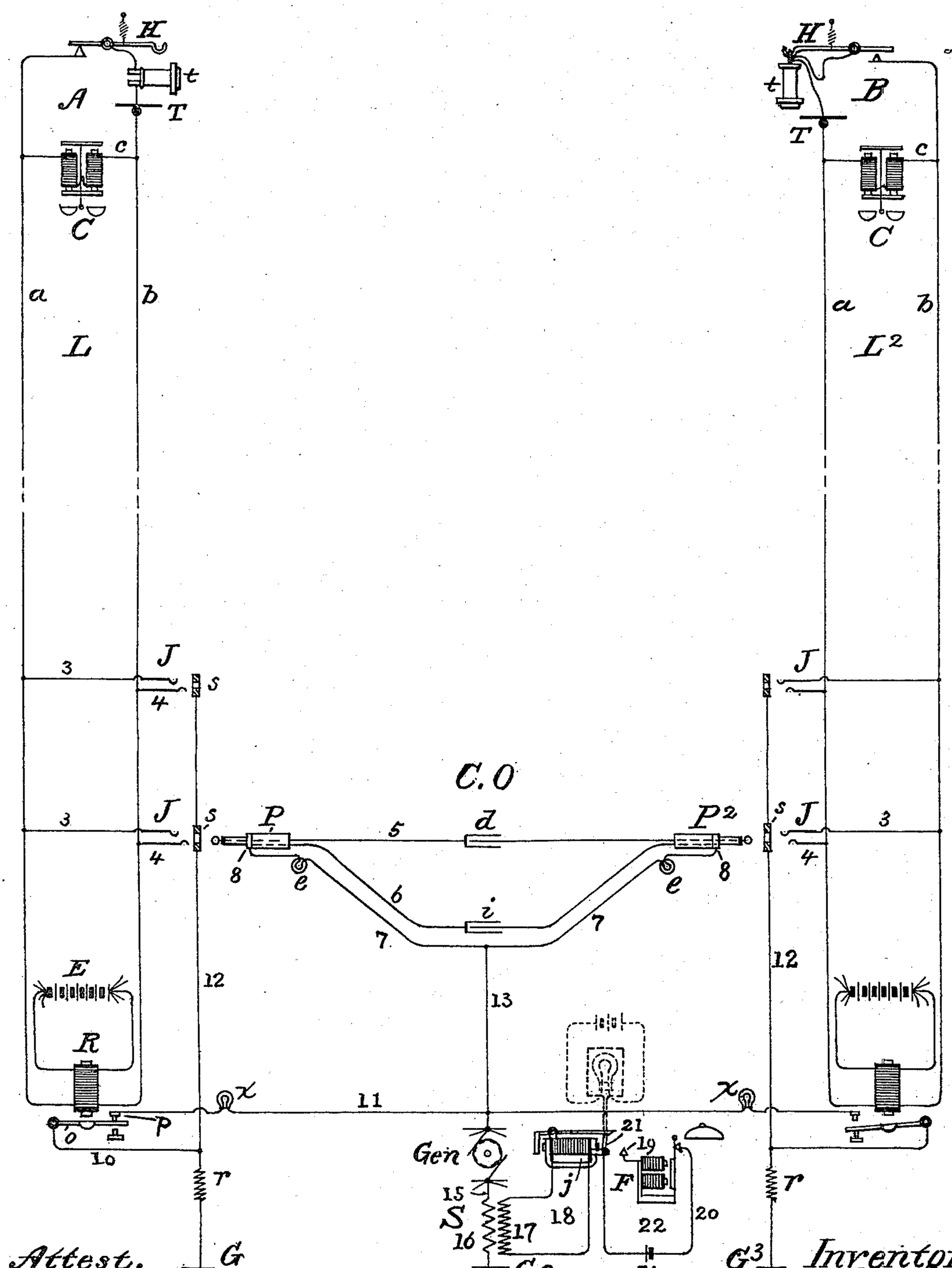
(No Model.)

# T. C. WALES, Jr. & C. H. ARNOLD.

## TELEPHONE CIRCUIT LINE SIGNAL.

No. 573,117. Patented Dec. 15, 1896.

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# UNITED STATES PATENT OFFICE.

THOMAS C. WALES, JR., AND CHESTER H. ARNOLD, OF BOSTON, MASSACHUSETTS, ASSIGNORS TO THE AMERICAN BELL TELEPHONE COMPANY, OF SAME PLACE.

## TELEPHONE-CIRCUIT LINE-SIGNAL.

SPECIFICATION forming part of Letters Patent No. 573,117, dated December 15, 1896.

Application filed July 20, 1896. Serial No. 599,928. (No model.)

*To all whom it may concern:*

Be it known that we, THOMAS C. WALES, Jr., and CHESTER H. ARNOLD, residing at Boston, in the county of Suffolk and State of Massachusetts, have invented certain Improvements in Telephone-Circuit Line-Signals, of which the following is a specification.

Owing to the comparatively few calls made by telephone subscribers during the night the office force at that time consists of a relatively small number of operators, who, having so many sections of switchboard in charge, cannot readily perceive the indication made by the ordinary line-signal at once, and consequently during this time special means require to be provided for calling the attention of the night operators to the line-signals (which are silent) when a call is made. It is also customary in some exchanges to place annunciators at the monitor's table, one for each day-operator's position, so arranged as to be operated and to remain operated until the call for a connection or a disconnection is answered by the operator at that position. This device assists the monitor in observing the efficiency of the individual operators and in regulating the division of labor among them all.

The ordinary means heretofore employed for this purpose have been associated with the shutter of the line-annunciator, which, when operated, is arranged to close a local circuit including a battery and a signal operated by current therefrom.

With the introduction of automatic signals and the employment for line-signals of small incandescent lamps which have no moving parts and cannot therefore be employed as relays to control the secondary-signal circuit it has become necessary to devise means for operating the secondary signal when the line lamp-signal lights up.

In general the means we have devised for operating the secondary, night, or monitor signals is to include them in the secondary circuit of an induction-coil or transformer, the primary of which is in the circuit of the dynamo or battery which supplies the lamp-signals on the board with the current which operates them.

When a telephone is removed from the hook-switch at a telephone-substation and the said switch closes the circuit, the line lamp-signal is lighted, and the current necessary to light it or the increase in current necessary to light it, acting upon the primary helix of the transformer, induces the current-impulse in the secondary thereof which causes the operation of the secondary-signal device. In much the same way the extinction of a line lamp-signal will cause the disappearance or diminution of the current flowing in the primary of the transformer, thereby inducing a current-impulse in the secondary opposite in direction to that which occurs when a line lamp-signal lights up. This current-impulse can also operate the secondary signal, if it be so desired; but in practice it is usually necessary to prevent the operation of the secondary-signal device when the line lamp-signal is extinguished, and for that purpose we prefer to employ a polarized or other electromagnetic device so placed in the secondary of the coil that it will be operated only by the current-impulses resulting in the secondary circuit due to increases in current in the primary circuit.

The application of the invention to a specific system of signal-circuits will now be described, reference being made to the drawing, which illustrates a common battery multiple-switchboard system employing glow-lamp calling and clearing-out signals.

A and B indicate substations connected with the central station C O by circuits L and $L^2$, each consisting of the conductors *a* and *b*. The apparatus at the substations consists of the telephones *t* and T, hook-switch H, and call-bell C in a permanent bridge *c*. The conductors *a* and *b* at the central office are provided with open branches 3 and 4 to each socket-switch J, and each includes a winding on each helix of the retardation coil-relay R, and unite at the poles of the common talking and signaling battery or dynamo E. 12 is a wire connecting the test-rings *s s* to ground through the resistance *r* with a branch 10 to the armature of the relay R.

The looping-plugs are provided with tip, shank, and ring contacts. The tips of a pair

are connected with each other by the conductor 5, in which is interposed the condenser *d*. The shanks are connected by the conductor 6, which includes the condenser *i*, and the rings are connected by the conductor 7, which contains a clearing-out lamp-signal *e* in each side thereof. A wire 13 unites the conductor 7 with one pole of the common source of current *Gen* provided for the operation of the line and cord signals, the opposite pole being connected to ground through the primary 16 of the transformer S. A wire 11 connects one contact *p* of the relay-armature *o* with the wire 13, and includes the line signal-lamp *x*, whose resistance is small compared with the resistance-coil *r*.

18 is a local circuit in inductive relation with the transformer S by means of the secondary 17, and it contains a polarized annunciator *j*, whose shutter 21 is adapted to fall upon the stop 19 and close the local circuit 22, which consists of a wire 20, extending from the said shutter to the stop 19, and including the battery *u* and trembling bell F. Of course any other suitable electromagnetic receiving instrument may take the place of this annunciator.

The operation of the invention is as follows: The subscriber calls by removing his telephone from the hook-switch, which rises and closes the circuit, causing an increase of current therein sufficient to energize the helices of the relay R, whose armature *o* is attracted, making contact with the point *p*. A circuit is thereby created from ground $G^2$, through primary 16 of the transformer S, dynamo *Gen*, line-lamp call-signal *x* of the calling-line, contact *p*, armature *o*, wire 10, resistance *r*, to ground G, and the signal *x* is lighted. The sudden establishment of current in or flux of current through primary 16 induces a current-impulse in the secondary 17 of the transformer S, which operates the secondary signal *j*, whose shutter falls upon or armature makes contact with the stop 19, closing the local circuit 22 and ringing the bell F, the sound of which calls the operator's attention to the lighted lamp-signal *x*. When the call is answered, by the insertion of the plug P into the socket-switch J the cord-signal *e* is placed in parallel with the line-signal *x*, and since the resistance *r* is large compared with that of the signals *x* and *e*, which are of equal resistance, the current through the said signals, which mutually shunt one another, becomes weakened to such an extent as to extinguish *x* and prevent the lighting of *e*.

Such increase in current in the undivided portions of the signal-circuit as results from the placing of the lamp *e* in parallel with *x* is not material, owing to the fact that the resistance *r* is large compared to that of the lamps.

The operator makes the usual test with the plug $P^2$, and if the circuit is not in use inserts the said plug into the socket-switch J of the called-for line.

When either subscriber clears out, by replacing the telephone upon the hook-switch the current in the main circuit is greatly reduced, the relay R at C O releases the armature *o*, the circuit of the line-signal *x* is opened, and increased current from the source *Gen* circulates through the clearing-out lamp-signal *e*, causing the same to be illuminated to indicate that disconnection is desired.

When the operator takes down the connection, the circuits of the two clearing-out lamp-signals are opened, and the disappearance of the current flowing through the primary 16 induces a current-impulse in the secondary-signal circuit of a polarity opposite to that which is capable of operating the said signal.

When the plug $P^2$ is inserted in the socket J, a circuit is completed from ground $G^2$, wire 15, transformer S, wire 13, conductor 7, ring 8, of plug $P^2$, wire 12, and from ground $G^3$ to ground $G^2$, and a current-impulse is induced in the secondary circuit 18 of the right polarity to operate the signal F. In practice this is prevented by having a normally open auxiliary winding on the electromagnet *j*, which will be closed by the depression of the operator's listening-key and render the secondary signal inoperative. As this forms no part of the present invention it is not shown in the drawings.

It is evident that the armature 21 of the polarized electromagnetic device *j* may be arranged to carry a screen adapted to normally cover a large incandescent-lamp signal placed in a conspicuous position, so that when operated the said screen may fall or be moved to one side, thus leaving the said lamp disclosed, as shown in dotted lines, and that such modification is within the scope of the invention.

Having now fully described the invention, we claim—

1. A telephone-circuit provided with a call-signal a signaling-current generator furnishing current therefor, a secondary line-signal in a local circuit, and a polarized electromagnetic device in inductive relation with the circuit of said generator, controlling the said secondary signal.

2. In a telephone-circuit central-station apparatus a call-signal lamp and a signaling-current generator combined with a secondary line-signal operated by a polarized electromagnetic device and an induction-coil having its primary in circuit with said generator, and its secondary in circuit with the said electromagnetic device, substantially as specified.

3. The combination with a telephone-circuit, a visual call-signal therefor, and a generator supplying current for said signal, of a polarized electromagnetic circuit-controlling device in a local circuit inductively associated with the circuit of said generator, and a secondary or auxiliary call-signal appliance in an independent local circuit controlled by said electromagnetic device.

4. A telephone substation-circuit, a call-receiving relay included therein at the central

station, a generator of signaling-current in a circuit controlled by said relay, and a call-signal lamp included in said generator-circuit in combination with a secondary call signal or alarm in a normally open local circuit, a polarized electromagnetic device controlling said local circuit, and an induction-coil interposed between said electromagnetic device and said generator-circuit.

5. The combination in a telephone system of a substation-circuit, a call-signal lamp therefor, in the normally open circuit of a call-current generator, and means for closing said generator-circuit and giving the signal when the current in the substation-circuit is strengthened; with a secondary or auxiliary call-signal common to a number of substation-circuits, a polarized electromagnetic appliance controlling the operation thereof, the said appliance being in inductive relation with the circuit of the call-current generator, and adapted to be operated by fluctuations in the strength of current in said circuit in response to changes produced in the strength of the substation-circuit current, substantially as specified.

In testimony whereof we have signed our names to this specification, in the presence of two subscribing witnesses, this 10th day of July, 1896.

THOMAS C. WALES, JR.
CHESTER H. ARNOLD.

Witnesses:
GEO. WILLIS PIERCE,
GEORGE J. RAUH.