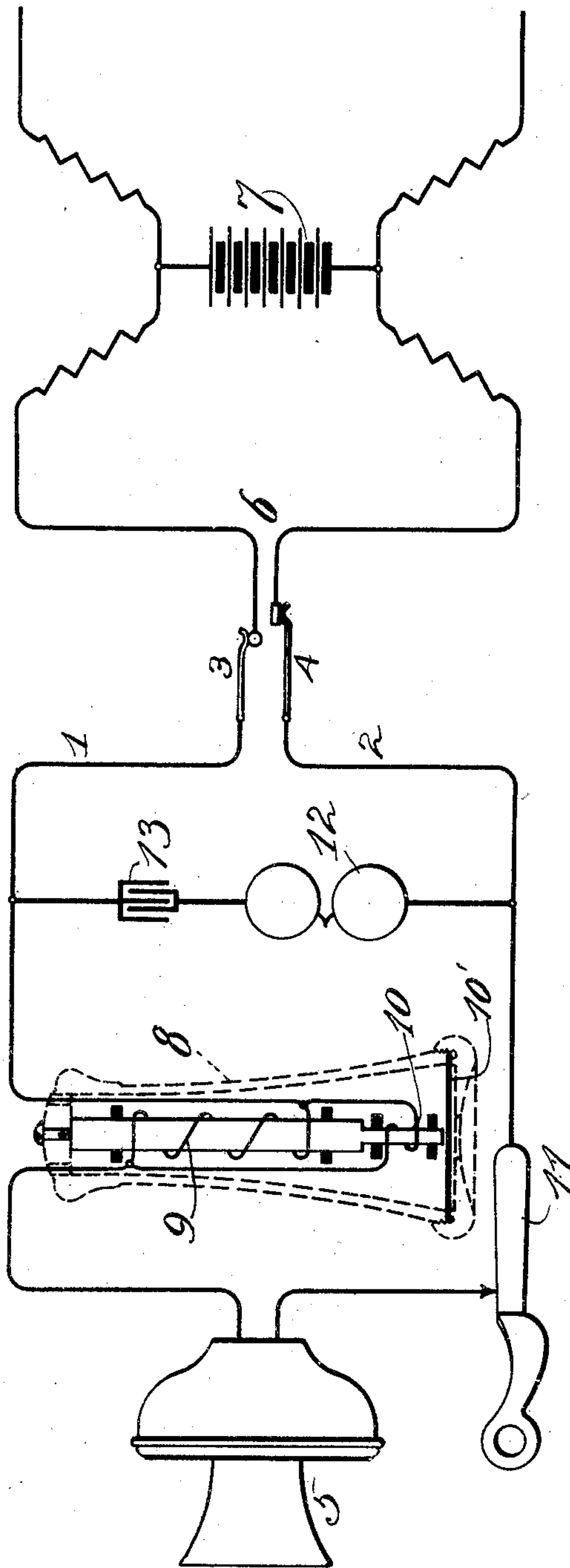


E. E. YAXLEY.  
TELEPHONE SYSTEM.

APPLICATION FILED JAN. 18, 1909.

**924,714.**

**Patented June 15, 1909.**



**WITNESSES:**

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# UNITED STATES PATENT OFFICE.

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## TELEPHONE SYSTEM.

No. 924,714.

Specification of Letters Patent.

Patented June 15, 1909.

Application filed January 18, 1909. Serial No. 472,809.

*To all whom it may concern:*

Be it known that I, ERNEST E. YAXLEY, citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Telephone Systems, 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, and has for its object the provision of a system wherein a common or central source of direct current may be employed to advantage in imparting magnetism to the telephone receivers, so that such receivers need not have permanent magnets included in their construction, whereby objections which are familiar to those skilled in the art are avoided.

I am aware that it is old to have a common battery of a telephone exchange system supply current to coils of telephone receivers having soft iron cores, which coils do not permit of the passage of voice currents, and to provide such receivers with coils that are restricted to the reception of voice currents, these latter coils being incapable of receiving direct current from the common source. In such a system of the prior art the coils that are adapted to receive the direct or continuous current from the common source, are in the nature of impedance coils, so that the voice currents are prevented from flowing to a material extent therethrough.

In the system of my invention, the coils that receive the voice currents are particularly and especially designed also to receive direct current from the common source, so that these telephone current receiving coils may supplement the companion coils in the polarization of the receivers, due to the flow of direct current. In the system of my invention, therefore, the telephone current receiving coils are well adapted to the passage of steady currents for the purpose stated, and, in the preferred embodiment of the invention, offer less resistance to the flow of steady current than do the companion coils that, in the preferred embodiment of the invention, are adapted to permit of the passage of little or no telephonic currents, but are restricted preferably practically to the passage of direct current.

As another feature of the preferred form

of my invention, I cause both kinds of winding of each receiver to convey direct current to the transmitter in association therewith, so that the common battery not only performs the functions which have been described in connection with the receiver, but also supplies the transmitter with straight current.

As another feature of my invention, the two kinds of winding of each receiver are included in parallel relation with each other and together are included in serial relation with the common source of current and the transmitter associated with the receiver. By including the two windings of each receiver in parallel relation with each other and the two in parallel in serial relation with the common battery, the joint resistance of said winding, which is opposed to the battery current, is much less than the resistance that would be offered to such common battery current if that winding of each receiver which is to be subject to the telephone currents were not traversed by direct current from the battery.

If in the system of the prior art, the resistance of the impedance coil is sufficiently increased properly to prevent the passage of voice currents therethrough, a correspondingly increased obstruction is provided to the passage of current from the common battery, which cannot be remedied by the system of the prior art but is remedied by the system of my invention, as the parallel path which I provide about the impedance coil, and which includes the voice current receiving winding, affords passage for the direct current, so that the increased resistance in the impedance coil is compensated for and the objectionable increase in the obstruction to the path of the direct current is avoided. I am also aware that it is old to have a single receiver winding provided for the double purpose of receiving voice currents and for receiving direct currents, to enable such single winding to impart magnetism to the receiver, due to the direct current, and to enable this magnetism to be modified by the voice currents traversing this single winding, but in such a system the single winding must be of low resistance in order to afford the proper passage of direct current for polarizing the receiver magnet and for energizing the transmitter and therefore, owing to the physical limitations as to the size of the re-



ceiver, of such few turns as to make the receiver inefficient with respect to its action upon the diaphragm under the influence of the voice currents. In the systems of the prior art therefore, where but one winding per receiver is subject to direct current, the resistance of such winding has to be so low as to introduce objectionable operative features. By providing the two windings as I do, and placing them in parallel relation so that the resistance offered by each to the battery currents is counteracted, I am able to make the resistance of each such winding sufficiently high to enable it to perform its functions properly.

By making the telephone current receiving winding of lower ohmic resistance than the impedance winding, I am enabled to relieve the impedance winding of a relatively great proportion of the total direct current flowing through the line for the energization of the transmitter. By doing this I increase the impedance of the impedance winding, because, as is well known, the impedance of any coil is greater as the magnetic flux through its core is smaller. As the magnetism in a core approaches the saturation point of that core, there is a marked reduction of impedance, and it is for this reason that I allow the voice current receiving winding to carry a large proportion of the current. The telephone current receiving winding thus aids in the polarization of the core, and at the same time allows a greater effective impedance to its companion winding.

As the impedance winding and the voice current receiving winding are each wound in the same direction, the polarizing influence of the two, due to the flow of direct current through them, are cumulative, and by virtue of the fact that the voice current receiving winding is close to the diaphragm, the steady polarization of the core is effective to its extreme end, which is not the case in those receivers of the prior art in which steady current is excluded from the voice current receiving winding. In my receiver, therefore, both of the coils contribute in marked degree to the polarizing of the receiver core, and while the two coils are in shunt, the very high relative impedance of the impedance winding serves to shunt practically all of the voice currents through the voice current receiving winding, where they will exert a maximum effect on the diaphragm, but any voice currents that do pass through the impedance winding are not lost in their effect, but add their effect to the effect produced by the voice currents in the telephone current receiving winding.

I will explain my invention more fully by reference to the accompanying drawing, diagrammatically illustrating a telephone substation in connection with a cord circuit at an exchange. The telephone line illustrated

is a metallic circuit line, to which, however, I do not wish to be limited, whose sides 1 and 2 terminate respectively in tip and sleeve contacts 3 and 4 of a spring-jack or jack-switch located at an exchange. A telephone transmitter 5 is preferably serially included between the sides 1 and 2 of the telephone line, direct current being supplied to said transmitter when connection is established with the line at the exchange, as, for example, by the plug 6, the drawing showing a battery 7 between the sides of the cord circuit for supplying the transmitter with direct current, which battery is in circuit with the tip and sleeve strands of the cord 6, in accordance with well known practice. The receiver 8, instead of having a permanently magnetized core, has a soft iron core provided with an impedance winding 9, through which circuit is desirably only established when connection is established with the line at the exchange, so that said receiver is not materially magnetized when the circuit of the line is open and is sufficiently energized when the common battery 7 is in closed relation with the line, so that the magnetism thus imparted to the receiver is equivalent to and acts in place of the magnetism that is imparted to those receivers of the prior art that include permanent magnets in their construction. All of the winding 9 which is to afford impedance, is desirably disposed about the core of the receiver, though I do not wish to be limited in all embodiments of my invention to this arrangement.

The winding of the receiver that is to be responsive to incoming voice currents for the purpose of enabling the receiver to act as such, is indicated at 10 in disposition about the same core that carries the winding 9. The coil 10, however, may be closer to the diaphragm than the winding 9, the winding 10 being in multiple relation with the winding 9, both windings 9 and 10 being in serial relation with the battery and the transmitter 5. Each receiver thus has two circuits that are in parallel, one of the circuits including winding which affords impedance to the voice currents and produces magnetism which takes the place of the magnetism hitherto furnished by a permanent magnet. The circuit which includes the impedance winding 9, desirably possesses an ohmic resistance of fifty-five ohms, while the remaining receiver circuit affords an ohmic resistance of forty-five ohms, so that the latter circuit, while being adapted to permit of the passage of voice currents, preferably affords a path of lower resistance to the direct current than does the former circuit. The joint resistance afforded by the two circuits of each receiver is sufficiently low to permit of the proper passage of current from the battery 7 over the line and through the transmitter.



The switch arrangement at the sub-station may be suited to the exchange system. I have shown a telephone switch-hook 11 having an upper contact to bring the sides 5 of the line in conductively continuous relation when the receiver is removed.

I have shown at the sub-station a signal bell 12 of high impedance, bridged between the sides of the line, the bell bridge including 10 the condenser 13.

I have not indicated any signaling apparatus at the exchange, nor other apparatus at the exchange, as such illustration is not needed for the purpose of an understanding 15 of my invention and as the application of the apparatus of the system of my invention will be readily understood by those skilled in the art.

It is obvious that changes may readily be 20 made in the preferred embodiment of the invention herein shown and particularly described, without departing from the spirit of the invention, and I do not, therefore, wish to be limited to the precise features illus- 25 trated, but,

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

1. A telephone system including a tele- 30 phone line extending between a telephone station and an exchange, a source of direct current at the exchange for supplying current to the telephone line, the telephone receiver at said station including a magnetizable core 35 and having two circuits in parallel relation with each other and in serial relation with the line and both adapted to be traversed by current from said source of direct current, and each including a winding serving to mag- 40 netize the receiver core, due to the passage of the direct current, one of said windings possessing impedance to obstruct the flow of voice currents and the other of said windings being adapted to permit of the passage of 45 voice currents, the transmitter at said station being in serial relation with the circuits of the receiver taken together, and thereby being adapted to be supplied also with current emanating from the source of direct 50 current.

2. A telephone system including a tele- phone line extending between a telephone station and an exchange, a source of direct current at the exchange for supplying cur- 55 rent to the telephone line, the telephone receiver at said station having two receiver energizing circuits in parallel relation with each other and in serial relation with the line and both adapted to be traversed by direct 60 current from said source of direct current to energize the receiver, and one adapted to be traversed by voice currents while the other possesses impedance to restrict the flow of voice currents, the transmitter at said sta- 65 tion being in serial relation with the circuits

of the receiver taken together, and thereby being adapted to be supplied also with current emanating from the source of direct current.

3. A telephone system including a tele- 70 phone line extending between a telephone station and an exchange, a source of direct current at the exchange for supplying current to the telephone line, the telephone receiver at said station including a magnetiz- 75 able core and having two circuits in parallel relation with each other and in serial relation with the line and both adapted to be traversed by current from said source of direct current, and each including a winding serv- 80 ing to magnetize the receiver core, due to the passage of the direct current, one of said windings possessing impedance to obstruct the flow of voice currents and the other of said windings being adapted to permit of the 85 passage of voice currents, the transmitter at said station being in serial relation with the circuits of the receiver taken together, and thereby being adapted to be supplied also with current emanating from the source of 90 direct current, the receiver circuit which is subject to the voice currents possessing lower ohmic resistance than the companion receiver circuit.

4. A telephone system including a tele- 95 phone line extending between a telephone station and an exchange, a source of direct current at the exchange for supplying current to the telephone line, the telephone receiver at said station having two receiver 100 energizing circuits in parallel relation with each other and in serial relation with the line and both adapted to be traversed by direct current from said source of direct current to energize the receiver, and one adapted to be 105 traversed by voice currents while the other possesses impedance to restrict the flow of voice currents, the transmitter at said station being in serial relation with the circuits of the receiver taken together, and thereby 110 being adapted to be supplied also with current emanating from the source of direct current, the receiver circuit which is subject to the voice currents possessing lower ohmic resistance than the companion receiver 115 circuit.

5. A telephone system including a tele- phone line extending from a telephone sta- tion and an exchange, a source of direct cur- 120 rent at the exchange for supplying current to the telephone line, the telephone receiver at said station including a magnetizable core and having two circuits in parallel relation with each other and in serial relation with the line and both adapted to be traversed by cur- 125 rent from said source of direct current, and each including a winding serving to magnetize the receiver core, due to the passage of the direct current, one of said windings pos- 130 sessing impedance to obstruct the flow of



voice currents and the other of said windings being adapted to permit of the passage of voice currents.

6. A telephone system including a telephone line extending between a telephone station and an exchange, a source of direct current at the exchange for supplying current to the telephone line, the telephone receiver at said station having two receiver energizing circuits in parallel relation with each other and in serial relation with the line and both adapted to be traversed by direct current from said source of direct current to energize the receiver, and one adapted to be traversed by voice currents while the other possesses impedance to restrict the flow of voice currents.

7. A telephone system including a telephone line extending between a telephone station and an exchange, a source of direct current at the exchange for supplying current to the telephone line, the telephone receiver at said station including a magnetizable core and having two circuits in parallel relation with each other and in serial relation with the line and both adapted to be traversed by current from said source of direct current, and each including a winding serving to magnetize the receiver core, due to the passage of the direct current, one of said windings possessing impedance to obstruct the flow of voice currents and the other of said windings being adapted to permit of the passage of voice currents, the receiver circuit which is subject to the voice currents possessing lower ohmic resistance than the companion receiver circuit.

8. A telephone system including a telephone line extending between a telephone station and an exchange, a source of direct current at the exchange for supplying current to the telephone line, the telephone receiver at said station having two receiver energizing circuits in parallel relation with each other and in serial relation with the line and both adapted to be traversed by direct current from said source of direct current, to energize the receiver, and one adapted to be traversed by voice currents while the other possesses impedance to restrict the flow of voice currents, the receiver circuit which is subject to the voice currents possessing lower ohmic resistance than the companion receiver circuit.

9. A telephone system including a telephone line extending between a telephone station and an exchange, a source of direct current at the exchange for supplying current to the telephone line, the telephone receiver at said station including a magnetizable core and having two circuits in parallel relation with each other and in serial relation with the line and both adapted to be traversed by current from said source of direct current, and each including a winding serving to mag-

netize the receiver core, due to the passage of the direct current, one of said windings serving to permit of the passage of voice currents, the transmitter at said station being in serial relation with the circuits of the receiver taken together, and thereby being adapted to be supplied also with current emanating from the source of direct current.

10. A telephone system including a telephone line extending between a telephone station and an exchange, a source of direct current at the exchange for supplying current to the telephone line, the telephone receiver at said station having two receiver energizing circuits in parallel relation with each other and in serial relation with the line and both adapted to be traversed by direct current from said source of direct current, to energize the receiver, one of said windings serving to permit of the passage of voice currents, the transmitter at said station being in serial relation with the circuits of the receiver taken together, and thereby being adapted to be supplied also with current emanating from the source of direct current.

11. A telephone system including a telephone line extending between a telephone station and an exchange, a source of direct current at the exchange for supplying current to the telephone line, the telephone receiver at said station including a magnetizable core and having two circuits in parallel relation with each other and in serial relation with the line and both adapted to be traversed by current from said source of direct current, and each including a winding serving to magnetize the receiver core, due to the passage of the direct current, one of said windings serving to permit of the passage of voice currents, the transmitter at said station being in serial relation with the circuits of the receiver taken together, and thereby being adapted to be supplied also with current emanating from the source of direct current, the receiver circuit which is subject to the voice currents possessing lower ohmic resistance than the companion receiver circuit.

12. A telephone system including a telephone line extending between a telephone station and an exchange, a source of direct current at the exchange for supplying current to the telephone line, the telephone receiver at said station having two receiver energizing circuits in parallel relation with each other and in serial relation with the line and both adapted to be traversed by direct current from said source of direct current, to energize the receiver, one of said windings serving to permit of the passage of voice currents, the transmitter at said station being in serial relation with the circuits of the receiver taken together, and thereby being adapted to be supplied also with current emanating from the source of direct current, the re-



ceiver circuit which is subject to the voice currents possessing lower ohmic resistance than the companion receiver circuit.

13. A telephone system including a telephone line extending between a telephone station and an exchange, a source of direct current at the exchange for supplying current to the telephone line, the telephone receiver at said station including a magnetizable core and having two circuits in parallel relation with each other and in serial relation with the line and both adapted to be traversed by current from said source of direct current, and each including a winding serving to magnetize the receiver core, due to the passage of the direct current, one of said windings serving to permit of the passage of voice currents.

14. A telephone system including a telephone line extending between a telephone station and an exchange, a source of direct current at the exchange for supplying current to the telephone line, the telephone receiver at said station having two receiver energizing circuits in parallel relation with each other and in serial relation with the line and both adapted to be traversed by direct current from said source of direct current, to energize the receiver, one of said windings serving to permit of the passage of voice currents.

15. A telephone system including a telephone line extending between a telephone station and an exchange, a source of direct current at the exchange for supplying current to the telephone line, the telephone receiver at said station including a magnetiz-

able core and having two circuits in parallel relation with each other and in serial relation with the line and both adapted to be traversed by current from said source of direct current, and each including a winding serving to magnetize the receiver core, due to the passage of the direct current, one of said windings serving to permit of the passage of voice currents, the receiver circuit which is subject to the voice currents possessing lower ohmic resistance than the companion receiver circuit.

16. A telephone system including a telephone line extending between a telephone station and an exchange, a source of direct current at the exchange for supplying current to the telephone line, the telephone receiver at said station having two receiver energizing circuits in parallel relation with each other and in serial relation with the line and both adapted to be traversed by direct current from said source of direct current, to energize the receiver, one of said windings serving to permit of the passage of voice currents, the receiver circuit which is subject to the voice currents possessing lower ohmic resistance than the companion receiver circuit.

In witness whereof, I hereunto subscribe my name this sixteenth day of January A. D. 1909.

ERNEST E. YAXLEY.

Witnesses:

L. G. STROH,

G. L. CRAGG.

## DISCLAIMER.

924,714.— *Ernest E. Varley*, Chicago, Ill. TELEPHONE SYSTEM. Patent dated June 15, 1909. Disclaimer filed January 3, 1913, by the assignee, *Monarch Telephone Manufacturing Company*.

Enters his disclaimer—

“To that part of the claim in said specification which is in the following words, to wit:

“9. A telephone system including a telephone line extending between a telephone station and an exchange, a source of direct current at the exchange for supplying current to the telephone line, the telephone receiver at said station including a magnetizable core and having two circuits in parallel relation with each other and in serial relation with the line and both adapted to be traversed by current from said source of direct current, and each including a winding serving to magnetize the receiver core, due to the passage of the direct current, one of said windings serving to permit of the passage of voice currents, the transmitter at said station being in serial relation with the circuits of the receiver taken together, and thereby being adapted to be supplied also with current emanating from the source of direct current.

“10. A telephone system including a telephone line extending between a telephone station and an exchange, a source of direct current at the exchange for supplying current to the telephone line, the telephone receiver at said station having two receiver energizing circuits in parallel relation with each other and in serial relation with the line and both adapted to be traversed by direct current from said source of direct current, to energize the receiver, one of said windings serving to permit of the passage of voice currents, the transmitter at said station being in serial relation with the circuits of the receiver taken together, and thereby being adapted to be supplied also with current emanating from the source of direct current.

“13. A telephone system including a telephone line extending between a telephone station and an exchange, a source of direct current at the exchange for supplying current to the telephone line, the telephone receiver at said station including a magnetizable core and having two circuits in parallel relation with each other and in serial relation with the line and both adapted to be traversed by current from said source of direct current, and each including a winding serving to magnetize the receiver core, due to the passage of the direct current, one of said windings serving to permit of the passage of voice currents.

“14. A telephone system including a telephone line extending between a telephone station and an exchange, a source of direct current at the exchange for supplying current to the telephone line, the telephone receiver at said station having two receiver energizing circuits in parallel relation with each other and in serial relation with the line and both adapted to be traversed by direct current from said source of direct current, to energize the receiver, one of said windings serving to permit of the passage of voice currents.”

[*Official Gazette*, January 14, 1913.]