected from any line-circuit when the telephone is in place. Line No. 1 enters at binding-screw 2, passes to the circuit-closer I I', and thence out by binding-screw 3. It is provided with normally-open branch circuits on either side to the proper connection-plates a. Line No. 2 is similarly connected on the other side of the partition.

It is not considered essential to describe particularly the connections of the branch circuits to the several plates, as they may be greatly varied, according to the specific condition described.

The circuit-breaker in this form of instrument consists in a spring, I, fastened to a stationary pin, and pressed, when the compound lever is influenced by the telephone, onto pin I'. The tendency of this spring, when released, is to recoil from the pin I', and thus break the line-circuit. The new connection through the telephone is then made, as before, by the traveling spring J, which rests on any one of the plates a, as may be determined by the regulating-stop.

The regulating-stop in this form of instrument may be adjusted so as to determine, before the telephone is taken from the support, what two lines or circuits shall be connected through the telephone. It consists of a piece of metal, E', with one edge cut into successive steps. This is fixed on a pivot, G', and fitted with a pointer, G, which, when the plate E' is turned, points to any letter or numeral on the scale E, and indicates the wires that are or that are to be connected with and by the telephone-loop. The compound lever F F' is fitted at front of the insulating-partition D with an upright plate, G^2, which strikes against that step of the plate E' which is presented to it. Thus in the drawings the plate E' is turned up to its utmost extent, and consequently the upright plate G^2 presses upward against the step 8 and permits the contact-spring J to make contact with the highest connection-plate. The second position of the stop-plate and compound lever is shown in dotted lines in Fig. 6, and a side view of the position shown in Fig. 5 is given in Fig. 7. The circuit-closer I is also shown in Fig. 7 as open—the position it naturally assumes when the lever is freed from the mechanical control of the telephone, which is of course, when at rest, placed in the yoke H.

The regulating-stop herein shown may be adjusted for the connection of such lines or circuits as the operator shall elect, either before or after the telephone is removed from its support.

I may use my invention either as an independent instrument, or I may incorporate it in any form of signal-box, such as ordinarily used for sending and receiving signals on the telephone-lines.

Although I have for convenience shown my circuit-changer as a rod or lever depressed by the weight of the telephone, it is evident that I may, without departing from the principle of my invention, substitute any method whereby the circuit-changer is influenced mechanically by the presence of the telephone. I may, for example, if I so elect, so construct my apparatus that the presence of the telephone in place shall press the lever upward, and provide that it shall, when the telephone is removed, be automatically depressed by a weight or spring for the proper connection of the telephone-circuits; or I may arrange that the telephone itself shall be provided with an external conducting-surface, which, when in place, may connect the two separate line-fragments, and thus form a continuous conductor.

Although, also, I have for greater lucidity of explanation confined my description to a system of two through-line circuits or four terminating circuits, it is obvious that I may increase that number, if I please, without departing from my invention.

I have shown the line-wires electrically connected with stationary contact-plates, and the telephone-wire with the movable contact-springs; but it is obvious that the positions may be reversed, the telephone-contacts being stationary and the line-contacts movable.

Having now fully described my invention, I claim—

1. A telephone-switch or circuit-changer for two or more line-circuits, comprising a movable telephone-support and contacts and connections, combined and arranged as set forth, whereby said switch or circuit-changer is adapted to include the telephone in either line-circuit, or in a loop composed of the fragmentary portions of any two of the lines, when the said telephone is removed from its support, and to be actuated positively by the replacement of the telephone to restore the normal condition of each line-circuit, and simultaneously to withdraw the telephone from all connection with any of the said line-circuits, substantially as described.

2. In a system of telephonic communication, the combination, with two or more line-circuits passing through an intermediate station, of a circuit-changer or telephone-switch comprising a movable telephone-support combined with contacts and connections, substantially as described, whereby the telephone, when in its support, is disconnected from the line-circuits, and which, when the telephone is removed, is actuated automatically to include the said telephone in that position in the two circuits in which it will be most frequently required for use.

3. The combination, with a telephone and two or more line-circuits, of a circuit-changing switch common to all the line-circuits, and comprising a movable telephone-support and contacts and connections, as explained, whereby said switch is adapted to automatically place the telephone, when removed from its support, in that position in the combined circuits where it is most frequently required, and automatically restore the normal condition of the several line-circuits, and the telephone, when the telephone is replaced in its support, and a stop or regulator adapted to be moved at will for the purpose of connecting the telephone in any other combination of the several line-circuits, substantially as and for the purpose set forth.

4. The combination, with a telephone and two or more line-circuits and contact-plates connected with said circuits, of a switch composed of a circuit-changing lever and movable contacts, and a stop therefor, the said lever being adapted on the removal of the telephone from its support to automatically connect the said telephone between any two fragments of the combined line-circuits, as may be determined by the adjustment of the said stop, substantially as described.

5. The combination, at a telephone-station, of a series of main or branch lines, a telephone common to all of the lines, a circuit-breaker, a circuit-changing switch forming a support or holder for the telephone, and contacts and connections, as indicated, whereby said circuit-breaker and switch are adapted, when the telephone is taken from its support, to automatically break the continuity of all the lines and connect any two of them together by an intermediate loop including the telephone, and when the telephone is replaced in its support to restore the continuity of the said lines and disconnect the telephone, and a regulating-stop, whereby it is determined which two lines shall be connected together on the removal of the telephone, substantially as specified.

6. The combination, at a telephone-station, of a series of main or branch lines, a telephone common to all of the lines, and a ground-wire, with a circuit-changing telephone-support and contacts and connections, as explained, whereby the said support is adapted to automatically break the continuity of the lines, and to connect any one of the said lines, or fragment thereof, through the telephone, to the ground-wire, leaving all the other lines open when the telephone is removed, as specified.

7. In a system of telephone line-circuits, a main line and a series of branch lines having a common ground-terminal, combined with a telephone and a circuit-changing switch located at the point of convergence of all the lines, and comprising a movable telephone-support and contacts and connections, as explained, whereby said switch is adapted by the removal of the telephone from its support to automatically place the main line in connection through the telephone with any predetermined branch line, and when the telephone is replaced to restore the normal line-connections, and means, as indicated, to place the main line in circuit with any other of the branch lines, substantially as described.

8. The combination, substantially as hereinbefore set forth, of two or more main lines, a circuit-closer adapted to maintain the continuity of the said main lines when the telephone is in place, a compound lever consisting of two bars insulated from one another, and a telephone-support, a normally-open telephone-circuit, one terminal of which is connected to each of the two insulated bars, a series of plates forming normally-open terminals of the several line-circuits, and a sliding spring metallically connected to each of the lever-bars and adapted to travel over the series of line-plates, and a regulating-stop whereby the travel of said spring is arrested, and it is maintained in contact with any one of the said line-plates, substantially as specified, and for the purpose described.

9. The combination, in a telephone-switch

or circuit-changer, of the compound lever composed of the two arms F F′, insulated from one another, and each electrically connected to one of the terminals of a telephone and forming a telephone-holder, the circuit-closer I, the sliding spring J, the metallic plates *a*, each normally forming an open terminal of a line, and the regulating-stop E′, all arranged substantially as and for the purpose specified.

10. The combination, in a telephone-switch, of the compound lever consisting of the two metallic bars insulated from one another, and carrying the circuit-spring J, with the regulating-stop E′, for the purpose set forth.

11. The combination, substantially as described, with a series of contact-plates, of a movable telephone-support and two contact-springs mechanically connected with said support, and movable over said contact-plates, or the equivalents of said plates, as explained, so as to pass entirely across the intermediate plates in order to make contact with the outer ones of the series.

12. A telephone, a support therefor, and contact-pieces, combined with one another and with the double line of a metallic circuit, as explained, so that the said lines may be broken and the two wires on either side of the break may be connected with each other through the telephone, and that the replacement of the telephone on its support will automatically restore the normal condition of both lines, substantially as described.

13. The combination, with four or more line-wires and a telephone, of contact-plates electrically connected with said wires, a movable telephone-support, contact-springs electrically connected with the telephone-wire and movable with said support, a spring acting upon said support, and a stop for regulating its movements, or the equivalents of said parts, as explained, the said combination being and operating substantially as described.

14. The combination of a movable telephone-support, a series of three or more contact-plates each permanently connected with its individual wire or conductor, and a contact-spring mechanically connected with said support and movable into individual contact with any one of said plates, substantially as described.

15. The combination of a movable telephone-support, a spring for shifting said support when the telephone is removed, a series of contact-plates, a contact-spring mechanically connected with said support, and an adjustable stop for regulating the movement of the said support and its contact-spring, substantially as described.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 29th day of November, A. D. 1881.

THEO. N. VAIL.

Witnesses:
C. F. DANFORTH,
GEO. WILLIS PIERCE.