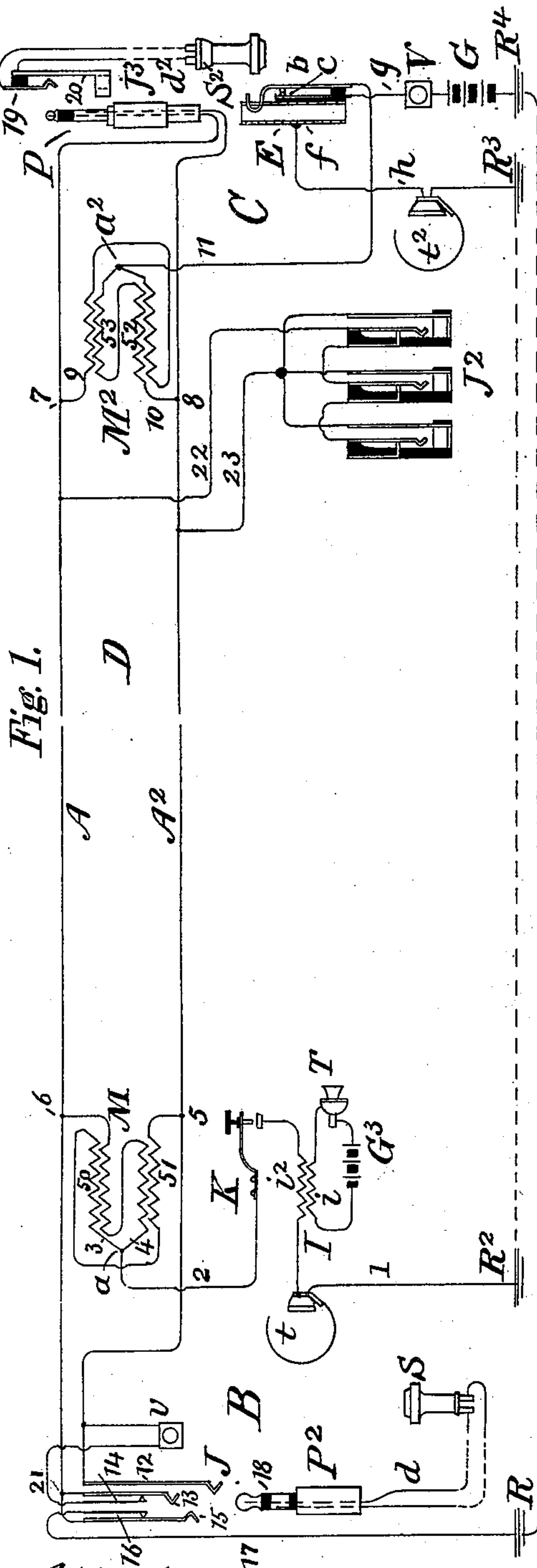


(No Model.)

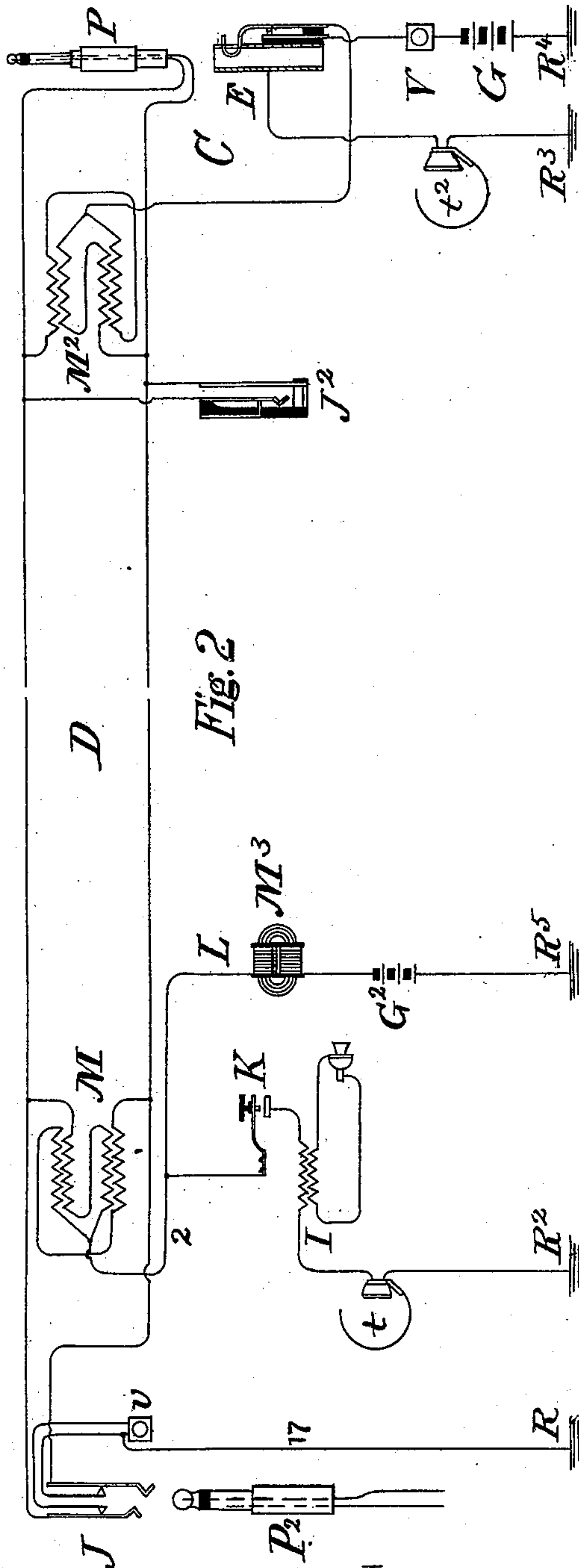
F. A. PICKERNELL.  
TELEPHONE AND SIGNALING CIRCUIT.

No. 534,373.

Patented Feb. 19, 1895.



Attest.  
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# UNITED STATES PATENT OFFICE.

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## TELEPHONE AND SIGNALING CIRCUIT.

SPECIFICATION forming part of Letters Patent No. 534,373, dated February 19, 1895.

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*To all whom it may concern:*

Be it known that I, FRANK A. PICKERNELL, residing at Newark, in the county of Essex and State of New Jersey, have invented certain Improvements in Telephone and Signaling Circuits, of which the following is a specification.

This invention relates to the construction and operation of telephone circuits, and especially of trunk lines extending between a central station and a branch exchange, for the purpose of affording facilities whereby telephone connections may be made between the branch exchange and any substation associated with the said central station with facility and expedition.

The objects of the invention are to enable a telephone trunk line to be operated in association with the useful adjuncts, of an order circuit, and a signaling circuit, whereby other lines may at either end of said trunk be connected therewith and disconnected therefrom with great promptness and speed, the disconnection at one end thereof being caused to automatically announce itself at the other; and to accomplish this without additional main line conductors for either class of auxiliary circuit.

In pursuance of these objects my invention consists in a double conductor trunk line adapted to form a portion of a metallic conversation circuit associated with two independent auxiliary circuits, one including the operators' telephones to serve as an order or instruction circuit, and the other containing signaling appliances and serving as a signal circuit over which a disconnection performed at one end of a circuit may be indicated automatically at the other; the main conductor of both auxiliary circuits being constituted of the direct and return conductors of the conversation circuit, considered as one, that is to say connected in parallel with one another.

It also consists in connecting obstruction coils or electro-magnetic resistances between the two conductors of the main circuit at the terminal or other stations; in connecting the independent portions of the instruction circuit including the operators' instruments between the central points of the windings of

the said obstruction coils, and an independent return conductor which, if desired, may be the earth; and in connecting the independent portions of the signaling circuit at one station between the two main circuit conductors direct, and a suitable return conductor, and at the other between the central point of the obstruction coil and the said return conductor through the signal receiving device: a current generator being located at any convenient point in the said independent portions of the circuit.

It further consist in combining with the above mentioned devices a plug seat switch at one end of the circuit in which the removal and replacement of a switch plug determines which of the two associated circuits shall at any given time be in operative condition; and a circuit closer placed in association with a plug socket or springjack at the other end of the circuit, and actuated by the insertion or withdrawal of a plug into or from said socket; and in certain other details of construction and arrangement, to be more fully recited hereinafter.

In the drawings which accompany this specification Figure 1 is a diagram of an arrangement of circuit conductors and appliances illustrative of my invention, and Fig. 2 a diagram of a modification of the same.

A and A<sup>2</sup> are the two conductors of a trunk telephone circuit D, extending between a central station C and a branch exchange station B. At C they terminate in a double conductor switch plug P, and at B in a springjack or plug socket J.

Referring to Fig. 1, at the branch exchange I provide also a plug P<sup>2</sup> which may represent an office trunk or more generally any of a number of circuits *d* which center there and which extend outwardly therefrom to telephone stations S; an operator's instruction outfit comprising transmitting and receiving telephones T, *t*, as usual; a key or circuit closer K controlling the connection of the said telephones; a visible signal device *v* in the normal circuit of the two conductors A and A<sup>2</sup>; and a differential obstruction coil or electro-magnetic resistance M bridged between the said main conductors A A<sup>2</sup>, and having a connection from the central point



$a$  of its winding to the stem of the key  $K$ . At the central station  $C$  to which may converge local telephone circuits  $d^2$  from any number of telephone stations  $S^2$ , is a similar differentially wound obstruction coil  $M^2$ , a number of multiple connection springjacks or plug sockets  $J^2$ ; a plug seat switch  $E$  which has for a movable element the spring contact  $b$ , and for two fixed elements the switch socket  $f$  and the insulated point  $c$ ; a branch connection  $g$  extending from point  $c$  through a visible signal appliance  $V$  and the generator  $G$ , which may be a battery, to the earth or other return conductor  $R^4$ ; and another branch connection  $h$  extending from the switch socket  $f$  through an operator's telephone also to the earth or return conductor  $R^3$ .

In the normal or quiescent condition of the circuits the metal base of the plug  $P$  at the central station  $C$  is in the plug seat or socket  $E$ , and the connection between the spring  $b$  and the contact  $c$  is broken by the plug forcing away the said spring, the telephone  $t^2$  being in connection with the trunk circuit  $D$  from ground  $R^3$ , wire  $h$ , socket case  $f$ , spring  $b$ , and wire 11; and at the branch exchange  $B$  the plug  $P^2$  is withdrawn. In the operation of connecting two distant substations together the following changes are effected in the circuits:

We will suppose that the plug  $P^2$  at the branch exchange  $B$  has been inserted into the springjack  $J$  for the purpose of connecting the circuit  $d$  with the circuit  $d^2$ , provided with a terminal switch or springjack  $J^2$  at the central station  $C$ . The operator at  $B$  notifies the operator at  $C$  to connect the trunk circuit  $D$  with the called for circuit  $d^2$  and this is done by the first operator pressing the key  $K$  and speaking to the listening operator at central station  $C$ , a circuit being formed from  $R^2$ , wire 1, telephone  $t$ , secondary  $i^2$  of induction coil  $I$ , key  $K$ , wire 2 to point  $a$  where the current is split and part of it traverses wire 3 and the windings 50 and 51 of the obstruction coil  $M$  to the point 5 on the conductor  $A^2$  and therealong to the point 8, and then by wire 10 through the windings 52 and 53 of the obstruction coil  $M^2$  to the point  $a^2$ . The other part of the current passes by wire 4 through the remaining portion of the winding of the coil  $M$  to the point 6 on the conductor  $A$  and therealong to the point 7 and then by wire 9 through the second portion of the winding of the coil  $M^2$  to the point  $a^2$ . The current uniting at the point  $a^2$  proceeds by wire 11 to the spring  $b$ , through the metal base of plug  $P$  to the metal socket  $E$ , and by wire  $h$  and operator's telephone  $t^2$  to  $R^3$ .  $R^2$  and  $R^3$  may be grounded terminals or they may be connected together by a return wire as indicated. The order having been received over the order circuit by the listening operator, the usual test is made to ascertain whether the line wanted is busy or not, and being found disconnected, the plug  $P$  of the trunk  $D$  is inserted into the jack  $J^3$  of the called for line and the two sta-

tions  $S$  and  $S^2$  are connected with each other over the following metallic circuit: Starting from the tip of plug  $P^2$ , (to which one side of the circuit  $d$  is connected,) to spring 13 of jack  $J$ , conductor  $A$  of trunk  $D$ , to the tip of plug  $P$ , spring 19 of jack  $J^3$ , and to and from telephone  $S^2$  by the circuit  $d^2$ , to the frame 20 of jack  $J^3$ , sleeve of plug  $P$ , conductor  $A^2$  of trunk  $D$ , spring 12 of jack  $J$ , sleeve of plug  $P^2$  to the other side of circuit  $d$ . When the plug  $P^2$  is inserted into jack  $J$  the spring 15 is lifted from the contact 16 and rests on the insulation 18 and the ground wire 17 is severed at that point, and at the same time the elevation of the spring 13 upon the tip of the plug separates the spring from the contact 14 and thereby opens the branch circuit which contains the visible signal  $v$ . The conversation being concluded between the stations  $S$  and  $S^2$ , notice thereof is given in any preferred manner to the operator at the branch exchange  $B$ , who thereupon withdraws the plug  $P^2$  from the jack  $J$  allowing the springs 13 and 15 to close upon their respective contacts 14 and 16 and to connect the ground branch wire 17 once more to the circuit  $D$ . The effect of connecting the grounded branch 17 is to operate and set the disconnecting signal  $V$  at the central station  $C$  by means of current from battery  $G$ , to notify the operator there of the termination of conversation between the stations  $S$  and  $S^2$  and of the readjustment of the circuit at the branch exchange. This will be seen by tracing the circuit from  $R$ , wire 17, contact 16, spring 15 to the point 21, the main circuit for the current being from this point by conductor  $A$  to point 7 and by wire 9 and the winding of the coil  $M^2$  to point  $a^2$ , a smaller current passing from point 21 by spring 13, contact 14 through the visible signal  $v$  (but not enough owing to its resistance to operate it) and by conductor  $A^2$  to point 8, and by wire 10 through the windings 52 and 53 of the coil  $M^2$  to the point  $a^2$ , and by wire 11 to spring  $b$ , thence to contact  $c$ , wire  $g$ , disconnecting signal  $V$  and battery  $G$  to ground  $R^4$ . The operator at the central station  $C$  in response to the notice given by the signal  $V$  withdraws the plug  $P$  from the jack  $J^3$  and replaces it in the plug socket switch  $E$  thereby forcing the spring  $b$  away from the contact  $c$  and thus opening the circuit, and resetting the signal  $V$ , which may be any of the well known forms of self setting visible signals.

The trunk circuit  $D$  is provided with springjacks  $J^2$  connected in parallel with its conductors by the wires 22 and 23 by means of which the central station  $C$  can connect with the branch exchange  $B$ , and the annunciator drop  $v$  is provided at the said exchange to indicate to the operator there that the central exchange wishes to communicate, the said drop  $v$  being operated by an alternating current, from the generator at the central station in a manner well understood.

In the modification shown in Fig. 2 the cir-



cuits and operations are similar to Fig. 1, excepting that the ground branch 17 is connected with the jack J in a different way, the same service being rendered however; and  
 5 that a grounded branch L including an additional battery  $G^2$  and obstruction coil  $M^3$  is connected with the wire 2 at the branch exchange B. The coil  $M^3$  prevents the telephone current in the ordering circuit from short circuiting between the grounds  $R^2$   $R^5$ . The batteries G and  $G^2$  have like poles connected to the trunk circuit D so that when the plug  $P^2$  is within the jack J, and the signal circuit is open, there is no flow of current from one to  
 15 the other, but when the plug  $P^2$  is withdrawn from the jack J the circuit is closed and the current from the two batteries passes in multiple upon the trunk lines A and  $A^2$  with respect only to the ground R at the branch exchange, and the signal V is thus operated by the battery G alone, as will be readily seen from the foregoing description of the operation of the signal of Fig. 1.

Having thus described my invention and  
 25 its mode of operation, I claim—

1. In a telephone system, the combination of a trunk line extending between two stations and having two conductors adapted to form portions of the going and return conductors of a metallic conversation circuit, means at the terminals of said trunk line for connecting the same at will with any subscriber's station, an independent instruction circuit including operators' telephones, and  
 30 an independent signaling circuit including suitable signal-sending and receiving devices, the two conductors of the said trunk-line constituting jointly the main line, or direct conductor of the said instruction and signaling  
 40 circuits, substantially as described.

2. In a telephone system a main telephone or conversation circuit having two conductors, serving respectively as its direct and return conductors; combined with two obstruction coils or electromagnetic resistances connected respectively between the said direct and return conductors of the said main circuit at each of two selected stations thereof; an instruction circuit extending between the  
 50 said two selected stations and composed of a direct conductor formed of the two conductors of the main circuit joined in parallel, the winding of the two obstruction coils from their two ends to their centers, and an inde-

pendent return conductor uniting the central 55 points of the said two obstruction coil windings, and including the telephones at each of the said stations; and a signaling circuit between the said stations comprising the said two main line conductors joined in parallel 60 the obstruction coil winding at one of the said stations from its two ends to its center, and a return conductor extending from the said center through a signal receiving device, and an electrical generator to a connection 65 with the two main line conductors at the other of said stations, substantially as described.

3. The combination of two main line conductors extending between two stations and terminating, at one in a double conductor 70 switch plug, and at the other in a switch socket or springjack; an obstruction coil at each station connected between the said two conductors; a plug seat switch at the switch plug terminal station, comprising a movable 75 and two fixed members and operated by the removal and replacement of the plug; a conductor extending between the movable member of said switch and the central point of the obstruction coil winding at the said station; a normally discontinuous return conductor extending from the central point of the obstruction coil winding at the socket terminal station through a circuit closer, and the station telephones, to one of the fixed members of said switch; a normally continuous return conductor extending from a separable connection at the plug socket station formed in said socket and adapted to be separated by the insertion of the plug therein, to the remaining fixed member of the plug seat switch at the other station, and a signal receiving device and generator included therein at said other station; whereby the said two main line conductors may serve separately as the direct 95 and return conductors of a double wire conversation circuit and together as the direct conductor of independent instruction and automatic signaling circuits, substantially as specified. 100

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 30th day of April, 1894.

FRANK A. PICKERNELL.

Witnesses:

THOS. D. LOCKWOOD,  
 JOSEPH A. GATELY.