(No Model.)

J. J. CARTY.

MULTIPLE TELEPHONY.

No. 425,862. Patented Apr. 15, 1890.

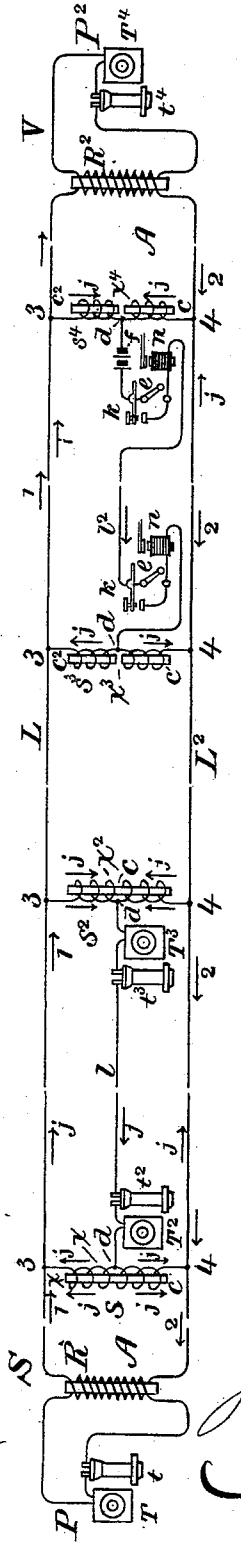

Fig. 1.

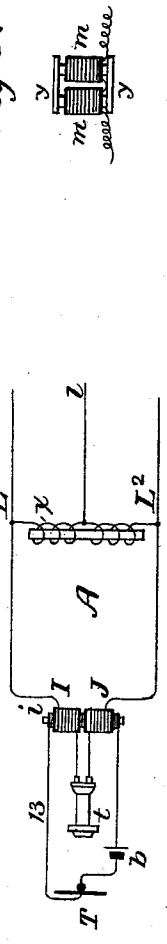

Fig. 2.

Fig. 3.

Witnesses.
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UNITED STATES PATENT OFFICE.

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MULTIPLE TELEPHONY.

SPECIFICATION forming part of Letters Patent No. 425,862, dated April 15, 1890.

Application filed November 13, 1889. Serial No. 330,125. (No model.)

To all whom it may concern:

Be it known that I, JOHN J. CARTY, residing at New York, in the county of New York and State of New York, have invented certain Improvements in Multiple Telephony, of which the following is a specification.

This invention concerns the subject of multiple telephony, and relates particularly to a mode of utilizing the wires of metallic or double-wire circuits extended between two distant points for one or more independent way-circuits which may be established between way-stations located on the line of route, whereby messages may be transmitted over the entire metallic circuit extended between the two terminal stations while other messages may independently and simultaneously be transmitted over portions of the same lines between any two way-stations or, in fact, between any number of pairs of adjacent way-stations. This is accomplished by stretching between the two way-stations concerned a single extra wire, which is then employed as one of the two conductors of a substantially independent circuit, and by using such portion of both of the original wires as is located on the route between said way-stations together as a joint return-conductor therefor. For example, assuming, first, a metallic inductively-neutral circuit constructed between New York and Boston and employed as a telephonic-circuit. This invention provides that a third wire may be stretched between New York and New Haven, which in association with that portion of the original two wires extended between the two last-mentioned cities can be independently and simultaneously utilized for a separate telegraphic or telephonic communication; and, similarly, any number of extra wires may be built between any two way-stations, or even a way and a terminal station, such as New London and Providence or Providence and Boston, and they could all be operated at the same time without interference.

The invention may properly be termed a "way multiplex."

From what has been stated the object of the invention is apparent.

In the drawings which form a part of this specification, Figure 1 is a diagram illustrating the principle of my invention; and Fig. 2 indicates a modification of the terminal-station apparatus, which, if desired, may be adopted without any departure from the said principle. Fig. 3 indicates one form of inductive resistance suitable for the purposes of the invention.

A is a metallic or double conductor-circuit extending between two terminal stations S and V, and L and L^2 are respectively the direct and return, or, as they are sometimes termed, the "outgoing" and "incoming" conductors of the said circuit. At S is placed the ordinary telephonic transmitting-instrument T and receiver t, and at V are similar telephones T^1 and t^1. In the present instance these are connected with the metallic circuit by and through repeating induction-coils R and R^2 respectively, which coils may be of any well-known construction.

I preferably make use of the standard repeating-coil, each helix of which is wound with a substantially equal number of convolutions of the same size of insulated wire; but I am not restricted to the employment of this construction. By means of these telephones acting through the said repeating-coils telephonic communication between the stations S and V is reciprocally established.

The metallic telephone-circuit A passes through certain intermediate or way stations s s^2 s^3 s^4, &c. Four such stations are shown in the diagram, these being sufficient to illustrate the invention, and at each is placed an inductive resistance (sometimes technically styled a "retardation-coil") x. These inductive resistances x x^2 x^3 x^4 may, as indicated in Figs. 1 and 2, be made with a single soft-iron core c, which may be solid or divided, so as to prevent the circulation of eddy-currents. They may be made, as shown in Fig. 3, of two bar electro-magnets m, united at both ends by soft-iron armatures or yoke-pieces y; or any ordinary and well-known construction of electro-magnetic coils having a comparatively high coefficient of self-induction may be employed, the form being immaterial so far as concerns this invention; but they are preferably constructed of a value in resistance and capacity to develop a counter electro-motive force when subjected to like conditions not less than that

of an ordinary telephonic transmitter and receiver.

It will be observed that the electro-magnetic coils x and x^2 are shown as having a continuous core c from end to end, while x^3 and x^4 are shown as having two cores c and c^2, each of half the length of the entire helix. Such a variation in construction is, however, immaterial. It is, however, important to obtain the best results that the direction of the helix x shall be continuous from one end to the other. These inductive resistances are each at its own way-station connected across from points 3 on one of the main wires L to points 4 on the other one L^2. From a point d at the middle of the helix of the inductive resistance x at way-station s a third line-wire l is extended to a similar point d at the middle of the like coil x^2 at way-station s^2, and between similar points d at the center of helices x^3 and x^4 at way-stations s^3 and s^4 another like line-wire l^2 is stretched. I have shown ordinary telephone-instruments T^2 t^2 and T^3 t^3 connected in circuit with the line l at stations s and s^2, and ordinary Morse telegraph-instruments—such as a key k and receiving-magnet n—in circuit with l^2 at the stations s^3 and s^4. A battery f will of course also be connected in circuit with these, and the keys will be provided with their usual circuit-closers e; or in a manner well understood the telegraph-circuit so constructed may be worked on the open-circuit system, each way-station having its own line-battery.

The working-currents developed at either terminal station in the repeating-coils R and R^2 and circulating in the entire metallic circuit may at a given moment be considered as flowing in the direction of the arrows 1 and 2—that is to say, they will necessarily flow in opposite directions in the two sides L and L^2 of their circuit. It is therefore evident that they will have no tendency to flow or circulate through the way-wires l and l^2, and can consequently exert no effect on such electrical instruments as are in circuit therewith. The currents generated, however, in either terminal induction-coil R or R^2 will operate upon the repeating-coil at the other end of the circuit to produce the desired effect upon the instrument t or t^4 there located. Communication is thus readily established between the terminal stations, while there is no interference with the instruments at the way-stations, though portions of the through-line wires are at the same time portions of the intermediate station-circuit. Moreover, when the instruments on the extra wire l at stations s or s^2 are operated it is also evident that no currents developed by them can affect the repeating-coils R and R^2, for such currents must necessarily divide at the points d, and traversing the inductive resistances in both directions will reach the main line-wires L and L^2, and traversing both in the same direction have no other circuit open to them than by way of the said main line, which jointly constitute one side of the way-circuit (the line l being the other side) to the point from which they originally started. In like manner the instruments in the way-line l^2 can also be operated without in any sense interfering with the other users of the system.

It is to be observed that the inductive resistance-helices being wound of continuous direction from end to end will have a considerable counter electro-motive force developed in them by any portion of the current traversing the main line between the terminal stations, which counter electro-motive force tends to prevent short-circuiting through the said helices of the said terminal-station currents, while on the other hand the counter electro-motive force set up in the said helices by the way-circuit current is very inconsiderable, by reason of the fact that the intermediate lines l connect with the middle of said helices and circulate therefrom in both directions, thus tending to determine a minimum magnetic variation in the cores c, and consequently very little self-induction. As a general result, it may be stated that the inductive resistance so made and connected offers little opposition to the way-currents, but very much to the main currents. The resistance of the "way-circuit" is further reduced by the circumstance that in the portion of the main circuit utilized as a return for the way-wire both sides of the said circuit are employed. The resistance of the return is thus halved.

The modification shown in Fig. 2 shows that instead of impressing the desired currents upon the main metallic circuit by a repeating-coil the ordinary telephonic outfit may be employed. In this one end of the circuit A, with its two line-wires L and L^2, is shown; also, a portion of the third wire l and its inductive resistance x. T is the variable resistance of the terminal-station transmitter, which, with its battery b, is included in the primary circuit 13 of an induction-coil I, having, as usual, a primary helix i and a secondary helix J. The said secondary helix J and the receiving-telephone t are included in the main-line metallic circuit A; but to maintain the requisite balance I divide the said secondary helix into two equal portions and connect the receiver between them, as shown. In this system it is essential that an electrical balance should be established and maintained between the two line-wires L and L^2.

It will be seen from what has been stated that my invention comprises a metallic telephone-circuit extending between two terminal stations and one or more intermediate electrical circuits superimposed thereon and extending between a pair or several pairs of way-stations, the said intermediate circuits being arranged so as to avail themselves of portions of the through-circuit associated in each individual case with a single extra line-wire, whereby the intermediate circuits are also inductively-neutral metallic circuits, and

whereby the amount of line-wire required for a plurality of circuits is maintained at a minimum. It comprises, also, the combination, with the above elements, of individualizing devices connected up with respect to the through and way circuits in such a way as to insure practical independence in operation.

Having now fully described my invention, I claim—

1. A through metallic telephone-circuit extending between two terminal stations, and one or more intermediate metallic electrical circuits superimposed thereon and extending between any two given stations on the said through-circuit, one of the conductors of each superimposed circuit being formed of the two sides of that section of the through metallic circuit which extends between the two stations of the superimposed circuit, serving jointly as a substantially single conductor, and having for its other side or conductor a separate and independent wire, also extended between the said stations.

2. The combination, in a telephone system, substantially as hereinbefore described, of two through wires extending between two terminal stations, the said wires being formed into a continuous metallic telephone-circuit, establishing telephonic communication between the said stations, sections of the said two wires extending between any two way-stations being also united at the way-stations concerned to serve jointly as a substantially single return-conductor for a third wire extending between the said way-stations.

3. The combination, substantially as hereinbefore described, of a through metallic telephone-circuit extending between two terminal stations, and telephones included therein or connected therewith at said stations, with inductive resistances connecting the two wires of the said metallic circuit at one or more pairs of way-stations located thereon, an extra line-wire uniting the central or middle points of any two of said inductive resistances, whereby an independent metallic circuit is constructed between said way-stations, the said extra wire constituting one side and the intervening section of the two wires of the through-circuit the other side of said independent circuit, and suitable communicating instruments connected in the circuit of the extra wire, whereby messages may simultaneously be transmitted between the terminal stations over the through-circuit and between any two way-stations over an independent circuit formed in part of the wires of said through-circuit.

4. In a metallic-circuit telephone system, a way-multiplex comprising a metallic circuit connecting two distant stations and including telephones at said stations, and a series of independently-operating metallic circuits provided with suitable instruments, each extending between two way-stations of the said through-circuit, and each formed in part of the two wires of said through-circuit and in part of a third wire extending between said stations, the said third wire being connected at its ends with the two wires of the through-circuit, which together serve as a return therefor by means of inductive resistances wound and connected, as described, in such a manner as to oppose the passage of electric currents circulating in the through-circuit, but to comparatively facilitate the passage of currents traversing the third wire and its circuit, substantially as specified.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 9th day of November, 1889.

JOHN J. CARTY.

Witnesses:
HERBERT LAWS WEBB,
O. A. BELL.