

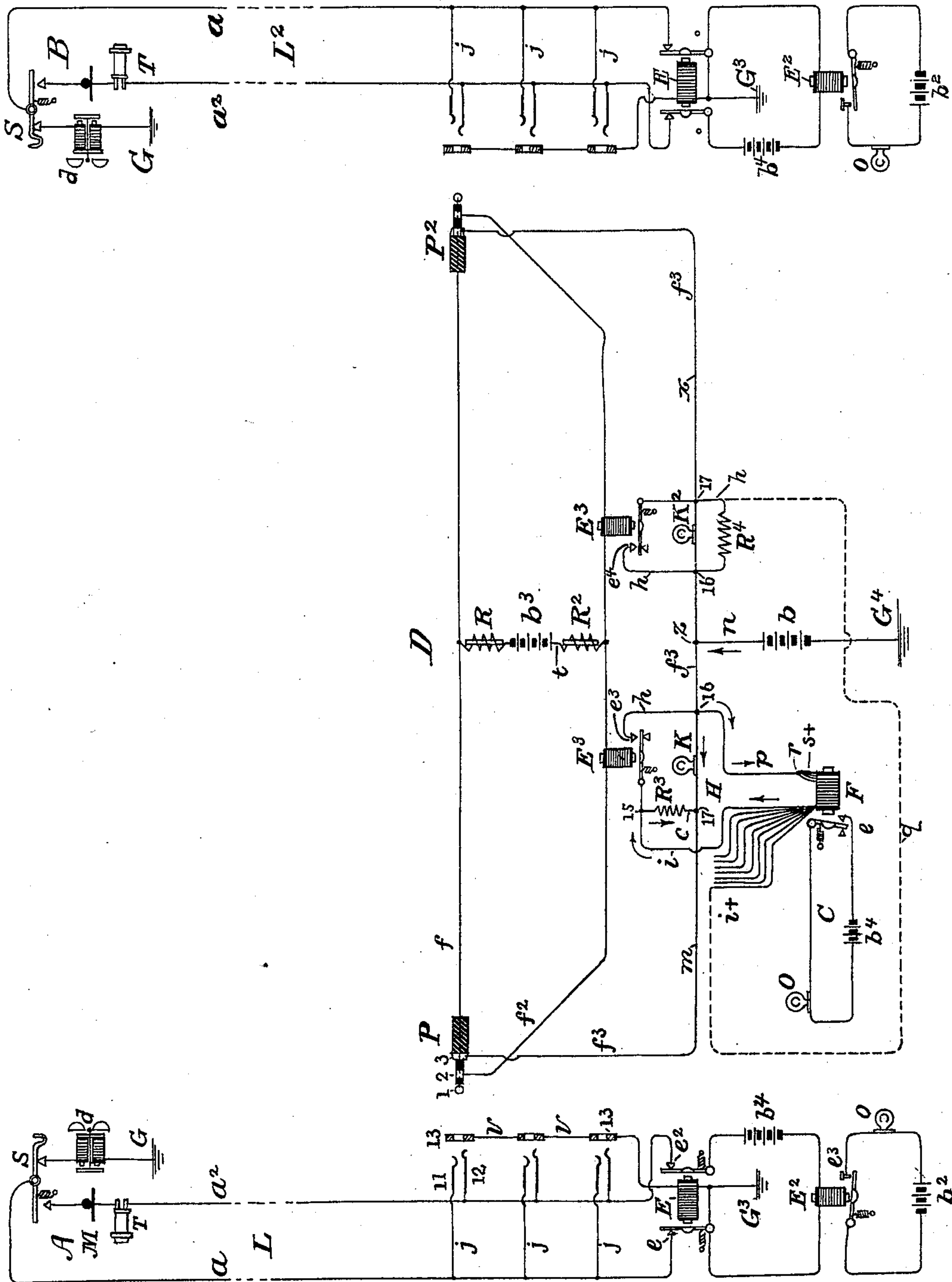
(No Model.)

G. K. THOMPSON.

TELEPHONE CENTRAL STATION SIGNALING CIRCUIT.

No. 587,467.

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Attest.

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UNITED STATES PATENT OFFICE.

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TELEPHONE CENTRAL-STATION SIGNALING-CIRCUIT.

SPECIFICATION forming part of Letters Patent No. 587,467, dated August 3, 1897.

Application filed May 25, 1897. Serial No. 638,022. (No model.)

To all whom it may concern:

Be it known that I, GEORGE K. THOMPSON, residing at Malden, in the county of Middlesex and State of Massachusetts, have invented certain Improvements in Telephone Central-Station Signaling-Circuits, of which the following is a specification.

In the practical operation of telephone-exchange central offices it has been found advisable to employ monitors or supervising operators, whose duty it becomes to keep a constant watch upon the switchboard operators and operations for the purposes of detecting any slowness or negligence on the part of the said operators in making connections or disconnections and in responding to signals calling for either operation and of forestalling or remedying the overcrowding with work of any particular switchboard operator or section at certain busy hours of the day when the total amount of work might otherwise be unequally distributed. Means are provided whereby such monitors are enabled readily and quickly to become apprised of the working condition of the charge of any switchboard-operator or group of operators.

This invention relates to such means, which comprise a supplementary or "pilot" signal (preferably a special glow-lamp) in an auxiliary local circuit associated with and common to the several local circuits of the several disconnecting-signals of a number of pairs of connection-cords. This pilot-signal is intended for operation whenever any of the individual disconnecting-signals are actuated, and is adapted to remain displayed as long as a single one of such disconnecting-signals is neglected or from any reason is disregarded, and is therefore easily and at once observed by the supervisor, who may proceed to inquire into the reason of the delay. For this purpose it is conveniently placed at some conspicuous part of such portion of the switchboard as it is designed to serve, and, if desired, may be provided with a bulb or globe of special color, in order that it may more readily catch the eye of the person in charge.

The invention is designed for use in connection with common-battery multiple-switchboard systems wherein the calls and other

signals from the substations are automatically made by the acts of taking the receiving-telephone up for use and restoring it to its place again and wherein the substation telephone-transmitters receive their current-supply from a source or generator placed at the central station.

It consists, essentially, in combining the series or group of plug or connection-cord circuits upon an operator's keyboard or switch-section, their respective associated supervisory or disconnecting signals, a shunt-circuit round each signal, an electromagnetic switch controlling the said shunt, and the supplementary or pilot signal in an auxiliary local circuit, with a relay controlling such auxiliary circuit and pilot-signal and wound with a plurality of exciting-coils, one for each connection-cord or pair of cords, the coil or winding for each cord being placed in a second and permanently-closed shunt or derivation round the disconnecting-signal, which second shunt is also controlled, albeit indirectly, by the electromagnetic switch of the first, not, however, in respect to its continuity, but in respect to the passage through it of current adapted to excite the relay. By means of the said multiple-coil relay and its connections the pilot-signal is operated efficiently in conjunction with any or all of the disconnecting-signals, and the resistance of each of the multiple windings thereof is of such magnitude that I am enabled to utilize the said windings, respectively, in place of a special resistance in a similar permanent shunt round the disconnecting signal-lamp, which otherwise requires to be provided to maintain the integrity of the local circuit containing such lamp in case the said lamp should burn out or have its conductor broken and for the appropriate operation of any of the well-known arrangements of multiple-switchboard busy-test. Two disconnecting-signals, one for each cord conductor of the pair constituting the complete connection between the two terminal plugs, are generally preferred, and each of these is preferably associated with one of the relay exciting-coils connected with its permanent shunt; but in cases where it is thought sufficient to have the relay and pilot-

signal worked in conjunction with but one cord of the pair the special resistance, of like magnitude with the relay-winding already mentioned, may be employed in the permanent shunt round the disconnecting-lamp of the other cord. Thus in the latter case the windings of the relay-magnet in the permanent shunt-circuit on one plug side of the connection-cord are each of the same resistance value as that of the resistance-coil on the opposite plug side of said cord, and in addition to exercising their principal function of exciting magnetism in the relay-core serve also incidentally in the same capacity as do such resistance-coils—viz., to maintain the continuity of the disconnecting-lamp circuit for testing and such other operations as may be necessary or convenient should such circuit be from any cause open in the lamp without interfering with the operativeness of such lamp when the same is in order.

The drawing which accompanies this specification is a diagram illustrating the invention as it may be arranged and operated at the central station of a telephone-exchange system in association with subscribers' circuits converging thereto.

L and L² represent main telephone-circuits converging from substations A and B to a central station D, where by means of switchboard apparatus they may be united or connected with any other substation-circuits, as desired.

The main telephone-circuits L L² have line conductors a a^2 , the former of which is shown as being normally connected to ground G at the substation through the hook-switch S and bell d and extends at the central station through the switchboard-sections (being provided in each branched connecting-socket j thereat with a spring 11) to the back-stop e of one armature of the cut-off relay E, which armature has a branch to ground G³ and continues by an extension through the electromagnet of line-relay E² to one pole of battery b^4 . The conductor a^2 (shown as being normally open at the substation) extends through the transmitter M and receiver T there placed to the springs 12 in each connecting-socket j of the central-station switchboard and to the back-stop e^2 of the other armature of relay E, which armature connects with the remaining pole of battery b^4 , thus closing the line-circuit at its central-station end.

o is the call signal-lamp in the normally open local circuit of battery b^2 , controlled by the armature of the relay E².

v is a wire extending from ground G³ to the test-rings 13 of each connecting-socket j and in its circuit including the helices of the relay E.

Each pair of connection-cords is provided with terminal plugs P and P², which are provided with insulated metallic contacts 1, 2, and 3. The tips 1 of the two plugs are joined by wire f , the sleeves 2 by wire f^2 , and the shanks 3 by the wire f^3 . The wires f and f^2 are united by the bridge t , in the center of

which is the transmitter-battery b^3 , placed between the electromagnetic resistances or impedance-coils R and R².

K and K² are the supervising or clearing-out lamp-signals in their local circuits m and x , which otherwise may together be regarded as the third conductor f^3 of the connecting-cord, uniting the contact-surfaces 3 of the two plugs thereof. The said local circuits each are adapted to be closed when the plugs P P² are inserted in the jack-sockets j , and may then for each plug be traced from ground G⁴, through battery b , conductor n , point z , conductor f^3 , plug-contact 3, test-rings or socket-frames 13, wire v , cut-off magnet E, to ground at G³. The disconnecting-signal and the cut-off relay are thus arranged in series in the same local circuit. When, therefore, the plug P is placed in its socket j , the cut-off relay is operated to sever the normal terminal extension from the main circuit. The disconnecting-signal is not, however, displayed, such display being prevented by the apparatus and circuits now to be described. The said disconnecting-signals are provided with normally open shunt-circuits h , which in practice may include a small resistance R³, as shown in the shunt of lamp K. The said resistance, however, has no intimate relation to this invention and requires no further reference. The said shunts connect with the conductor f^3 at two points 16 17 on the two sides of the lamps, and pass from thence through the local points e^3 e^4 of the relays E³, which local points therefore, together with the relay-magnet and armature, form an electromagnetic switch maintaining the shunt-circuit open as long as the conductor f^2 is on open circuit, but closing the same when by inserting the plug P in a jack representing a closed line-circuit the battery b^3 is enabled to send its current through the coils of the relay E³. The said relay under such conditions becomes excited and attracts its armature, thus closing the shunt-circuit h and withdrawing current from the lamps K K², which consequently are not illuminated as long as the shunt-circuit remains closed.

In the drawing the lamp K² is shown as being provided also with a permanently-closed shunt h , containing a resistance R⁴ of about three hundred ohms. This shunt and resistance preserves the continuity of the circuit when, as sometimes happens, the lamp-filament is burned out or broken.

The device which forms the essential element or feature of my invention is shown in the drawing as being particularly associated with the disconnecting lamp-signal K, although, as hereinbefore explained, it can readily be applied to both lamps.

F is a relay wound with as many exciting-coils as there are pairs of plugs and cords at an operator's section, say fifteen, each having a resistance of about three hundred ohms, and s^+ may represent one end of each coil, united at point r to a common wire p , which

is connected at point 16 on wire f^3 . An extension i of an opposite end of one of the coils is connected at point 15 to the first shunt-circuit h , and thereby to the armature-lever of the relay E^2 , and i^+ represents the opposite ends of the other coils, each of which is connected in a similar manner to the local-circuit conductors of the other cord-circuits. (Not, however, shown.)

C is a local circuit in which is connected the pilot-lamp signal O and battery b^4 , the said circuit being controlled by the relay F , acting through its local points e . This circuit can be extended to any desired distance and to any place, so that the lamp O shall be under the attention of the central-exchange monitor.

The several coils are given a resistance of three hundred ohms each, so that they may not only exercise their designed function, but may likewise serve as substitutes for the special resistance R^4 and safeguard the continuity of the test-circuit without drawing much current from the lamp.

As already suggested, although the signal K^2 is shown as being supplied with a special resistance R^4 in a shunt, it is preferable that this signal as well as K shall be provided with an exciting-coil of the pilot-lamp controlling relay F ; otherwise the display of the signal by said lamp K^2 will not be accompanied by the concomitant display of the pilot-signal. I have, however, shown the said special resistance R^4 mainly as an indication that it would be required for continuity-maintaining purposes if the multiple-coil relay F were absent altogether, and that when a coil of said relay is associated with the signals K or K^2 it need not be in addition to such resistance R^4 , but is adapted to be employed as a substitute therefor.

In the operation of the system when a call is to be made from a substation the telephone T is removed from the hook-switch S , which, impelled by its spring, closes the main circuit through the telephones. Current from battery b^4 then excites the relay E^3 , whose armature becomes attracted and closes the contacts e^3 of the line-signal local circuit, causing the said signal o to be displayed. The operator thereupon inserts the plug P in the answering-socket j and connects in her telephone (not shown in the diagram) and receives the call. When the plug is inserted, its tip 1 connects with spring 11, its sleeve 2 with spring 12, and its shank 3 with the ring 13 and a circuit is formed from ground G^4 to the complementary ground G^3 for the current of battery b , as hereinbefore described. The cut-off relay E becomes excited and attracts its two armatures from the contact-points e and e^2 , opening the normal main circuit, demagnetizing the relay E^2 , and extinguishing the line lamp-signal o . A portion of the current from the battery b tends to be diverted between points 16 and 17 on conductor f^3 by way of the derivation through wire p , the ap-

propriate coil of relay F , wire i , point 15, resistance R^3 , and conductor c ; but when the local points e^3 are held in contact by relay E^3 the amount of current actually passing that way is negligible. A talking-circuit is also established by the introduction of the plug into the socket, as follows: from battery b^3 by way of retardation-coil R , wire f , tip 1 of plug, spring 11 of socket j , conductor a , switch S , telephones M and T , conductor a^2 , spring 12 of socket j , sleeve 2 of plug, wire f^2 , relay E^3 , and retardation-coil R^2 to the other pole of the battery. The current in this circuit of the battery b^3 excites the relay E^3 , causing its armature to unite the contacts e^3 , thereby operating the electromagnetic switch, which the said relay-armature and points constitute, and closing the shunt-circuit h round the disconnecting lamp-signal K , so that the major part of the current from the battery b , which splits at point 16, is diverted from the lamp K and also from the relay F and passes through the shunt h by way of the contacts e^3 and conductor c , and as such portion of the current as finds its way through the signal K and through the relay-coil is insufficient to light the lamp or excite the relay-magnet the disconnecting and pilot signals remain quiescent. The said lamp and relay both remain shunted and consequently undisplayed as long as the current from the transmitter supply-battery b^3 circulates in the main substation-circuit, but when the receiver T is returned to the switch-support on the conclusion of a conversation the said switch, actuated by the weight of said receiver, opens the line-circuit and this current is interrupted. The magnet of relay E^3 then loses its excitement and its armature is retracted, operating the electromagnetic switch and opening the shunt-circuit h . There being now no low-resistance path round the lamp K and relay-coil, which are in parallel, the former receives sufficient current for its illumination and the relay-coil receives sufficient current for the operative excitation of its core. Thus the lamp K displays the signal to disconnect and the relay F closes the local circuit C for the operation of the pilot-signal O , whereby the latter is enabled to simultaneously display its signal also.

Since the relay has exciting-coils equal in number to the disconnecting-signals of the connection-cords with which it is associated and to which it is common, or to any desired number of such disconnecting-signals, it is obvious that whenever any one of the said disconnecting-lamps so associated is lighted current will flow through the corresponding winding of relay F , which is bridged round such lamp, and that the relay F and the pilot-signal O controlled thereby will uniformly be operated when any disconnecting-signal is displayed, and will remain in operation as long as any of the series of disconnecting-signals remains displayed or is unattended to; and it is also obvious as the resistance of each

of the said exciting-coils of the relay F is substantially the same as that of the shunt resistance R^4 , and as the said coils occupy the same relation to the conductor f^3 and their
 5 respective associated lamps K or K^2 as otherwise would be occupied by the said resistances, that they serve not only to excite magnetism in the cores of the relay F, but also serve to maintain the continuity of their re-
 10 spective conductors f^3 , so that whenever such relay-coils are employed in association with the disconnecting signal-lamp the special continuity-preserving resistances may be dispensed with. This function of the relay-coil
 15 is indicated by the broken-line alternative circuit q , which includes one of the coils of the relay F.

I claim—

1. The combination in a telephone central-
 20 station apparatus, of a series or group of connecting cords or conductors, a corresponding series of disconnecting lamp-signals, a shunt-circuit round each signal, an electromagnetic switch controlling each shunt-circuit, and a
 25 common supplementary or pilot signal in an auxiliary local circuit, with a relay controlling such auxiliary local circuit and pilot-lamp, and wound with a plurality of exciting-coils, associated with the said cords and dis-
 30 connecting-signals respectively, the said coils or windings being each connected in parallel with its associated lamp, and sustaining like relations with said lamp to the shunt-circuit thereof, and its controlling-switch, substan-
 35 tially as described.

2. In a telephone central-station switch-
 board apparatus, the combination substan-
 40 tially as hereinbefore described, of a group or series of local signal-circuits; a disconnecting lamp-signal in each; an auxiliary local signal-circuit; a supplementary or pilot signal common to the said series of circuits and lamps contained therein; a relay controlling the said auxiliary circuit and pilot-signal, and
 45 wound with a plurality of independent magnetizing-coils each associated and connected in parallel with a corresponding one of said disconnecting lamp-signals; a shunt-circuit round each of the said signals and its associ-
 50 ated relay-coil; and a main-line relay for each of the said shunt-circuits, forming an electromagnetic switch adapted to open and

close the same, and thereby control the display and withdrawal of the disconnecting and pilot signals.

3. The combination in a telephone central-
 station switching apparatus, with a plurality or group of disconnecting-signal circuits; a lamp-signal in each; a low-resistance shunt-circuit about each signal; and a switch con-
 60 trolling said shunt; of a supplementary signal, common to and adapted to operate with each and all of the said group of disconnecting-signals and their circuits, included in an auxiliary signal-circuit; and a relay control-
 65 ling such auxiliary circuit and signal, and wound with a number of exciting-coils of equal resistance, the said windings being included in a second and permanently-closed shunt-circuit of their associated disconnect-
 70 ing signal-lamps respectively; substantially as described.

4. The combination in a telephone central station of a series or group of plug and cord switchboard-conductors two disconnecting
 75 signal-lamps for each conductor, one associated with each terminal plug to respond to signal from a line connected therewith; and two shunt-circuits round each lamp, one being of low resistance and controlled by an
 80 electromagnetic switch, and the other permanently closed and containing a coil having a resistance relatively high to that of the said lamp; with an associated auxiliary circuit and pilot-signal; and a controlling-relay therefor,
 85 having a number of exciting-coils, each interposed in the said permanently-closed shunt-circuit of some one of the said disconnecting lamp-signals, and constituting the said coil of relatively high resistance, whereby the
 90 pilot-signal is enabled to operate on the operation of any or each of the said disconnecting-signals, and whereby the continuity of the lamp-signal circuit is maintained; 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 May, 1897.

GEORGE K. THOMPSON.

Witnesses:

KATHARINE DURFEE,
 JOSEPH A. GATELY.