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DISCHARGE TUBE CIRCUIT

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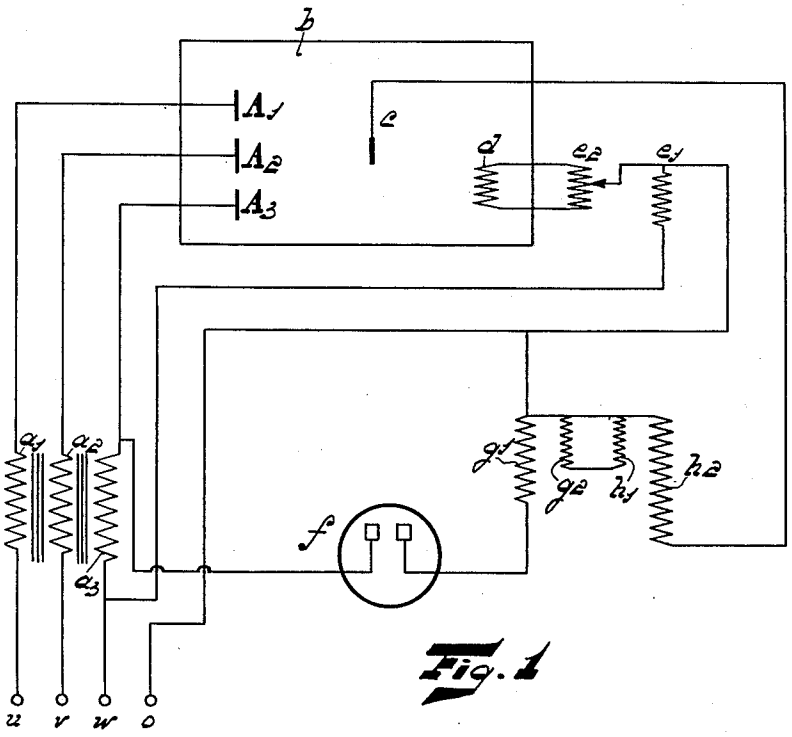


Fig. 1

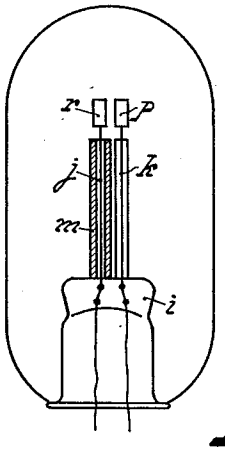


Fig. 2.

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DISCHARGE TUBE CIRCUIT

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10 Claims. (Cl. 176—124)

This invention relates to a circuit arrangement for the delayed ignition of an electric discharge tube and more particularly of an electric discharge tube with positive column light having an incandescent cathode.

With discharge tubes of this type, it is advisable to switch on the operating current some time after the switching on of the heating current. Moreover, the voltage required for the ignition is usually higher than the voltage required for maintaining the discharge in the tube after it has been ignited.

According to the invention, the ignition of the tube with the required delay may be effected in a very simple manner, by inserting a retarding or time delay relay into the conductor controlling the ignition of the tube, said relay being so adjusted that it is rendered operative at the voltage to which the discharge tube is normally connected, but ceases to operate when the voltage decreases appreciably below this value.

The relay serves consequently for placing the tube in operation, while after the ignition of the tube its operating voltage being much lower, the relay ceases working. Due to this, the ignition device is automatically placed out of service, so that it causes no losses during the operation of the tube.

As a rule, a choke coil is connected between the junction terminals of the network and the anodes of the tube. The delay relay is preferably shunted across the conductors leading to the cathode and one anode and is connected to the supply conductor of the anode between the choke coil and the anode. Since a considerable voltage drop occurs in the choke coil immediately after the ignition of the tube, the voltage impressed on the relay also decreases so that it ceases to work.

A very simple arrangement may be obtained by interposing the primary winding of a high tension transformer in series with the relay, the secondary winding of which is connected with the electrode initiating the discharge of the discharge tube. When switching on the relay a current impulse is produced in the primary winding of this transformer, due to which a very high potential difference is set up between the ends of the secondary winding, so that the discharge tube is ignited. Instead of using a transformer an induction coil with an interrupter may also be used. In this case, the ignition is further assured by the rapidly succeeding interruptions of the primary current.

As relay preferably a glow discharge tube is used which is inserted in the circuit arrangement. The ignition of this tube results from deformation of an electrode caused by temperature variations due to the passage of the discharge.

After the discharge has been initiated, the passage of current through the relay should be prevented during the time in which the cathode has a positive potential relatively to the anode to which the relay is connected. This may be insured by means of a relay characterized by the features that one of the electrodes or each electrode is carried by a bimetallic element, while the electrodes are so constructed, that the passage of a current in one direction is entirely or almost entirely prevented. To this effect one of the electrode supports and, if desired, part of the electrode itself is preferably provided with an insulating covering, consisting, for example, of mica.

The invention will be more clearly understood by reference to the accompanying drawing, representing, by way of example, a circuit arrangement for three-phase current, though the circuit arrangement may be also used for discharge tubes which are connected to another number of phases.

Figure 1 shows schematically a discharge tube with positive column light having an incandescent cathode, this tube being placed in a circuit arrangement according to the invention.

Figure 2 shows a form of construction of the relay proper.

In Figure 1 the junction terminals for a three phase network together with a neutral wire are designated by u, v, w, o. These terminals are connected to the anodes A_1, A_2, A_3 of a discharge tube b through choke coils a_1, a_2, a_3. Moreover, the discharge tube includes an auxiliary electrode c for the ignition and an incandescent cathode d, which is fed by a transformer having a primary winding e_1 and a secondary winding e_2.

Between the choke coil a_3 and the anode A_3 a retarding relay is connected to the supply conductor leading to this anode. On its other side this relay is connected to a primary winding g_1 of a high tension transformer. In the embodiment illustrated the tension, by means of the windings g_1, g_2, is first stepped down to that tension for which the primary winding of the high tension transformer h_1, h_2 has been calculated. As stated before an induction coil together with an interrupter may be used, for example, as high tension transformer. The end of the winding h_2 is connected to the auxiliary electrode c.

The relay f may be constructed as shown in

Figure 2. Two bimetallic elements j and k are mounted on a stem i within an evacuated vessel containing an inert gas, for example, a rare gas. One of the elements is surrounded by an envelope m consisting, for example, of mica. The ends of the said elements carry the electrodes r and p. When an adequate tension is applied between these electrodes a glow discharge is produced between the same. Due to the heating the bimetallic elements are curved so that the electrodes r and p bear on each other. Usually two bimetallic elements are used which are so arranged that they are bent in the same direction on heating. Indeed, the sealing of the conductors into the pinch i is attended with a very high temperature. If only one single bimetallic element were used and the other electrode made of an ordinary metal wire, the sealing would be attended with the risk that due to the extremely high temperature the bimetallic element is curved so much, that the other electrode is permanently bent out of position. This is prevented by using two bimetallic elements which are curved in the same direction. If the relay is put into service in the usual way, i. e. by means of a glow discharge, the electrodes will approach each other notwithstanding, since one of the bimetallic elements is covered with mica, so that it does not participate in the discharge, whereas of the other electrode not only the electrode p itself, but also the bi-metal member is covered with the glow, so that this element is heated more quickly up to the required temperature. It has been found, that a very good relay may be obtained also by making only one of the electrodes of a bi-metal, whereas the other electrode is mounted on an elastic support made for example, of molybdenum steel.

However, the mica covering plays still another part. Due to this covering, the glow discharge relay will act more or less as a rectifier, so that the current passing in one direction is much stronger than that passing in the other direction.

This is of great importance to the circuit arrangement shown in Figure 1. As soon as the network is connected to the terminals u, v, w, o a glow discharge current will pass through the relay f, due to which this is closed after some time. Owing to the high tension impressed on the electrode c the discharge tube is ignited. Now the relay will cease working, since the voltage drop occurring in the choke coil a_3 is so great, that the remaining tension while sufficient for the passage of a discharge between A_3 and d in the ignited discharge tube, is insufficient for the passage of an appreciable current through the conductor into which the relay is inserted. During the time in which the discharge passes across A_2 and A_3, however, the cathode will have a positive potential with respect to the anode A_3 so that the electrodes r and p of the glow discharge relay also show a rather great potential difference with respect to each other. However, the passage of a discharge is prevented since in this case the electrode r must act as cathode. This electrode is covered for the greater part with mica, so that a discharge in the direction above referred to will not occur.

Consequently, the losses occurring in the relay during the operation are minimized.

Various modifications are possible without departing from the principle of the invention. It is not absolutely necessary, for example, to mount the ignition electrode within the discharge tube, since an electrode located outside this tube may equally well be used for this purpose, for example, a stroke of aquadag provided on the tube wall.

Furthermore, it is not absolutely necessary to use as a relay a glow lamp having electrodes serving at the same time as a thermo-element, since the retarding relay and the glow lamp may be mounted separately. In this case, the glow lamp serves as a means for assuring the passage of a current only in one direction, the purpose of which has already been set out hereinbefore. This glow lamp may be replaced by any desired type of rectifier. The retarding relay is constituted, for example, by a thermal relay inserted in the conductor between g_2 and h_1, the thermo-element of which is heated by a resistance connected in parallel with the winding g_1.

The whole device is particularly adapted for giving signals and for road and ground lighting, in particular, for use in aeronautics.

What I claim is:

1. In combination a discharge tube for producing light rays and having a gaseous filling and means including a conductor for controlling the ignition of the tube, means for producing the delayed ignition of the tube, said last-mentioned means comprising a slow action relay inserted in the conductor controlling the ignition of the tube, said relay being so adjusted, that it starts operating at the voltage to which the discharge tube is normally connected, but ceases operation when the voltage falls appreciably below this value.

2. Circuit arrangement as claimed in claim 1 comprising at least one anode and a cathode, an impedance connected in circuit with each anode, said relay being connected at one side at a point between one impedance and the respective anode and on the other side to the cathode.

3. Circuit arrangement as claimed in claim 1 comprising an electrode for igniting the tube, a high tension transformer, the primary winding of which is inserted in series with the relay, the secondary winding of this transformer being connected with the electrode igniting the discharge tube.

4. In combination, a discharge tube for producing light rays and having a gaseous filling and an electrode for igniting the tube, means including a conductor for controlling the ignition, means for producing the delayed ignition of the tube, said last-mentioned means comprising a slow action relay and inductance coil and an interrupter inserted in the conductor controlling the ignition of the tube, said relay being so adjusted that it starts operating at the voltage to which the discharge tube is normally connected but ceases operation when the voltage falls appreciably below this value.

5. In combination, a discharge tube for producing light rays and having a gaseous filling means including a conductor for controlling the ignition of the tube means for producing the delayed ignition of the tube, said last-mentioned means comprising a glow discharge tube inserted in the conductor controlling the ignition of the tube and having electrodes which are deformable when subjected to heat, the said glow discharge tube starting operation at the voltage to which the first-mentioned discharge tube is normally connected due to temperature rise resulting when the passage of current therethrough but ceasing operation when the voltage falls appreciably below said value.

6. In combination, a discharge tube for producing light rays and having at least one anode

and a current and a gaseous filling and means including conductors for controlling the ignition of said tube means for producing the delayed ignition of the tube, said last-mentioned means comprising a slow action relay inserted in the conductor controlling the ignition of the tube, an impedance connected in circuit with each anode, a high tension transformer, the primary winding of which is inserted in series with the relay, said relay being connected at one end at a point between one impedance and the corresponding anode, and at the other end to the secondary winding of the said transformer, the other end of the said secondary being connected with the electrode igniting the said tube, said relay being so adjusted that it starts operating at the voltage at which the discharge tube is normally connected, but ceases operation when the voltage falls appreciately below this value.

7. In combination, a discharge tube for producing light rays and having a gaseous filling, and means including a conductor for controlling the ignition of said tube, means for the delayed ignition of the tube, said last-mentioned means comprising a slow action relay inserted in the conductor controlling the ignition of the tube said relay comprising elements subjected to deformation due to the passage of electric energy therethrough, said relay being so adjusted that it starts operation at the voltage normally impressed across the discharge tube, but ceases operation when the voltage falls appreciably below this value.

8. In combination, a discharge tube for producing light rays and having a gaseous filling, and means including a conductor for controlling the ignition of said tube, means for the delayed ignition of the tube, said last-mentioned means comprising a slow action relay inserted in the conductor controlling the ignition of the tube, a glow discharge tube and an electrode deformed due to temperature variations resulting from the discharge therebetween, said relay being so adjusted that it starts operation at the voltage normally impressed across the discharge tube, but ceases operation when the voltage falls appreciably below this value.

9. In a circuit arrangement for the delayed ignition of a discharge tube, a discharge tube, a slow action relay, circuit connections connecting said relay in multiple with said tube, a source of electric supply for said circuit, and an impedance connected in series with the discharge tube for reducing the voltage across the relay after the discharge tube has been ignited.

10. A discharge tube with gaseous filling, comprising main electrodes and an auxiliary electrode, a slow acting relay shunted across said main electrodes, a transformer having a primary winding connected in series with said relay, and a secondary winding connected across said auxiliary electrode and one of said main electrodes.

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