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J. J. KNOUSE ET AL

2,278,079

LAG VOLTAGE CONTROLLER AND DISCHARGE LAMP CIRCUIT

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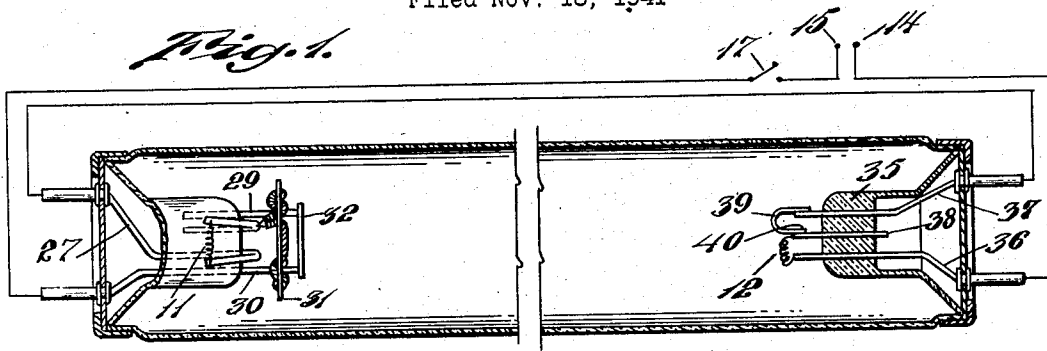


Fig. 2.

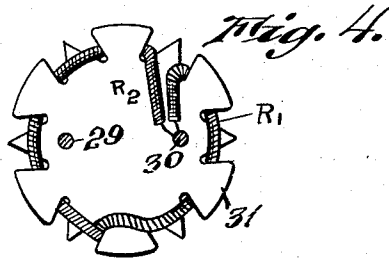
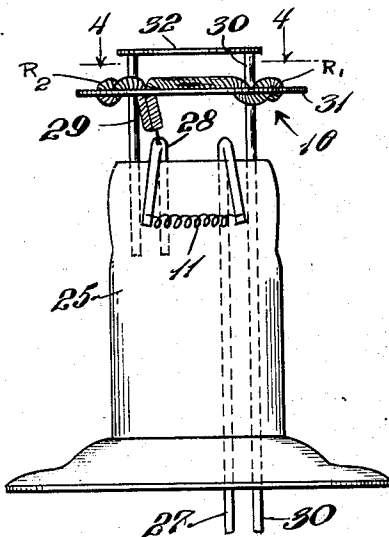


Fig. 5.

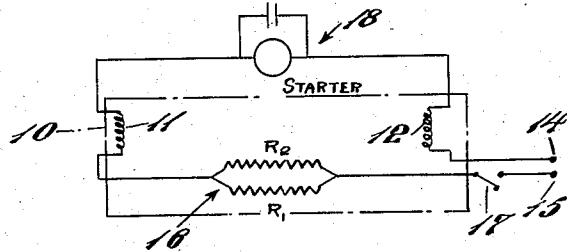


Fig. 5.

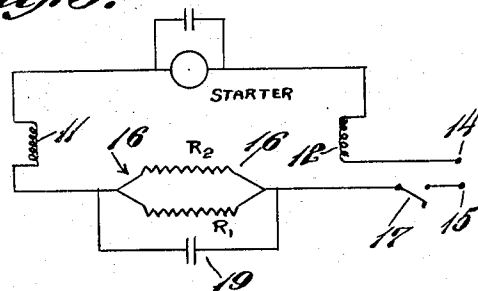
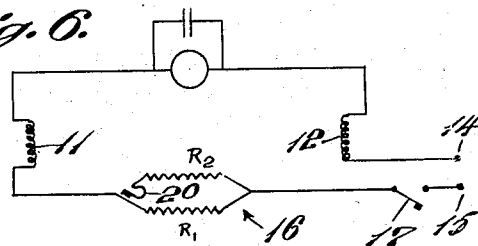


Fig. 6.



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LAG VOLTAGE CONTROLLER AND
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10 Claims. (Cl. 176-124)

This invention relates to gaseous discharge lamp, such for instance as the lamp used in fluorescent lighting at the present time, and particularly to such lamps which are operable at or below the potential of the customary domestic source of electrical energy.

In lamps of this type wherein a gas-filled electric discharge tube is provided with oppositely disposed filamentary electrodes which are provided with a suitable electron emitting coating and heated from a suitable source of electrical energy, to an electron emitting temperature, the electrodes are usually connected in series with an inductor and some capacitor across the terminals of the current source to produce the voltage drop to obtain the operating voltage of the lamp; and some device is connected in the series to interrupt the heating current after the electrodes have become heated sufficiently to start a discharge at the electrodes, which interruption causes a greater voltage than normal. The arrangement therefore was such that upon interrupting the series connected electrodes a voltage surge occurs, due to the inductance which builds up this voltage sufficiently so that a discharge occurs between the electrodes. Automatic devices have usually been provided called starters for the purpose of interrupting the series circuit. The inductor is one of the more expensive parts of the circuit, and this inductor together with the capacitor usually must be shielded because of the disturbance which may be caused to parts with which it is associated.

One of the objects of this invention is to eliminate the expensive inductor which is provided in such a circuit and to substitute therefor a pure resistance of a high resistance coefficient arranged in such a way as to give the proper time lag required for heating the filament.

Another object of this invention is to provide a controlled current surge in the circuit.

Another object of this invention is to utilize the heat generated by such resistance voltage to enhance the lighting value of the glow between the electrodes of our lamp.

Another object of the invention is to arrange this resistance within the gaseous discharge lamp itself making unnecessary the handling of such a part as a separate unit for the circuit.

Another object of the invention is to include the automatic circuit-interrupting device within the gaseous discharge tube itself and to utilize the gas of the tube itself in connection with the interrupter.

With these and other objects in view, the in-

vention consists of certain novel features of construction, as will be more fully described and particularly pointed out in the appended claims.

In the accompanying drawing:

5 Fig. 1 is a sectional view shown largely diagrammatic of a gaseous discharge lamp and illustrating the line source of potential as connected thereto.

Fig. 2 is an elevational view of the stem portion shown at the left hand end of Fig. 1.

Fig. 3 is a diagrammatic view of the circuit.

10 Fig. 4 is a sectional view on line 4-4 of Fig. 2.

Figs. 5 and 6 are diagrammatic circuits showing some modifications as may be employed in the use of this invention.

15 In proceeding with this invention we have eliminated the expensive inductor which is frequently used in the circuit of a gaseous discharge lamp such for instance as a fluorescent lamp which is supplied from the domestic potential. This inductor which provided the voltage drop and produced the voltage surge when the circuit was interrupted in order that a discharge might occur between the electrodes of the gaseous discharge lamp, is replaced by the use of unequal noninductive resistances connected in parallel in the circuit so that the heat of these resistances will be distributed and a time lag will occur, to permit the filaments to become hot, followed by a change in the current circuit to cause a discharge between the electrodes. The pure resistance which we use may be made of rather small volume and may be supported within the gaseous discharge lamp itself. Thus the heat which is generated by this resistance will increase the ionization of the lamp thus giving a greater efficiency of light output. The resistance may operate by connection of different values of resistance in parallel permanently but under some conditions it may be desirable to permit the electrodes to heat before the parallel arrangement of the resistances is put in the circuit and accordingly we may regulate the time of cutting in of the resistance in parallel by the use of a bi-metal switch so that desirable results of this delay may be provided for.

20 We have also found that the so-called starter or circuit interrupter, now a separate unit, and in many instances utilizing a rare gas for a glow discharge between its electrodes, may be incorporated in the gaseous discharge lamp itself, thus eliminating the separate handling of a starter, and socket therefor, which has heretofore been provided. From this arrangement it will therefore be apparent that we may make an

electric discharge lamp which for installation need only have sockets therefor provided and a separate handling of a starter or an inductor and capacitor may be eliminated. Thus the installation of a fluorescent lamp or gaseous discharge lamp of this character will be much simplified.

With reference to the drawing and with particular reference to Fig. 3 we have shown at 10 in dotted lines a gaseous discharge lamp such as a fluorescent tube being provided with electrodes 11 and 12 therein which are of a filamentary character and usually composed of a refractory metal such as tungsten or the like in a coil which coil is coated with an electron emitting material such as an oxide of barium or strontium to provide a flow of electrons when heated. The lamp is usually evacuated and filled with a rare gas such as argon at a few millimeters pressure so as to facilitate starting and to which is added a few drops of mercury.

The source of supply of electrical energy is usually the domestic house current, the terminals of which are designated 14 and 15 and as shown in Fig. 3 one terminal 14 is connected to the electrode 12 while the other terminal of the electric source of supply is connected to the electrode 11 with resistance element 16, to be later described in greater detail, and a circuit closing switch 17 interposed in this line. The two electrodes are connected together in series through a starter designated generally 18 which may be a known starter utilized in the trade, or the starter may be of a type to be mounted within the lamp which will be later described in greater detail. The circuit just described is similar to that already in use except that the resistance element 16 is different and is supplied in the circuit instead of an inductor.

The starter designated 18 and including a condenser when used as a separate unit such as illustrated in Fig. 3, may be a starter of the type shown in the Dench Patent 2,200,443 or the Hayes Patent 2,228,210. Its function is to break the circuit automatically after sufficient heating of the electrodes has occurred.

In a circuit of this character it is sometimes desirable to build up a voltage above the line voltage for starting, which we accomplish by a capacitor designated generally 19 shunted across the resistances 16 and as we have shown in Fig. 5 although under most circumstances where the lamp will start at line voltage we would not need a capacitor in this location.

The resistance unit 16 will be of a pure resistance character and will comprise two sections of resistances connected in parallel. The resistance unit as a whole will be so chosen with reference to the lamp with which it is to be used so that there will be a voltage drop from the source of supply to bring the line voltage down to the voltage at which the lamp is designed to operate. The two sections of resistances R_1 and R_2 will be so chosen as to provide a sufficient differential between them so that a current surge equal to or greater than the operating current of the lamp will occur when the circuit is closed by the starter in Fig. 3. It will be readily realized that the values of the resistances R_1 and R_2 will vary according to the different conditions under which the resistance unit is called upon to operate, but for illustrative purposes assuming a line voltage of substantially 115 volts and a 20 watt lamp designed to operate at 60 volts .440 MA current we will choose one resistance R_1 at 400 ohms and the other resistance R_2 at 250 ohms

and we find that this will provide values in accordance with the formula

$$\frac{R_1 \times R_2}{R_1 + R_2}$$

to give the desired results.

In some cases it may be desirable to provide a delayed action in the cutting in of one of the resistances so as to allow sufficient time for the electrodes 11 and 12 to become heated and where this is desirable we provide a bi-metal 20, see Fig. 6 connected to the resistance R_2 which is so designed that when the heat generated by R_1 becomes sufficient the bi-metal 20 will flex to shunt in the resistance R_2 so that these two may operate in parallel in the circuit. The bi-metal may be so chosen as to provide the desired time lag for the heating required. By the use of this arrangement in many instances we may prevent blackening at the end of the lamp which might occur and does in some cases occur where a fluctuating discharge occurs before the electrodes become heated sufficiently.

By the arrangement of unequal resistances in this manner the shunting of one resistance across another will produce a current and build up the ionization in the gaseous discharge tube until it becomes sufficiently dense to extend across the tube from one electrode to the other and cause a glow discharge to occur.

The resistances may be very small and take up much less space than an inductance ballast which heretofore was frequently used in a circuit of this character. The resistances may be made sufficiently small to be incorporated in the envelope end of a gaseous discharge tube and when the resistance is located within such tube the heat which it generates serves to raise the temperature of the tube that it may burn brighter. In Fig. 2 we have illustrated a stem 25 of glass material which shows the resistance designated generally 16 as mounted in position on a stem for location within a gaseous discharge tube. The stem 25 has two lead-in wires 30 and 27 with spuds 28 and 29 also shown in the stem. The electrode 11 is shown as positioned between lead-in 27 and the spud 28, a resistance support 31 comprising a disc with a plurality of notches in its edge is mounted on the spud 29 and lead-in 30. The coiled resistances R_1 and R_2 are woven back and forth in the notches and are both connected to spud 28 at one end and to the lead-in 30 at the other end. A suitable shield 32 is provided over the top of the resistors.

It will be readily apparent that the resistor designated generally 16 may either be provided as a separate unit to be substituted for the inductor now used in the circuit or it may be mounted on a stem press to be incorporated in the lamp itself, and thus require no outside connection and be much more simple for installation of the lamp. The non-inductive resistors are sufficiently inexpensive so that recovery when the lamp is burned out is of no importance.

Although the lamp heretofore described may be utilized as a complete unit with a separate starter, the starter may be also utilized within the lamp itself, and we have shown in Fig. 6 a stem designated generally 35 having lead-in wires 36 and 37 and a spud 38 provided in the stem. An electrode filament 12 will be supported between the lead-in 36 and the spud 38 while we may provide a bi-metal 39 secured to the lead-in 37 as by welding and so arranged that it normally contacts spud 38. The bi-metal 39 is so

arranged that when it becomes heated its end 40 will separate from spud 38 to break the circuit.

In operation the electrodes 11 and 12 become heated, and when heated sufficiently, the tube will become lighted. This heating of the electrodes also heats the bi-metal 39 by reason of current passing therethrough and from the heat of the electrodes and causes the bi-metal to contract sufficiently so as to separate its end 40 from the spud 38 and thereby break the shunt circuit. The ionization of the gas in the tube for a glow discharge between the electrodes serves to keep the bi-metal contracted and the shunt circuit open.

By the use of our resistance, we are able to do away with the expensive part of the fluorescent lighting circuit as it at present exists in domestic installation; the resistance being of such a type that it may be made small also enables us to incorporate the resistance in the lamp itself, to also reduce installation cost and while carrying the matter of reducing installation cost still further we may incorporate the starter within the tube which starter operates differently than the separate starter mentioned above in either the Dench or Hayes patent, as in our lamp the bi-metal initially closes the circuit which opens and remains open during the operation of the gaseous discharge lamp.

We claim:

1. A gaseous electric discharge lamp comprising an envelope, electrodes and an ionizable medium therein, and unequal resistances within said envelope and connected in parallel in the lead to one of said electrodes for producing a current surge at the start of the lamp.

2. A gaseous electric discharge lamp comprising an envelope, electrodes and an ionizable medium therein, and unequal resistances within said envelope and connected in parallel in the line to one of said electrodes for producing a current surge at the start of the lamp, and a starter within said envelope to be in series with one of said electrodes.

3. A gaseous electric discharge lamp comprising an envelope, an ionizable medium within said envelope, a pair of stems extending into said envelope, an electrode supported by each stem, unequal resistances supported by one stem and connected in parallel in the line to the electrode on said stem for producing a current surge.

4. A gaseous electric discharge lamp comprising an envelope, an ionizable medium within said envelope, a pair of stems extending into said envelope, an electrode supported by each stem, unequal resistances supported by one stem and connected in parallel in the line to the electrode on said stem for producing a current surge, and a relay supported by the other stem within said envelope and in series with the electrode supporting said relay.

5. The combination with a source of electrical energy a load designed to operate at a voltage below that of said source of energy, means for causing a voltage drop in said line between said source and line comprising a resistance unit having therein unequal resistances connected in parallel, a shunt circuit across said load, and means for making and breaking said shunt circuit so arranged as to break said shunt circuit

upon operation of said load and re-establish said circuit upon inoperation of said load.

6. The combination with a source of electrical energy a load designed to operate at a voltage below that of said source of energy, means for causing a voltage drop in said line between said source and line comprising a resistance unit having therein unequal resistances connected in parallel, a shunt circuit across said load, and an electric relay for making and breaking said shunt circuit so arranged as to break said shunt circuit upon operation of said load and re-establish said circuit upon inoperation of said load.

7. The combination with a source of electrical energy a load designed to operate at a voltage below that of said source of energy, means for causing a voltage drop in said line between said source and line comprising a resistance unit having therein unequal resistances connected in parallel, a shunt circuit across said load, and a gaseous electric relay for making and breaking said shunt circuit so arranged as to break said shunt circuit upon operation of said load and re-establish said circuit upon inoperation of said load.

8. In combination, a circuit having a source of electrical energy, a gaseous electric discharge lamp provided with a readily ionizable medium and having therein electrodes adapted to be heated to electron-emitting temperature, a resistance unit in said circuit comprising non-induction resistances in parallel, said resistances being chosen of such unequal values as to produce sufficient delay for the heating of the filament to proper electrode-emitting temperature and a current surge for the operation of said lamp, and a controlled shunt circuit across said lamp.

9. In combination, a circuit having a source of electrical energy, a gaseous electric discharge lamp designed to operate at less than that of the voltage of the electrical source and provided with a readily ionizable medium and having therein electrodes adapted to be heated to electron-emitting temperature, a resistance unit in said circuit of such total value as to reduce the voltage of the electrical source to the voltage of the lamp comprising non-induction resistances in parallel, said resistances being chosen of such unequal values as to produce sufficient delay for the heating of the filament to proper electrode-emitting temperature and a current surge for the operation of said lamp, and a controlled shunt circuit across said lamp.

10. In combination, a circuit having a source of electrical energy, a gaseous electric discharge lamp provided with a readily ionizable medium and having therein electrodes adapted to be heated to electron-emitting temperature, a resistance unit in said circuit comprising non-induction resistances in parallel, means to shunt one of said resistances across the other after a predetermined length of time, said resistances being chosen of such unequal values as to produce sufficient delay for the heating of the filament to proper electrode-emitting temperature and a current surge for the operation of said lamp, and a controlled shunt circuit across said lamp.

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