No. 754,224. PATENTED MAR. 8, 1904.

S. P. LEVENBERG.

TELEPHONE REPEATER AND SYSTEM.

APPLICATION FILED APR. 24, 1903.

NO MODEL.

Fig. 1.

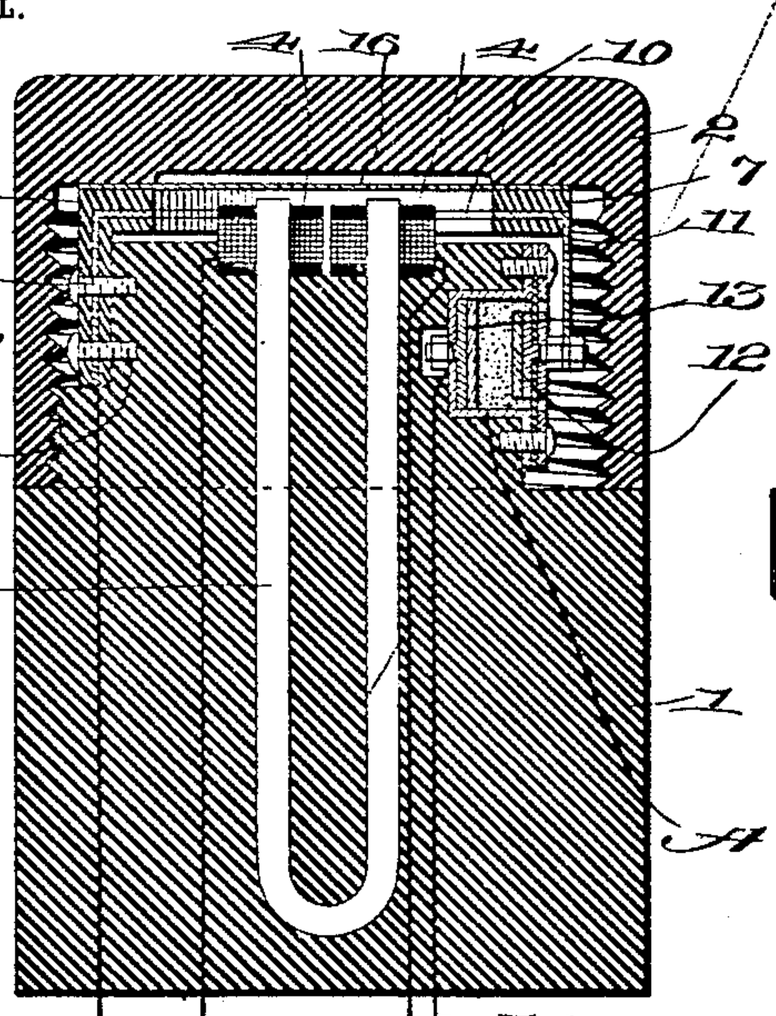


Fig. 2.

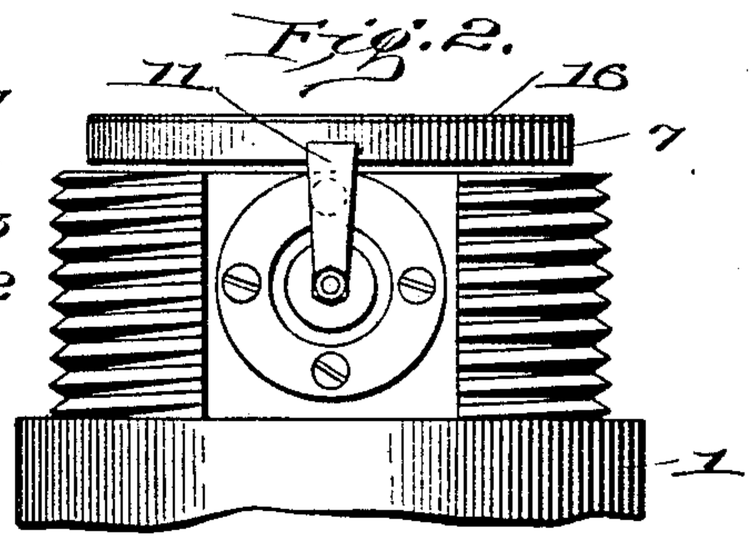


Fig. 3.

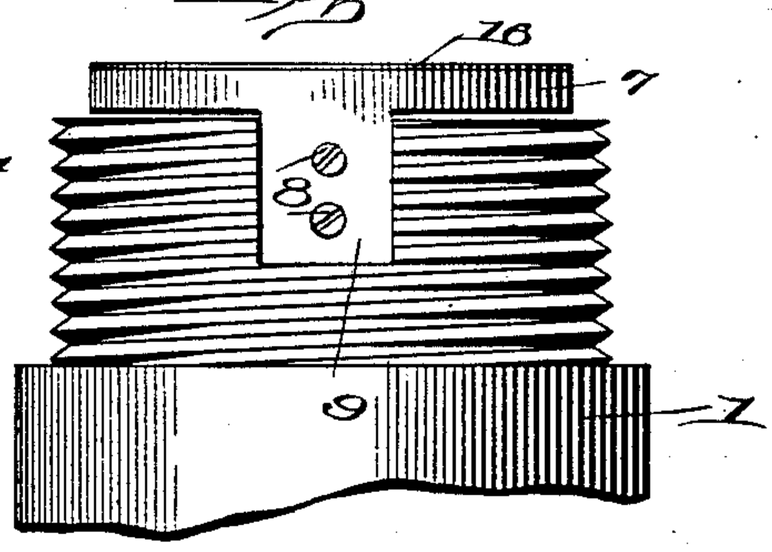


Fig. 5.

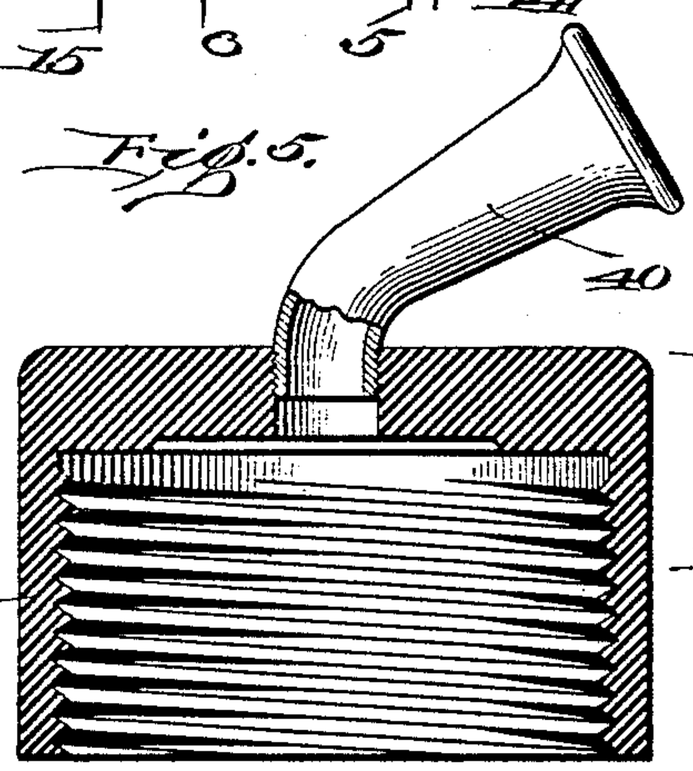


Fig. 6.

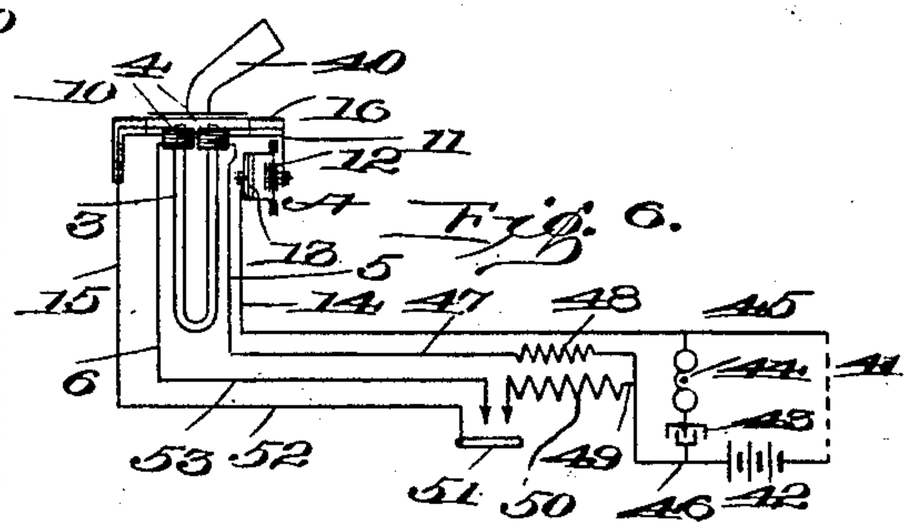
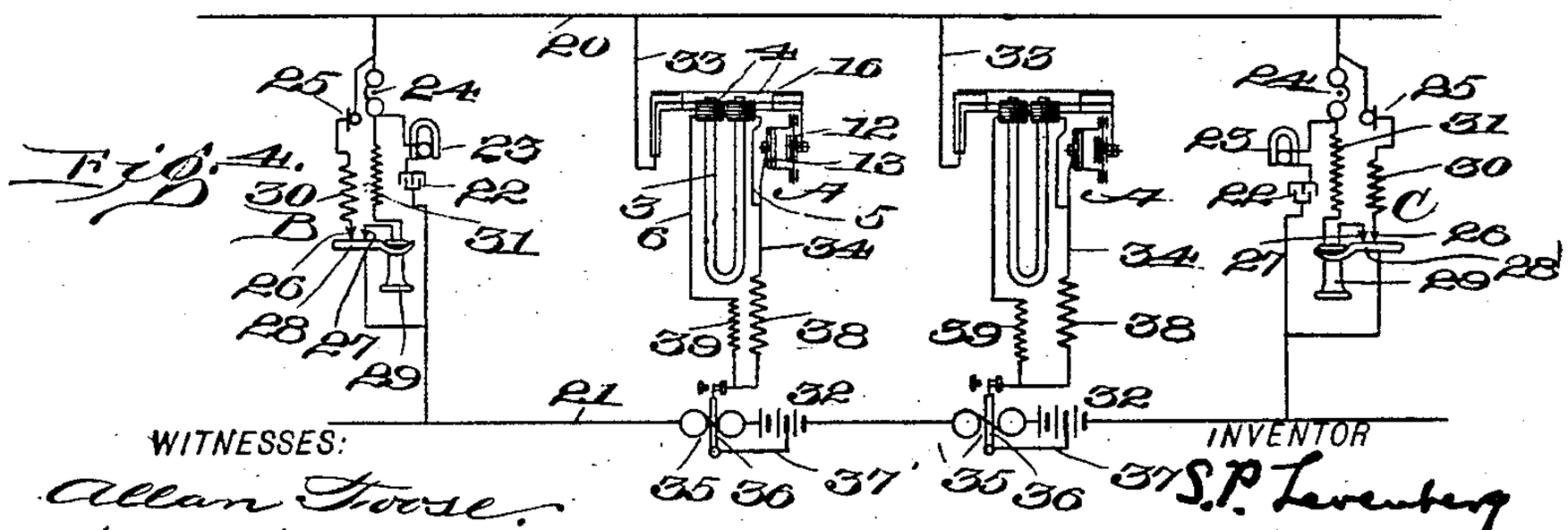


Fig. 4.



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No. 754,224. Patented March 8, 1904.

UNITED STATES PATENT OFFICE.

SAMUEL P. LEVENBERG, OF NEW YORK, N. Y.

TELEPHONE REPEATER AND SYSTEM.

SPECIFICATION forming part of Letters Patent No. 754,224, dated March 8, 1904.

Application filed April 24, 1903. Serial No. 154,086. (No model.)

To all whom it may concern:

Be it known that I, SAMUEL P. LEVENBERG, residing at New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Telephone Repeaters and Systems, of which the following is a full, clear, and exact description, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to a telephone repeater and system.

It has been usual in telephone-repeaters to connect the center of the speaking-diaphragm of the magneto-receiver to a variable-resistance contact or the like of a microphonic transmitter. Such construction, however, results in imperfect vibration and inefficient reproduction of the quality and quantity of tone in the transmitting part of the instrument.

The object of the present invention is to provide a repeater which shall obviate this and other disadvantages of repeaters as now known and also to provide a system for the use of such repeaters whereby the distance to which sound and other vibrations can be intelligibly transmitted may be increased.

The accompanying drawings, which are referred to herein and which form a part hereof, illustrate an embodiment of my invention and will serve, in connection with the following description, to explain the principles thereof and the best mode contemplated by me of carrying those principles into effect.

Referring to the drawings, Figure 1 is a sectional view of my improved repeater. Figs. 2 and 3 are details thereof in side elevation, taken from opposite sides of the instrument with the cap or cover removed. Fig. 4 illustrates diagrammatically a system in which are embodied repeaters of the type illustrated in Fig. 1. Figs. 5 and 6 show the manner in which the repeater may be used directly as a transmitting or receiving instrument.

Similar reference characters refer to similar parts throughout the several views.

The base of the instrument (indicated at 1) is formed of hard rubber or other suitable substance and at its upper end is screw-threaded for the reception of an interiorly-screw-threaded inclosing cap 2. Embedded in the base is an electromagnet having its core 3 preferably in the form of an elongated horseshoe, with bobbins 4, of closely-wound fine wire, on the poles thereof, such bobbins being connected in series through the leads 5 6. A ring 7, preferably of hard rubber, is connected at one side of the base, as by the screws 8, which pass through a lug 9, projecting downwardly from said ring, and the bobbins 4 are situated within the opening of such ring, but slightly below the upper plane thereof. Embedded in this rubber ring is a ring 10, of iron or other suitable conducting substance, which has a lug 11, projecting downwardly therefrom and carrying one of the electrodes 12 of a variable-resistance transmitter (designated generally by A) preferably constructed, as shown, of a shell containing granulated carbon or other suitable material and having one of its electrodes free for limited movement with respect to said particles of carbon, whereby the resistance of said material may be varied. To the other electrode 13 the lead 14 is connected, which may be included in any desired circuit with the lead 15, connected to ring 10. Mounted upon the ring 7, so as to be free for vibration thereon above the poles of the magnet, is a diaphragm 16, of suitable elastic material, adapted to be held lightly in position by screwing the cap 2 thereon without thereby preventing the communication of the vibration of the diaphragm through the rings 7 and 10 and the downwardly-projecting lug 11 to the movable electrode of the variable-resistance transmitter. I provide in this way a diaphragm so mounted and so connected to one of the electrodes of the variable-resistance transmitter that the vibration of such diaphragm under the influence of the magnet when current is passed through the coils of said magnet will be sharply and efficiently transmitted to said movable electrode, thereby reproducing with great exactness, but in greater amplitude, the vibrations of such diaphragm and of the circuit by which they are influenced to the circuit in which is embodied the variable-resistance transmitter.

More specifically, it will be understood that the vibrating or swinging ring 7 will under

the influence of the magnet as transmitted through the diaphragm be given a swinging or pivotal movement, which movement will be at its maximum at the point where the connection is made, as by the lug 11, to the movable electrode of the variable-resistance transmitter. Thus the ring vibrates or swings about a pivot, while the diaphragm both vibrates and swings under the influence of the magnet, the vibration of its periphery being wholly or partially restrained by contact of the ring or inclosing cap 2. The diaphragm also partakes of the vibrating or swinging movement of the ring, so that the diaphragm may be said to have both a vibrating movement proper and a swinging or pivotal movement, the maximum of which is at the point at which the connection to the variable-resistance transmitter is made.

The system shown in Fig. 4 includes two terminal stations B C, shown as bridged across between the conductors 20 21, and provided, as is usual, with condensers 22, magneto-generators 23, bells 24, and transmitters 25. In the present instance the talking-circuit is shown as closed at both terminal stations, contact being made at the points 26 27 through the hook 28. The receiver 29, transmitter 25, and magneto 23 are included in branches of the main bridge between the two conductors, the transmitter and receiver branch having also included the primary 30 and secondary 31, respectively, of an induction-coil.

Any desired source of current for the line may be provided, there being shown in the present instance batteries 32 in series in the conductor 21.

In Fig. 4 are shown two repeaters bridged across the circuit; but it should be understood that any desired number of repeaters may be provided, the number depending upon the length and character of the main circuit. The variable-resistance transmitter (designated by A) is included in the main circuit of the bridge, as by the leads 33 34. I provide also relays in connection with the main line, whereby the circuits of the repeaters may be normally open, but may be closed by the action of the current in the main line, as by relay-magnets 35 in series with the conductor 21 and carrying armatures 36, adapted to close the circuit between the repeaters and the line through armatures 36 and the lead 37. It will be understood that with the circuits closed at the terminal stations, as shown, the armatures would be in the position shown such that the circuits are closed through the repeaters, while when the circuits are open at the terminals, such that there is no current in the main conductors, the circuits through the repeaters would be open, thus obtaining the advantage of a normally open working both in the line and in the repeaters.

While it will be obvious that the circuit through the repeating-magnets 4 may be independent of the circuit through the variable-resistance transmitter, one being controlled from the other by induction or otherwise, I prefer the construction shown, wherein the leads 5 6, which are connected to the bobbins of the magnet, are in shunt from the lead 34 of the variable-resistance transmitter. I also prefer the construction as shown, wherein the primary 38 of an induction-coil is embodied in the lead 34 of the variable-resistance transmitter, the secondary 39 being embodied in the lead 6 of the magnet, or vice versa, the purpose and advantages of which, as well as of the other windings and connections shown, being obvious to those skilled in the art without further elaboration.

It will be clear that with this system I provide means whereby the action of any repeater or of any station will not be confined to the nearest repeater or station, but wherein the influence of each repeater or station is exerted upon the whole line and upon each of the elements of said line, although, of course, the effect of each will be most marked on the instrument or instruments most closely connected therewith.

I thus provide a system such that speech or other vibrations may be transmitted from one station to another station at very great distances, the repeaters acting to preserve the relation of the vibrations so transmitted such that the quality or quantity and phase thereof will approximate very closely the character of the vibrations imposed upon the initial transmitting instrument.

Figs. 5 and 6 show an arrangement, the advantages of which under certain circumstances will be obvious, whereby I may use my repeater directly as a receiving or transmitting instrument. This may be done by connecting the horn 40 to the cap 2, through which sound-waves may be transmitted to or from the vibrating diaphragm 16 to the repeating instrument, as shown in Fig. 6. In this case the instrument may be connected with any desired line, (indicated by the dotted line 41,) the current being supplied by the battery 42 and a condenser 43 and bell 44 being bridged across the leads 45 46. One of these leads is connected directly to one of the electrodes 13 of the variable-resistance transmitter A, while the other is divided into a branch 47, which forms one of the leads of the circuit of the bobbins 4, said branch including the secondary 48 of an induction-coil and a branch 49 which includes the primary 50 of an induction-coil. This branch is controlled by a switch 51 and is itself divided into two branches, one branch, 52, being the lead of the movable electrode of the variable-resistance transmitter, while the other is the second lead 53 of the bobbins 4. The operation of the instrument in this relation will be clear from the description already given. The vibrations of the

diaphragm 16 under the influence of sound-waves received through the horn or when caused by the magnet under the control of the line-circuit will be amplified and made more clear by the connections between the variable-resistance transmitter and the magnet-circuit, as already described.

Under some circumstances the efficiency of the operation of the instrument is increased by creating a vacuum within the case in the chamber formed between the base 1 and cap 2. This may be done in any desired way. It will be apparent that many changes may be made both in construction of the instrument and in the system of wiring without departing from the scope of the invention herein set forth. It will also be apparent that the various elements, leads, &c., of the system described may be looked at from different view-points and given different names without destroying the identity of said elements. As what would perhaps properly be termed the main "bridge-circuit," or bridge which includes the variable-resistance transmitter, is and may be considered a part of the primary circuit, the circuit to the magnet or translating device being itself in shunt or bridged across said primary circuit, the pertinency of such a description will be especially clear upon considering the arrangement of circuits as shown in Fig. 6. It will also be clear, notwithstanding the fact that I prefer the system of wiring shown, that the various bridge-leads, shunt-leads, &c., may be taken off from the respective conductors at different points than those indicated, while still preserving many of the valuable features of this invention.

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

1. In a telephone-repeater, a variable-resistance transmitter, an electromagnet included in a shunt from one of the leads of said variable-resistance transmitter, a vibrating diaphragm mounted adjacent said magnet, and means for controlling one of the electrodes of said transmitter in accordance with the vibrations of said diaphragm.

2. In a telephone-repeater, a variable-resistance transmitter, an electromagnet included in a shunt from one of the leads thereof, a vibrating diaphragm loosely mounted adjacent said magnet, means for controlling one of the electrodes of said transmitter in accordance with the vibrations of said diaphragm, and an induction-coil having its windings embodied respectively in the transmitter-circuit and in the magnet-circuit.

3. In a telephone-repeater, in combination, an electromagnet, a vibrating ring mounted adjacent to and surrounding the poles of said magnet, a variable-resistance transmitter, connections between said ring and one of the electrodes of said transmitter, and an elastic diaphragm loosely carried by said ring above the poles of said magnet.

4. In a telephone-repeater, in combination, an electromagnet, a vibrating ring mounted adjacent to and surrounding the poles of said magnet, a variable-resistance transmitter, connections between said ring and one of the electrodes of said transmitter, an elastic diaphragm loosely carried by said ring above the poles of said magnet, and a cap adapted to inclose said elements and to rest lightly upon the upper surface of said diaphragm at its periphery.

5. In combination with a telephonic circuit, a repeater bridged across said circuit, said repeater comprising a variable-resistance transmitter included in the circuit of said bridge, an electromagnet included in a shunt from said bridge-circuit, and a vibrating diaphragm adapted to be actuated by said magnet and controlling one of the electrodes of said variable-resistance transmitter.

6. In combination with a telephonic circuit, a repeater bridged across said circuit, said repeater comprising a variable-resistance transmitter included in the circuit of said bridge, an electromagnet included in a shunt from said bridge-circuit, a vibrating diaphragm adapted to be actuated by said magnet and controlling one of the electrodes of said variable-resistance transmitter, and an induction-coil having one of the members thereof in said main bridge-circuit and the other in said shunt-circuit.

7. In combination with the terminal stations and circuit of a telephone system, a variable-resistance transmitter included in a line bridged across said circuit, an electromagnet shunt-wound from said bridge, and a diaphragm adapted to be vibrated by said magnet and to control said variable-resistance transmitter.

8. In combination with the terminal stations and circuit of a telephone system, a variable-resistance transmitter included in a line bridged across said circuit, an electromagnet shunt-wound from said bridge, a diaphragm adapted to be vibrated by said magnet and to control said variable-resistance transmitter, and means whereby a break in said bridge-circuit is under the control of the main line.

9. In combination with the terminal stations and circuit of a telephone system, a variable-resistance transmitter included in a line bridged across said circuit, an electromagnet shunt-wound from said bridge-circuit, a diaphragm adapted to be controlled by said magnet and to control said transmitter, and an induction-coil having the elements thereof included in the circuit of said transmitter and said magnet respectively.

10. In combination with a telephonic circuit, a repeater bridged across said circuit, said repeater comprising a variable-resistance

transmitter included in the main circuit of said bridge, an electromagnet included in a shunt from said bridge-circuit, and a vibrating diaphragm adapted to be actuated from said magnet and to control one of the electrodes of said transmitter.

11. In combination with a telephonic circuit, a repeater bridged across said circuit, said repeater comprising a variable-resistance transmitter included in the main circuit of said bridge, an electromagnet included in a shunt from said bridge-circuit, a vibrating diaphragm adapted to be actuated from said magnet and to control one of the electrodes of said transmitter, and an induction-coil having one of the members thereof included in said main bridge-circuit and the other in said shunt-circuit.

12. In a telephone system, in combination, a circuit embodying a variable-resistance transmitter, a shunt therefrom embodying an electromagnet, a vibrating diaphragm within the field of the poles of said magnet, and means for controlling said transmitter in accordance with the vibrations of said diaphragm.

13. In a telephonic system, a primary circuit comprised in the main-line conductors, a repeater-bridge bridged across the line conductors and also in inductive relation to said primary circuit, and a variable resistance in said primary circuit controlled by a translating device in said repeater-bridge.

In testimony whereof I affix my signature in the presence of two witnesses.

SAMUEL P. LEVENBERG.

Witnesses:

H. M. SEAMANS,

J. B. KNOX.