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CIRCUIT ARRANGEMENT FOR GAS FILLED DISCHARGE TUBES

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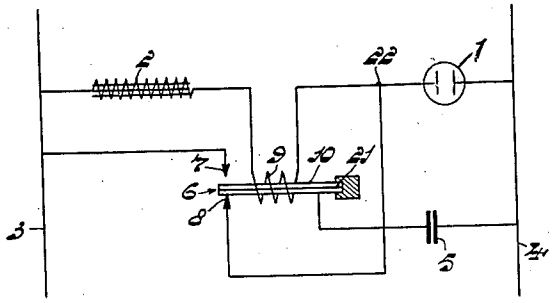


Fig. 1

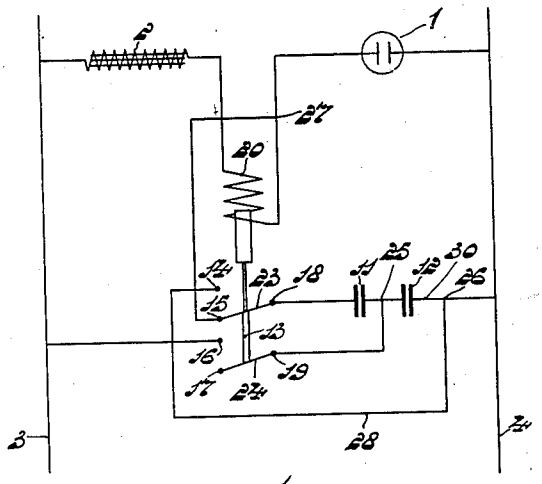


Fig. 2

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CIRCUIT ARRANGEMENT FOR GAS FILLED DISCHARGE TUBES

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The present invention relates to circuit arrangements for discharge tubes, and more particularly to circuit arrangements in which an electric discharge tube having a gaseous filling operates in series connection with an inductance.

As is well known, various gaseous discharge tubes operate in series connection with an inductance, which inductance is to stabilize or limit the discharge current of the tube. The inductance causes the current to lag with respect to the voltage of the alternating current source feeding the circuit, which lowers the power factor of the installation. The current lag can be counteracted and thus the power factor increased, by connecting a capacity in parallel with the series arrangement of the discharge tube and the inductance.

To facilitate the ignition of such discharge tubes it has already been proposed to connect for igniting the tube a capacity in parallel with the discharge tube, and in series with the inductance, whereby preferably the value of the capacity is so selected that a condition of resonance, or approximating resonance, is obtained in the circuit arrangement.

The present invention relates to a circuit arrangement in which one or more condensers have the double function of both facilitating the ignition of the discharge tube during the ignition period and of improving the power factor during operation of the tube. For this purpose I provide switching means which connect the condenser or condensers either in parallel with the discharge tube only, or in parallel with the series connection of the discharge tube and the inductance.

Furthermore, in accordance with the invention, for the ignition of the tube, the switch is brought into, or preferably automatically assumes, a position whereby the condenser or condensers are connected in parallel with the discharge tube only during ignition and after the tube has been ignited the switch is brought into, or preferably automatically assumes, a position which connects the condenser or condensers in parallel with the series connection of the tube and the inductance.

Frequently the value of the capacity required to obtain the best results to facilitate ignition of the tube, is different from that required in operation for proper power factor correction. According to my invention, this can be properly taken care of by different groupings of the condensers, or of a number of same, for ignition and for power factor correction. For example, I have found that under certain conditions, proper phase compensation, or power factor correction, requires a capacity about four times as large as is the desired capacity for ignition. In this case two condensers of identical capacity are series-connected for ignition and parallel-connected for power factor correction. In other cases, a series connection of condensers of unequal capacities is used for ignition and a parallel connection of these condensers is used for power factor correction. Other groupings of the condensers may also be used, and under conditions only part of the condensers are required to serve a double function. Irrespective of the exact groupings of the condensers used for ignition and power factor correction respectively, my invention broadly relates to an arrangement in which a capacity is connected by means of switching means in parallel with the tube to facilitate its ignition, and after the tube is ignited, at least part of the same capacity is connected in parallel with the series arrangement of the tube and of the inductance, to increase the power factor.

Preferably the switch is so designed as to automatically effect the required changes in the condenser connection. For this purpose, for instance, a thermostatic switch, for example, a bimetallic switch may be used, the bimetallic member of the switch being actuated by a heating element through which may pass the discharge current of the tube.

Or a magnetic switch may be used, the coil of which is energized by the discharge current of the tube, after the tube has been ignited. Instead of providing a separate coil for the magnetic switch, the latter may be combined with the inductance, whereby when the discharge current of the tube passes through the coil of the inductance, the increased leakage field of the inductance actuates the switch.

My invention will be more clearly understood by reference to the accompanying drawing in which two forms of construction thereof are schematically represented by way of example.

Figure 1 is a circuit diagram embodying a simple form of my invention in which a bimetallic switch is used for automatically changing the connection of a condenser.

Figure 2 is a circuit diagram showing another arrangement in accordance with my invention, in which an electromagnetic switch is used, which connects two condensers in series with each other and in parallel to the discharge tube for the ignition of the tube, and which automatically connects the same condensers in parallel to each other and in parallel to the series connection of the dis-

charge tube and the inductance after the tube has been ignited.

Referring to Figure 1, 1 represents schematically a gas-filled discharge tube. By referring hereinafter to a gas-filled discharge tube is meant a discharge tube having a gaseous filling, irrespective of whether the filling consists of a gas or of a vapor, or of a mixture of gas and vapor, or of a plurality of gases or vapors, or mixtures thereof. Furthermore, the tube 1 comprises either cold or hot electrodes and in the case of hot electrodes, these may be heated either directly or indirectly, or may be heated by the discharge.

Various gases, for instance, inert gases, such as neon, argon, helium, etc. and/or vapors, as that of mercury or of other metals, may be used as the gaseous filling.

In the example given, the discharge tube is assumed to have a neon filling and to serve for the emission of light.

The inductance 2 is shown as a choke coil which is in series arrangement with the discharge tube 1, this series arrangement being connected between the supply conductors 3—4, which are connected through a switch, to an alternating current source (not shown).

Connected between the choke coil 2 and the tube 1 is a heating element 9 shown as a coiled wire and forming part of a bimetallic switch 6. The switch 6 includes a bimetallic strip 10 anchored at its end 21, and cooperating with its free end with an upper contact 7 and a lower contact 8, depending upon the temperature of the strip 10.

A condenser 5 is permanently connected with one terminal to the supply conductor 4 and with its other terminal to the bimetallic strip 10.

The contact 8 is connected at 22, with one end of the discharge tube, whereas the contact 7 is connected with the supply conductor 3.

As long as no current passes through the discharge tube 1 the bimetallic strip 10 remains cold and thereby assumes the position shown in Figure 1, whereby it contacts with the lower contact 8. This connects the condenser through strip 10 to the point 22 whereby the condenser is placed in parallel with the discharge tube 1, and upon application of voltage to the supply conductors 3 and 4 assists in the ignition of the tube.

The current passing through the condenser 5 and the choke coil 2 is small and while passing through the heating element 9 does not cause a substantial heating of the bimetallic strip 10.

However, after the tube 1 has been ignited, the discharge current also passes through the heating element 9. The latter current is of sufficient magnitude to cause the strip to heat up. The strip 10 then assumes a posiiton in which it contacts with the upper contact 7, having first broken its connection with the contact 8.

With the strip 10 in this position the condenser 5 is connected through strip 10 and contact 7, to the supply conductor 3, thereby placing the condenser 5 in parallel with the series arrangement of the discharge tube 1 and the inductance 2. The result is that the current lead caused by the condenser partly or fully compensates the current lag caused by the choke coil, and a satisfactory power factor is obtained.

In the circuit arrangement shown in Fig. 2, instead of a bimetallic switch, an electromagnetic switch is used, the coil 20 of which is inserted in the series connection of the discharge tube 1 and the choke coil 2. The plunger 13 of the switch is of insulating material, and carries two levers or contact arms 23 and 24. The lever 23 is hinged at 18 and cooperates with its free end with an upper contact 14, and a lower contact 15, and the lever 24 is hinged at 19 and cooperates with its free end with an upper contact 16 and a lower contact 17. Depending upon the position assumed by the plunger 13, the levers contact with either their lower or their upper cooperating contact.

Connected between the supply conductor 4 and the heel 18 of the lever 23 are two series-connected condensers 11 and 12. The junction point 25 of the two condensers is connected to the heel 19 of the lever 24, whereas the lead 30 connecting the condenser 12 to the supply conductor 4, is connected at 26 to the upper contact 14 of lever 23 by means of the lead 28.

The upper contact 16 is connected to the supply conductor 3 and the contact 15 is connected to a point 27 intermediate between the discharge tube 1 and the coil 20; the contact 17 being a dead contact.

Before the discharge tube is ignited the switch 13 occupies the position shown in Fig. 2, in which the levers 23 and 24 contact with the lower contacts 15 and 17 respectively. In this position of the switch the condensers 11 and 12 are in a series connection, which is connected with one end to the supply conductor 4 (to which is also connected one end of the discharge tube 1), whereas the other end of the series connection of the condensers is connected through heel 18, lever 23, contact 15 and at 27, to the other end of the discharge tube 1. The two series-connected condensers are thus in parallel with the discharge tube and facilitate the ignition of the tube. The condensers 11 and 12 may be given such a value that when so connected they are in resonance with the choke coil 2, with which they are in series connection.

After the tube 1 has been ignited, a discharge current passes through same, as well as through the winding 20 and choke coil 2, which current is of sufficient magnitude to energize coil 20 as to attract the plunger 13.

The attraction of the plunger 13 swings the levers 23 and 24 into that position in which they contact with the upper contacts 14 and 16 respectively. As a result thereof, the point 25 of the condensers 11 and 12 is connected through lever 24 and contact 16, to the supply conductor 3, and the lever 23 is connected through contact 14 and wire 28 to the point 26.

In this manner one terminal of each of the condensers 11 and 12 is connected to the supply conductor 4; the terminal of condenser 11 being connected to point 26 through heel 18, lever 23, upper contact 14 and wire 28. The other terminals of the condensers 11 and 12 are connected to the point 25 which is connected through heel 19, lever 24 and contact 16 to the supply conductor 3.

This places the condensers 11 and 12 in parallel connection with each other and also in parallel to the series connection of the discharge tube 1 and the choke coil 2.

When in the latter connection, the condensers serve to compensate for the phase lag due to the choke coil, the capacity available for this purpose being four times that used for ignition.

With other constants of the circuits, other relations of the capacities may be required. In such cases, the proper values of the capacities for ignition and operation may be obtained, for instance, by using two or more condensers which are not of equal capacity. In general, by proper

selection of the number and capacity of the condensers and by their different grouping for ignition and for phase compensation, it is possible to obtain substantially the most desirable capacity values for both the ignition and the phase compensation.

While I have described my invention in connection with specific embodiments and in specific applications, I do not wish to be limited thereto, but desire the appended claims to be construed as broadly as permissible in view of the prior art.

What I claim is:

1. A circuit arrangement comprising a gas-filled discharge tube, an inductance connected in series with the tube, a capacity, and switching means to alternately connect said capacity in parallel with the discharge tube and in parallel with the series connection of the discharge tube and inductance.

2. A circuit arrangement comprising a gas-filled discharge tube, an inductance connected in series with the tube, a capacity comprising two condensers, and a two-position switching means to connect in one position said two condensers in series with each other and in parallel with the tube and in the other position in parallel with each other and in parallel with the series connection of the tube and inductance.

3. A circuit arrangement comprising a gas-filled discharge tube, an inductance connected in series with the tube, a capacity, and means to automatically connect said capacity in parallel with the tube to facilitate the ignition of the tube, and to automatically connect said capacity in parallel with the series connection of said tube and inductance after the tube has been ignited.

4. A circuit arrangement comprising a gas-filled discharge tube, an inductance connected in series with the tube, and a current-responsive device connected in series with said tube and said inductance, a capacity connected in parallel with said tube for the ignition of said tube, said current-responsive device upon passage of the discharge current of the ignited tube causing said capacity to be connected in parallel with the series connection of said discharge tube and inductance.

5. A circuit arrangement comprising a gas-filled discharge tube, an inductance connected in series with the tube, a capacity comprising a plurality of condensers, and a switching means having two positions, in one of said positions grouping said condensers into a group and connecting said group in parallel with the tube, and in its other position grouping said condenser into a different group and connecting said group in parallel with the series connection of the tube and inductance.

6. A circuit arrangement comprising a gas-filled discharge tube, an inductance connected in series with the tube, a bimetallic switch having a heating coil connected in series with said tube and said inductance, and a capacity connected in parallel with said tube for the ignition of the tube, said switch upon the passage of the discharge current of the ignited tube causing said capacity to be connected in parallel to the series connection of said discharge tube and inductance.

7. A circuit arrangement comprising a gas-filled discharge tube, an inductance connected in series with the tube, an electromagnetic switch having an actuating coil in series with said tube and said inductance, and a capacity connected in parallel with said tube for the ignition of the tube, said switch upon the passage of the discharge current of the ignited tube causing said capacity to be connected in parallel to the series connection of said discharge tube and inductance.

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