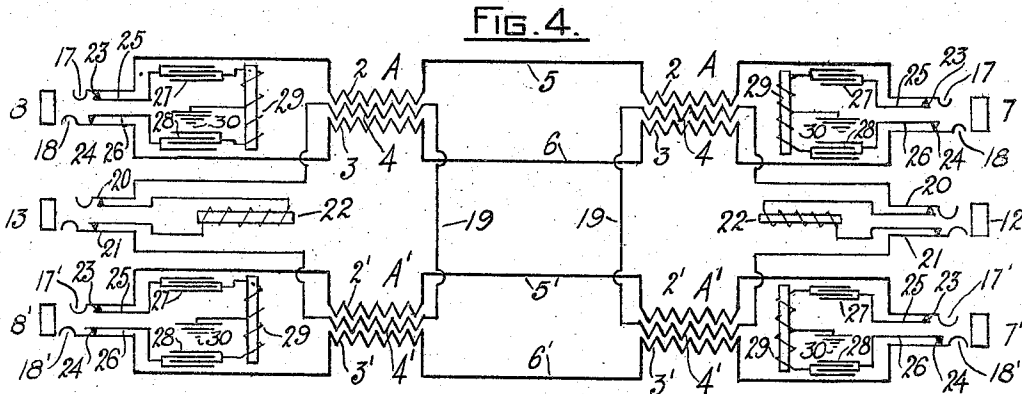
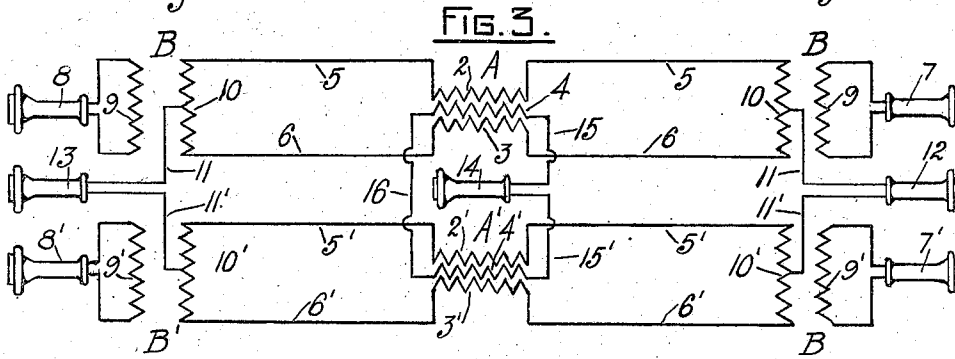
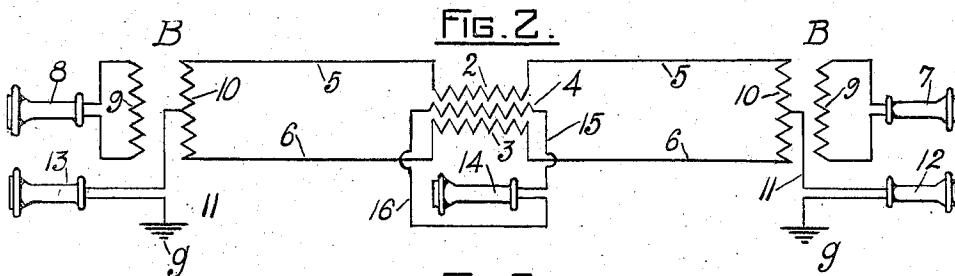
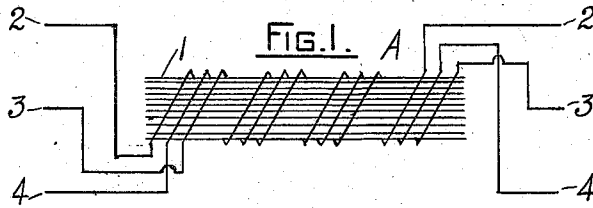


H. B. STONE.  
 PHANTOM ELECTRIC CIRCUIT.  
 APPLICATION FILED NOV. 26, 1907.

911,774.

Patented Feb. 9, 1909.



WITNESSES:

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# UNITED STATES PATENT OFFICE.

HENRY B. STONE, OF PROVIDENCE, RHODE ISLAND.

## PHANTOM ELECTRIC CIRCUIT.

No. 911,774.

Specification of Letters Patent.

Patented Feb. 9, 1909.

Application filed November 26, 1907. Serial No. 403,899.

*To all whom it may concern:*

Be it known that I, HENRY B. STONE, of Providence, in the county of Providence and State of Rhode Island, have invented certain new and useful Improvements in Phantom Electric Circuits; and I do hereby declare the following specification, taken in connection with the accompanying drawings, forming a part of the same, to be a full, clear, and exact description thereof.

The invention relates to an improved system of phantoming electric circuits and is particularly designed for use in telephone systems.

Heretofore the use of phantom circuits in telephone systems has been limited by reason of the fact that said phantom circuits have been introduced by bridging a repeating coil across the main metallic circuit, which method of phantoming affects the efficiency of the main circuits and prevents the use of said main circuits for direct signaling or for telegraphic purposes.

It is the object of the present invention to obviate these objections to old methods of phantoming electric circuits and to produce a new and efficient system which will not affect the efficiency of the main circuits and will not interfere with the sending of direct currents over each of the metallic conductors comprising said main circuits.

To this end my invention consists in the novel combination of circuits hereinafter described and claimed, reference being had to the accompanying drawings in which—

Figure 1 is a diagrammatic view of my repeating coil. Fig. 2 is a diagrammatic view of a single metallic telephone circuit, a grounded phantom circuit and a way station circuit introduced by my novel method. Fig. 3 is a diagrammatic view of two metallic telephone circuits, a metallic phantom circuit and a way station circuit introduced by my method. Fig. 4 is a diagrammatic view of two metallic telephone circuits and a metallic phantom circuit introduced by my novel method between said telephone circuits.

Referring to the drawings, Fig. 1 shows a repeating coil A of peculiar construction consisting of an iron core 1 and three separate insulated windings 2, 3 and 4. Two of these windings 2 and 3 respectively may be called the secondary windings and the winding 4 the primary winding. The two secondary windings 2 and 3 should be alike in resistance

and number of turns and symmetrically arranged around the core 1 in such a manner that the magnetic effect of a current flowing in one direction over the winding 2 would be neutralized by an equal current flowing in the opposite direction over the winding 3. The primary winding 4 may be the same as the secondary windings 2 and 3 in resistance and the number of turns or may differ from said secondary windings in these respects as desired. The different windings are preferably led to convenient binding posts and the whole mounted upon a suitable base, not shown.

Fig. 2 shows a main metallic telephone circuit composed of the two conductors 5 and 6 connecting two telephone stations 7 and 8. The wiring at the various stations is not shown in detail, as the same is well known and is not necessary for an understanding of the system herein described. Inserted in the main circuit adjacent each of the stations 7 and 8 is a repeating coil B consisting of two windings 9 and 10. The winding 9, for convenience called the primary winding, is connected at one end to the conductor 5 and at the other end to the conductor 6, and thus forms a bridge across that part of the main circuit which leads to the nearby station. The winding 10, for convenience called the secondary winding, is likewise connected at one end to the conductor 5 and at the other end to the conductor 6 and thus forms a bridge across that part of the main circuit leading to the distant station. Leading from the middle point of each of the secondary windings 10 is a conductor 11 which leads to the stations 12 and 13 and then to the ground *g*, thereby forming an old and well-known form of phantom circuit. With this system of phantoming it will be seen that the main circuit is separated or divided at each repeating coil into two parts insulated from each other, and hence direct currents cannot be transmitted from one of these parts to the other.

I will now describe my improved method of introducing an extra or phantom circuit by the use of the repeating coil A, and in Fig. 2 I have shown said phantom circuit introduced at a way station 14. At any desired part of the main circuit the repeating coil A is introduced in series by connecting one end of the secondary winding 2 with one part of the conductor 5 and the other

end of said winding 2 to the other part of said conductor 5. The secondary winding 3 is similarly connected in series with the conductor 6, as shown. The primary winding 4 is connected at one end to a wire 15 and at the other end to a wire 16, which wires form the way station circuit.

With the above described form of repeating coil and the manner of connecting the same in the main circuit and to the way station, it will be seen that alternating or voice currents from station 14 passing through the primary winding 4 produce currents in the secondary windings 2 and 3 and hence in the two conductors 5 and 6, which currents are alike in direction and intensity. Such currents will not be transformed by the repeating coils B, but will pass through the secondary winding 10 to the middle point, where the two currents will join and pass through the wire 11 to station 12, and thence to ground *g*. Said current would then pass through the ground to station 13 at the other end of the main circuit over wire 11, secondary winding 10 at said end and conductors 5 and 6 back to secondary windings 2 and 3, thus completing the circuit.

Fig. 3 shows a way station introduced by my improved method into a phantom circuit where both sides of said phantom circuit are metallic circuits. In this system the second main or trunk-circuit extending between the stations 7' and 8' is the exact duplicate of the other main circuit extending from station 7 to station 8, as shown in Fig. 2, and the primaries of the repeating coils A and A' are connected to the way station 14 so that said way station may communicate with stations 12 or 13. When such communication is carried on the voice currents will pass through the primaries 4 and 4' and induce currents in the secondaries 2 and 3 of repeating coil A in one direction and in the secondaries 2' and 3' of repeating coil A' in the opposite direction. It will thus be seen that an alternating current will pass over the phantom circuit between stations 12 and 13.

In Fig. 4 I have shown my system of phantoming as applied to trunk lines in which the common battery system is employed for signaling purposes. There are shown two metallic main circuits, one formed by the conductors 5 and 6 extending from stations 7 to 8, and the other formed by the conductors 5' and 6' extending from stations 7' to 8'. Two repeating coils A are connected in series into the main circuit leading from stations 7 to 8, one at or adjacent each of said stations, and two repeating coils A' are similarly connected into the main circuit leading from stations 7' to 8'. The conductors 5 and 6 terminate, respectively, in the short and long line-springs 17 and 18 of a line spring-jack, and the con-

ductors 5' and 6' terminate, respectively, in the short and long line-spring 17' and 18'. The primaries 4 and 4' of the repeating coils A and A', respectively, are connected together on one side by the wire 19 and the other ends of said primaries terminate, respectively in the short and long line-springs 20 and 21 at each of the stations 12 and 13. A line-relay 22 constituting a line indicator magnet is normally included in circuit with the line springs 20 and 21 and the phantom-circuit for signaling purposes.

It is necessary that the main circuits be continued through suitable balancing apparatus to a common connection or ground, and the operator's cord-circuit generally supplies this connection, but when the cord-circuit is disconnected means should be provided for automatically connecting the line to apparatus having practically the same electrical properties as the cord-circuit. Such means are shown at each station on the main circuits, and comprise the contacts 23 and 24, wires 25 and 26, condensers 27 and 28, inductive resistance coil 29 and ground 30.

By means of this apparatus it will be seen that the insertion of the plug attached to the cord-circuit between the line springs 17 and 18 will throw said springs out of engagement with the contacts 23 and 24 and thereby disconnect the balancing apparatus from the main circuit, and that the withdrawal of said plugs will automatically connect said balancing apparatus into said telephone circuit.

The operation of this system is as follows: Voice or alternating currents at station 12 will pass through the primary winding 4 of repeating coil A, over wire 19, through the primary winding 4' of repeating coil A' in the opposite direction from the direction of said current in coil A, and back to station 12. If now the current is starting from right to left through the primary winding 4 of coil A it will induce a current flowing from left to right in the secondary windings 2 and 3 of said coil, and said current will pass through the cord-circuit or the balancing apparatus at station 7 to the ground, through the ground to the cord-circuit or balancing apparatus at station 8, and through the secondary windings 2 and 3 of the second coil A from left to right to the main conductors 5 and 6 and back to the place of starting. As the current passes through the secondaries 2 and 3 of the second coil A at the left in Fig. 4, a current will be included in the primary 4 in said coil flowing from right to left, which current will pass through the station 13, primary winding 4' and wire 19, thus completing the phantom circuit. In like manner the current which flows from right to left in the primary winding 4' of coil A', at the right in Fig. 4, will induce currents flowing from left to right in the secondary windings 2' and 3' in said coil, which cur-

rents will flow over the main conductors 5' and 6', through the secondaries 2' and 3' of coil *a'* at the left in Fig. 4, through the cord-circuit or balancing apparatus at station 8' to the ground and back to station 7' and to the place of beginning. Thus it will be seen that alternating or voice currents may be sent over the phantom circuit between stations 12 and 13, and that the main conductors 5 and 6 and 5' and 6' can be used for direct signaling or for telegraphic purposes as desired.

What I claim as my invention and desire to secure by Letters Patent is:

15 1. The combination, with the two conductors of a telephone circuit, of a repeating coil interposed between two parts of said circuit, said repeating coil containing three separate windings, two of which windings  
20 are electrically balanced and connected in series with the two conductors of said telephone circuit in such a manner that variable or alternating currents in the third winding will induce currents in the two balanced windings and in the two conductors of the tele-  
25 phone circuit which are alike in direction and intensity.

2. The combination, with the two conductors of a telephone circuit, of a repeating  
30 coil interposed between two parts of said circuit, said repeating coil containing three separate windings, two of which windings are electrically balanced and connected in series with the two conductors of said telephone  
35 circuit, both of said windings being connected on one side of the coil to the conductors on the corresponding side of said coil and on the other side of the coil to the conductors on that side of said coil, and the third winding  
40 connected in to a phantom circuit.

3. The combination, with two metallic tele-  
45 phone circuits, of two repeating coils, each of said coils being interposed between two parts of each of said telephone circuits and contain-  
ing two secondary windings electrically bal-

anced and connected in series with the two sides of each of said telephone circuits, and a primary winding in both repeating coils connected together and into a phantom circuit.

4. The combination, with two metallic  
50 telephone circuits, of a phantom circuit introduced between said metallic telephone circuits by means of a series of repeating coils interposed in series into said telephone  
55 circuits, and means for extending said telephone circuits to a connection common to both metallic circuits.

5. The combination, with two telephone  
60 circuits, of a phantom circuit introduced between said telephone circuits by means of a series of repeating coils interposed in series into said telephone circuits, and a balancing apparatus in each of said telephone circuits.

6. The combination, with two telephone  
65 circuits, of a phantom circuit introduced between said telephone circuits by means of a series of repeating coils interposed in series into said telephone circuits, and a balancing apparatus adapted to be automatically connected into or disconnected from said tele-  
70 phone circuits.

7. The combination, with two metallic  
75 telephone circuits, of a phantom telephone circuit comprising a series of repeating coils interposed in series in both of said metallic telephone circuits, and a balancing apparatus at both ends of each of said metallic cir-  
80 cuits, said balancing apparatus comprising two condensers, means for connecting one of said condensers into one side of the metallic telephone circuit and the other condenser into the other side of said circuit, an induction coil having connections to each of said condensers, and a connection from said induction coil to the ground

HENRY B. STONE.

Witnesses:

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