R. C. BROWNE.

CURRENT REINFORCING MEANS.

APPLICATION FILED MAY 25, 1907.

960,495.

Patented June 7, 1910.

Fig. 1.

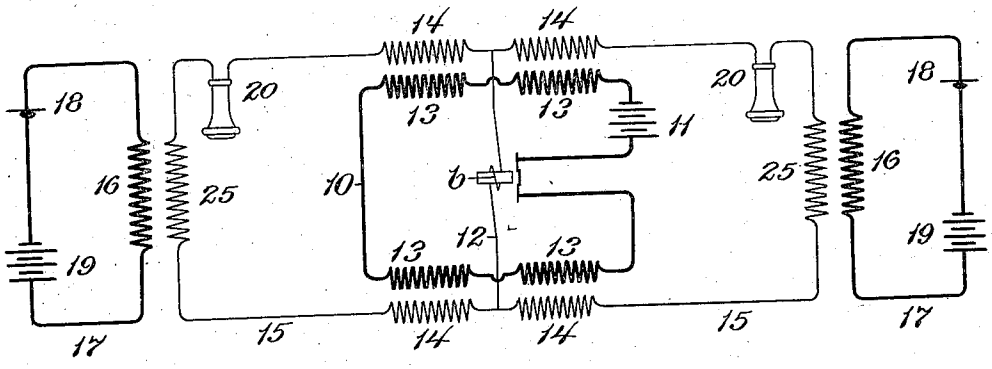


Fig. 2.

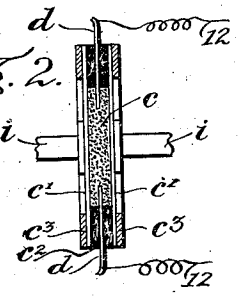
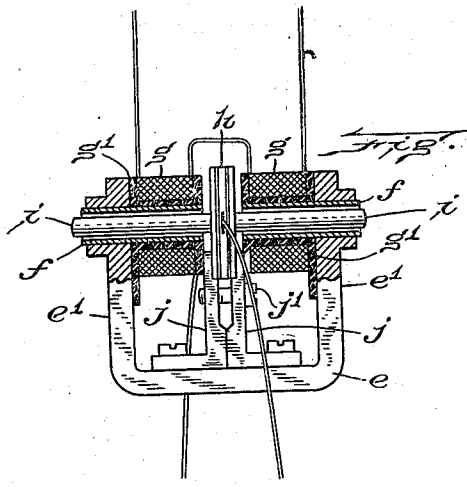


Fig. 3.



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UNITED STATES PATENT OFFICE.

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CURRENT-REINFORCING MEANS.

960,495. Specification of Letters Patent. Patented June 7, 1910.

Application filed May 25, 1907. Serial No. 375,573.

To all whom it may concern:

Be it known that I, RALPH C. BROWNE, of Salem, in the county of Essex and State of Massachusetts, have invented certain new and useful Improvements in Current-Reinforcing Means, of which the following is a specification.

This invention relates to means for reinforcing or renewing varying currents such as are employed for telephonic transmission, and more particularly to those instruments employing a variable receiving magnet and a variable resistance medium arranged in operative relation thereto, so as to be acted upon thereby for automatically augmenting the energy in the varying current circuit, by adding thereto and in synchronism therewith, additional energy derived from a battery or other electrical generator. In telephony practical results have been secured in instruments of this character by causing the current, to be reinforced in the telephone circuit, to act upon a diaphragm through the agency of the variable receiving magnet, which diaphragm is connected to an electrode between which and a second fixed electrode is placed the variable resistance medium. Said electrodes and said resistance medium are arranged in series in a local battery circuit, so that when the diaphragm is vibrated, it causes fluctuations in the local or battery circuit in synchronism with the fluctuations of the current in the telephone circuit. In instruments such as described, the diaphragm is made of magnetic material which is fairly rigid and heavy, and its inertia must be overcome by the magnetic field induced by the telephone current acting on the variable receiving magnet before the diaphragm is vibrated. The electrode which is affixed to the diaphragm to move therewith, adds to the weight which must be moved by the magnet, and if, as in most cases, it is made of polished carbon or like material, it is apt to become roughened and less effective. Telephone currents are feeble at best, and they grow weaker with the length of the telephone line in consequence of the increased resistance thereof and of leakages and other losses. On account of the feebleness of the current in a telephone circuit, the diaphragm and the electrode connected thereto, have a very slight movement, and the two electrodes therefore must be brought very close together so that the pressure on the resistance medium may effect even a small part of the dead resistance between them. The closer the electrodes are brought together, the lower the resistance of the intervening medium, and the possible range of the instrument is correspondingly limited. The close adjacency of the electrodes greatly limits the amount of battery power that may be employed without such harmful results as burning or heating etc., and moreover, the closer the electrodes are brought together, the greater is the danger of the resistance medium packing.

The object of this invention is to improve such current reinforcing or renewing means by increasing their sensitiveness and their range of action, and by enhancing their efficiency, and durability. This is accomplished by employing in conjunction with a variable magnet arranged in the telephone circuit or sequence of circuits, an armature or movable pole piece operating upon a thin resistance medium through which the current flows between electrodes so placed that the path of the current is substantially at right angles to the lines of pressure of the armature or movable pole piece upon the resistance medium. The two electrodes are stationary and neither of them is carried by the movable pole piece or armature, nor vibrated by the action thereof. The resistance medium, which is preferably carbon in a comminuted form, is arranged in a thin layer between insulated retaining walls, of which one or both may be made of light flexible material, such as mica or other suitable substance. Thus I dispense with the employment of a magnetic diaphragm and the necessity of overcoming its inertia. By arranging the resistance medium in a thin layer, as described, and employing stationary electrodes, I secure the greatest possible sensitiveness in the resistance medium, and am able to increase or decrease the resistance to any desired extent. The thinness of the layer is such that a slight or delicate movement of the armature or movable pole piece compresses the resistance medium sufficiently to vary its resistance from maximum to minimum, and thereby cause a large amount of energy to be thrown upon the line of the battery circuit for reinforcing the current in the telephone circuit.

On the accompanying drawings,—Figure

1 represents diagrammatically the electric connections of the reinforcing instrument, associated with a telephone circuit at an intermediate point thereof. Fig. 2 represents a magnified section through the receptacle containing the variable resistance medium. Fig. 3 represents a magnified vertical section of another form of instrument embodying the invention.

The electrodes and the variable resistance medium to be hereinafter described are designed to be connected in a main circuit 10, as illustrated conventionally in Fig. 1, said main circuit including a battery or source of power as at 11. The magnetization-varying coil b is arranged to be connected with another main circuit section 12. In the circuit 10 may be included the primary windings 13 13 of induction coils, the secondary windings 14 14 of which are included in the main telephone circuit 15. As illustrated, the apparatus is shown as being placed in the middle of the circuit 15, the section 12 bridging across the circuit and having its ends terminating between each pair of coils 14 14 on each side of said main circuit 15. At each end of the telephone circuit is shown a secondary winding 25 in inductive relation to a primary winding 16, located in a section 17 of the main telephone circuit. Said section 17 includes a transmitter 18 and a battery or source of power 19. In this figure the bridge or section which includes the coil b is in position to be operated from either end of the telephone circuit or said sections 17, 17, there being in the section 15 at each end, a receiver 20.

The telephone currents passing through the coil b cause a variation in the field of the variable magnet so that the pole pieces a' a^2 are attracted in accordance with such variation, to effect a similar variation in the compression of the resistance medium. Consequently telephonic currents synchronous with those in the main circuit 15, are set up in the circuit 10, and by reason of the coils 13, 13 in inductive relation to the coils 14, 14, the telephonic currents in the main telephonic circuit are renewed or reinforced in a manner now well understood.

In Figs. 2 and 3 I have illustrated an embodiment of the invention in which I employ a magnet e of the horse-shoe type. This has the parallel arms e' e' which are apertured to receive the inwardly extending pole pieces f which are formed of tubular magnetic material, such as soft iron. Upon these pole pieces are supported the spools g' of two magnetization-varying coils g g whose axes are in alinement. These two coils may be placed in series in the main telephonic circuit or in one of the sections thereof, as for instance in the bridge 12. Between the adjacent ends of the coils is placed a receptacle h of substantially the construction shown in Fig. 2. Said receptacle contains a thin layer c of a suitable resistance medium such as granular carbon, with separate stationary electrodes d d arranged in a line transverse to the axes of the coils. The layer is preferably about one-tenth of an inch in thickness, and the retaining walls c' c' are preferably thin (say .001 of an inch in thickness) and have smooth surfaces. I find that mica is an excellent material for these walls. Said walls are spaced apart by an intervening frame c^2 of insulating material to which they are clamped by outer frames c^3 c^3, and the frames or walls constitute a chamber or receptacle for the resistance of the medium. The electrodes may consist of stampings of this metal foil (preferably platinum) which are pointed at their ends, and they are supported by the frame c^2 so as to centralize or focus the flow of current through the variable resistance medium in lines transverse to the axes or median lines of the pole pieces i i. The receptacle is mounted upon a support attached to a neutral point of the magnet e, said support comprising the two members j j clamped together by a screw j' to receive and rigidly support said receptacle. Attached to the outer faces of the two flexible retaining walls of the receptacle, are two movable pole pieces i i arranged with their axes in alinement with the axes of the pole pieces f f, but out of contact therewith as shown. The movable pole pieces i i are formed of light tubing having solid bosses or inner ends and have but little inertia. The movable pole pieces are attached in any suitable manner to the retaining walls, but I find that with advantage they may be cemented to a facing of fine or delicate silk fabric which is in turn cemented to said walls. By reason of magnetic induction, the pole pieces i i become magnetized more or less, according to the strength of the magnet e, and thereby attract each other with a certain force to cause the variable resistance medium to be compressed more or less. When the telephonic current passes through the coils g g, the magnetic field is either increased or decreased thereby causing a variation in the force with which said pole pieces i i attract each other. The pressure upon the resistance medium is effected directly against both faces thereof by the variation in the telephonic current, and as said medium is in a very thin layer with the electrodes widely separated, the greatest possible microphonic action is had, and a maximum electromagnetic force is utilized for reinforcing the telephonic currents in the main telephonic circuit. The electrodes which are in contact with the variable resistance medium are separated a distance several times greater than the thickness of the layer of the variable resistance medium, and the resistance of

the medium may be as great or greater than the line resistance of the battery circuit.

I have not attempted to show the parts in their relative dimensions, as these will vary according to circumstances, nor have I attempted to describe the modifications of the apparatus in which the invention may be embodied. It will be understood by those to whom this specification is addressed, that the illustrated details of construction and arrangement may be greatly varied without departing from the spirit and scope of the invention, that the reinforcing means herein described and claimed may be employed for reinforcing all kinds of varying currents in electrical systems for the transmission of intelligence, and that the phraseology which I employ is for the purpose of description and not of limitation.

Having thus explained the nature of my said invention and described a way of constructing and using the same, although without attempting to set forth all of the forms in which it may be made, or all of the modes of its use, I declare that what I claim is:—

1. A current retransmitting and reinforcing apparatus comprising a variable magnet having opposing fixed pole pieces; a receiving or magnetization-varying coil around each pole of said magnet for varying its field; a variable resistance medium; opposing movable pole pieces or armatures in the fields of said fixed pole pieces to impart pressure to both sides or faces of said resistance medium; and electrodes for said resistance medium arranged in a line transverse to the lines of pressure of said movable pole pieces on said resistance medium.

2. A current retransmitting and reinforcing apparatus, comprising a variable magnet having opposing fixed pole pieces; a receiving or magnetization-varying coil around each pole of said magnet for varying its field; a variable resistance medium; opposing movable pole pieces or armatures in the fields of said fixed pole pieces to impart pressure to both sides or faces of said resistance medium; a receptacle for said resistance medium, and a fixed support for said receptacle.

3. A current retransmitting and reinforcing apparatus, comprising a variable magnet having opposing fixed pole pieces; a receiving or magnetization-varying coil around each pole of said magnet for varying its field; a variable resistance medium; opposing movable pole pieces or armatures in the fields of said fixed pole pieces to impart pressure to both sides or faces of said resistance medium; said pole pieces all being arranged in axial alinement; electrodes mounted in a line transverse to the axes of said pole pieces; and a receptacle for receiving and supporting said resistance medium and said electrodes.

In testimony whereof I have affixed my signature, in presence of two witnesses.

RALPH C. BROWNE.

Witnesses:
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