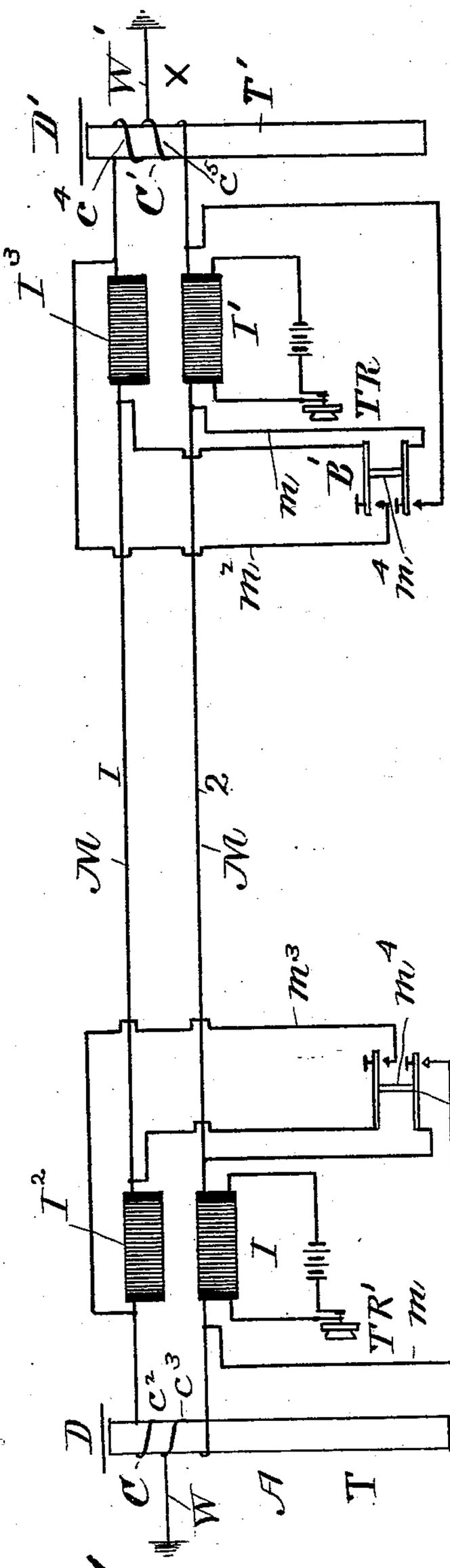
(No Model.)

C. A. SHEA.

TELEPHONE METALLIC CIRCUIT.

No. 534,083. Patented Feb. 12, 1895.



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TELEPHONE METALLIC CIRCUIT.

SPECIFICATION forming part of Letters Patent No. 534,083, dated February 12, 1895.

Application filed July 30, 1892. Serial No. 441,742. (No model.)

To all whom it may concern:

Be it known that I, CHRISTOPHER A. SHEA, a citizen of the United States, residing at Boston, in the county of Suffolk, State of Massachusetts, have invented a new and useful Improvement in Telephone Metallic Circuits, of which the following is a full, clear, and exact description, reference being had to the accompanying drawing, forming a part of this specification, in explaining its nature.

The telephone service so far as I am aware was first intended, or at any rate used for short lines, and there was employed but single wires, the circuit being completed by earth connections. As the wires for electrical purposes increased in number and the necessity for increasing the distance between telephone stations increased, the single wire service began to suffer from the effects of induction currents from neighboring wires, from the atmosphere and from the earth, and it was finally ascertained that it was desirable to cut off the earth connections and connect the termini of the line by another wire, to form a continuous metallic circuit not connected with the earth, and when such additional wire was run parallel with the first and close to it, it was discovered that induced currents of all kinds were neutralized to such an extent that there was much less, or no disturbance from them produced in the telephones, and in practice it has been found that a continuous metallic circuit of this kind does in effect practically silence all noise in the telephone caused by inductive disturbance.

While the metallic circuit has this advantage, it is found to have a disadvantage in that the distance over which its telephone currents travel is doubled by its use, the telephone currents traversing the entire circuit created by the two lines instead of a single wire as in the old system. This correspondingly decreases at the receiving end the strength of the telephone currents, while it very much adds to the expense of erecting, operating and maintaining the line, it being necessary to provide wire, instrument, &c., of a capacity and power suitable for a line just twice as long as the actual distance between two stations, and much more expensive than would be required if the service could be effected by a current traversing one-half the distance, or over one line of the circuit or in one direction only. Not only this, but if one side of the line only be used, the telephone current would be more effective for longer distances under known or commercial conditions. I mean that with the same currents, instruments, &c., now used between stations two hundred or five hundred miles apart it would be possible to obtain an efficient service between stations twice that distance or four hundred or one thousand miles apart and without increasing the gage of the wire. It is, however, possible to use the metallic circuit for the purpose of preventing induction and at the same time to employ but one of the wires or lines of the circuit for telephone or talking purposes. This result I accomplish by connecting the metallic circuit with the telephones or telephone converters at each end, substantially as hereinafter specified, and connecting each telephone or telephone converter midway the winding of its coil with the earth.

The telephones or telephone converters used vary from the ordinary telephone or telephone converter in the winding. This is because the coil of the telephone or telephone converter core is connected with the earth at the center of its length, and there must be upon each side of the earth connection the winding effect and capacity of a telephone or telephone converter suitable for the service, in order that a current coming from either line shall efficiently actuate the telephone or telephone converter in its passage over its section or part of the coil to earth. The telephone or telephone converter thus wound and connected with the earth becomes in effect a double telephone or telephone converter in that its core has two full windings, either one of which when vitalized by the energizing current actuates the diaphragm, and each of which acts independently of the other, being electrically separated from the other by an earth connection.

It will thus be seen that the system comprises two line wires, one a transmitting line, and the other a neutralizing line. It is very essential for the successful operation of the system, that these lines be balanced to the same resistance. I provide means for accom-

plishing this, and I further provide means for balancing the resistance of the neutralizing line to that of the transmitting line, when the transmitting instrument is cut out of the line at either end, which in practice is the case when the message is transmitted from the other end.

In the diagram A and X are terminal stations of the metallic circuit M.

T T′ are telephones or telephone converters at the respective ends of such circuit. The coils C C′, respectively, of these telephones or telephone converters are wound to twice the number of convolutions and resistance of the ordinary telephone suitable for the service, and the coils of each are connected at their middle with earth by the wires W W′ and this forms a double telephone or converter at each end of the line, divided or separated electrically by an earth connection. In other words, the telephone or converter thus constructed is effectively operated by a current traversing either of the lines, the said current going through the necessary number of actuating coils on the core of the telephone or converter to earth.

c^2 and c^3 represent the two sets of actuating coils of telephone T, and c^4 and c^5 the two sets of actuating coils of telephone T′.

It will be understood that whichever way the current enters the telephone or telephone converter, and whichever of the coils is used the telephone or telephone converter is constructed so that each set of coils has as great an effect as though the other were not used; or, in other words, that the telephone or telephone converter has two actuating coils each taking its currents from a single line, each operating only when receiving current from said line, and each of a power and effectiveness of a full or complete telephone or converter; while at the same time there is no disturbance in the telephone or converter from inductive currents.

D D′ are the diaphragms of the telephones.

I I′ are the induction coils with usual primary and secondary circuits.

B B′ are keys for shunting the secondaries.

The telephones, induction coils, &c., can be loops from the central exchange.

The action will be described in connection with the diagram. When A talks to X the current starts from induction coil I, goes out on wire 2 of the metallic circuit to station X, around the coil c^5 of telephone T′, and the wire W′ to earth and back by earth to station A, and induction coil I. If for any reason it is desired to switch the current leaving station A off the line 2 and on to the line 1 so that it goes out on wire 1 instead of wire 2 it then actuates the telephone T′ by traversing the coil c^4, connecting with wire W′ to earth; and in the same manner that it actuated the telephone when it traversed the other coil c^5 from wire 2 to the earth wire W′. With this system the balance of the line is more easily thrown out or disturbed than with an ungrounded circuit, and when either, for instance, of the secondary coils I or I′ is thrown on to the line 2, the line 1 would be unbalanced, unless it were correspondingly treated; and for this purpose there are arranged to be connected or thrown into line 1 the balancing coils I^2 I^2 which are connected with the line 1 by the same impulse which throws either of the coils I or I′ into circuit with the line 2, and there is thus continued the balancing relation between the two line wires, as both are simultaneously loaded and unloaded.

T R and T R′ represent the telephone transmitters.

m m' are loops in the line 2, and each has a circuit-breaking key. These loops shunt the secondaries when the circuits are completed by pressing down the keys, and the line is so used while receiving a message, as it has been ascertained that it is delivered more clearly to the receiving telephone if it is not passed through the secondary coil, but about it. At the same time to cause the current to pass about the balancing secondary coil of line 1, there is arranged in said line the loops m^2 m^3, and for each of these loops there is a key which is connected with the key of the corresponding loops of line 2 by an insulating connection m^4. The two keys are connected to be moved by a single impulse, so that in use the companion loops of both lines are let on or off at the same time. When off, as in speaking, the current passes through the secondary of line 2, and the secondary of line 1 being also on balances the secondary of line 2. When the secondary of line 2 is off, as in receiving, the secondary of line 1 is off also and both lines are again simultaneously brought into the same balanced relation.

From the above it will be seen that the telephone currents traverse but one wire or side of the metallic circuit and meet with only the resistance of one wire or one-half that of the circuit, whereas in the metallic systems now used the telephone currents traversing both wires meet the resistance of the entire circuit at least double that of one side or wire. This practically shortens the line one-half or better, for the potential of the first half of the current upon the line is higher than that of the second half.

The substantial benefit arising from this invention will be understood when it is stated that with a telephone metallic circuit of say a thousand miles in length between stations, wires of larger gage and consequently greater cost, and more delicate instruments, and consequently less reliable, are needed for installing and working the system than in lines of half the distance; or, in other words, with one section or line of the telephone metallic circuit used as herein specified, wire of the same gage can be employed, and instruments of known efficiency used between stations a

thousand miles in length as are now effectively employed between stations upon complete metallic circuits of half that length. This makes a great saving in the cost of the construction of long distance lines, and does not deteriorate the service in any respect, but on the contrary gives a better service for the long extra distance lines than could be otherwise obtained for such distances.

It will be understood, of course, that cross-talk is prevented by crossing the wires of the line and presenting reciprocally inductive sections to each other as in the Barrett system, and particularly as represented in Fig. 3 of the drawings in his patent, No. 392,775.

Having thus fully described my invention, I claim and desire to secure by Letters Patent of the United States—

1. The combination, in a telephone system, of the telephones or telephone converters, each having a winding connected at the center of its length with earth, the line 2 having the secondaries I′ and the loops *m m′*, about the secondaries, the line 1 having the balancing coils I^2, I^3, the loops m^2, m^3, and keys for simultaneously shunting and unshunting the loops, substantially as described.

2. The combination of two main lines, a receiving instrument at each end included in both main lines, a transmitting instrument at each end connected with one only of said main lines, means for cutting out of the line, at either end, the transmitting instrument, and means for thereupon balancing the resistance of the other line with the transmitting line, substantially as described.

3. The combination of two main lines, a receiving instrument at each end included in both main lines, a transmitting instrument at each end connected with one only of said main lines, and, on the other line, a balancing device at each end balancing the transmitting instrument at that end, substantially as described.

4. The combination of two main lines, a receiving instrument at each end included in both main lines, a transmitting instrument at each end connected with one only of said main lines, a balancing device at each end on the other line for balancing the transmitting instrument, and means for cutting out of the lines, at either end, the transmitting instrument and balancing device, substantially as described.

5. The circuit herein described for the transmission of electrical impulses, comprising two wires presenting reciprocally inductive sections to each other, the wires being connected at each end with the earth, and at one end being wound around a receiving instrument, at the other end one wire having therein the secondary coil of a telephone transmitter, and the other a coil similar to and balancing said secondary, substantially as described.

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Witnesses:
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