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DISCHARGE TUBE RELAY FOR UNDULATORY CURRENTS.

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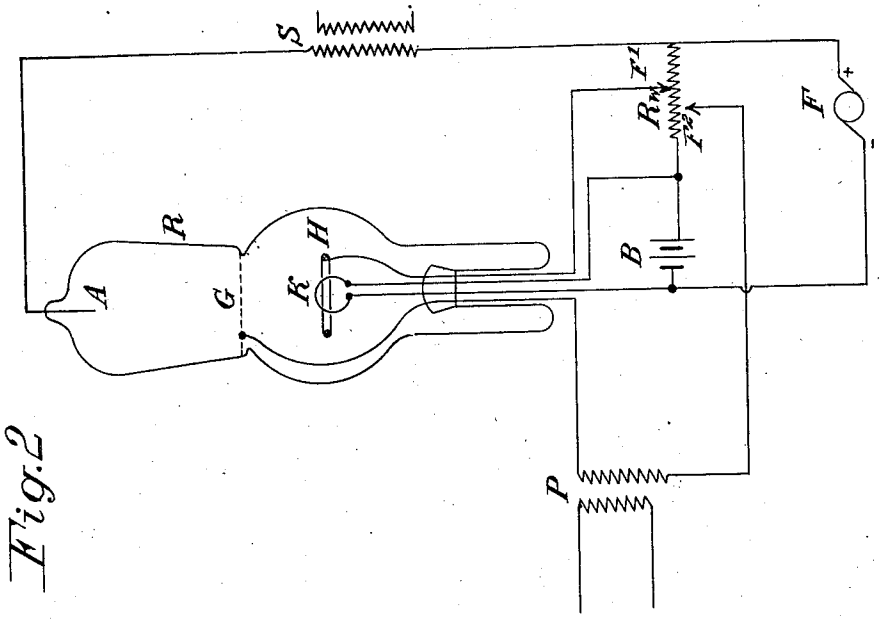


Fig. 2

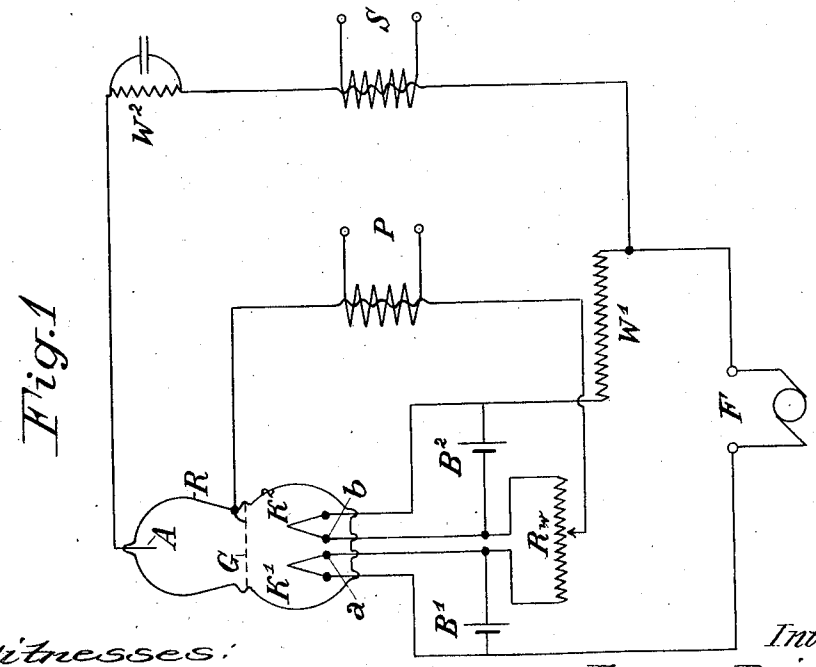


Fig. 1

Witnesses:

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DISCHARGE-TUBE RELAY FOR UNDULATORY CURRENTS.

1,418,022. Specification of Letters Patent. Patented May 30, 1922.

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(GRANTED UNDER THE PROVISIONS OF THE ACT OF MARCH 3, 1921, 41 STAT. L., 1313.)

To all whom it may concern:

Be it known that I, EUGEN REISZ, an engineer by occupation, subject of the Emperor of Austria, residing at 13 Moesdorferstrasse, Treptow, near Berlin, Germany, have invented certain new and useful Improvements in Discharge-Tube Relays for Undulatory Currents, of which the following is a specification.

In the United States Patent No. 1,038,910 of September 17, 1912, granted to R. v. Lieben and to me there is described a relay for undulatory currents in which the reinforcement of weak current undulations is effected in a vacuum tube by influencing the electric discharge between a Wehnelt cathode and an anode by means of a grid-like auxiliary electrode intersecting and dividing the said tube. In relays of the said kind a great amount of electrical energy is required for the purpose of heating the Wehnelt cathode so that for this reason the volume of the tube must be a very large one.

The internal resistance of tubes having ample superficial electrode areas and a large volume is however comparatively small, so that in the case of large voltages at the electrodes such as are necessary for the purpose in question, the intensity of the discharge current that will occur will be very high. This fact will in turn give rise to difficulties whenever very weak currents are to be re-inforced and the receiving apparatus in the discharge circuit are to be adjusted to a great sensitivity. If abnormal variations of the tension occur in the primary circuit in which the currents to be reinforced flow, then the current intensity in the secondary circuit will, in consequence of the small resistance prevailing in the discharge tube, rise to such a degree that the sensitive apparatus connected into this circuit is apt to be easily damaged. It is therefore of great advantage to augment the resistance in the discharge or secondary circuit. This may be done by reducing the superficial area of the cathode. By these means the further advantage will be gained that the materially reduced voltage existing in the heating current will prove sufficient.

If however the amount of electrical energy necessary to heat the cathode is reduced, and if this reduction is carried beyond a certain value, then the discharge will become unstable and the current intensity of the discharge cannot be maintained at a constant value. Whenever therefore any considerable variation of the voltage occurs, the discharge will cease and will not restart in the course of any subsequent rise of voltage. This phenomenon is due to an insufficient ionization of that portion of the discharge tube which is situated at the cathode side of the grid-like auxiliary electrode. In relays working with high heating current voltages there reigns a rather strong ionization in the portion of the tube situated below the auxiliary electrode, so that great variations of the voltage in the discharge circuit even when these drop to a point below the ionization voltage of the gas or vapours in the tube will not be able to extinguish the discharge, since the ionization due to the drop of potential caused by the heating current is sufficiently strong to be always able to restart the discharge when required.

It is the object of this invention to provide an arrangement whereby—even when cathodes of small area and of small heating current voltages are employed, the ionization in the lower space of the tube (serving to contain the cathode) will be such that the discharge will always remain stable. This object is attained by dividing the incandescent cathode into two parts, separated by a resistance, and further by the application of the electrode voltage to these said parts, a second resistance being however interposed. By these means there is obtained the difference of potentials between the two parts of the cathode required to produce a strong ionization.

In the drawing the invention is illustrated by way of example. Each of the figures shows diagrammatically a modification of the apparatus by the aid of which the object of the invention may be practically carried out.

In Fig. 1 of the drawings R is the discharge tube; K^1 and K^2 designate the two parts of the cathode; G is the auxiliary electrode; A is the anode, and Rw, W^1 and W^2 are the resistances. B^1 and B^2 are two batteries or similar sources of direct current, adapted to supply the heating current to

both parts of the cathode. The resistance Rw which is connected in between the two parts of the cathode, is so chosen that a difference of potentials will be caused to exist between the points *a* and *b*; this difference being sufficiently ample to produce a strong ionization in that part of the discharge tube which is located below the auxiliary grid-like electrode G of the relay. Experiments have shown that if a voltage of 220 volts exists between the electrodes, the best relay action will be obtained if a difference of about 30 volts prevails between the points *a* and *b*.

For practical reasons it would prove advantageous to so select the resistance W^1 and Rw that their value will be comparatively large and this to the end that the value of the current intensity in the circuit embracing the source of current, the cathode and the resistances will not become too large.

All other conditions remaining the same, the same relay action will be obtained by the aid of a divided cathode as when a single cathode is employed; the first arrangement however necessitating only an amount of electrical energy which is from 7 to 10 times as small as that of the second arrangement. This material reduction of the heating energy furthermore permits a very considerable reduction of the volume of the discharge tube.

In the modification shown in Fig. 2, the same object is attained by arranging a cold or unheated cathode in immediate vicinity of the heated cathode. To this cold cathode there is applied a constant but adjustable voltage, which is so chosen that between the two cathodes there will exist a difference of potential sufficient to produce the necessary ionization in the lower discharge tube portion. This auxiliary cathode may be of any suitable shape desired. Preferably it may be given the form of a ring or collar or of a cylinder surrounding the incandescent cathode either wholly or only in part. It will of course be understood that it is necessary to arrange the auxiliary cathode below the grid.

In Fig. 2, R is the discharge tube; A the anode; G the grid-like auxiliary electrode; K the heated cathode and H the cold auxiliary cathode which in the present case is given an annular form. B is battery or other source of current adapted to heat the cathode K. Rw is a resistance connected in between the circuit of the electrodes that likewise contain a source of current F; this last-named resistance being furthermore provided with sliding contacts F^1 and F^2. The contact F^1 is connected to the auxiliary cathode H and serves to apply the necessary potential thereto. From the contact F^2 a connection leads to the transformer P of the circuit carrying the currents which are to be re-inforced, and also to the grid G. There is moreover provided a transformer S serving to transform the re-inforced currents.

In this modification the battery B may consist of a single accumulator cell. A further advantage of this modification resides in the fact of only five conductors leading from the tube, whereas six are required in the case of the first-mentioned modification. Besides the introduction of the cold cathode is followed by the advantage that the gleaming or glimmering discharge takes place immediately.

As already mentioned, discharge tubes provided with electrodes of a small superficial area and having a small volume possess a high internal resistance, so that the intensity of the discharge current will be small. Assuming 220 volts to be the difference of voltage between the electrodes and 8 watts to be the amount of electrical energy required to heat the cathode, then the current intensity of the anode current will only amount to a few milliampères. If now a higher voltage is induced in the circuit containing the cathode and the grid electrode, the relay will only re-inforce the currents up to values as are within the limits of the current intensity of the anode current. If only very small energies are present in the primary circuit, the resistance W^2 chosen will preferably be one of a great value so as to reduce the current intensity of the discharge. In such a case the apparatus in the secondary circuit S may be adjusted to a great sensitivity, and this without giving rise to any apprehension of the apparatus being damaged in consequence of any unexpected variations of the voltage in the primary circuit P.

This fact is of particular importance whenever the relay is to be used in wireless telegraphy or telephony, since the strong rush of current caused by atmospheric discharges will not in the case under notice overload the receiving apparatus and thus imperil the same. Further advantages will be secured in connection with portable apparatus in view of the fact that the capacity of the source of current is materially reduced.

What I claim is:—

1. In a relay for undulatory currents comprising a discharge tube with an anode, a cathode, and grid-like auxiliary electrode between said anode and cathode dividing the relay into two separate parts, means to supply current of definite potential to each of said electrodes, and an auxiliary cathode in the portion of the relay containing the cathode, the potential applied to said auxiliary cathode being higher than that of the cathode but less than that of the grid-like electrode.

2. A discharge tube relay for undulatory

currents, comprising an anode, a grid-like auxiliary electrode separating the discharge tube portion into two distinct parts, a cathode divided into two parts, a resistance connected in circuit between the said parts of the cathode, another resistance at the positive end of the cathode, and means for supplying current to said parts of the cathode and to the resistances in order to produce thereby a sufficiently large difference in potential between the different parts of the cathode to cause powerful ionization within the discharge tube below the auxiliary electrode.

3. A discharge tube relay for undulatory currents, comprising an anode, a grid-like auxiliary electrode separating the discharge tube portion into two distinct parts and arranged between the anode and the cathode, a cathode divided into a plurality of parts, resistances interposed between the said parts of the cathode, which parts together with other resistances are connected with the electric tension between the electrodes respectively with the source of current in such a manner that a sufficiently large difference in potential is produced between the said parts of the cathode to cause powerful ionization within the discharge tube below the auxiliary electrode.

4. A discharge tube relay for undulatory currents, comprising an anode, a grid-like auxiliary electrode separating the discharge tube portion into two distinct parts and which is arranged in the tube between the anode and the cathode, a cathode consisting of an incandescent band or wire, which cathode is divided into two parts, these said parts being connected with one another by means of a resistance and being connected with another resistance, as well as with the first-mentioned resistance in circuit in such a manner as to produce a powerful ionization in the discharge tube space below the grid electrode.

5. A discharge tube relay for undulatory currents, comprising an anode, a grid-like auxiliary electrode dividing the discharge tube space into two distinct parts and which is arranged in the tube between the anode and the cathode, a cathode consisting of an incandescent wire or band portion and another non-incandescent portion, the said portions being connected with one another by means of a resistance, and all these parts and the resistance being connected together with another resistance in a common circuit in such a manner as to produce a large difference in potential between the incandescent and the non-incandescent cathode portion and thus obtaining a powerful ionization in the discharge tube portion below the grid-like auxiliary electrode.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

EUGEN REISZ.

Witnesses:
ANNEMARIE REISZ,
HENRY HASPER.