

(No Model.)

F. R. McBERTY.
TELEPHONE SYSTEM.

No. 584,393.

Patented June 15, 1897.

Fig. 1.

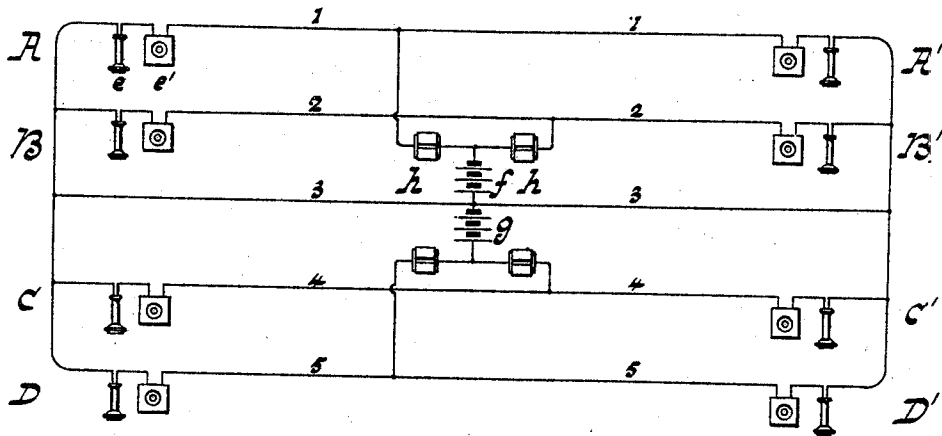
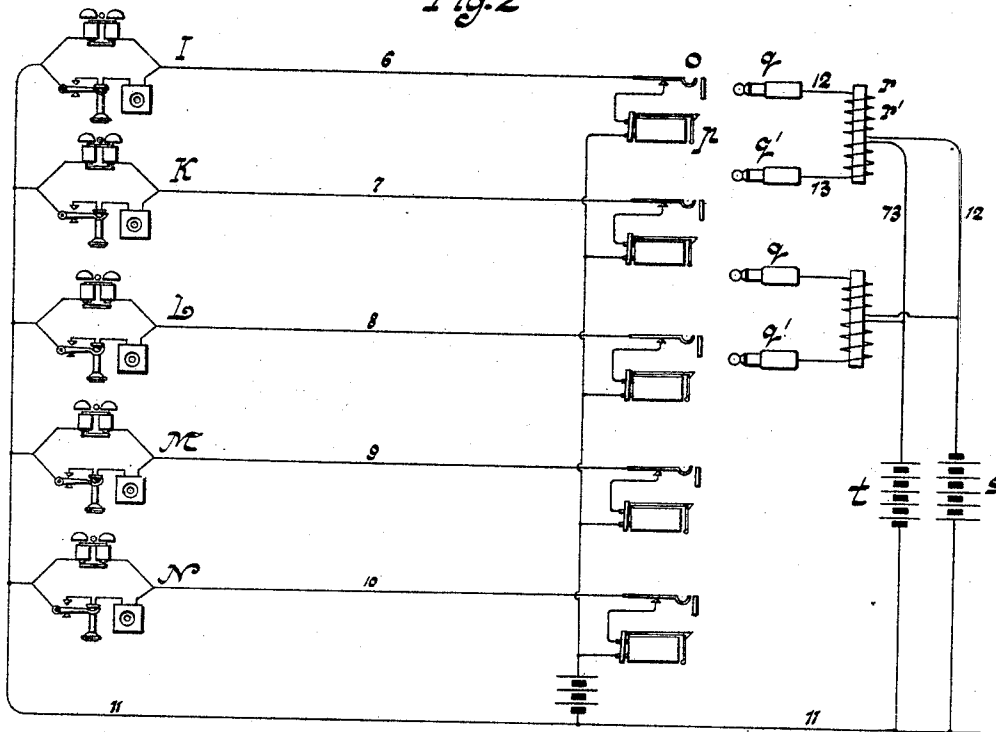


Fig. 2.



Witnesses:

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UNITED STATES PATENT OFFICE.

FRANK R. McBERTY, OF DOWNER'S GROVE, ILLINOIS, ASSIGNOR TO THE
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TELEPHONE SYSTEM.

SPECIFICATION forming part of Letters Patent No. 584,393, dated June 15, 1897.

Application filed May 14, 1896. Serial No. 591,460. (No model.)

To all whom it may concern:

Be it known that I, FRANK R. McBERTY, a citizen of the United States, residing at Downer's Grove, in the county of Du Page and State of Illinois, have invented a certain new and useful Improvement in Telephone Systems, (Case No. 38,) 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 applies to systems of current-supply for telephone-transmitters comprising single-wire circuits provided with a common return. Its object is to reduce or eliminate the resistance of the common return-wire and thus to avoid cross-talk, which would result from resistance in the return-wire. Such systems of current-supply are well known in the art of telephony. It is common to construct single-wire telephone-lines each with a telephone-transmitter included in it at its substation and each connected with a source of current at a central office, a common return-wire of comparatively low resistance being provided for the entire group of lines. It has been of course impracticable to reduce the resistance of this cross-wire to a very small amount on account of the cost of metal for the conductor. Hence such systems have been subject to cross-talk between different lines simultaneously in use, one line or group of lines acting in joint with the return-wire as a return for another line.

The present invention aims to attain the equivalent of a reduction of resistance of the cross-wire by connecting to the different lines sources of current of opposite polarity, the lines being separated into suitable groups for this purpose, whereby in a considerable group of lines in use at the same time a tendency to produce a condition of no potential at their common junction with the return-wire may be created. On account of the frequent variation in the number of lines in use and in the currents in the different lines such a balance of potentials will of course not be perfectly effected; but to whatever extent such a condition can be created by a proper grouping and distribution of the lines the resistance of the return-wire will be eliminated and

the cross-talk between lines will be reduced. The result will be somewhat analogous to the neutral return-wire in the well-known "three-wire" system for incandescent lighting, excepting that the result aimed at is to eliminate the resistance of the return-wire instead of reducing its cross-section.

In applying the invention to the simplest arrangement of circuits—namely, to a number of telephone-circuits radiating from a common point and connected through a common return-wire—it will be sufficient to connect the central ends of half the circuits with one pole of a source of current whose other pole is connected with the return-wire and the corresponding ends of the remaining circuits with the opposite pole of a similar source of current.

In this system the ideal condition would be that in which the lines were connected together for conversation in pairs, whose inner ends were connected to the different sources of current, the currents being equal in the two members of each pair. Under such a condition no difference of potential would exist between the two ends of the return-wire, and the resistance of the wire would be perfectly eliminated. The attainment of a close approximation to such a result in practice is of course a matter of engineering.

Under more usual conditions of a telephone-exchange the different lines are not normally connected with sources of current for the supply of their substation-transmitters, but become connected with such sources through the instrumentality of the plugs and plug-circuits for uniting different lines. Commonly a repeating-coil is included in each plug-circuit to effect the conductive separation of the lines in order that the line of lower resistance may not divert the current from its mate of higher resistance. In such a system my invention contemplates the use of sources of current in the manner before described, one pole of each battery being connected to one member only of each pair of plugs. Then of two united lines one derives current from one pole of one of the sources, while the other derives current from the opposite pole of the other source. Thus in such a system also the connection of lines in pairs

by means of plugs and plug-circuits would result in a tendency toward a condition of no difference of potential between the terminals of the return-wire of the lines.

5 The invention is illustrated in the accompanying drawings, Figures 1 and 2. Of these the first represents the group of simple circuits before mentioned, while Fig. 2 illustrates the application of the invention to the
10 more complicated conditions of a telephone-exchange provided with the customary switching apparatus.

In Fig. 1 eight telephone sets are represented at stations A B C D and A' B' C' D'.
15 Each station is equipped with a receiving-telephone *e* and a transmitting-telephone *e'*. The stations A and A' are united by a line-wire 1 and stations B and B' by line-wires 2. A common return-conductor 3 is provided for
20 all the stations. At a point intermediate of the stations are located two batteries *f* and *g*, whose opposite poles are connected with the common return-conductor 3. The free pole of battery *f* is led through conductors to the line-wires 1 and 2, impedance-coils *h* being
25 interposed in the conductors to prevent the shunting of telephonic current through the branches. From the free pole of the battery *g* other conductors, also including im-
30 pedance-coils, are led to the line-wires 4 and 5. While these lines are in use a positively-directed current flows out from battery *f* over line-wires 1 and 2 to the terminal stations and
35 thence to the common return-conductor 3, while a negatively-directed current flows from battery *g* over line-wires 4 and 5, also finding circuit to the common return-wire 3. If these
40 currents were all equal, a condition of no difference of potential between the extremities and the middle point of conductor 3 would be created, so that this conductor would be practically eliminated from the circuit. If at such
45 a time a variation in the current in one of the lines occurred without a compensating variation in some other line, the return-wire
50 would become the path of a current corresponding to the excess or deficiency thus produced, the current in the remaining lines being also somewhat varied in inverse proportion
55 to their resistance as respects the common return-wire. Under this condition the cross-talk would be nearly equal to that produced in the ordinary arrangement of circuits
60 with return-wires. If, however, while a variation of current occurred in one line a corresponding but reverse variation occurred in
65 another line of a group carrying current of different polarity, then the null-potential condition would remain undisturbed and no cross-talk whatever would result. As the number
of lines constituting the group is increased the probability of the occurrence of such compensating fluctuations of telephonic current becomes gradually increased, so that with a
large number of lines, such as would be found in practice, the condition of no potential would be closely approximated. Thus

in a properly-organized system the resistance of the return-wire would produce no more cross-talk than with the usual arrangement,
70 while under normal circumstances, a large number of lines being simultaneously in use, no appreciable cross-talk will be experienced, the return-wire being inert.

In Fig. 2 telephone-lines 6, 7, 8, 9, and 10
75 are represented extending from stations I K, &c., and terminating in the usual spring-jacks *o* and annunciators *p* in a telephone-switchboard. The lines are provided with a
80 common return 11. In the switchboard are located pairs of connecting-plugs *q q'*, each pair having a conductor leading from each plug through a winding of a repeating-coil *r*
85 to a pole of one of the sources of current. Thus conductor 12 includes the coil *r'* and extends to one pole of the battery *s*. Conductor 13 includes the other helix of the repeating-coil and is connected with the free pole
90 of battery *t* of opposite polarity. Of course any number of switchboard-cords can be connected with the same batteries *s* and *t*. When
95 any two lines are brought into connection by means of plugs *q* and *q'*, the currents in these lines are of opposite direction, so that the point of their connection with the return-
100 wire will be at the same potential as the point of the return-wire with which batteries *s* and *t* are connected. Hence the return-wire will be neutral as to currents in these lines and no tendency to produce cross-talk in other
lines of the system will exist.

In ordinary exchange practice it would not be practicable to run a single return-wire to all the stations of the system nor to have the
105 points of connection between the line-wires and the return-wire identical. The proper grouping of lines likely to be used in connection with each other with a common return-wire for attaining the best results with the
110 present invention would become a matter of telephone-engineering. It is of course not necessary to enter into an extended discussion of the possible arrangements in such
115 groups. Combinations of lines would necessarily be made in accordance with peculiarities in the use of the lines and with the location of the different stations. Other modes
120 of connecting the battery with the plug-circuits may also be adopted under special circumstances without departing from the intention of this invention.

I claim as new and desire to secure by Letters Patent—

1. The combination with a number of telephone-circuits including transmitting-tele-
125 phones and having a common return-conductor, of two or more sources of current having different poles connected with the common return-conductor and their other poles
130 connected with different circuits, whereby cross-talk in the circuits is diminished or prevented, as described.

2. The combination with a group of telephone-circuits including transmitting-tele-

phones and provided with a common return-conductor, of equal sources of current of opposite polarity, each included in approximately half the line-circuits, whereby cross-talk arising from the existence of the return-wire is prevented, substantially as described.

3. The combination with a number of telephone-lines including transmitting-telephones having a common return-wire, each provided with means for uniting it with another line, of sources of current of opposite polarity adapted to be applied to the lines, and means for applying said sources of current to excite substantially equal numbers of lines connected with a common return-wire with currents of opposite polarity, whereby cross-talk between the lines may be eliminated, as described.

4. The combination with a number of telephone-lines having a common return, and each provided with a socket in a switchboard, of plug-circuits for uniting the sockets of dif-

ferent lines, sources of current of opposite polarity, said oppositely-polarized sources of current being connected between the return-wire and substantially equal numbers of plugs likely to be simultaneously in connection with lines, substantially as described.

5. The combination with telephone-lines having a common return-wire, of pairs of plugs for making connection with the lines, sources of current having opposite poles connected with different members of each pair of plugs, and a device in each plug-circuit for effecting connection between the plugs as regards varying currents, substantially as described.

In witness whereof I hereunto subscribe my name this 7th day of April, A. D. 1896.

FRANK R. McBERTY.

Witnesses:

ELLA EDLER,

DUNCAN E. WILLET.