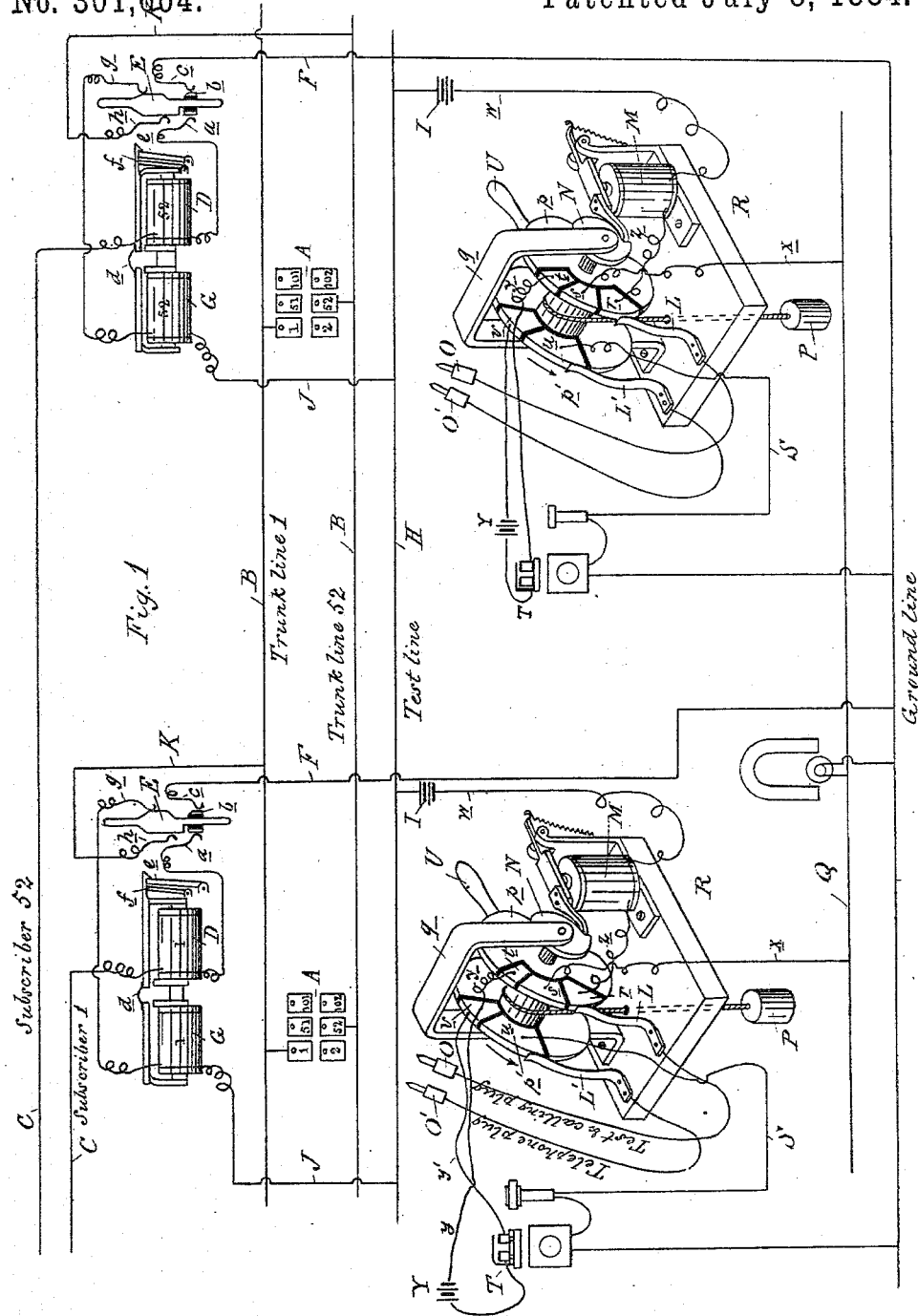


W. A. JACKSON & W. R. COLE.

TELEPHONE SYSTEM.

No. 301,604.

Patented July 8, 1884.



Attest
J. Paul Mayer
W. J. Sprague

Inventors
William A. Jackson
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(No Model.)

2 Sheets—Sheet 2.

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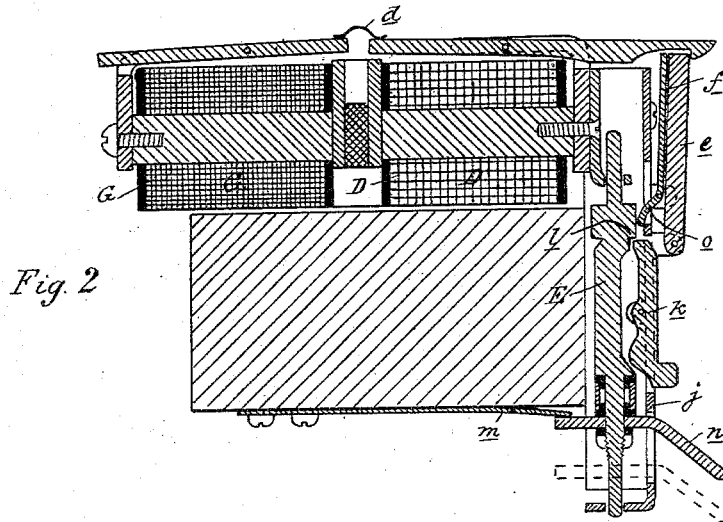


Fig. 2

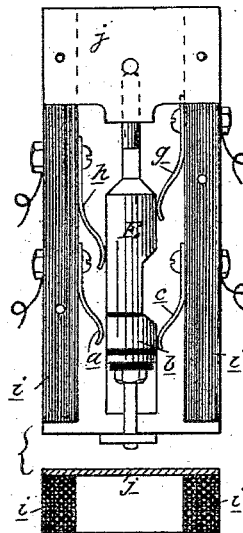


Fig. 3

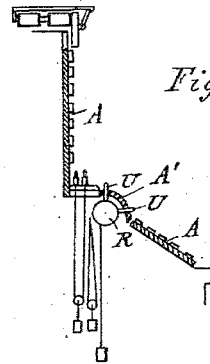


Fig. 4

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UNITED STATES PATENT OFFICE.

WILLIAM A. JACKSON AND WILLIAM R. COLE, OF DETROIT, MICHIGAN,
ASSIGNORS TO THE WESTERN ELECTRIC COMPANY, OF CHICAGO, ILL.

TELEPHONE SYSTEM.

SPECIFICATION forming part of Letters Patent No. 301,604, dated July 8, 1884.

Application filed March 5, 1884. (No model.)

To all whom it may concern:

Be it known that we, WILLIAM A. JACKSON and WILLIAM R. COLE, of Detroit, in the county of Wayne and State of Michigan, have
5 invented new and useful Improvements in Telephone Systems; and we do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, which form a
10 part of this specification.

This invention relates to certain new and useful improvements in telephone-exchange system and apparatus therefor; and the invention consists in the construction and arrangement of automatic switching mechanism,
15 whereby a large part of the manual work of connecting two subscribers' lines is done away with. This improved switching apparatus is herein shown and described in connection with a telephone system wherein the subscribers'
20 drops are arranged in groups placed upon separate disks having a multiple switch-board, provided with line-plates, which normally are disconnected from the lines, and are connected
25 by a series of trunk-lines, each trunk line connecting all the line-plates of like mark on all the switch-boards in the exchange.

In the drawings which accompany this specification, Figure 1 is a diagram of the apparatus and connections necessary for connecting two
30 subscribers. Fig. 2 is a section through the combined local and subscriber's drop. Fig. 3 is a detached rear elevation of the switch which operates in connection with each drop. Fig. 4 is a diagram showing the position of
35 the switching apparatus on the operator's desk.

A is a section of a multiple switch-board, showing a number of line-plates marked with
40 the number of subscriber. Each of these line-plates is insulated from all the others, and is provided with a plug-hole for connecting any two line-plates by means of two electrically-connected plugs.

45 B B are trunk lines, each trunk line connecting all the line-plates of like mark.

50 C C are two subscribers' lines, each of which is provided with a drop, D, and is normally grounded by a sliding switch, E, in the following manner: *a* is a contact-spring forming

the terminal of the subscribers' line. *b* is a metallic ferrule secured to the lower end of the sliding switch E, and insulated therefrom. *c* is another contact-spring, which connects with the branch wire F, which forms the terminal to earth for the subscriber's line. At the
55 normal position of the switch E the contact-springs *a* and *c* are both in contact with the metallic ferrule *b*.

G is a local drop, which is combined with the subscriber's drop D, as shown, so that the armature of the local drop will also actuate the armature of the subscriber's drop. This is obtained by means of a small plate, *d*, which
60 is secured to the forward end of the armature of the local drop and rests upon the rear end of the armature of the subscriber's drop.

e is the shutter of the subscriber's drop, and *f* is the clearing-out shutter of the local drop.

H is a test-line. I are test-batteries in the
70 circuits of the test-line.

J is a branch starting from the test-line, and after passing through the local drop terminates in a contact-spring, *g*, which normally is in contact with the sliding switch E.
75

K is another branch line terminating in a contact-spring, *h*, which is always in contact with the sliding switch E. There is one of these branch lines K for each trunk line, connecting the trunk line with the sliding switch
80 of like mark. The sliding switch E is automatically operated by the subscriber's drop.

In Figs. 2 and 3 the sliding switch is shown in detail and connected to the drop, by which it is operated, and is constructed as follows:
85 *a c h g* are the contact-springs before described. *b* is the insulated ferrule between the contact-springs *a c*. These contact-springs are secured to the insulating-strips *i*. *j* is a plate secured to the strips *i*. *k* is a little lever pivoted in a proper slot in the plate *j*. *l* is a shoulder formed on the switch-key E, by means of which the upper end of the lever *k* prevents the switch-key E from being drawn downward
90 by the action of the spring *m*, which presses upon the thumb-piece or handle *n*, secured to the lower end of the switch-key.

In operation, whenever the shutter *e* is released by the action of the drop D, in falling it strikes against the lower end of the lever *k*
100

with sufficient force to disengage the shoulder *l*, allowing the switch-key *E* to be drawn down by the action of the spring *m*. In this latter position the electrical contact between the contact-springs *a* and *c* is then broken, and a new electrical contact between the contact-springs *a* and *h* is formed. The contact-spring *g* has also broken its contact with the switch-key. The clearing-out shutter *f*, which lies back of the shutter *e*, is provided below its pivotal point with a tail-piece, *o*, which rests against the shoulder *l* of the switch-key, except when the latter is in its depressed position. Thus the shutter *e* will drop whenever released by the armature; but the shutter *f* will not drop unless released by the armature and by the shoulder *l*. The object of this different construction is to prevent the shutter *f* from dropping by one single action of the armature of the drop *D*, (as the electrical current passing over the subscriber's line through the drop *D* and contact-springs *a c* to earth will be broken before the shutter *f* can leave the retaining-notch of the armature of the drop *D*.)

R is a revolving switch. (Shown in diagrams in Fig. 1.) It is constructed as follows: *p p'* are two metallic disks secured at a small distance apart upon a shaft which is journaled in a proper frame, *q*. The disk *p* is provided with the insulated sections *r s t*, and the disk *p'* with the insulated sections *u* and *v*. *L L'* are two contact-springs adapted to bear against the face of each disk. *M* is an electro-magnet provided with an armature the free end of which is adapted to engage with a shoulder or stop on the wheel *N*, which is secured to the shaft of the disks *p p'*. *O* is a plug electrically connected to the contact-spring *L*. *O'* is a plug electrically connected with the contact-spring *L'*. *P* is a weight attached to a cord which passes over and around the shaft between the disks *p p'*. There are as many of these switches *R* placed upon each operator's desk as will be found necessary for the business of the office, and each switch is electrically connected as follows: A branch wire, *w*, connects the electro-magnet *M* with the test-line. A branch wire, *x*, connects the insulated section *s* of the disk *p* with the generator-line *Q*. A branch wire, *S*, connects the insulated section *u* of the disk *p'* with the operator's telephone and transmitter, and then extends onto the ground-line.

Y is a signal-battery, one pole of which is connected by the wire *y* to the insulated section *v*, while the other pole is connected by the wire *y'* to the insulated section *t*. *T* is a buzzer in the circuit of the signal-battery.

The operation of the revolving switch *R* is as follows: Suppose a call is received from subscriber 1, the operator seeing the shutter No. 1 open takes up telephone-plug *O'* and puts it in the socket of line-plate 1. This puts the operator's telephone onto subscriber's line, the connection being established as follows: From subscriber's line through drop *D* to contact-spring *a*; then to contact-spring *h*, (the

switch-key *E* having been depressed by the action of the shutter;) then through branch *K* to trunk line *B 1* to line-plate 1; from there to plug *O'* and connecting-cord to spring *L'*, through sections *u* and branch wire *S*, through operator's telephone to ground. Upon ascertaining the wants of the subscriber, which we will suppose to be a call for connection with No. 52 subscriber, the operator seizes the test-plug *O* and inserts it into the socket of line-plate 52, and if subscriber's line 52 is not in use a test-circuit will be established which automatically connects the two subscribers. The test-circuit is established as follows: From line-plate 52 through plug *O* and its connecting-cord to contact-spring *L*; through insulated section *r* to electro-magnet *M*; through branch *w* to test-line *H*; then, passing over on this test-line to the switch-board on which No. 52 line terminates, it passes through branch wire *J* and local drop 52 to contact-spring *g*, switch-key *E*, contact-spring *h*, branch wire *K* into trunk-line *B 52*, back to line-plate 52 on operator's board, thus closing the circuit. The establishing of this test-circuit performs two operations: first, it actuates the switch-key *E*, so as to break subscriber's 52 ground and connect it with its trunk line; and, secondly, it actuates the electro-magnet *M* and disengages its armature from the stop on the wheel *N*, allowing the disk *p p'* to rotate with the shaft under the impulse from the weight *P*. Fig. 1 shows the normal position of the disks *p p'*, in which plug *O'* is a telephone-plug, as it connects through the insulated section *u* with the telephone. The plug *O* may be called a "test-plug," as it is connected through the insulated section *r* with the test-line. The revolutions of the disks *p p'* bring the contact-spring *L* successively in contact with the insulated sections *s*, and then with the insulated section *t*, and then with the solid part of the disk *p*, while the contact-spring *L'* comes in contact, first, with the insulated section *v*, and then with the solid part of the disk *p'*. The handle or stop *U* prevents the switch from making a complete revolution, as the handle is arrested by being stopped against the frame. Now, bearing in mind that both the line-plates 1 and 52 are the terminals of their respective lines, it will be seen that at the moment the insulated section *s* comes in contact with the contact-spring *L* a generator-current will be sent through the station of subscriber 52. Upon the insulated section *t* coming in contact with the contact-spring *L*, the insulated section *v* has also come in contact with the contact-spring *L'*. This establishes the signal-current of battery *Y*, which passes from insulated sections *t v* through the connecting-plugs *O O'* over trunk lines 1 52 and subscribers' lines 1 52 to ground, while the subscribers' lines simultaneously ground each other. The audible signal produced by the buzzer *T* can thus be heard by each subscriber, and No. 1, who is supposed to listen at his telephone, will interpret this signal for "go ahead." Immediately after receiving

this preconcerted signal subscribers Nos. 1 and 52 will be connected for talking, as both the contact-springs L L' have now come in contact with the solid part of the disks p p' , which, through the medium of the metallic shaft upon which said disks are secured, complete the connection between the terminals of the lines of subscribers 1 and 52. It will be understood that the establishing of the test-circuit, succeeded by a generator-current, must drop both shutters on 52 drop, and the operator in charge of this line, understanding it to be a local call, (a direct call would have only dropped the outside shutter,) replaces the inside shutter. Now, while subscribers 1 and 52 are talking the inside or clearing-out shutters of both drops 1 and 52 are closed, and upon ringing off by either of the subscribers both will drop, after which the shutters and the sliding keys E are restored to their normal position. This may be done by a stick provided with a little fork at the end, which engages with the thumb-piece upon the end of the sliding key and lifts the shutters at the same time. The switch R is restored to its normal position by the operator taking hold of the handle U and giving the switch the necessary turn to bring the stop of the wheel N again in engagement with the free end of the armature of the electro-magnet M. For the speedy transaction of the business of the exchange-office, it is of course necessary to provide each operator with a sufficient number of switches R, and in practice we propose to arrange these switches on the operators' desks, as shown in Fig. 4, where the switch-board is divided into two sections—one upright and one inclined—with a partly-rounded shelf between, through which the handles U sufficiently project to wind the switch and indicate its condition. On the straight part of the shelf the connecting-plugs may then be arranged and provided with devices for retracting their cords below the table when not in use.

By using separate connecting-plugs for the lines and connecting the springs L L' to talking and calling and test bars alternately arranged between the line-plates, as shown in another application of ours, one switch, R, for each operator is then sufficient.

We are aware that either or both of the automatic switches herein described may be advantageously applied to other exchange systems and for like purposes. The advantage of these automatic switches for making quick connections is easily apparent, as the time consumed is represented by the time it takes the operator to place the plug O into its respective line-plate, plus the time the disks p p' take to revolve over the different sections placed thereon.

What we claim as our invention is—

1. The combination, in a telephone-exchange system, of a series of multiple switch-boards, each provided with line-plates normally disconnected from the lines, but forming the line-connecting terminals of a series of sub-

scribers' lines formed into groups, one group for each switch-board; of a series of trunk lines connecting all the line-plates of like mark; of a talking, calling, testing, and line-connecting outfit for the operator of each switch-board; of a series of line and trunk-line drops, connected in pairs and grouped the same as the lines, and of a series of automatic switch-keys, one for each pair of drops, and so arranged that either drop will automatically operate it, substantially as and for the purposes described.

2. The combination, in a telephone-exchange switch, of a series of multiple switch-boards having line-plates normally disconnected from the lines; of a series of subscribers' lines divided in groups among the switch-boards; of a series of trunk lines normally disconnected from the lines and connecting the line-plates of like mark; of a talking, calling, testing, and line-connecting outfit for each operator; of a series of line and trunk-line drops connected in pairs and grouped and marked the same as the lines; of a series of switches, one for each pair of drops, for automatically connecting the lines with their respective trunk lines by the mechanical operation of the annunciator-shutter, and of a series of impelled switches, one or more for each switch-board operator, for automatically connecting and disconnecting his talking and calling outfit with the lines by the operation of the test-circuit, substantially as and for the purposes described.

3. In a telephone-exchange-switch system having normally-disconnected line-plates arranged upon multiple switch-boards, and trunk lines connecting the line-plates of like mark, the combination, with a series of automatic line and trunk-line connecting-switches, of a second series of switches automatically operating make-and-break contacts in each operator's talking, calling, and testing outfit, with means for connecting either outfit to any line-plate; of a test-circuit normally closed through all the switches and forming terminals of all the line-plates, and of devices for automatically actuating the switches by the establishing of the test-circuit, substantially as and for the purpose described.

4. In a telephone-exchange switch having multiple switch-boards, the line-plates of which form the line-connecting terminals, and trunk lines connecting all the line-plates of like mark, the combination, with a series of subscribers' lines grouped among the switch-boards, of a series of switches for automatically disconnecting each line from earth and connecting it with its trunk line; of a series of switches forming automatically-operated make-and-break contacts in the operators' talking, calling, and testing circuits, and of a series of switch-plugs connected in pairs by flexible cords to each of the aforesaid switches, and so arranged that normally they are electrically disconnected from each other, but are electrically connected to each other by the

automatic operation of the switches to which they are attached, substantially as and for the purposes described.

5 In a telephone-exchange switch, the combination, with a series of line-plates provided with plug-sockets and constituting the line-connecting terminals, of one or more automatically-operating switches in the signaling-outfit for each series of line-plates; of a pair
10 of plugs electrically connected by flexible cords to the stationary contacts of the switch; of a series of insulated contact-pieces on the movable part of the switch; of connections between the insulated contact-pieces of the movable part of the switch and the different signaling-circuits; of electrically-connected contacts on the movable part of the switch; of
15 impelling devices for the switch, and of an electro-magnet in the test-circuit, which forms an automatically-operating detent for the impelling device.

6. The combination, in a telephone-exchange system having multiple switch-boards, each under the care of one operator, and provided
25 with line-plates which are normally disconnected from the lines, but constitute the line-connecting terminals, of subscribers' drops and trunk-line drops connected in pairs, and divided in groups among the switch-boards; of
30 an inside and outside shutter for each pair of drops in common; of mechanical devices for preventing the subscriber's drop to release more than one shutter at a time; of a series of switch-keys operated by the falling of the outside shutter, which automatically disconnects
35 the line of the drop from its earth-terminal and connects it with its trunk line, and of a test-circuit and connecting-plugs, whereby each operator can make any line-plate on his
40 board the terminal of the line without the aid of another operator, while at the same time a visual signal, distinguishable from a subscriber's signal, is disclosed on that operator's desk from which the line has been taken.

45 7. The combination, in a telephone-exchange system having multiple switch-boards, each under the care of one operator, and provided with line-plates which are normally disconnected from the lines, but constitute the line-connecting terminals, of subscribers' drops
50 and trunk-line drops connected in pairs and divided in groups among the boards; of annunciating and clearing-out shutters in common for each pair of drops; of a series of switch-keys operated by the annunciator-shutter, which automatically disconnects the subscriber's line from earth and connects it with
55 its trunk line; of a talking, testing, calling, and connecting outfit for each operator; of a series of automatic signal-switches, one or more for each operator, forming an integral part of his signaling-outfit, and provided with an impelling device controlled by the test-circuit, and
60 of a signal-battery and buzzer controlled by the automatic signal-switch, all so arranged that when the operator has inserted one of a pair of connecting-plugs into his sub-

scriber's line-plate and the other into the respondent's line-plate, the whole *modus operandi* of connecting two subscribers will be performed automatically, substantially as described. 70

8. The combination, in a telephone-exchange system, of the talking-outfit of an operator with a buzzer, a signal-battery, and an impelled switch, the latter constructed substantially as described, whereby the breaking of
75 the generator-current rings up the respondent subscriber, sends a battery-current through the buzzer, and simultaneously grounds the lines of the two subscribers for the purpose of conveying an audible signal from the buzzer to one or both. 80

9. In a telephone exchange system, the combination of any two line-plates forming terminals of two lines; of a pair of connecting-plugs, O O', and their cords; of the stationary contacts L L'; of the impelled switch R, having
85 disks *p p'*, provided with insulated and non-insulated sections, which form the movable contacts of the switch, substantially as described, and of the electro-magnet M, forming an automatically-operating detent. 90

10. The combination of a series of revolving signal-switches, R, provided with handles U, for rotating the same to their normal position, and connecting-plugs O O', with the shelf
95 A' of the desk, through the rounded portion of which the handles U project, to limit the rotation of said switches, substantially as and for the purposes set forth. 100

11. In a telephone-exchange system, the combination, with any two-line plates, of a series of line-plates normally disconnected from the lines, but constituting the line-connecting terminals; of the two connecting-plugs O O', provided with flexible cords; of the stationary
105 contacts L L'; of the insulated segmental contacts *u r*; of the impelled switch R; of the connections between the insulated contacts *u r* and the talking and testing circuits; of the electro-magnet M, and of the test-circuit, all
110 so arranged that normally the talking and testing circuit is closed through the switch.

12. In combination with subscribers' lines, and corresponding trunk lines having their drops connected in pairs and grouped among
115 separate operating-tables, switches for said wires normally disconnecting them; a test-circuit normally including the connections between the test-line and each trunk line on which the trunk-line drops are placed; a flexible cord and plug forming a terminal of the
120 test-line, and closing its circuit by contact with a line-plate, and an impelled switch in the test-circuit, which is normally inactive, but upon the closing of the test-circuit is impelled, whereby a visual and positive signal is given to the test-operator, substantially as
125 set forth. 130

13. In combination with subscribers' lines and their trunk lines having their corresponding drops combined in pairs and grouped among separate operating-tables, which have

multiple line-plates normally disconnected from the lines; switches for each line and its trunk line, which are automatically operated by the action of either drop, and whereby the line is connected to its trunk line, and the trunk line disconnected from the test-line; an impelled switch set in motion by the closing of the test-circuit; contacts in said impelled switch for the test-battery and generator, and a flexible cord and plug connected to the impelled switch, whereby the closing of the test-circuit will automatically start the switch, and, after breaking the test-circuit, will make and break a generator-circuit for ringing up.

14. The combination of the annunciating-shutter *e*, sliding switch *E*, having shoulder *l*, detent *k*, and spring *m*.

15. The combination of the clearing-out shutter *f*, its tail-piece *o*, and the sliding key *E*, the latter constructed and arranged to hold the shutter in place independently of the armature of the drop.

16. The combination of the sliding switch *E*, spring *m*, shutters *e f*, and thumb-piece *n*, the parts being constructed and arranged to allow the switch and shutters to be simultaneously returned to their normal position.

17. The combination of the contacts *L L'*, disks *pp'*, stop *U*, detent *N*, electro-magnet *M*, and impelling-weight *P*.

18. The combination, with a central-office switch, of an impelled signaling-switch which controls the signaling apparatus; of devices for connecting any one or two subscribers' lines with this signaling-switch; of an electro-magnet in the test-circuit, and of the signaling apparatus, the armature of which forms a detent for the impelling device of the switch, so that the act of establishing the test-circuit will automatically start the switch, substantially as set forth.

19. The combination, with a central-office switch, of an impelled signaling-switch, which controls the signaling apparatus of an operator; of devices for connecting any two lines with this signaling-switch, and of a signal-battery and buzzer forming an integral part of the signal apparatus, and connected with the impelled switch, so that the latter will, while in action, automatically insert the signal-battery between the office-terminals of two subscribers' lines, substantially as and for the purpose set forth.

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Witnesses:

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E. SCULLY.