R. VON LIEBEN & E. REISZ.

RELAY FOR UNDULATORY CURRENTS.

APPLICATION FILED JAN. 30, 1911.

1,038,910.

Patented Sept. 17, 1912.

2 SHEETS—SHEET 1.

Fig. 1

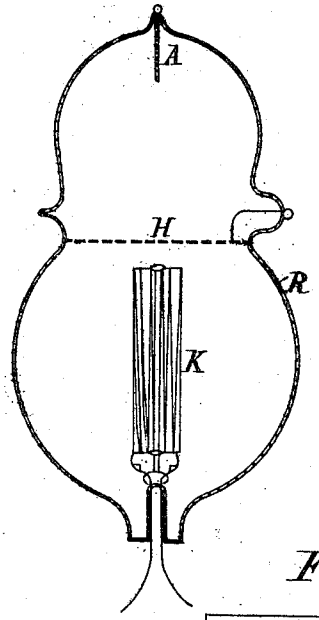


Fig. 2

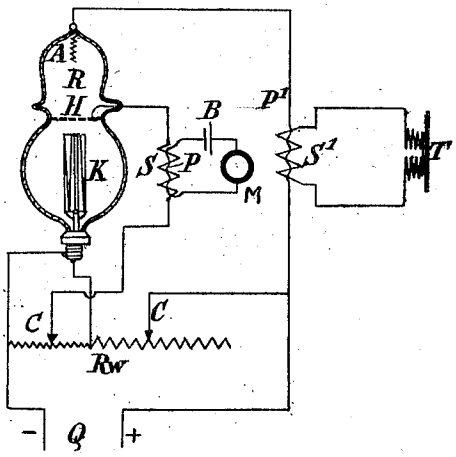
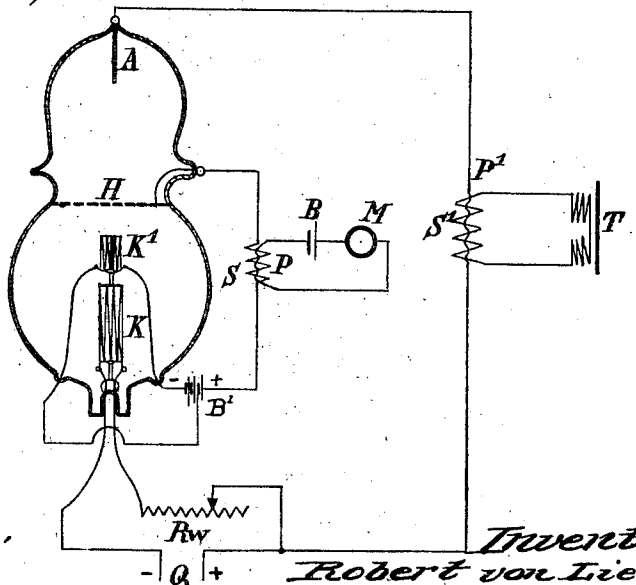


Fig. 2a



Witnesses:

J. B. Keeler

C. E. Keeler

Inventors

Robert von Lieben

Eugen Reisz

by James L. Norris

Atty.

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2 SHEETS—SHEET 2.

Fig. 3

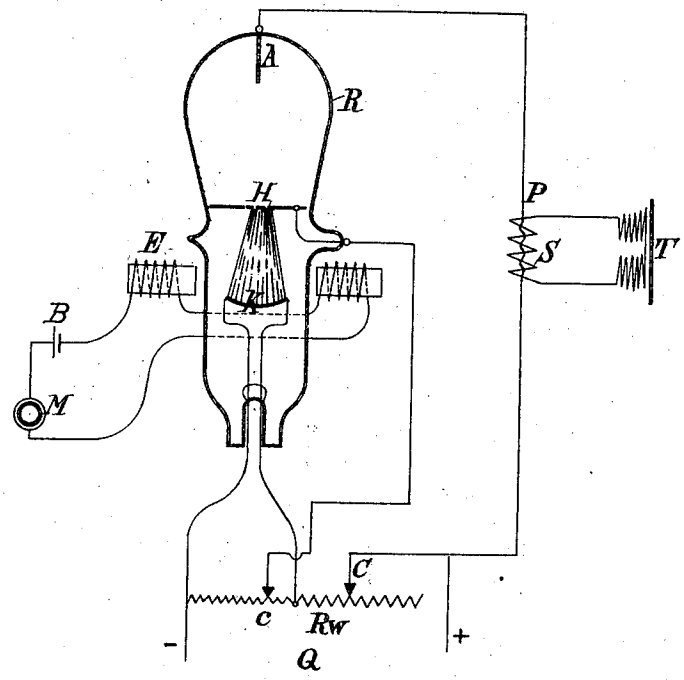
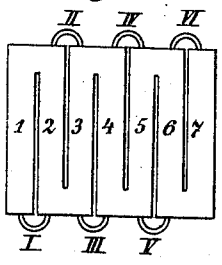


Fig. 3a



Witnesses:

Inventors
Robert von Lieben
Eugen Reisz

By James L. Norris
Atty

UNITED STATES PATENT OFFICE.

ROBERT von LIEBEN AND EUGEN REISZ, OF VIENNA, AUSTRIA-HUNGARY, ASSIGNORS OF ONE-THIRD TO SIEGMUND STRAUSS, OF VIENNA, AUSTRIA-HUNGARY.

RELAY FOR UNDULATORY CURRENTS.

1,038,910. Specification of Letters Patent. Patented Sept. 17, 1912.

Application filed January 30, 1911. Serial No. 605,548. REISSUED

To all whom it may concern:

Be it known that we, ROBERT VON LIEBEN and EUGEN REISZ, subjects of the Emperor of Austria-Hungary, residing at Vienna, Austria-Hungary, have invented certain new and useful Improvements in Relays for Undulatory Currents, of which the following is a specification.

This invention relates to improvements in undulatory current relays, and the primary object of the same is to reinforce current waves of the most varied frequency and form.

The invention as hereinafter disclosed and illustrated in the drawings constitutes an improvement on that disclosed in our co-pending application Serial No. 605,547, wherein by means of varying the ionization of the space between the electrodes, as for instance by means of cathode rays, the resistance of the circuit connected to the electrodes is altered so that the current waves introduced will produce proportionate variations.

The subject of the present invention is a further development of the above mentioned invention, wherein instead of being altered indirectly by means of an ionizer the resistance in the main circuit is altered directly by means of an auxiliary electrode, on which the currents to be reinforced act. For this purpose the auxiliary electrode, which is likewise made of grid or net form, is arranged in such a manner that it completely intersects or divides the space between the cathode and anode in the discharge tube; moreover, it is connected with a source of direct current in such a manner that it has an exactly defined potential corresponding to the degree of reinforcement required for the time being. In order to enable this potential to be adjusted as required, an adjustable resistance is preferably introduced between the electrode and the source of electric current. By this means the valve-like action of the incandescent electrode is dispensed with, since the alternating current to be reinforced is superposed on a constant direct current, whereby an undulatory current is formed from the alternating current. Also the presence of the constant potential of the electrode, the magnitude of which is suitably chosen between that of the cathode and that of the anode, causes the formation of an artificial dark space near the cathode and thus of a space where the number of ions is small, around the apertures of the auxiliary electrode toward the anode, whereby again the resistance of the main circuit, which is just what it is desired to alter, is considerably increased. This displacement of the maximum drop of potential into proximity to and into the openings of the auxiliary electrode and also the circumstance that this grid-electrode entirely fills up the cross-section of the discharge tube, permit the employment of currents which are practically of any desired strength, since here the formation of an arc outside the grid is rendered impossible and the formation of an arc in the apertures of the grid is rendered very difficult by the production of the artificial dark space near said apertures.

The openings or contractions, as is known, form a virtual resistance for the gas discharge, which resistance, however, as we have discovered, can be very considerably altered if, between the cathode and the partition-wall, a constant but regulable voltage be applied; and it appears that even with a very slight increase or reduction of the potential-difference, the resistance or back electromotive force in the discharge tube will be smaller or greater. The currents to be reinforced now alter the resistance of the auxiliary electrode, whereby the currents passing between the cathode and anode are altered in proportion to this resistance.

The drawings show by way of example some constructional forms of the subject of the application.

In these drawings: Figure 1 is a section of the discharge tube. Fig. 2 is a diagram of the connections of the relay. Fig. 2ª shows a further constructional form of the relay with an auxiliary cathode. Fig. 3 shows a further constructional form of the subject of the application, wherein another method of altering the resistance of the auxiliary electrode is employed. Fig. 3ª is a development of the cathode belonging thereto.

In Fig. 1 the cathode K is arranged in the discharge tube R. This cathode is preferably an incandescent metallic oxid cathode (a Wehnelt cathode) and has the form of incandescent metal bands covered with metallic oxids, which bands are wound on a carrier or support in a similar manner

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to that in which metal filament lamps are constructed. This construction of the cathode has the advantage that the irregularly distributed cathode rays emitted by the incandescent bands (filaments) do not strike the auxiliary electrode directly whereby the current density is uniformly distributed over the auxiliary electrode. H is the said auxiliary electrode, which divides or intersects the space between the cathode K and the anode A and is preferably made in the form of wire gauze or netting or perforated sheet metal or as a combination of the two.

The cathode K, in combination with a regulating resistance Rw (Fig. 2) which regulates the temperature of the incandescent metal bands, is connected to the source of direct curernt Q. The anode A is connected to the positive pole of the said source of current through the primary winding P'. To the regulating resistance Rw is further connected at c the auxiliary electrode H through the secondary winding of a second transformer. As shown in Fig. 2, the microphone circuit BM acts inductively on the gas current between K and H through the primary winding P. The voltage which exists between the cathode K and the auxiliary electrode H, is given by the adjustment of the contact c of the regulating resistance Rw. This application of a regulable pressure has been found to be an extremely important expedient for the sensitiveness of the relay, since a proportionally strong alteration of resistance in the gas discharge tube only occurs with a quite definite value of the voltage and this depends on the pressure of the gas in the tube, the temperature of the electrode, etc. It was further established by experiment that with greater strengths of the current and more especially with such strengths as first render the relay practically useful, the auxiliary electrode H, as above mentioned, must entirely shut off the cross-section of the tube, since otherwise shunting of the gas-current would occur, which almost entirely destroys the action of the relay.

The method of operation of the relay is as follows: The currents from the microphone circuit superposed inductively on the circuit between K and H through the transformer PS alter the back electromotive force or resistance of the gas discharge tube, so that the main current passing through the anode A acts through the second transformer P' S' on the telephone T. As already set forth, with a definite difference of potentials between K and H, which can be adjusted by means of the sliding contact c, the resistance of the gas discharge produced by the auxiliary electrode is extremely sensitive and the small variations of potential caused by the variations of resistance of the microphone are therefore sufficient to alter the strength of the current in the discharge tube very considerably, so that a powerful relay action is obtained.

In Fig. 2a a second cathode K' is provided, which is connected to a separate source of current B', and to the positive pole of which the electrode H is connected through the transformer. Since in this system of connections the temperature of the cathode K' can be made independent of the cathode K, the drop of potential at the cathode K' can be very considerably reduced by a correspondingly high temperature of the bands at K' and consequently the variations of current of the transformer PS increased, without the main current flowing to the anode in the discharge tube being considerably increased. The temperature of the main cathode and therefore the current flowing through the anode A cannot be increased indefinitely, since at a critical value of the current determined by the cross-section of the tube the sensitiveness of the relay again decreases.

Another form of construction of the relay is shown in Fig. 3. In this, the cathode K is made in the form of a concave mirror, in order to unite the rays emitted thereby into one pencil; H is the auxiliary electrode, which is again arranged as a partition-wall between the cathode and anode and has an opening or window, provided with a perforated metal sheet or wire gauze forming a grid. The anode A is connected in a known manner to the positive pole of Q. The pair of electromagnets E is connected in series with the microphone M and a battery. In the opening or window of the auxiliary electrode H is mounted a piece of perforated sheet metal, a grid or a combination of the two, in order to increase the back electromotive force or rather the main resistance to be altered of the tube between K and A. The regulating resistance Rw with the contacts c and C is connected as in the form shown in Fig. 2. The alterations of current in the microphone circuit cause the pencil of rays to be deflected, whereby the apertures in the window of the auxiliary electrode H, to which a constant direct current potential can be applied, are more or less struck by the pencil of cathode rays and are therefore subjected to an ionization of varying intensity. By this means the back electromotive force or the resistance in the main circuit between K and A is altered according to the variations of current in the primary. The back electromotive force or resistance in the discharge tube increases when the pencil of rays is deflected from the opening and decreases when the pencil of rays strikes the opening or window. The concave mirror cathode is preferably made in such a manner that in order to avoid too high currents for the

heating thereof, the conductor is arranged in zigzag form and the several strips are mechanically supported relatively to each other by fire-proof bridge-pieces *e. g.*, of glass or porcelain, as shown by way of example in Fig. 3ª, in which the transverse members of the zigzag conductor produced by slotting a sheet of platinum alternately on opposite sides are marked 1, 2, 3, and the glass bridge-pieces I, II, III.

For both arrangements experiments have shown that for the proportional reproduction of alternating currents, the openings in the partition-wall must be made of different sizes.

The above described relay for undulating currents can be employed for strengthening sound, as a relay in overhead wire and cable telephony in short and long distance communication, also in wireless telegraphy and telephony, as an auxiliary apparatus for the telegraphone and as a cell sensitive to light for the electric transmission of pictures, etc.

What is claimed is:

1. A relay for undulatory currents comprising a discharge tube, a cathode and an anode therein, an auxiliary electrode to cause a drop of potential between the cathode and anode and formed with apertures and intersecting the space in the discharge tube between said cathode and anode and dividing it into separate parts, and a source of direct current connected to said auxiliary electrode.

2. A relay for undulatory currents comprising a discharge tube, a cathode and an anode therein embodied in an electric circuit with said cathode, an auxiliary electrode formed with apertures and intersecting the space between the cathode and the anode, a source of direct current connected to said auxiliary electrode, the latter forming a resistance for the currents in the circuit, and means for varying said resistance in accordance with the currents to be reinforced.

3. In a relay for undulatory currents, an exhausted discharge tube, a cathode and an anode therein, embodied in an electric circuit, a grid-like auxiliary electrode intersecting the discharge tube between the cathode and the anode and dividing it into separate parts, a source of direct current connected to the auxiliary electrode, the latter forming a resistance for the currents in the circuit, an adjustable resistance between said source of direct current and the auxiliary electrode, and means for varying the resistance of said electrode in accordance with the currents to be reinforced.

4. In a relay for undulatory currents, an exhausted discharge tube, a cathode of metallic oxid filaments heated to incandesence, the filaments being wound on a carrier in the manner of a metal filament lamp, an anode embodied in an electric circuit with said cathode, a grid-like auxiliary electrode intersecting the space of the discharge tube and dividing it into separate parts, this electrode being perpendicular to the axis of the carrier, a source of direct current connected to said electrode, the latter thus forming a resistance for the currents in the circuit, an adjustable resistance between the source of direct current and the electrode, and means for varying the resistance of said electrode in accordance with the currents to be reinforced.

5. In a relay for undulatory currents, an exhausted discharge tube, a cathode and an anode therein embodied in an electric circuit, a grid-like auxiliary electrode intersecting the discharge tube between the cathode and the anode and dividing it into separate parts, a source of direct current connected to the auxiliary electrode, an adjustable resistance in the circuit between the source of direct current and the auxiliary electrode, and means to superpose the undulating currents to be reinforced on said circuit.

6. In a relay for undulatory currents, an exhausted discharge tube, a cathode and an anode therein embodied in an electric circuit, an auxiliary cathode embodied in a separate circuit, a grid-like auxiliary electrode intersecting the discharge tube between the auxiliary cathode and the anode and dividing it into separate parts, a source of direct current connected to the auxiliary electrode and the circuit of the auxiliary cathode, and means to superpose the undulating currents to be reinforced on the circuit of the direct current source.

In testimony whereof we have hereunto set our hands in presence of two subscribing witnesses.

ROBERT VON LIEBEN.
EUGEN REISZ.

Witnesses:
JOSEF RUBRENCH,
AUGUST FUGGER.