

(No Model.)

2 Sheets—Sheet 1.

S. J. LARNED & F. A. PICKERNELL.
TELEPHONE CIRCUIT AND APPARATUS.

No. 501,085.

Patented July 11, 1893.

Fig. 1.

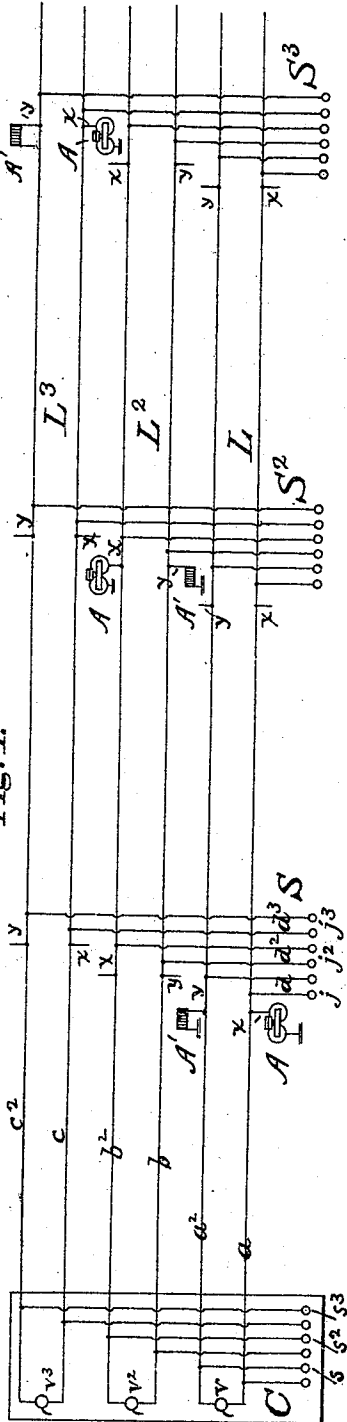


Fig. 2.

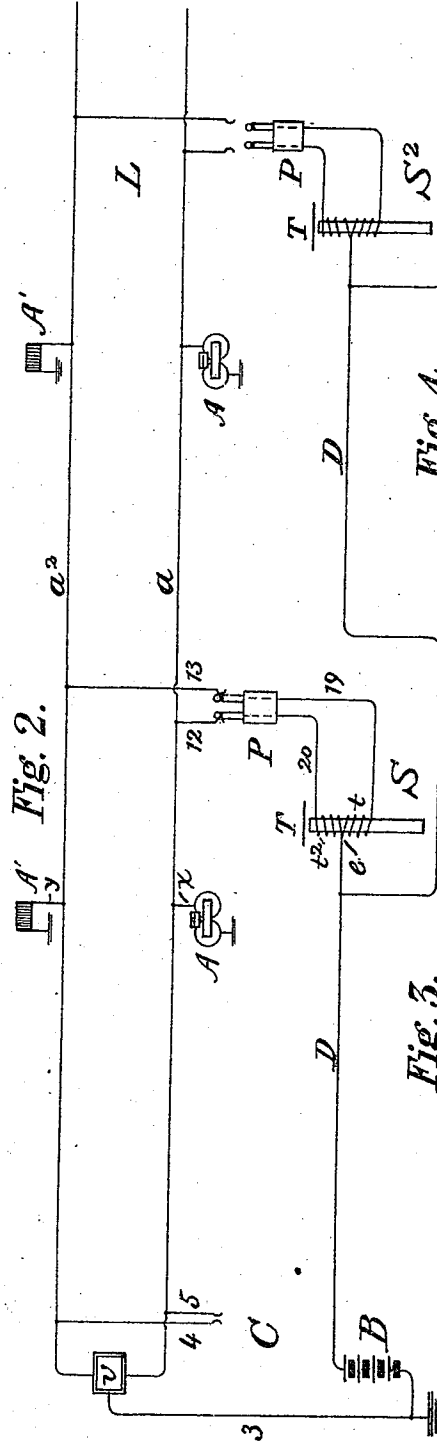


Fig. 4.

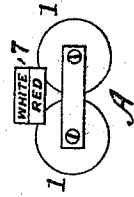
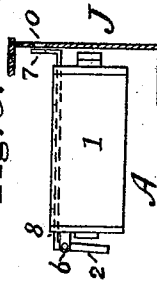


Fig. 3.



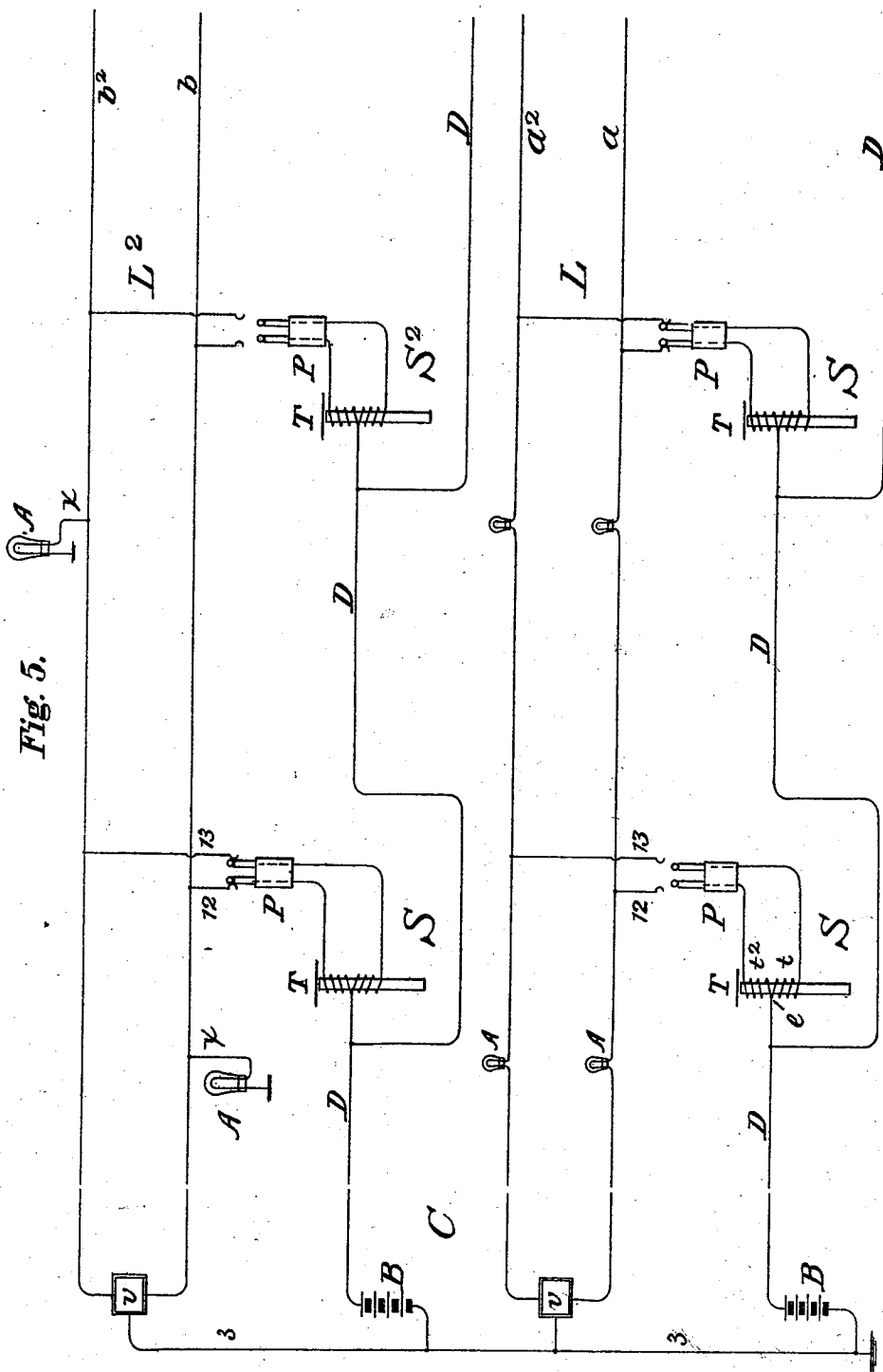
Witnesses.
Frederick Lewis
Geo. T. Smallwood

Inventors
F. A. Pickernell & S. J. Larned
by *Pollock & Munn*
their attorneys.

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Inventors
F. A. Pickernell & S. J. Larned
by *Charles M. Moore*
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UNITED STATES PATENT OFFICE.

SHERWOOD J. LARNED, OF EVANSTON, ILLINOIS, AND FRANK A. PICKERNELL, OF NEWARK, NEW JERSEY, ASSIGNORS TO THE AMERICAN TELEPHONE AND TELEGRAPH COMPANY, OF NEW YORK.

TELEPHONE CIRCUIT AND APPARATUS.

SPECIFICATION forming part of Letters Patent No. 501,085, dated July 11, 1893.

Application filed March 20, 1893. Serial No. 466,867. (No model.)

To all whom it may concern:

Be it known that we, SHERWOOD J. LARNED, residing at Evanston, in the county of Cook and State of Illinois, and FRANK A. PICKERNELL, residing at Newark, in the county of Essex and State of New Jersey, have invented certain Improvements in Telephone Circuits and Apparatus, of which the following is a specification.

10 This invention relates to that class of telephone exchange systems in which a series of stations are served by a smaller number of main circuits which however are common to and accessible by all stations of the series
15 and which all extend from all substations to a central station. In such an exchange there is great economy in the main line conductors; while by reason of the fact that each substation has a number of main lines, leading to the central office, there is a reasonable
20 expectation, though each line is capable of being used by any substation in the system, that each substation desiring communication, will always find a conductor free and at
25 its disposal.

In another application, filed of even date herewith, by Frank A. Pickernell are described and claimed, apparatus and circuit arrangements whereby in such a system the
30 substation may at any time send a call signal to the central office, indicating that communication is desired, and whereby the said substation, or its correspondent, may be enabled at the close of said communication to apprise
35 the central station of the fact, and thus indicate the necessity of disconnection.

The invention relates to apparatus and circuits whereby in such a system, as has been outlined, the substation may be able to distinguish among the lines accessible thereto,
40 the lines in use from the free lines or the lines not in use, and thus to prevent the connection of any second telephone to a line already in use.

45 In carrying out the invention, suitable call sending and receiving appliances are provided, to be operated in conjunction with any member of a series of metallic circuits, and associated therewith are disconnecting signals. The metallic or double conductor main

circuit extending between a central station and a substation, or a number of substations, or in fact between any two stations, is provided with suitable means for indicating the
55 lines which are in use or busy, and those that are not; and with said main circuit, or any number of such main circuits is associated a common source of electric current, for example a primary or storage battery which can be
60 located either at the central station, or at any suitable and convenient place. One of the poles of this source of electrical energy may be connected to earth, and the other is extended by a supply conductor to the several
65 substations, entering these by branches which, when applied, unite with the center of the telephone coil or helix. The main circuit normally is open at the substations, but has plug
70 socket or spring jack branch terminals adapted to receive connecting plugs which are respectively the terminals of the telephone coil, and which, when thrust into their sockets, thereby close the said circuit through the
75 telephone helix; the telephone is thus included in the main circuit operatively, and in such a way as to be fully responsive to currents circulating therein.

We may employ any suitable means to indicate whether a line is busy or not. We preferably use an electro-magnetic device,
80 one in each main line at each substation, connected to or in the said main line; the electro-magnet has an armature pivoted thereto, connected to which is a long arm carrying on its end a target, divided into two parts, which
85 may be distinguished from each other in any way. We arrange the target opposite an opening in the case inclosing the electro magnetic device, so that one part of the target
90 will be displayed to indicate whether the line is not busy or not in use, or whether it is busy or in use. The same source of electric current used to call the central office operates these electro magnets, and when a line is in
95 use, *i. e.*, when the connecting plug at any substation is in a socket thus closing the circuit at that point of any main line, all the electro-magnets legged or branched on to the
100 line at each substation through which it passes, have their armatures attracted, dis-

playing the lower part of the target at the case opening, and each substation thus has a visual indication that the particular main line in question is busy, which indication remains as long as the plug is inserted. If the line is free, the circuit is open and the source of electricity cut off, the armatures of the electro-magnets remain unattracted and the upper part of the target is exposed at the case opening to indicate the fact.

Instead of the electro magnetic device just described the condition of the subscribers' lines may be indicated by means of high voltage incandescent lamps legged from each line to the ground as described of the electro-magnets; or, by means of low voltage lamps placed directly in the line, in either case, the glow of the lamp would indicate a busy line, and the absence of glow would indicate that the line was not in use. The main circuit is a double conductor or metallic circuit, and at the central station has a branch to earth including an electro magnetic call annunciator common to all of the substations connected to the said main circuit.

Figure 1 is a diagram of a general system with which the invention may be associated. Fig. 2 is a diagram of one main circuit illustrating the invention. Figs. 3 and 4 are respectively side and end views of my electro-magnetic indicating device, and Fig. 5 is a diagram of two associated main circuits employing as line indicators high and low resistance incandescent lamps.

In Fig. 1 is shown the general arrangement of a combination line system in association with which the invention may be conveniently operated. C represents a central or end station for a number of metallic or double conductor circuits L , L^2 , and L^3 ; S, S^2 and S^3 representing out or substations into which the said circuits enter by paired branches d , d^2 , d^3 ; the several pairs terminating respectively in spring jack or other plug sockets j , j^2 and j^3 . Thus the two conductors a , a^2 , b , b^2 and c , c^2 of the several main circuits L , L^2 and L^3 , lead into all of the substations normally connected with such circuits by multiple arc or parallel branches, which so far as this invention is concerned, are normally open or discontinuous; while at the end station C, the two conductors of each main circuit are joined through the coils of suitable call receiving devices v , v^2 and v^3 , and are furthermore provided with spring jack connections s , s^2 , s^3 , whereby central station appliances may be connected, or whereby any two circuits may be interconnected by the use of intermediate connecting or linking conducting devices of any ordinary or well known character.

Fig. 2 indicates the mode in which my invention will be preferably carried out. L represents one of the double conductor circuits, and a and a^2 are the direct and return conductors thereof, provided at the central or end station C with connecting branches 4 and 5 leading to contacts in spring jacks s. A

differentially wound annunciator drop v is connected between the two main conductors and the earth branch 3; and at the station S it is assumed that the telephone T has been connected with the circuit and that the metallic circuit by such a connection has been closed through the telephone coils or helices t^2 . A source of electricity, shown as a battery B, is located at the central station C, or at any other suitable and convenient place, and has one of its poles earthed, while the other connects with a call current supply conductor D which may form an extra member of the group of line conductors and passes to the several substations of the system, a branch being led from it into each, which branch is permanently united to the telephone helix at a point e at the center thereof; or, if the said telephones have two distinct helices, serially connected at a point between them.

A at substations S and S^2 represents the electro magnetic line-condition indicating device legged or branched from one side a of the main circuit L by wire x to ground. Its construction is shown in Figs. 3 and 4. 1, 1 are helices or coils joined together to form an electro magnet. 2 is the armature therefor pivoted at points 6; attached to the armature is a lever 8 extending to the opposite end of the helices and carrying upon its end a target 7 which is divided into two parts, by different colors, as white and red, or in any other suitable way. In practice the electro-magnet is placed in a case J with its target 7 opposite an opening o , so as to display but one color or indication at a time. When the line is not in use or not busy, the armature is in the position shown in Fig. 3, not attracted to the electro-magnet and the white part of the target 7 is seen through the opening o ; but when the line is in use, the armature is attracted, thereby lifting the target 7 to conceal the white part and to bring opposite the opening o , the red or lower portion and thus indicate the fact. The said supply circuit D is normally open, and the armatures 2 of the several indicating devices are normally retracted, showing that the line is not in use; but when the plug P is inserted, as shown at substation S, the circuit is closed and the telephone there is connected with the main circuit; the armatures 2 of the indicating devices are attracted, changing the line indication from "not in use" to "busy" at all of the substations, and the annunciator v at the central station indicates a call; the circuit being from earth at central station, battery B, wire D, to the point e in the telephone coils where it divides, branching through the plug P to the limbs a a^2 of the main circuit, uniting at the annunciator v , and returning to earth or the opposite pole of battery B by wire 3. A portion of the current leaks by the legs or branches x to earth through the electromagnets 1, 1 at each substation, operating their armatures. While the plug P remains connected the subscriber at each substation knows that the line

is in use. In each limb of the main circuit, opposite the indicating device A, we have shown an electro-magnet A' of like resistance and retardation, to properly balance the circuit. Practically the same effect will be effected by placing the helices of the indicating device in one limb of the circuit at one substation and in the other limb of the circuit at the succeeding station.

Fig. 5 shows two main circuits L and L² extending from a central station C through two substations S and S², the line-in-use indicators in circuit L being low resistance incandescent lamps, and in circuit L² high resistance incandescent lamps. The low resistance lamps in the circuit L are placed directly in the line, and the high resistance lamps in circuit L² are in ground branches legged from a limb or side thereof in the same manner as the electro-magnetic devices; in both cases when the plugs are up or connected in a socket or line jack, the lamps are caused to glow by means of the electric current flowing in the closed circuit, and thus to indicate that that main circuit is busy or in use. And when the plugs are down, or disconnected from the line terminals, the absence of the glow in the lamps shows that the line is not busy and therefore may be used. When the two sides of the main circuit are closed by means of the plug, as stated, the said main circuit is also closed through its terminal ground branch 3, and earthed line-indicating-device branches at the substations with the independent earth branch D, which includes the source of current, and simultaneously the calling annunciator *v* gives its indication, and the line indicating devices are all set to denote the line to be in use. The current circulates from the earth branch including the calling annunciator through both branches of the main circuit and connection devices and telephone at the substation, and by the independent earth branch including the source of electric energy. The branch derivations including the line condition indicating devices or annunciators at the substations form circuits from the main circuit through the earth to the independent earth branch D.

Having now fully described the invention, we claim—

1. The combination of a main double conductor telephone circuit extending between an end or central station and a series of substations and provided at the said substations with plug socket terminals: a line condition indicating device connected with or in said circuit at each substation; a suitably located battery or equivalent source of electricity; an earth branch conductor including the said source of current, provided with connecting plug terminals adapted to be inserted in the said plug sockets, and thereby to simultaneously close the said main circuit, and the earth branch circuit including the source of electricity for the purpose described.

2. The combination of a main double con-

ductor telephone circuit, extending from a terminal station to two substations and provided at the said substations with plug socket terminals; a line condition indicating device included in an earth branch of said circuit at each of said substations; a telephone at the substations; a suitably located battery or equivalent source of current; an earth branch conductor extending from the said terminal station to the substations including the source of current, and branching to the helices of the said telephones; and connecting plug terminals for the helices of the said telephones adapted to be inserted in the said plug sockets and thereby to simultaneously close the main circuit, and the earth branch circuit, for the purpose described.

3. The combination of a main double conductor telephone circuit extending between a terminal and two or more substations; a line condition indicating device connected with or in said circuit or branches thereof at all of said substations; an independent earth branch extending from said terminal station to all of said substations, normally disconnected from said main circuit, and including an electrical generator; and means for closing the earth branch and thereby the generator circuit through the double conductor circuit whereby the closure of the generator circuit is enabled to change the indication of the line condition indicating devices, substantially as described.

4. The combination of a main double conductor telephone circuit extending from a central station to a number of substations, and provided at each substation with plug socket branch terminals united respectively to the conductors of said circuit; line condition indicating devices connected with or in said circuit, one at each substation, an electric generator such as a battery, common to all of the substations, located at any desired point; an earth branch conductor including the said source of current, extending to each substation and provided with connecting plug terminals branched to each substation, adapted to be inserted in either of the said plug sockets thereof, and thereby to simultaneously close the main circuit, and the earth branch circuit including the source of current, and also to change the indication of the line condition indicating devices at all the substations, substantially as described.

5. The combination of a main telephone circuit extending between an end or central station and a series of substations and provided at the said substations with plug socket terminals; an annunciator at the central station included in an earth branch of the said main circuit; a line condition indicating device connected with or in said main circuit at each substation; a suitably located battery or equivalent source of electricity; an earth branch conductor including the said source of current, provided with connecting plug terminals adapted to be inserted in the said

plug sockets and thereby to simultaneously close the said main circuit and the earth branch circuit including the source of electricity, and to simultaneously actuate the
5 annunciator at the central office to indicate a call, and the line condition indicating devices at the substations to indicate line in use.

6. The combination of a main double conductor telephone circuit extending between
10 an end or central station and a series of substations with a branch to earth including a call annunciator at said central station, and provided at the said substation with plug socket terminals; a line condition indicating
15 device included in an earth branch of said main circuit at each of the said substations; an independent earth branch conductor including a source of current provided with connecting plug terminals adapted to be inserted
20 in the said plug sockets and thereby to simultaneously close the said main circuit through its annunciator earth branch at the central station and through all of the line condition indicating device earth branches at the substations, and the independent earth branch
25 conductor, including the source of electricity, substantially as described.

7. The combination of a double wire circuit extending between a central station and a series of substations, and having a permanent
30

earth branch including an annunciator at the central station, and annunciators included at the substations in each of the two conductors of the main circuit or in derivations thereof; with an independent earth branch at each
35 substation including a source of electrical energy; and connection devices for closing the main circuit through the substation telephone and for simultaneously connecting the said independent earth branch thereto, whereby a
40 current is caused to flow in both sides of the said main, and in the said permanent and independent earth branches, substantially as and for the purposes specified.

In testimony whereof I have signed my
45 name to this specification, in the presence of two subscribing witnesses, this 25th day of February, 1893.

SHERWOOD J. LARNED.

Witnesses:

FRED GERLACH,

ALBERTA ADAMICK.

In testimony whereof I have signed my
name to this specification, in the presence of two subscribing witnesses, this 6th day of
March, 1893.

FRANK A. PICKERNELL.

Witnesses:

R. J. MORGAN,

CHARLES D. M. COLE.