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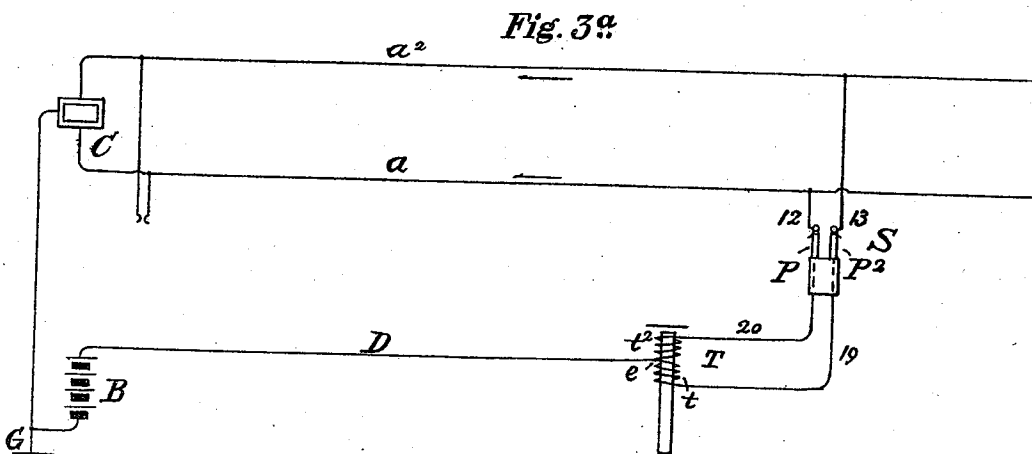
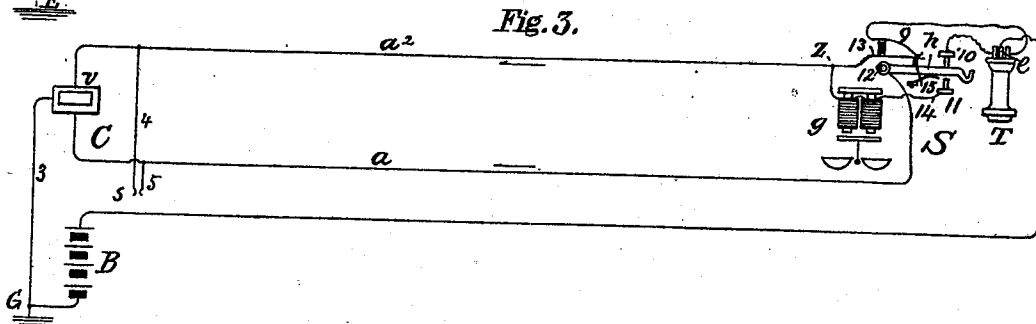
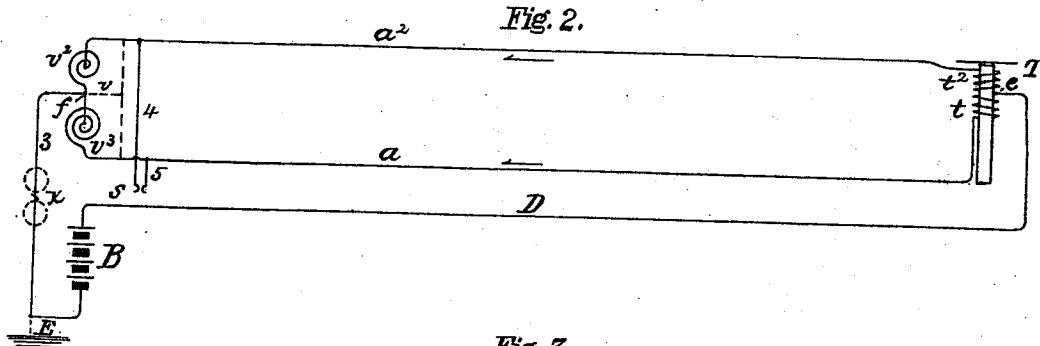
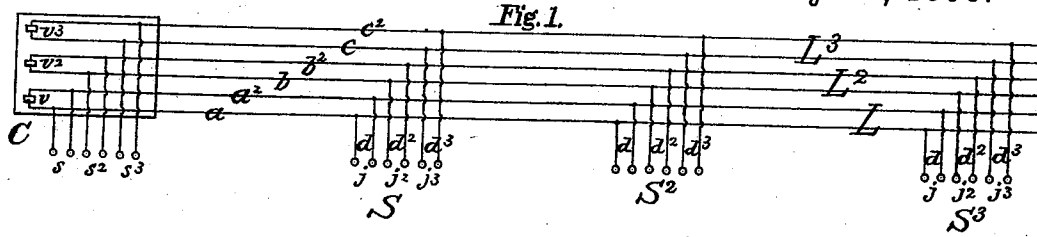
2 Sheets—Sheet 1.

F. A. PICKERNELL.

TELEPHONE SIGNALING APPARATUS AND CIRCUIT.

No. 501,102.

Patented July 11, 1893.



Witnesses.

Reverend Lewis.
Geo. T. Smallwood.

Inventor.

Frank A. Pickernell,
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(No Model.)

2 Sheets—Sheet 2.

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Fig. 4.

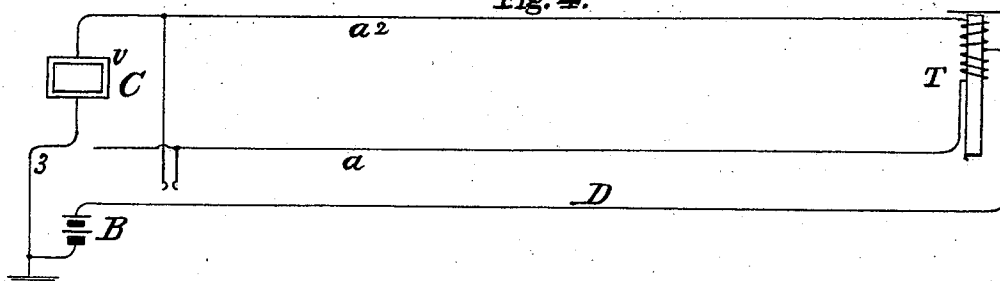


Fig. 1.^a

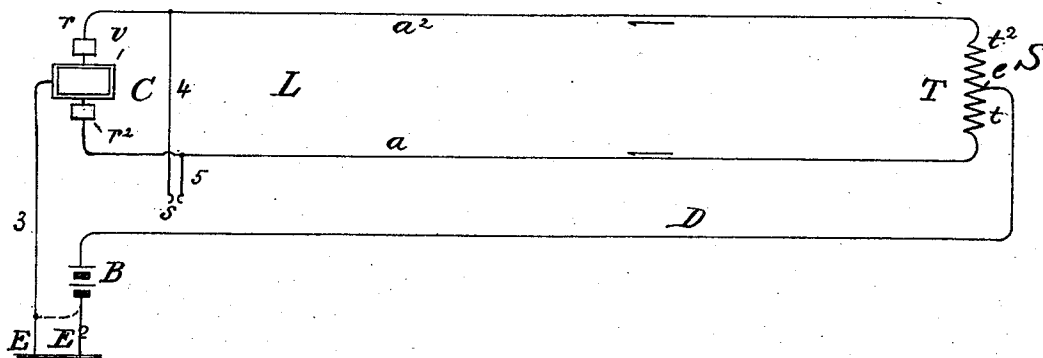
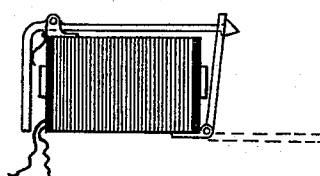


Fig. 5.



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UNITED STATES PATENT OFFICE.

FRANK A. PICKERNELL, OF NEWARK, NEW JERSEY, ASSIGNOR TO THE
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TELEPHONE SIGNALING APPARATUS AND CIRCUIT.

SPECIFICATION forming part of Letters Patent No. 501,102, dated July 11, 1893.

Application filed March 20, 1893. Serial No. 466,931. (No model.)

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 Signaling Apparatus and Circuits, of which the following is a specification.

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, 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 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 its disposal.

The invention more particularly and specifically refers to apparatus and circuit arrangements whereby in such a system, the sub-station 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 the central office of the fact and thus indicate the necessity of disconnection.

In ordinary telephone exchanges a magneto electric call generator is most frequently employed, but in view of the fact that there is necessarily more complicated station apparatus in an exchange of the character with which we are now dealing, it has been found desirable to effect such reductions as are possible in the amount of apparatus employed; especially where substituted apparatus or portions thereof may be utilized for a variety of functions.

The invention then has for its object the provision of suitable call sending and receiving appliances to be operated in conjunction with any member of a series of metallic circuits; and of such additions and modifications thereto, as may be required, in order that disconnecting signals likewise may be

comprehended in their functions. To carry out this object, 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 at the central station with a suitable electromagnetic call receiving device such as an annunciator, and with the said main circuit or any number of such main circuits is associated a common source of calling current, for example, a primary or storage battery, which can be located either at the central station, or at any suitable and convenient place. One of the poles of this current source may be connected to earth, and the other is extended by a supply conductor to the several substations, entering these by branches which unite with the center of the telephone coil or helix. The main circuit normally is open at the substations, but has plug socket or springjack 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 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. The coils of the central station annunciator are neutrally connected with the main circuit. That is to say, the annunciator may have one or more electromagnetic spools; if it have one spool it may be wound double with two wires constituting respectively extensions of the two circuit conductors; and if it have two spools, they must be so wound or connected that a given current circulating in the main circuit and through them shall tend to determine magnetic poles of like polarity in both. In either event, the annunciator is made neutral to main line currents circulating in the metallic circuit, but are responsive to currents circulating in the same direction in both conductors. To provide for such circulation, I extend an earth branch from the center of the annunciator helix, and by this means the act of closing the metallic telephone circuit at the substation through the telephone, also closes the calling circuit through the telephone neutrally or differen-

tially, the call circuit entering at the center of the telephone helix and splitting into two divisions each including one half of the said helix; also through the two line conductors in the same direction and through the coils of the annunciator in such direction as to energize the cores thereof and to produce the signal. The two halves of the calling current passing oppositely round the telephone magnet exercise no influence thereon. By this arrangement, currents circulating in the metallic circuit affect the telephone, but neutralize the annunciator; while the calling current passing over the two wires of the said metallic circuit in the same direction operate the annunciator, but are neutral with respect to the telephone. The same result would of course be reached, were the two metallic circuit conductors to be united directly together at the central station, and the annunciator wound in the ordinary way included in the earth branch. When the calling battery or generator is located at the central station as would most generally be convenient, instead of connecting one of its poles to earth, and providing also an earth branch for the annunciator and main circuit, an equivalent construction would be to extend a conductor from the said pole directly to the said annunciator and double conductor circuit. The annunciator lever is arranged to retain its shutter whether its armature be attracted or retracted, and to release the same to give the signal upon any change from retraction to attraction or vice versa. It thus responds when the battery is sent to line by the connection of the substation telephone, and it also responds when the battery is taken from the line by the disconnection of the said telephone and is capable therefore of serving both as an original call and a disconnecting signal; but it remains in a quiescent condition while no battery is connected with the circuit, and also during the pendency of a communication while the battery is connected. The substation telephone instead of being associated with sockets and plugs and thereby made capable of manual connections and disconnections, may of course be associated with an automatic switch for automatic connections and disconnections.

Figure 1 is a diaphragm illustrating a general system with which the invention may be associated; Fig. 1^a, a conventional diagram of electrical connections illustrating the invention; Fig. 2, a similar diagram showing more in detail suitable electrical connections for the telephone and annunciator respectively. Fig. 3 is a diagram also similar illustrating automatic devices for connecting the telephone to the circuit and for closing the calling circuit; Fig. 3^a another diagram illustrative of manually operating devices for the said connections. Fig. 4 shows a modified general arrangement in which the metallic circuit is normally open at the central station. Fig. 5 represents a suitable double act-

ing annunciator adapted for use in connection with this invention.

In Fig. 1 is shown the general arrangement of a combination line system in association with which, the invention may be conveniently operated; C symbolizing a central or end station for a number of metallic or double conductor circuits, represented by L, L², and L³; and S, S², and S³ in like manner symbolizing out or substations into which the said circuits enter by paired branches *d*, *d*², and *d*³; the several pairs terminating respectively in springjack 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, L², and L³, lead into all of the substations normally connected with such circuits by multiple or parallel branches; which so far as this invention is concerned, are normally open or discontinuous; while at the end station C the two main conductors of each main circuit are joined through the coils of suitable call receiving devices *v*, *v*², *v*³, and are furthermore provided with springjack 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 construction.

The diagram Fig. 1^a, indicates a preferred mode of carrying out the principal feature of the invention, viz: the operation of the call annunciator in such a system by the mere act of connecting the substation telephone. In it, L represents one of the double conductor circuits and *a*, *a*² the direct and return conductors thereof, provided at the central station C with connecting branches 4 and 5 leading to contacts in a springjack *s*. A differentially wound or connected annunciator drop *v* is connected between the two main conductors and the earth branch conductor 3; and at the other station S, it is assumed that the telephone T has been connected with the circuit, to send or receive a message and that the metallic circuit by such connection has been closed through the telephone coils or helices *t*. These coils may be formed as usual with one continuous winding, or may be formed of two separate spools, but in either case they are so arranged in the metallic circuit that all of their convolutions will tend to exercise like effects upon the telephone magnet. 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. Thus the said supply circuit is normally open, but when-

ever a telephone is connected with a main circuit at any substation, it is closed, and then extends from the earth E^2 at the earthed pole of the source B, to the earth E of the annunciator v ; and the current of the said source circulates through the main supply conductor D to the point e in the telephone t where it divides, half going through the part helix t and by main conductor a , and half through the part helix t^2 and by main conductor a^2 to the central station, the call current in both being (as indicated by the arrows) of like direction. But as the said call current enters the telephone helix at its center, it traverses the two halves thereof in opposite directions, and its effect on the said telephone is neutralized and zero, the telephone being differentially connected with the call circuit. On the other hand the annunciator v being differentially or neutrally connected in the metallic circuit, has its helices directly or operatively connected in circuit with the earth branch 3, and with the two main conductors a and a^2 . It is therefore fully responsive to the split call current, and its armature is attracted, allowing its shutter to fall and giving the call signal.

It is preferred that the annunciator shall be so constructed, that it shall be capable of giving a second signal when disconnection is desired, notwithstanding the facts that it initially responded to the circulation of the call current caused by the connection of the distant telephone, and that the said current continues to circulate through its coils maintaining the attraction of its armature as long as the telephone connection endures. When so constructed and arranged, it is evident that the disconnecting signal will be responsive to the withdrawal of said calling current from the circuit, and therefore that it can be operated by the act of disconnecting the telephone at the substation. To accomplish this, the armature lever of the drop is fitted at its end as shown in Fig. 5, with a double catch or detent, one catch being on the upper and the other on the under side of the lever. One of these catches then will engage the shutter when no current is on the circuit and the armature consequently retracted, while the other is equally well adapted to retain the shutter when the call current circulates in the circuit, and the armature therefore is attracted. No claim is made to such an annunciator *per se*, since it is old and is disclosed in Letters Patent granted to John I. Sabin, March 14, 1882, No. 255,031. Instead of arranging the catches one considerably in advance of the other as shown in the said patent, it is preferred to arrange them in the same plane or differing very slightly, as otherwise upon the initial call the second catch would engage the shutter immediately upon its release by the first and before it had time to fall and the signal would not be given. To use the annunciator so constructed as a disconnecting signal, the fallen shutter may be

restored to its place; to fall a second time when the disconnecting signal is sent; or, if desired, the drop may be furnished with two shutters, one of which is released by the attraction of the armature to give the call signal, while the other is released upon the retraction of the armature to give the disconnecting signal. Instead of grounding the branch 3, and one pole of the battery B, the branch 3 may be connected directly with the otherwise grounded battery pole, as indicated in dotted lines.

Fig. 2 shows in a more particular manner the connections indicated in Fig. 1^a. In practice the helix portions t and t^2 of the telephone T both surround the front pole thereof, and are shown here as being opened out so as to show more clearly the mode of connection. The annunciator helices v^2 and v^3 are indicated as being included in the main line circuit, but so wound or connected that a current flowing in such circuit would tend to determine like polarity in each and they are therefore neutral to metallic circuit currents; but the call currents flowing in the two main conductors in the same direction, develop dissimilar poles in the magnet the said currents reuniting at the central point f , and thus reaching the earth or return conductor 3. An equivalent construction so far as concerns the signaling would be to unite the main line conductors directly instead of through the magnet coils, to attach the earth branch to them and then to connect the coils serially in the said earth branch 3, winding them as in an ordinary electro-magnet, such mode of connection being indicated by the dotted line spools at x .

Fig. 3 indicates automatic switch connections, whereby signaling as contemplated by this invention may be automatically effectuated. The drawings indicate a telephone circuit normally closed through a bell magnet when the telephone is in place on the gravity switch, and closed through the telephone when the telephone is removed from the switch. The conductor a of the main circuit may permanently connect at 12 with the stem of the telephone supporting gravity switch h . The conductor a^2 , forks at z , one branch 14 leading through a call bell g to the inferior contact 11 of the switch hook. The telephone being in place on the hook, the main line circuit is closed through the bell. The other branch 13 of conductor a^2 terminates in a flat contact spring, which lies under, but does not touch a complementary contact spring or piece 9 which is one of the normally discontinuous telephone helix terminals; the limit screw or back contact 10 forming the other. A non-conducting stud or peg 15 is secured to the upper edge of the switch bar, and when the telephone is displaced, the bar flies upward and by means of the stud pushes the spring 13 upward, and into contact with the spring 9; while the hook lever itself makes contact with the stop 10. The bell branch is

therefore opened, and the branch through the telephone closed, while the supply conductor D being centrally united to the telephone helix the current divides and passes to the station C operating the annunciator in the before described manner. If however the circuit be normally open at the substation, as has been contemplated, the lower switch limit stop 11 would have a non-conducting point; and the branch 14 leading thereto together with the bell *g* would in this connection be dispensed with.

In Fig. 3^a, the differences are entirely in detail, and relate to such a construction as imply the closing of the metallic main or talking circuit, and the simultaneous closing of the call circuit by a single manual act. At the substation S, the branch connections of the main conductors terminate in plug sockets 12 and 13. The terminal wires 19 and 20 of the telephone helix are provided with plug connectors P and P² which, as shown, may have a single handle and which fit in the sockets 12 and 13 respectively closing the telephone and call circuits and sending the call.

A slight change in the arrangement of the circuits is shown in the diagram Fig. 4. The supply circuits and the telephone circuits at the substation remain unchanged, but at the central station C, the line drop *v* is in a branch to earth from one side α^2 of the circuit only, the other side being left normally discontinuous. The said drop responds to the connection of the telephone exactly as in former cases, the call current in this case traversing the earthed conductor α^2 alone.

Referring once more to the arrangement shown in Fig. 1^a, and the other figures which illustrate the same arrangement of circuits, it may be stated that in cases where it is found that the annunciator *v* when used as a disconnecting drop bridged across the circuit, does not of itself furnish a sufficiently high apparent resistance to the voice currents, but shunts away some sensible portion of the working current, auxiliary electromagnetic resistances r^2 , may be included in its bridge to any requisite amount.

Having now fully described the invention, I claim—

1. The combination of a metallic or double conductor telephone circuit extending between a central office and a substation, and provided at the latter station with plug socket terminals; an electro-magnetic annunciator at the central station included in an earth branch of the said circuit; a telephone at the substation; a suitably located battery or equivalent source of current; an earth branch conductor extending from the center of the telephone helix and including the said source of current; and connecting plug terminals for the helix of the said telephone adapted to be inserted in the said plug sockets, and thereby to simultaneously close the metallic circuit through the telephone and the earth branch circuit including the said source of

current through the annunciator, substantially as described.

2. The combination of a double conductor telephone circuit extending between two stations; an electro magnetic call receiving device at one of the said stations included in an earth branch of the said circuit; an independent earth branch at the other of said stations normally disconnected from the said circuit and having its disconnected end split into two divisions adapted for connection respectively with the two main circuit conductors; a differential or split coil telephone having its coils connected serially in the said divisions, and differentially between said earth branch and its said divisions; an electrical generator in one of the said earth branches; and means as indicated for connecting the divisions of the split earth branch with the two main conductors whereby the closure of the battery circuit through the call receiving device to give the call, is effected by the act of connecting the telephone with the metallic main circuit, substantially as described.

3. The combination of a double conductor telephone circuit extending from a central station to a number of substations, and provided at each substation with plugsocket branch terminals united respectively to the conductors of said circuit; an electromagnetic annunciator at the central station included in an earth branch of the said circuit; and a telephone at each substation; with a current supply conductor extending from an earth connection by independent branches to the centers of the helices of the several substation telephones; an electric generator such as a battery, common to all substations, included in the main circuit of said supply conductor, and located at any desired point; and connecting plugs forming the terminals of the helix of each substation telephone, adapted to be inserted in their respective station plug sockets, and thereupon to simultaneously close a signaling circuit including the common generator, the telephone differentially and the central station annunciator and a metallic telephone circuit including serially the substation telephone; substantially as described.

4. The combination of a double conductor telephone circuit extending from a central station to a substation, and provided at the latter with plug sockets one for each conductor; an electro-magnetic annunciator included therein, at the central station and wound or connected therewith differentially so as to be irresponsive to currents circulating therein; a telephone at the substation connecting plugs adapted to fit the said sockets and forming the terminals of the telephone helix respectively; a normally incomplete call current supply circuit extending from the center of the said annunciator helix through a battery or equivalent source of current to the center of the said telephone helix, and adapted to be closed through the main circuit conductors in parallel, when the said main

circuit is closed through the telephone by the insertion of the plugs in their respective sockets; whereby the call is sent by switching the telephone into circuit, substantially as described.

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15 5. The combination with a main telephone circuit extending from a substation to a central station; a telephone at the said substation; a suitably located source of calling currents such as a battery; and switching devices at the said substation, adapted to connect the said telephone and the said source of calling current with the said main circuit, and to disconnect them therefrom; of a double acting central station electromagnetic annunciator

constructed to retain its signal shutter drop in place in an electrical condition of the line so long as such condition remains unchanged, but adapted to release the same and give the signal on any change in such condition substantially as described. 20

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 15th day of March, 1893.

FRANK A. PICKERNELL.

Witnesses:

R. J. MORGAN,
CHARLES D. M. COLE.