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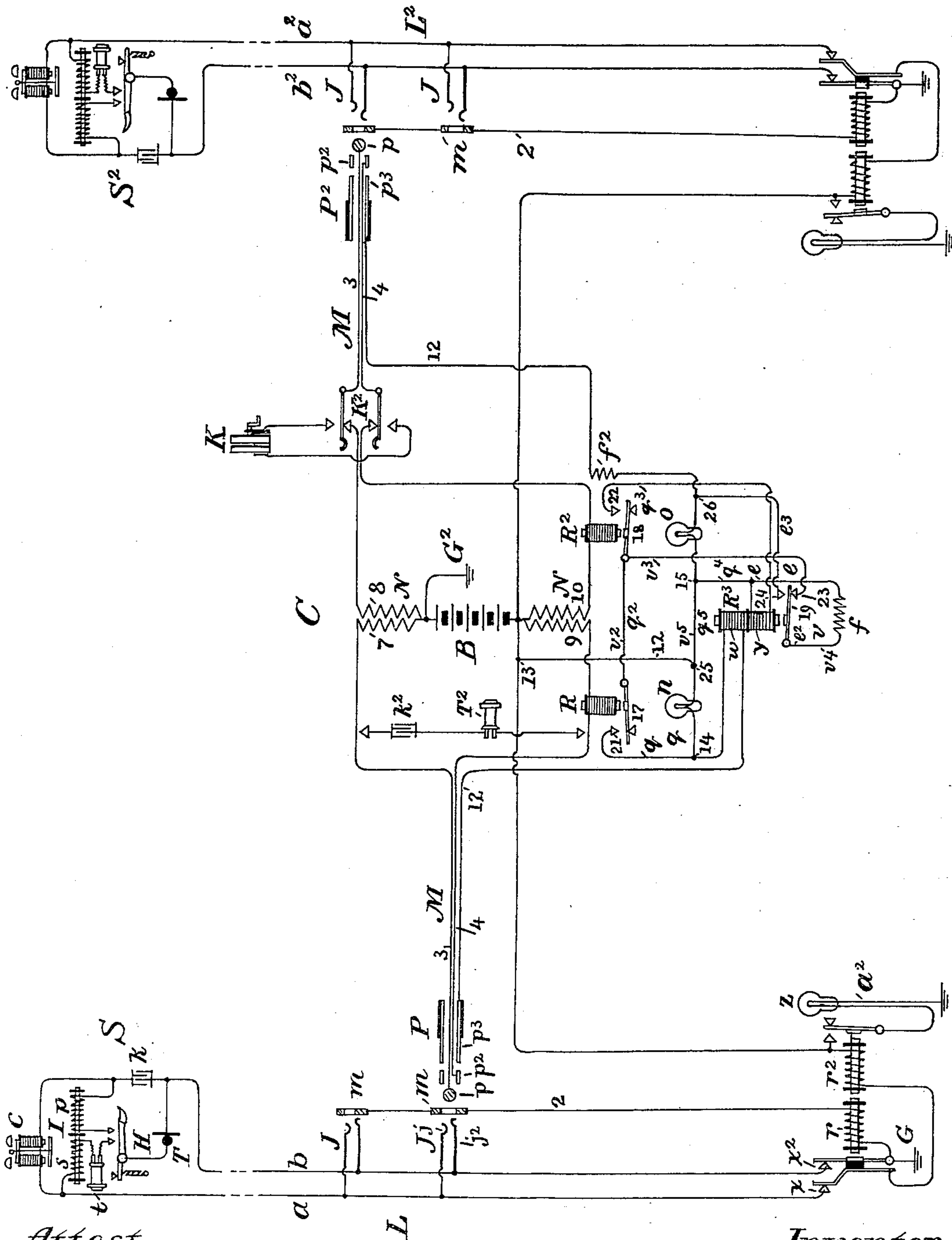
Patented Sept. 19, 1899.

T. C. WALES, JR.

TELEPHONE EXCHANGE SWITCHBOARD SIGNALING APPARATUS.

(Application filed Jan. 23, 1899.)

(No Model.)



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TELEPHONE-EXCHANGE SWITCHBOARD SIGNALING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 633,403, dated September 19, 1899.

Application filed January 23, 1899. Serial No. 703,142. (No model.)

To all whom it may concern:

Be it known that I, THOMAS C. WALES, Jr., residing at Newton, in the county of Middlesex and State of Massachusetts, have invented certain Improvements in Telephone-Exchange Switchboard Signaling Apparatus, of which the following is a specification.

This invention relates to the switching and switchboard signaling apparatus of a telephone-exchange central station, and more particularly has reference to a certain improved arrangement of such switchboard-signals, their controlling appliances and circuits, and an improved system of operation whereby their indications are made positive, definite, and distinct.

The invention is especially well adapted for association with systems wherein the source of current-supply for signaling or for the telephone-transmitters, or for both, is placed at the central station, and which, therefore, may be denominated "central-energy" systems.

In the practical operation of telephone central stations equipped with switchboards of the modern "relay-operated" type it has been found advantageous to place pairs of signals in juxtaposition before each operator, one such pair being associated with each complete switch-cord connection. These signals have been intended to indicate the discontinuance of a conversation or the desire of a subscriber for communication with the operator and to inform the operator in general of the condition of the substation apparatus. They have been termed "disconnecting" or, more generally, "supervisory" signals, and each has been so arranged in connection with other apparatus that it will be exhibited when at the close of a conversation the receiving-telephone is restored to its support at the corresponding substation. The conditions necessary for the steady display of one of these signals are that the terminal plug of the connection-cord with which the signal is associated shall be inserted in a switch-socket of a main telephone-circuit and that at the substation of such circuit the receiving-telephone shall occupy its place of rest upon the switch-hook provided for it. Now when a call-signal is to be transmitted to a substation from the

central station a terminal switch-plug of a connecting-cord circuit is inserted in a switch-socket of the desired main substation-circuit, and the call being sent in the usual way the call-bell at the substation is caused to ring; but under these circumstances it is evident that until the subscriber thus signaled in response to such summons removes the receiving-telephone from its support, taking it up for use, the exact conditions exist which have been stated as necessary and sufficient for the operation of the disconnection-signal, and as a consequence during this interval of time a false signal is displayed to the central-station operator; or to state the facts otherwise, the information conveyed by these signals is not definite or positive, the operator being required upon noticing the display of the signal associated with the called substation to remember whether the said substation has merely failed to respond to the call or whether the signal does, indeed, indicate a request for disconnection.

The object of the present invention is to bring about such a novel arrangement of the signals, their circuit connections, and controlling devices that one of the said signals shall in its display serve as a positive disconnecting-signal and the other as an information-signal. Thus by this invention it is provided that the constant or steady display of one of the signals may constitute an absolute and definite order to detach the plugs from the switch-sockets, the said signal being operative from the substations of either of two united main lines or circuits by the replacement of the telephones of either or both substations upon their respective suspension-switches. It is easy as a corollary of this proposition to see that the act of lifting the receiver from the said suspension-switch and again restoring it thereto several times in rapid succession will effect an intermittent display of the said signal, and that this also is an absolute signal and may constitute in all cases an indication that telephonic communication with the operator is desired, as, for instance, would be the case if either of the two parties who had been conversing wished immediately to speak with a third; and it is also provided that the exhibition of

the other signal shall invariably and positively give the information that the telephone has not yet been removed from the suspension-switch at the called substation, while of course its disappearance gives the converse information.

Although I have shown but one plug-and-cord circuit, it is of course to be understood that each operator is supplied with a number of these sufficient for the service.

The invention will be more fully understood by reference to the drawing accompanying this specification, wherein I have shown in diagram a system embodying the same.

Referring to said drawing, L and L^2 are main telephone-substation circuits converging from substations S S^2 to a central station C , a b and a^2 b^2 indicating the main conductors of the said circuits, respectively. The substation arrangement and the normal central-station arrangement of both circuits is of a standard central-energy type and is well understood. Briefly, there is at the substations a call-bell c , a condenser k , an induction-coil I , with primary and secondary windings p and s , a suspension-switch H , a transmitting-telephone T , and a receiving-telephone t . Normally the receiver is hung upon the hook of the suspension-switch, and the circuit leads from conductor a through the call-bell and condenser to conductor b , the presence of the condenser making the circuit conductively discontinuous and preventing the flow of current. When the receiver is taken from the hook, a conducting-path is closed around the condenser and the current flows and operates the call-signal at the central station. At the same time a short local inductive circuit is established which includes the transmitter T and the condenser, so that the operation of the said transmitter produces variations of potential between its terminals, and consequently waves in the said local circuit, which, by means of the induction-coil, propagate themselves in the main circuit in the form of voice-currents.

The conductors of the substation-circuits at the central station are led normally through contacts x x^2 of the usual cut-off relay r , after which conductor b is shown as being grounded at G , while conductor a continues through the call-signal relay r^2 , controlling the call-signal lamp z , and to one pole of the universal battery, the other pole of which has among other connections one with a ground terminal G^2 . The call-signal lamp z is shown as being in a ground branch a^2 of this circuit, but of course may be in any local circuit controlled by the said relay.

J J are branch terminal spring-jacks or switch-sockets, whereby the several lines may be united to one another or to the operator's apparatus through the intermediation of the plug-and-cord connection M , and the test-rings m of these sockets are connected by a conductor 2 through the coils of the cut-off relay r to ground.

M represents the plug-and-cord switch connection as a whole, P the answering-plug, and P^2 the calling-plug. Both plugs have a tip-contact p and a forward-sleeve contact p^2 adapted to engage, respectively, the contact-springs j j^2 of the switch-socket when the plug is thrust thereinto and a rearward-sleeve contact p^3 adapted to register with the test-ring m of the said socket.

N is a split repeating induction-coil, with windings 7 and 8 on one side and windings 9 and 10 on the other side of the battery B , the inner ends of windings 7 and 8 being united to one pole and the inner ends of windings 9 and 10 being similarly united to the other pole of said battery.

The plug-and-cord connection M comprises two main-circuit conductors 3 and 4 and one local-circuit conductor 12, the conductor 3 being in each plug united to the tip, conductor 4 to the forward-sleeve, and conductor 12 to the rearward-sleeve contacts. From plug P the conductors 3 and 4 lead to the outward ends of the repeating-coil windings 7 and 9, respectively, and are united thereto, and from plug P^2 the said conductors extend to and are connected similarly with the outer ends of windings 8 and 10. This arrangement divides the switch-cord main conductors into two sectional loops, each extending from the tip-contact to the forward-sleeve contact of its own plug, through two windings of the induction-coil, and through the battery B , which, being in a bridge between the conductors 3 and 4, is thus common to both loops, which, moreover, are inductively united by the repeating-coil.

R and R^2 are relays included in the sectional loops of the plugs P P^2 , respectively, and in the main telephone-circuits L L^2 when the said plugs are placed in the switch-sockets J . Thus as soon as the telephones at the substations of such circuits are lifted from their suspension-switches, the plugs being placed in their switch-sockets, a strong current flows through the circuits and the relays R R^2 , included therein, exciting the latter and bringing about the forward motion of their armatures 17 and 18, respectively, as hereinafter described. It is obvious then that the suspension-switch of each substation controls the relay included in the main circuit of said substation, and then when the receiving-telephone is replaced on the hook of such switch the circuit will be restored to its conductively discontinuous condition, so that the attractive power of the relay will cease, allowing the armature to fall back, and it is also evident that by repeating the operation of removing and replacing the receiver several times in rapid succession or (which amounts to the same thing) moving the suspension-switch up and down several times the armature of the relay will be successively attracted and retracted and will oscillate between its front and back stops.

T^2 represents the operator's telephone in-

struments and may be bridged between the switch-cord main conductors in series, if desired, with the condenser k^2 , by the aid of a listening-key, in the usual manner.

5 K is a generator supplying call-currents, and K^2 a call-key associated with the cord-circuit M, whereby outgoing call-signals may be transmitted over the circuit L^2 of a desired substation S^2 for the operation of the call-
10 bell there.

R^3 is the switching-relay, having an armature 19 and two reinforcing exciting-coils w and y . f and f^2 are artificial resistances to avoid short-circuiting of the current. n is
15 the supervisory disconnecting-signal, and o the information-signal, these signals being preferably glow-lamps. Said switching-relay R^3 , which in a manner presently to be described aids the main relays R R^2 in actuat-
20 ing and differentiating the lamp-signals n and o and which when brought into operation acts to open certain controlling-circuits and to close others, is so designed or adjusted in a man-
ner well understood by those skilled in the
25 art that the normal current through either winding w or y is insufficient for its operation; but when the normal current passes through both windings w and y simultaneously the
30 relay-magnet becomes sufficiently excited and is able to attract the armature 19 to its forward position. When the armature is once attracted, however, the current through either winding alone is sufficient to sustain the
35 same, and consequently the connection thereof with its front contact stops. The exciting-coil w of the switching-relay R^3 is in a local circuit associated with the answering-plug in
sequence with the lamp-signal thereof, and
40 exciting-coil y is in a shunt-circuit controlled by both main-line relays and adapted to be established around the said lamp-signal under certain conditions, all as will more fully
be hereinafter explained.

The local circuit 12, associated with plug
45 P, extends from the battery-main at point 13 through the disconnection-signal n and the winding w of the switching-relay R^3 to the rear-sleeve contact of the plug, while that associated with plug P^2 extends from the same
50 or similar point 13 through the information-signal o and the resistance f^2 to the rear-sleeve contact of plug P^2 . Both of these circuits are closed (when their associate plugs are placed in the main-line switch-sockets)
55 through the test-ring conductors 2 and the cut-off relays r . Hence the act of inserting the plug operates the cut-off relay.

Three shunt-circuits v , q , and e are associated with the signals n and o , and as por-
60 tions of the same conductors are utilized in all of the said shunts the circuit of each is indicated by its characteristic letter placed at intervals throughout the circuit. Two of these shunt-circuits v and q belong to signal
65 n and the shunt-circuit e belongs to signal o .

The shunt v extends from point 14 of the local conductor 12 of plug P on one side of

the lamp n , through the contacts 21 and 17
of relay R, conductors v^2 and v^3 , back and
armature contacts 23 and 19 of switching-re- 70
lay R^3 , conductor v^4 , resistance f , junction-
point 15, conductor v^5 , to the point 25 on the
other side of the lamp. Since the local cur-
rent which flows through winding w of the
relay R^3 is not strong enough to effect the at- 75
traction of the armature 19 thereof, the said
armature remains on its back-stop, maintain-
ing the shunt-circuit closed there, and since
the said circuit is closed immediately when
the plug P is inserted in its socket to answer 80
a call at the contact 21 of relay R, which
then becomes excited, the signal n is not dis-
played, the shunt v being established around
it from the beginning of the operation. Until
connection is made by the plug P^2 with the 85
wanted line and the call sent thereover and
responded to by the substation thereof the
shunt v remains closed around the signal n ,
and it (and consequently the said signal) is
controlled by the relay R only. The action 90
of this shunt-circuit prevents the display of
the disconnecting-signal when the answering-
plug P is inserted into a jack J of the calling-
subscriber's line.

The shunt q may be traced as follows: from 95
the same starting-point 14 on one side of the
lamp n , by conductor q , contacts 21 and 17 of
relay R, conductor q^2 , the armature and fixed
contacts 18 and 22 of relay R^2 , conductor q^3 ,
second exciting-coil y of switching-relay R^3 , 100
conductor q^4 , junction-point 15, conductor q^5 ,
to the point 25 on the other side of the lamp.
This shunt q , being in part controlled by the
relay R^2 , cannot close until the said relay, sub-
sequent to the connection of the second plug 105
and line, becomes excited. When answer-
ing the call which has been sent, the suspen-
sion-switch is operated at the substation S^2
and closes the circuit L^2 , allowing the current
of the battery B to flow therein. When, 110
however, this is done, the armatures of both
relays R and R^2 are attracted, closing the
shunt-circuit q through both sets of contact-
points, so that from this period of the opera-
tion the shunt q is established around the 115
signal n and is controlled by both relays, and
consequently can be operated by the switch
at both stations; but as the said second shunt
leads through winding y of the switch-relay
the said relay now becomes fully excited and 120
attracts its armature away from the back
contact 23, thus opening the shunt v . The
action of this second shunt-circuit prevents
the display of the disconnecting-signal n when
the plug P^2 is inserted into jack J of the called- 125
subscriber's line.

The shunt-circuit e belongs to the informa-
tion-signal o and is adapted for establishment
around said signal in the local circuit associ-
ated with the calling-plug and governs the 130
operation of the signal. It being desired that
signal o shall be displayed after the plug P^2
is inserted into the socket of the wanted line
and until the call transmitted to the substa-

tion thereof is attended to, the said shunt e is so arranged that it does not close and extinguish the signal until the telephone at the desired substation is taken up for use. It extends from the point 15 on one side of that signal to the point 26 on the other by way of conductor e , resistance f , conductor e^2 , armature 19 of relay R^3 , front contact 24 thereof, and conductor e^3 . This shunt-circuit is normally disestablished and remains so when the plug P^2 is inserted in the socket J. Consequently the lamp o is lighted as soon as the said plug is inserted and its local circuit thereby closed to earth through the cut-off relay. While it remains lighted the operator knows that the telephone-receiver has not been removed from the switch at the substation S^2 . When the telephone is displaced therefrom, the circuit L^2 closed by the switch, and the relay R^2 excited, the switch-relay R^3 also becomes operative, as already stated, and besides opening the first shunt at 23 closes the third shunt at 24. The lamp o is thus extinguished, and having by the disappearance of its light informed the operator that the substation-receiver has been taken up for use it has no further function or office during the pendency of this particular communication and remains extinguished; but the other signal n being operative from both substations when either substation-telephone is replaced on its switch the armature of the corresponding relay falls back, opens the shunt-circuit q , and exhibits the disconnection-signal.

Should either substation desire to attract the attention of the central-station operator prior to the termination of the message, this can be done by alternately elevating and depressing the switch H repeatedly, and thus intermittently opening the main circuit. The effect of this is the oscillation of the armature of relay R or R^2 , as the case may be, and a flash-signal of lamp n . This does not affect the shunt e around lamp o or the lamp o itself, because though the circuit through the winding y of the switch-relay is opened the current in the upper winding is strong enough to maintain the magnetization and to sustain the armature 19 in its forward position, though not in the first place to attract it thereto.

When the substations have sent the disconnecting-signal by replacing their telephones on their switches, the plugs P and P^2 are withdrawn from the sockets and all appliances associated with the switch-cord circuit assume their normal state.

Having thus fully described the invention and its operation, I claim—

1. In a telephone-exchange system, the combination of two telephone-substation circuits united by switch apparatus at a central station for through communication; a switch at the substations of said circuits controlling the electrical condition thereof; a supervisory signal at the central station associated with the said through circuit; and two relays one for each component circuit, both controlling the

said supervisory signal, and responsive each to the action of the switch at the substation of its respective component circuit.

2. The combination in a telephone-exchange switch apparatus, with a switch-cord connection having a switch-plug at each terminal for uniting two substation-circuits, a supervisory signal associated with one of the said plugs, a shunt-circuit therefor governing the display thereof, all at a central station; and a suspension-switch at the substations of the said two circuits; of two relays associated with the said switch-plugs respectively, and connected in the main circuits of the said switch-cord, both of the said relays being organized to control the said supervisory-signal shunt-circuit, and to respond to the operation of the substation suspension-switches of the circuits with which their associated plugs are respectively connected.

3. In a telephone system and switching apparatus, two main circuits extending respectively between independent substations and the central station, and provided at the latter with switch-sockets; a switch-cord circuit connection uniting the said circuits for through communication, having its terminal switch-plugs placed in the switch-sockets of the calling and called circuits respectively; two relays, one in each main circuit; a supervisory signal associated with the calling-circuit switch-plug; a shunt-circuit governing the display of said signal and controlled by the substation apparatus of the calling main circuit through the relay thereof; a second shunt-circuit for the said signal controlled by the substation apparatus of both main circuits through their respective relays; means for establishing the first shunt-circuit when connection is made between one of the said plugs and the calling main circuit; and means for establishing the second shunt-circuit and disestablishing the first, when switch connections having been made between the remaining plug and the called main circuit, a call-signal is transmitted thereover and responded to; substantially as set forth.

4. In a telephone switchboard apparatus, a sectional switch plug and cord connection circuit having main and local circuit conductors; a supervisory signal connected with the local circuit thereof; two relays associated with the sectional main circuits of the two terminal plugs respectively, of said switch-cord connection; a shunt-circuit for the said signal controlled by one of the said relays; a second shunt-circuit therefor, controlled by both of the said relays; and a switch-relay operated by the closing of the second shunt, and adapted thereupon to open the first; substantially as and for the purposes specified.

5. The combination in a telephone-exchange system, with two main substation-circuits, each having a switch controlling the electrical condition of the circuit at the substation, and switch-sockets at the central sta-

tion; and a plug and cord switch connection circuit therefor; of two determinate and absolute signals associated with the said switch connection, one being responsive to the initial
 5 operation of the substation-switch of the called substation and adapted to indicate the said operation; and the other being responsive to every operation of the switch at the calling substation, and to every subsequent
 10 operation of the called station, and adapted to indicate a desired disconnection; substantially as specified.

6. In a telephone-exchange and switching system the combination of a switch connection comprising a cord-circuit having terminal switch-plugs P P^2 at its ends, and containing two main-circuit conductors extending between the plugs and divided into two sectional loops by a battery-bridge, and the
 20 conductors of two local circuits, one associated with each loop; a supervisory disconnecting-signal in the local circuit of the plug P ; an information-signal in the local circuit of the plug P^2 ; and two relays in the main-circuit sectional loops respectively; with a
 25 shunt-circuit governing the disconnecting-signal and controlled by one of the said relays; a second shunt-circuit for the said signal controlled by both relays; an independent shunt-circuit governing the display of
 30 the said information-signal; and a switching-relay operated by the closing of the second shunt-circuit, and adapted thereupon to open the first shunt-circuit around the disconnecting-signal, to maintain the control of said signal by the relays associated with the main
 35 loops of both plugs, and to close and maintain closed the independent shunt-circuit of the information-signal, substantially as set
 40 forth.

7. The combination in a telephone switch apparatus, substantially as hereinbefore set forth, of a switch-cord having terminal switch-plugs P P^2 , and containing two main-circuit
 45 conductors divided centrally into two sectional loops by a battery-bridge, and the conductors of two local circuits, one associated with each loop; a disconnecting-signal in the

local circuit of plug P ; an information-signal in the local circuit of plug P^2 ; two relays R , R^2 in the said main-circuit sectional loops
 50 respectively; a shunt-circuit governing the display of the disconnecting-signal and controlled by the relay R ; a second shunt-circuit also governing the said signal, controlled by
 55 both relays; a third shunt-circuit governing the display of the information-signal; and a switching-relay with two independent exciting-coils contained respectively in the local signal-circuit of plug P , and in the second
 60 shunt-circuit, and adapted to attract its armature only when the said two coils reinforce one another, but to maintain the said attraction under the magnetizing influence of either
 65 winding alone, the said switching-relay being thereby adapted to respond to the closing of the second shunt-circuit, and thereupon to open the first shunt-circuit and to close the third shunt-circuit.

8. The combination in a plug and cord
 70 switchboard connection comprising main and local circuits, of a disconnecting-signal in the local circuit of one plug; an information-signal in the local circuit of the other plug; two
 80 relays in the main circuits of the two plugs respectively; a double-wound switching-relay; a shunt-circuit around the disconnecting-signal leading through the back contacts of the said switching-relay, and the contacts of
 85 one of the said main-circuit relays; a second shunt-circuit around the said disconnecting-signal extending through the contact-points of both main-circuit relays and one winding of the switching-relay; and a shunt-circuit for the information-signal, extending through
 85 the front contacts of the said switching-relay; substantially as set forth.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 18th day of
 90 January, 1899.

THOMAS C. WALES, JR.

Witnesses:

GEO. WILLIS PIERCE,
 JOSEPH A. GATELY.

It is hereby certified that in Letters Patent No. 633,403, granted September 19, 1899, upon the application of Thomas C. Wales, Jr., of Newton, Massachusetts, for an improvement in "Telephone-Exchange Switchboard Signaling Apparatus," errors appear in the printed specification requiring correction, as follows: On page 5, lines 77 and 81, the word "around" should read *round*, same page, line 79, the word "contents" should read *contacts*, and same page and column, in line numbers the numeral "80" should read 75; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed, countersigned, and sealed this 10th day of October, A. D., 1899.

[SEAL.]

WEBSTER DAVIS,
Assistant Secretary of the Interior.

Countersigned:

C. H. DUELL,
Commissioner of Patents.