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H. E. SHREEVE.

TELEPHONE REPEATER CIRCUIT AND APPARATUS.

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Fig. 1.

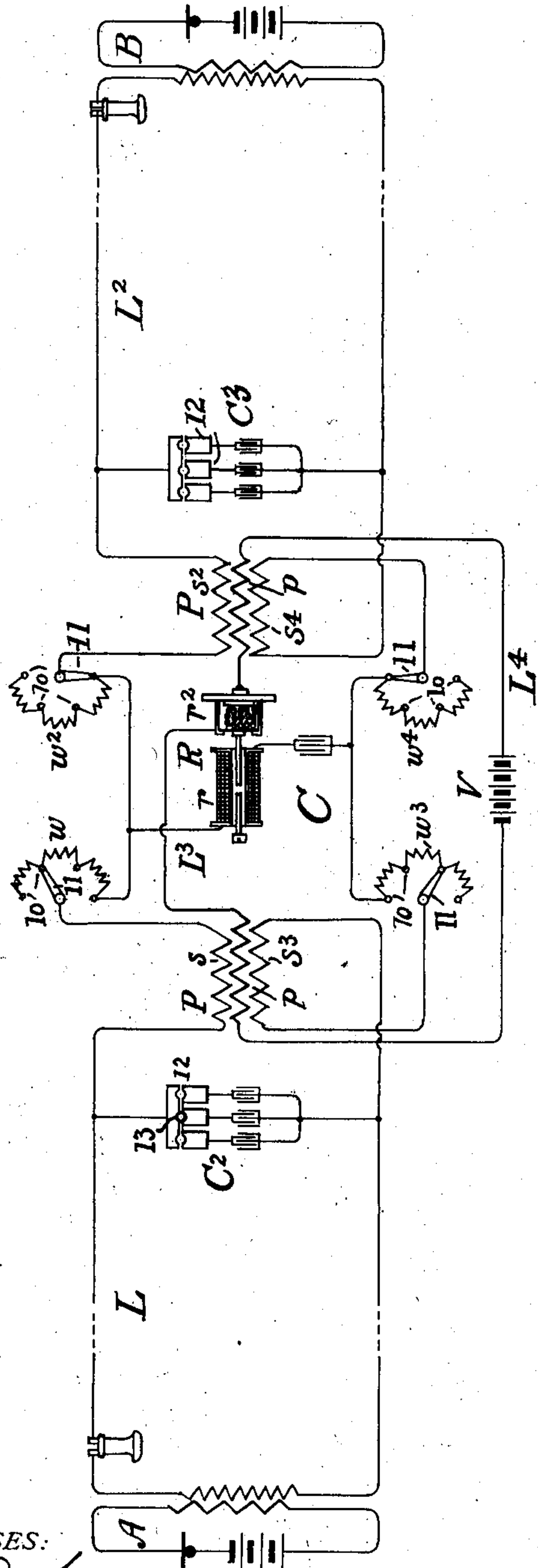
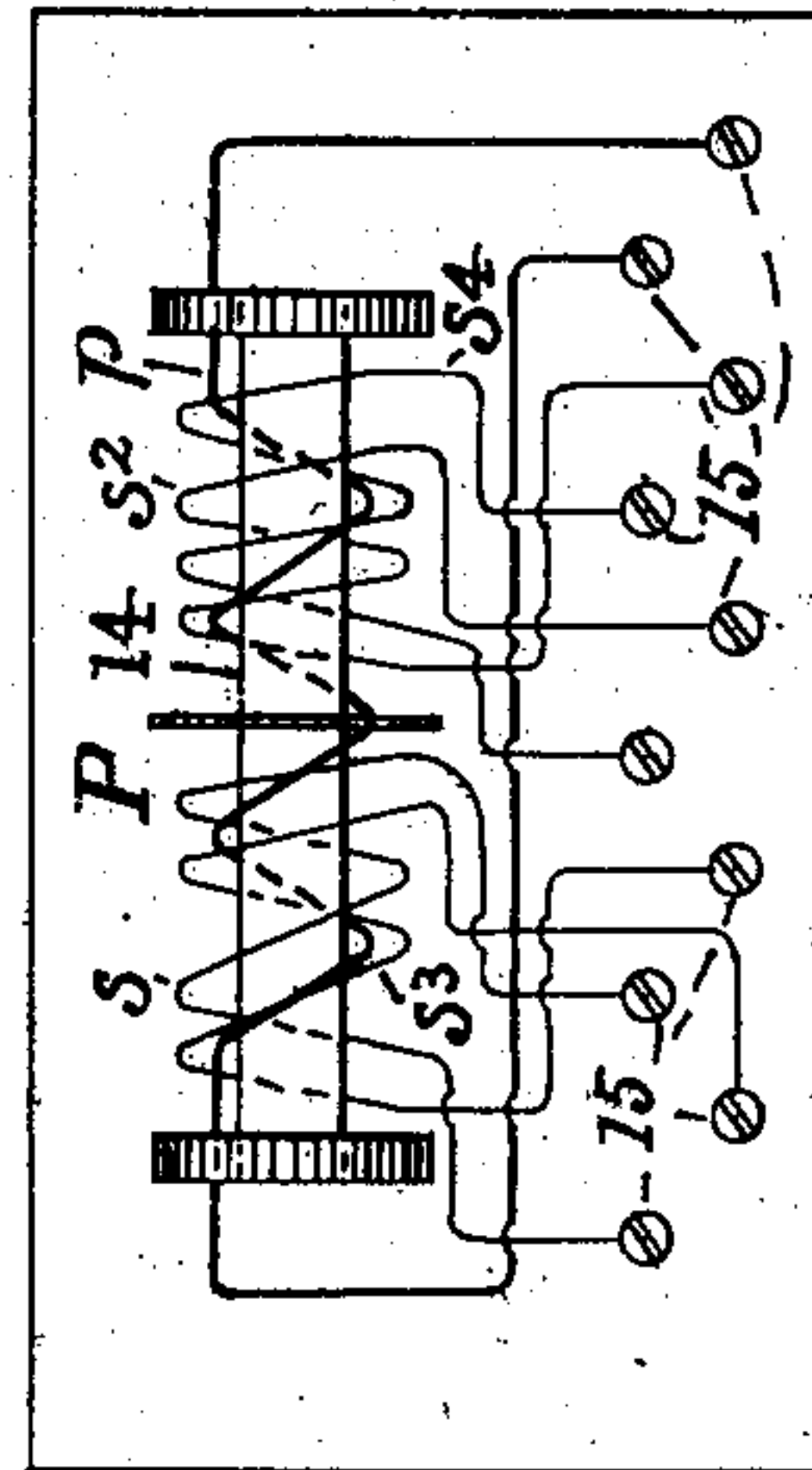


Fig. 2.



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TELEPHONE REPEATER CIRCUIT AND APPARATUS.

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To all whom it may concern:

Be it known that I, HERBERT E. SHREEVE, residing at Newton, in the county of Middlesex and State of Massachusetts, have invented certain Improvements in Telephone Repeater Circuits and Apparatus, of which the following is a specification.

This invention relates to systems for the reinforcement or renewal of currents employed in telephonic transmission, and more especially to means for balancing the circuits.

In systems in which a relay or repeater circuit is arranged similarly to a Wheatstone bridge—such, for example, as that described in my Patent No. 791,656, dated June 6, 1905—it is important that the electrical conditions in the main line upon opposite sides of said relay-circuit shall be substantially the same. If the impedance of the sections of the main-line circuit or independent lines constituting such a circuit is materially different, induced currents may flow in the bridge connection and produce a "singing" in the relay. Moreover, the difference in impedance tends to alter the phase of the currents in the main-line sections, interfering with transmission.

The principal object of my invention is to provide means for so balancing lines of different character and dimensions that these difficulties may be overcome.

The invention consists, more essentially, in the inclusion in a main-line telephone-circuit and associated with a bridged relay of means for altering the electrical conditions or properties by adjusting either the resistance or capacity of said circuit, the arrangement being such that these agencies will most effectively perform their functions.

In the accompanying drawings, in which like characters designate like parts throughout both views, Figure 1 shows diagrammatically one embodiment of my improved system, and Fig. 2 is a top plan view in diagram of a form of induction-coil used in said system in practice.

I have in the present instance illustrated a metallic telephonic main-line circuit extending between stations A and B and having an intermediate station C. This station C divides the line into sections L and L², which, as is commonly the case in practice, are un-

balanced, the impedance of the section L being considered the lower. At the station C is a current-reinforcing message-repeating or relay apparatus R, having its receiving element r situated in a bridge connection L³, extending between opposite sides of the main line. The transmitting element r^2 of said apparatus is included in a local circuit L⁴, containing the primary winding p of a transmitting induction-coil P and a battery or like source of electrical energy V. The secondary winding of the coil P is electrically divided into four sections s , s^2 , s^3 , and s^4 , these sections being connected in pairs upon opposite sides of the bridge and in such a manner that they do not themselves disturb the balance of the line and so that the currents induced in them will not oppose one another in the main circuit or circuits. This organization is similar to that described in the previously-mentioned patent. The repeating induction-coil there illustrated has, however, been omitted, though it may be used, if desired, in connection with the present invention.

Included in each side of the main-line circuit is an adjustable resistance, this being preferably in four sections w , w^2 , w^3 , and w^4 , situated between the secondary windings s , s^2 , s^3 , and s^4 , respectively, of the induction-coil P and the complementary end of the bridge connection. Each of these resistances preferably includes separated coils connected to contacts 10, over which is movable a lever 11, thus enabling a greater or less amount of resistance to be inserted in the line.

Bridged between the conductors of the main circuits or circuit-sections L and L² are condensers C² and C³, respectively, of variable capacity, each in parallel or shunt relation to the two sections of the associated induction-coil secondary winding, each condenser being arranged in sections connected to circuit-changing plates 12, which may be joined by plugs 13 to alter the capacity. These condensers may be effectively placed at the opposite sides of the associated pairs of secondary windings from the relay. As shown, these condensers are bridged across the main circuit or circuit-sections independently of both the relay apparatus at sta-

tion C and the telephone apparatus at stations A and B.

In balancing the lines or line-sections similar electrical conditions are attained by varying, through either addition or subtraction, the resistance and capacity of either or both of said lines or line-sections until the most effective transmission in both directions is attained. To secure this result in the particular system illustrated, a suitable amount of resistance is thrown in by moving the levers of the resistances w w^3 and capacity introduced by the application of one or more plugs to the circuit-changer controlling the condenser C. This latter operation also permits the equalizing of the phase in the sections. If necessary, these adjustments may be readily altered to meet varying electrical properties or conditions of the line. It should be noticed that the placing of the resistances and condensers at the points shown allows the balance of all portions of the main-line circuit with which is associated a reinforcing system of the character described without the introduction of disturbing conditions by these agencies.

While this invention has been described in connection with a continuous circuit having sections, it will be obvious that it is equally applicable to independent circuits organized and adapted to repeat into one another reciprocally.

The relay apparatus operates in a manner well known and need not be particularly referred to.

Though the induction-coil P for the sake of clearness is shown diagrammatically in Fig. 1 as being in two independent portions, it will be evident that the windings may be about a single core 14, as has been illustrated in Fig. 2, these windings leading to terminals 15, to which the circuits are connected. An arrangement of this sort is the one usual in practice.

Having thus described my invention, I claim—

1. In a system for the reinforcement or renewal of telephone-currents, the combination with telephonic current-transmitting circuits or circuit-sections, of a transmitting induction-coil situated at the juncture of the sections, a relay or reinforcing apparatus associated with the induction-coil, and means independent of the induction-coil for adjusting the relative resistance and capacity of the circuits or circuit-sections.

2. A system for the reinforcement or renewal of telephone-currents comprising transmitting-circuit sections, an induction-coil situated at the juncture of the circuit-sections, a reinforcing apparatus associated with the induction-coil, and means for varying the electrical properties of the circuit-sections, the said means for each circuit-section being

connected with the said circuit-section to which it belongs, at one side only of the induction-coil and reinforcing apparatus.

3. In a system for the reinforcement or renewal of telephone-currents, the combination with a circuit comprising sections offering different impedance, of an induction-coil having windings situated at each side of the circuit, a relay apparatus bridged across the circuit between the induction-coil windings, and a resistance included in the circuit between an induction-coil winding and the relay apparatus and serving to balance the impedance of the circuit-sections, substantially as described.

4. In a system for the reinforcement or renewal of telephone-currents, the combination with a circuit comprising main circuits or circuit-sections, of a relay apparatus bridged across the circuit at the juncture of the said circuits or circuit-sections, and an adjustable resistance included in each side of the circuit and in series therewith upon opposite sides of the bridge.

5. The combination with the telephone-circuit, of an induction-coil having electrically-divided windings situated in each side of the circuit, a bridge connection across the circuit from points between the divisions of the induction-coil windings, a relay apparatus in the bridge connection, and an adjustable resistance included in the circuit between an induction-coil winding and the bridge connection.

6. The combination with the telephone-circuit, of an induction-coil, having electrically-divided windings situated in each side of the circuit, a bridge connection across the circuit from points between the divisions of the induction-coil windings, a relay apparatus in the bridge connection, and an adjustable resistance included in the circuit between each division of the induction-coil winding and the bridge connection.

7. In a system for the reinforcement or renewal of telephone-currents, the combination with a circuit comprising telephonic current-transmitting sections of different capacity, of a relay apparatus associated with the circuit, and means connected with the circuit for balancing the capacity of its said sections.

8. In a system for the reinforcement or renewal of telephone-currents, the combination with a circuit, of a bridge connection across the circuit, a relay apparatus in the bridge connection, and a condenser of adjustable capacity bridged across the circuit independently of the relay apparatus and of the telephone apparatus.

9. The combination with the telephone-circuit, of an induction-coil, having electrically-divided windings situated in each side of the circuit, a bridge connection across the

circuit from points between the divisions of the induction-coil windings, a relay apparatus in the bridge connection, and capacity-varying means bridged across the circuit at each side of the bridge connection.

10. In a system for the reinforcement or renewal of telephone-currents, the combination with a circuit, of a bridge connection across the circuit, a relay apparatus in the bridge connection, an adjustable resistance in the circuit at each side of the bridge connection, and capacity-varying means shunted across the circuit, substantially as set forth.

11. The combination with the telephone circuit, of an induction-coil having electrically-divided windings situated in each side of the circuit, a bridge connection across the circuit from points between the divisions of the induction-coil windings, a relay apparatus in the bridge connection, an adjustable resistance included in the circuit between an induction-coil winding and the bridge con-

nection, and a condenser bridged across the circuit independently of the relay apparatus.

12. The combination with a metallic telephone-circuit, of an induction-coil having a divided secondary winding, there being a plurality of divisions at each side of the circuit, a relay apparatus connected with the opposite sides of the circuit between the divisions of the secondary winding, an adjustable resistance joined in series with the circuit between the relay apparatus and each of said divisions, and a condenser of adjustable capacity bridged across the circuit at each side of the relay apparatus.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 22d day of January, 1906.

HERBERT E. SHREEVE.

Witnesses:

GEO. WILLIS PIERCE,
JOSEPH A. GATELY.