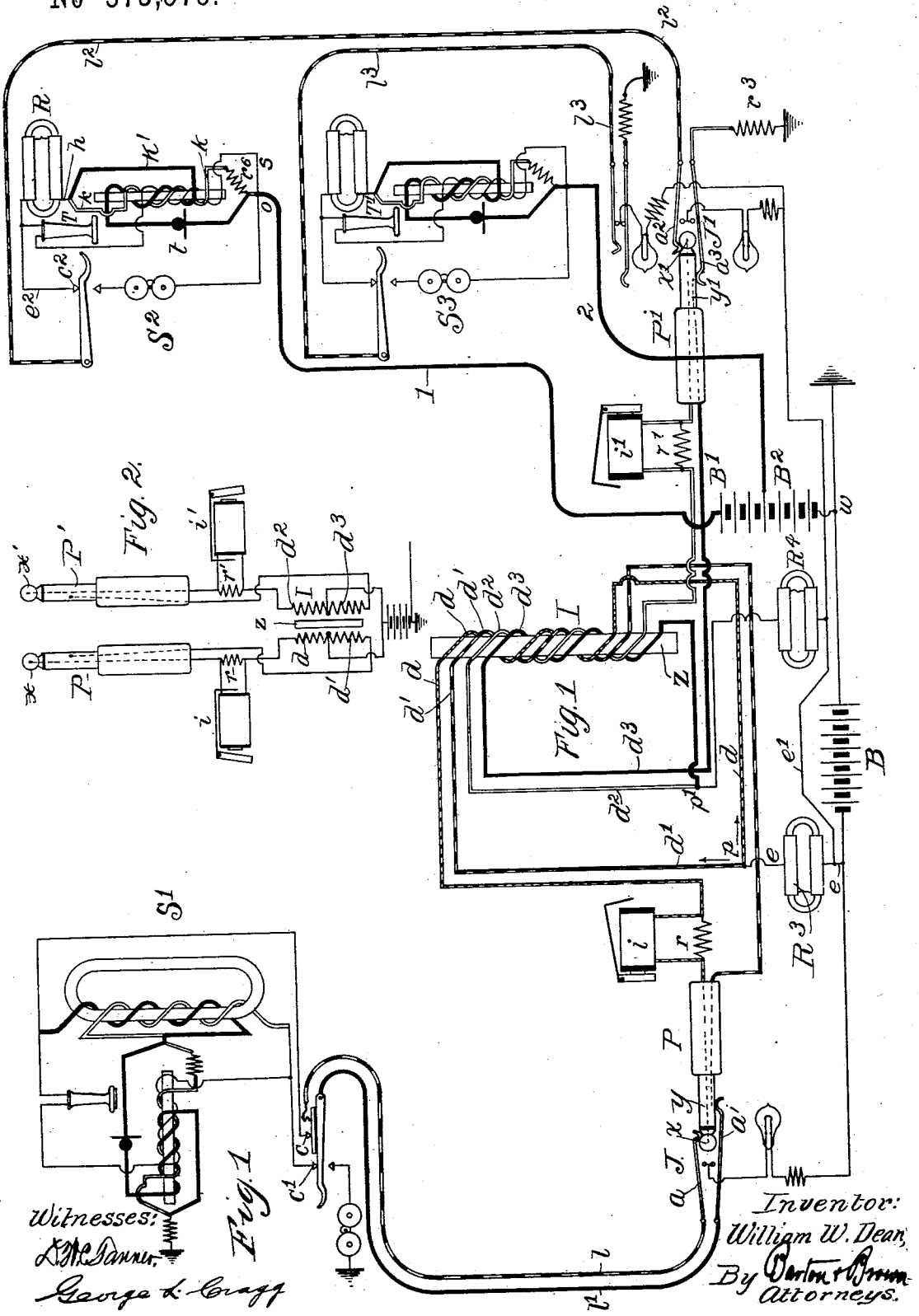
(No Model.)

W. W. DEAN.

TELEPHONE EXCHANGE SYSTEM.

No 573,575. Patented Dec. 22, 1896.



UNITED STATES PATENT OFFICE.

WILLIAM W. DEAN, OF ST. LOUIS, MISSOURI, ASSIGNOR TO THE BELL TELEPHONE COMPANY OF MISSOURI, OF SAME PLACE.

TELEPHONE-EXCHANGE SYSTEM.

SPECIFICATION forming part of Letters Patent No. 573,575, dated December 22, 1896.

Application filed June 11, 1896. Serial No. 595,109. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM W. DEAN, a citizen of the United States, residing at St. Louis, in the State of Missouri, have invented a certain new and useful Improvement in Telephone-Exchange Systems, (Case No. 11,) of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

My invention relates to telephone-exchange systems in which centralized batteries are employed for supplying the transmitter-circuits; and its object is to adapt such a centralized battery to systems employing grounded lines. To this end I employ, in addition to the main battery, a battery in the common return-wire which serves the grounded lines, this additional battery being so connected that it coöperates with the main battery in supplying the necessary voltage for the grounded lines, leaving the main battery to supply the less voltage, which is usually required for metallic-circuit lines.

My invention consists in the circuits, mechanism, and arrangement of parts which are hereinafter described, and which will be more readily understood by reference to the accompanying drawings, in which—

Figure 1 represents two subscribers' stations connected together, one subscriber being connected with the central station by a metallic circuit, the other by a grounded line. Fig. 2 represents, diagrammatically, the plugs and cord-circuits at the central office.

Like letters refer to similar parts in both figures.

In Fig. 1 the subscriber's station S′ is represented with the regular metallic circuit. When the plug P of the double connecting-cord is inserted in the jack J of the subscriber S′, current will flow from the battery B by way of the wire e, retardation-coil R^3 to the point p, where it will divide, one part of the current flowing through the winding d' of the induction-coil i to the sheath y of the plug P, to the spring a' of the jack J, the limb l', the contact c', to the subscriber's-station apparatus, and to the ground. Starting from p again the other part of the current will flow by way of the winding d, the clearing-out indicator i, to the tip x of the plug P, to the spring a of the jack; thence by way of the limb l, the contact c, the subscriber's station, to earth.

It will be seen that battery B supplies the two branches of the metallic circuit in multiple, and the resistance, therefore, of this circuit is practically one-half what it would be if only one branch of the circuit were used and one-fourth what it would be if the two branches of the metallic circuit were in series. It will be seen also that practically equal and opposite currrents will flow through the windings d and d', and the core Z of induction-coil I will not be magnetized, so that the coil will retain its efficiency as a transformer.

The induction-coil I in Fig. 1 is shown having four layers, two of said layers being connected in series and forming one half of the induction-coil, while the two other layers connected in series form the other half of the induction-coil. In Fig. 2 the induction-coil is shown with its connections in a simplified diagrammatic form.

Referring to Fig. 1 again, it will be seen that when the plug P′ is inserted in the jack J′ of the grounded subscriber S^2 current will flow from the battery B, by way of the wires e and e', through coil R^4 to the point p', at which point the current will divide, part flowing through the winding d^2, by way of the clearing-out indicator i', to the tip x' of the plug P′, to the spring a^2 of the jack by way of the single line l^2, the contact c^2, thence by wire e^2, the retardation-coil R, to the wire h. The current here divides, half going through primary circuit k', which includes the transmitter t, to the point o, and the other half flowing through the primary winding k and balancing-resistance r^6 to the same point o. Here the current will reunite and flow by way of the common return-line 1, the battery B′ B^2, to battery B. Returning to point p' it will be seen that current will also flow through the winding d^3 to the sheath y' of the plug P′, the spring a^3 of the jack J′, the non-inductive resistance r^3, to earth. The resistance r^3 is adjusted so that the same current will flow through the winding d^3 as flows through the winding d^2. There will then be equal and opposite currents flowing through windings

d^3 and d^2, so that they do not magnetize the core Z of the inductive coil I, and its efficiency is maintained the same when used with grounded lines as when used with metallic-circuit lines. If the spring a^3 of jack J′ were left in open circuit, then current would flow only through the winding d^2, and, as there would be no neutralizing-current flowing through the winding d^3, the core Z would be magnetized, and the efficiency of the induction-coil I as a repeating-coil would be impaired. Still another purpose is secured by the grounding of the spring a^3 of the spring-jack J′ through the non-inductive resistance r^3, for thereby the alternating voice-currents emanating from the station of the grounded subscriber S^2 are enabled to pass through the entire induction-coil I, thus avoiding the weakening of the induction in the coils d and d', which would ensue if winding d^3 should be left open at the spring-jack contact y' and spring a^3.

It will be seen that the circuit of the grounded subscriber, in which the return-ground 1 is included in series with the single line l^2, has much greater resistance than a metallic-circuit line in which the two branches are in multiple when the stations are the same distance from the central office. Hence it will be necessary in order to balance the current supplied from the battery to these lines to insert resistance with the metallic-circuit line to compensate for the extra resistance of the grounded-circuit line. This, of course, is objectionable, and this I avoid by means of my invention.

I will describe the operation of the apparatus and circuits which I have referred to. Suppose that subscriber S^2 speaks in his transmitter t. Alternating currents will be set up in the secondary circuit s and will flow from the grounded battery B′ B^2 by conductor 1 to the point o, thence through the secondary helix s of the induction-coil and hand-telephone T, wire e^2, contact c^2, line l^2, spring a^2, plug-contact x', non-inductive resistance r', and clearing-out indicator i' in multiple, the winding d^2, and the winding d^3 upon the repeating-coil I, to the sheath y' of the plug P′, the spring a^3, the non-inductive resistance r^3, to earth. The battery B′ being inserted in the return-wire 1, supplies no current to the metallic circuit, but is connected in series with battery B, so that the grounded subscriber has the added voltage of the two batteries, as will be observed by tracing the circuit of the two batteries through the station S^2. Starting from the point w, where the battery B′ is connected with the line to earth, the battery supplies the primary circuit of the transmitter by the return-wire 1. Its path is, after leaving the induction-coil, through the retardation-coil R, the line e^2, contact c^2, line l^2, spring a^2, plug-tip x', resistance r', and indicator i' in multiple, winding d^2 to the point p' by lines e' and e to the battery B, and back to the point w.

The battery B′ is preferably provided of a size sufficient to supply the additional voltage required for the longest grounded line-circuit over what is required for the metallic-circuit lines and its polarity is opposite to that of the battery B, as is shown, so that there will be sufficient voltage to furnish the grounded subscriber with the standard current. I have shown another grounded subscriber S^3 connected to a portion of the battery B^2, indicating that the line l^3, connecting with station S^3, is of lower resistance, and therefore will require less of the battery B^2 than the station S^2, before described. Numerous subscribers may be connected to the common returns 1 and 2, it being only necessary to have the different groups of grounded lines which are connected to a common return provided with lines of approximately the same length and resistance, and in this manner the lines will be furnished with the same standard of currents from the centralized batteries without the necessity of providing artificial resistances at the central station, as would be necessary if the battery B were of sufficient electromotive force to supply the grounded lines having the greatest resistance with the standard of current required.

The retardation-coils R^3 and R^4 are inserted to prevent leakage of voice-currents to earth through the battery B. The non-inductive resistances r and r' are connected in shunt of the clearing-out indicators to form a non-inductive path for the undulating voice-currents, which would not pass freely through the electromagnets i and i'.

I believe it is broadly new with me to insert an additional battery of proper potential in the return-ground, serving a group of grounded-subscribers' lines, and I desire to claim this broadly. I believe it is also new with me to put the balancing-resistance r^3 in circuit to ground from the usually open point of a grounded-subscriber's spring-jack for the purpose of maintaining the core of the repeating-coil I non-magnetic, and this I intend to claim broadly.

It will be apparent that my invention is described in combination with mechanism and circuits which may be modified without departing from the spirit of my invention. I desire, therefore, not to be strictly limited to the details of mechanism and circuits which I have shown; but,

Having described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. The combination with metallic-circuit and grounded telephone-lines, of a common battery, and an additional battery in circuit with the grounded lines and adapted to supply additional electromotive force to the grounded lines, whereby the standard current may be maintained upon both metallic-circuit and grounded lines.

2. In a telephone-exchange system, the combination with a grounded line terminat-

ing in one spring of a spring-jack, of a repeating-coil having substantially equal and opposing windings adapted to be connected in said line, and a balancing-resistance adapted to be connected between said windings and ground, whereby the efficiency of the repeating-coil is increased, substantially as described.

3. In a telephone-exchange system, the combination with metallic-circuit and grounded telephone-lines, of a common battery adapted to supply current to said grounded telephone-lines and current in multiple to the two sides of each of the metallic telephone-lines, and an additional battery adapted to be included in circuit with said grounded telephone-lines to reinforce the pressure of said common battery, substantially as described.

4. In a telephone-exchange system, the combination with metallic-circuit and grounded telephone-lines, of a common battery adapted to supply current to said lines, and an additional battery adapted to be included in series with said common battery and in circuit with said grounded lines, substantially as and for the purpose described.

5. In a telephone-exchange system, the combination with grounded and metallic-circuit telephone-lines, of a common battery adapted to supply current to said grounded telephone-lines and, in multiple, to the two sides of each of said metallic-circuit lines, and an additional battery adapted to be included in circuit with said grounded lines and in series with said common battery, substantially as and for the purpose described.

6. In a telephone-exchange system, the combination with metallic-circuit lines grounded at the substation and grounded telephone-lines, of a common grounded battery adapted to supply current to said grounded telephone-lines and, in multiple, over the two sides of each of said metallic-circuit lines, and an additional battery adapted to be included in circuit with said grounded telephone-lines, substantially as and for the purpose described.

7. In a telephone-exchange system, the combination with metallic-circuit and common return telephone-lines, of a common battery adapted to supply current thereto, and an additional battery adapted to be included in circuit with said common return, substantially as and for the purpose described.

8. In a telephone-exchange system, the combination with metallic-circuit and common return telephone-lines, of a common battery adapted to supply current to said common return-lines and, in multiple, over the two sides of each of said metallic-circuit lines, and an additional battery adapted to be included in series with said battery and common return, substantially as and for the purpose described.

9. In a telephone-exchange system, the combination with a telephone-line extending to the exchange, of a repeating-coil, having substantially equal and opposing windings, means for connecting one of said windings in series with said line, means for connecting an opposing winding in shunt of said telephone-line, and balancing-resistance adapted to be included in circuit with the latter of said windings, substantially as and for the purpose described.

In witness whereof I hereunto subscribe my name this 29th day of May, A. D. 1896.

WILLIAM W. DEAN.

Witnesses:
J. J. CRAWSHAW,
F. WOELTGE.