F. LOWENSTEIN.

TELEPHONE RELAY.

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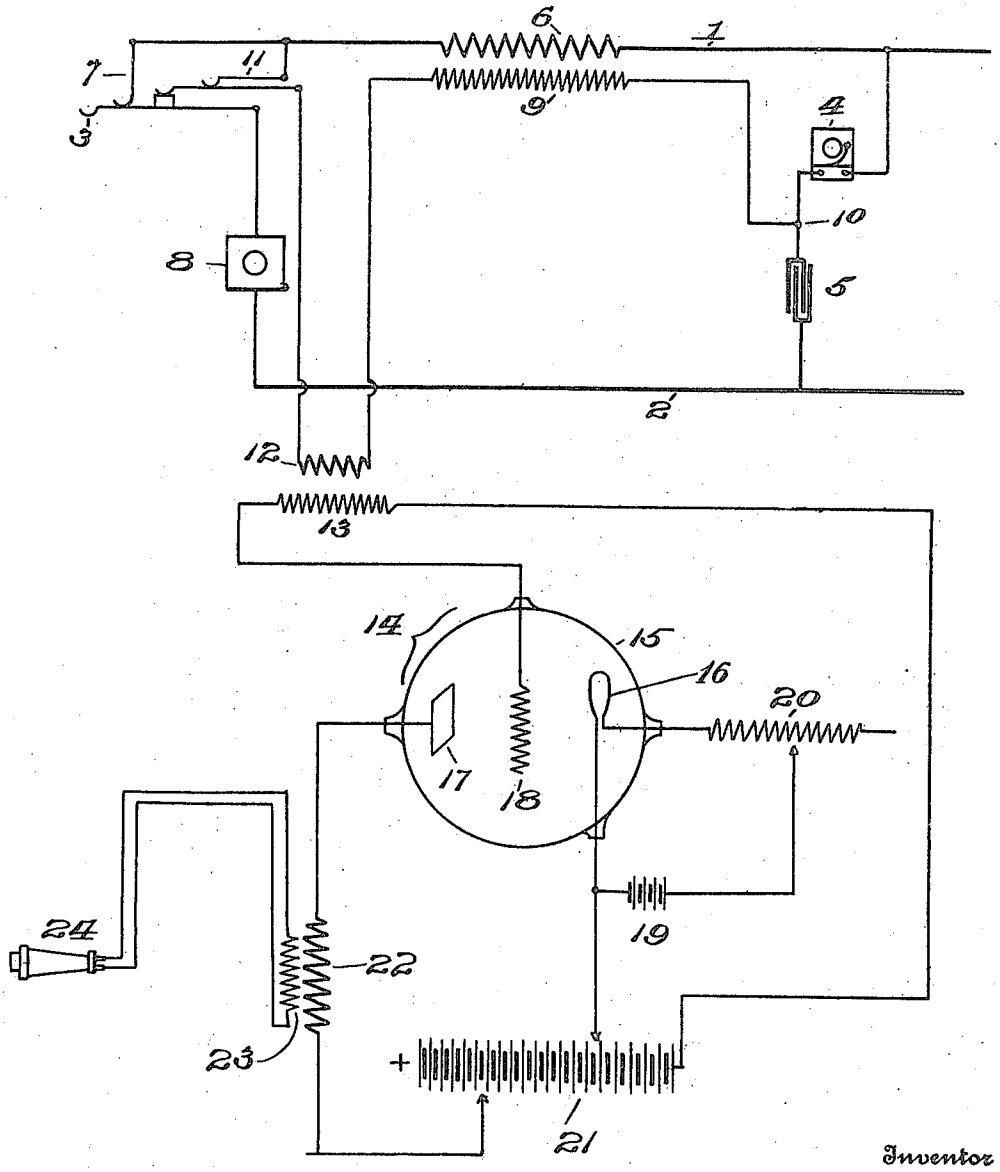
1,231,764. Patented July 3, 1917.



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TELEPHONE-RELAY.

1,231,764. Specification of Letters Patent. Patented July 3, 1917.

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To all whom it may concern:

Be it known that I, FRITZ LOWENSTEIN, a citizen of the United States, residing at New York city, in the county of New York and State of New York, have invented certain new and useful Improvements in Telephone-Relays, of which the following is a specification.

My invention relates to improvements in telephone relays.

The object of my invention is to provide a relay by means of which the relation of the potential differences of the complex incoming speech currents is well maintained in the telephone receiver so that the sound reproduced by the receiver diaphragm will be composed of waves of practically the same frequencies as impinge upon the transmitter diaphragm, and, what I consider most important, these various frequencies will have about the same relative amplitudes as in the original sound waves actuating the transmitter. As a result of this the reproduced sound is intelligible.

It is frequently the case with long distance telephoning that under certain conditions the sound of a speaker's voice may be heard very plainly in the receiver, while at the same time it is unintelligible. As a result of experiments I have ascertained that this lack of intelligibility is due principally to the fact that the speech currents of higher frequencies are attenuated to a greater relative extent than are the speech currents of low frequency due to electrical properties of a long line, so that the incoming speech current is distorted. Furthermore, this distortion is but little affected by terminal conditions, and hence relays or receiving apparatus functioning according to current values cannot remedy the distortion or compensate for the effects thereon.

On the other hand the terminal voltages are materially affected by terminal conditions, and hence it is possible to select such terminal conditions as will enable the relative amplitudes of the original voltages to be well maintained at the incoming end of the line. Therefore, a relay apparatus which functions according to terminal voltages is well adapted for the production of receiver operating currents of the desired absolute strengths and in the relative strengths necessary for the successful operation of the telephone receiver.

My invention will now be explained in connection with one embodiment thereof.

The drawing is a diagrammatic view of so much of one well known form of telephone system as is necessary to explain the construction and operation of my improved relay.

Referring first to the old elements of the system, it will be seen that two wires only, 1 and 2, are used for the three purposes of ringing, microphone operation and transmitting the talking current. When the station is not in use and the receiver is on hook 3 the line 1—2 is connected only through the bridge containing a bell 4 of high self-inductance and a condenser 5 proportioned so as to be in resonance with the self-inductance 4 on 16 cycles, which frequency is used for ringing current.

When the receiver is removed from the hook 3, the line 1—2 is closed also by way of primary 6 of the telephone induction coil, switch contact 7 and microphone 8. On the same core with primary 6 of the induction coil is secondary 9, one terminal of which is connected on the junction point 10 between the bell and condenser of the ringing circuit and the other terminal of which connects through the telephone receiver and contact switch 11 to one side of the primary 6 of the induction coil.

In applying my instrument I substitute for the usual telephone receiver the primary 12 of a step-up transformer which produces in its secondary 13 comparatively high potential. At 14 is an ion or an electron controller, or audion, consisting of a container 15 evacuated and provided with an incandescent filament 16, an anode 17 and a modulating or controlling member 18, which in the present example is a mere grid. Incandescent filament 16 is fed by battery 19 through an adjustable rheostat 20 which permits fine adjustments of the incandescence of the filament. A battery 21 is provided which furnishes current through the evacuated field, the positive pole of the battery being connected to anode 17, a negative point of the battery being connected to filament 16. The potentials created in secondary 13 are made to control the current flowing through the ionic field and originating in battery 21 by connecting the one terminal of coil 13 to the modulating member 18 and the other terminal of said coil to a point on the battery 21, which is

located ultranegatively relative to the negative point of the battery connected to the filament. This ultranegative connection is especially desirable and constitutes an important feature of my invention in its preferred embodiment. The volume and clearness of speech as heard in the receiver in the arrangement shown is materially greater than where the grid 18 and coil 13 are connected, for example, to a point at the same potential as the filament 16. The theoretical considerations involved are somewhat abstruse and not fully understood; but the advantage of the ultranegative connection is fully established by repeated tests which I have carried out in actual practice. I therefore note the fact without attempting to explain it. Both the positive and the ultranegative points of connection to battery 21 are adjustable to enable variation of the driving potential of battery 21 for the ionic field and of the ultranegative potential. A telephone of many convolutions, may be inserted at 22, but to enable the use of the usual commercial telephone where desired, 22 should be a high winding of an induction coil transforming the energy from small current and high potential in coil 23 into a current of lower potential but higher amperage so as to make this energy more available for the commercial telephone receiver 24.

The operation of the ionic controller is as follows:

The incandescent filament 16 produces ionization of the gas contained in container 15 and thereby makes the gas a conductor. The potential between filament 16 and anode 17 derived from battery 21 creates a static field between such filament and anode which exerts a driving power on the ionized gas particles which come in contact with incandescent filament 16 and which are thereby electrically charged. A negative charge in an electric field is acted upon by a force in the direction of the field lines from negative to positive point of the field and the amount of negative current which is therefore conveyed through the field is dependent on the ionization power of the filament, the quantity of the individual charge and the strength of the electric field.

The ionization power of the filament is a function of its temperature and therefore of its incandescence. The individual charge is a function of the negative potential of the filament and also of the degree of evacuation. The intensity of the field is a function of the potential difference between filament and anode and of their distance, which two dependencies may therefore be expressed as the potential gradient of the field. Therefore the current in the ionic field circuit will increase with the incandescence of the filament, the potential difference of the battery and, up to a certain point, with the evacuation.

By providing a modifying or controlling device, such for example as the modulating means 18, which is subjected to an impressed potential more negative than that of the cathode and which is adapted and arranged to interpose between the anode and cathode a modifying or controlling field of the desired character, the potential gradient between the filament and the controlling device or modulating means may be changed and thereby the current which flows through the ionic circuit changed accordingly. By applying variable potentials to the modulating means 18 the currents in the ionic field circuit are varied accordingly and as the impressing of a potential on conductor 18 need not be accompanied by an appreciable expenditure of energy, whereas the energy of the ionic field circuit is varying considerably, I have a means to produce great changes of energy in that field circuit by variation of potentials which do not require appreciable energy.

Having thus fully described my invention, what I claim is:

1. Telephone apparatus comprising the combination, with a talking circuit, of a suitably energized relay circuit including an anode and a cathode separated by a conductive gap, a modulating device interposed in said gap and electrically connected with said talking circuit, means for impressing upon said modulating device a potential more negative than that of said cathode, and a translating device arranged to be energized from said relay circuit.

2. Telephone receiving apparatus, comprising the combination with a talking circuit, of an ion controller having an anode and a cathode connected in a second circuit electrically related to said talking circuit, a modulating device interposed between said anode and cathode, means for energizing said modulating device from said talking circuit and also from a source of potential which is negative with respect to said cathode, and a telephone receiver arranged to be energized from the controller circuit.

3. Telephone receiving apparatus comprising the combination, with a talking circuit, of an ionic controller having an anode and a cathode suitably spaced apart, a battery, connections from said anode and cathode to the battery, a grid electrically connected to said talking circuit and interposed between said anode and cathode, a connection from said grid to said battery, the battery connecton of the grid being negative with respect to the battery connection of the cathode, and a telephone receiver arranged to be energized from the controller circuit.

4. Telephone apparatus comprising the

combination, with a talking circuit, of a cooperating circuit suitably energized and including an anode and a cathode separated by a conductive gap, a modifying or controlling device interposed between said anode and cathode and subjected to an impressed potential more negative than that of said cathode, and a third circuit energized by said coöperating circuit.

5. The combination, with an exhausted container, and an anode and a cathode located therein and included in a suitably energized circuit, of a modifying or controlling device interposed between said anode and cathode and connected to a source of potential more negative than said cathode, and another circuit inductively related to the first mentioned circuit.

6. The combination, with an exhausted container, and an anode and a cathode located therein and included in a suitably energized circuit, of a modifying or controlling device connected to a source of potential more negative than said cathode and adapted and arranged to influence the character of the field between said anode and cathode, and another circuit inductively related to the first mentioned circuit.

7. The combination, with an audion having its anode and cathode included in a suitably energized circuit, of means for impressing upon the audion grid a potential more negative than that of the audion cathode.

In witness whereof I have hereunto affixed my hand this tenth day of January, 1912.

FRITZ LOWENSTEIN.

Witnesses:
O. F. ROTHEN,
L. BASCHANG.