

# United States Patent

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**[54] DISCHARGE LAMP WITH CIRCUIT ELEMENTS  
INCORPORATED IN THE ENVELOPE  
8 Claims, 2 Drawing Figs.**

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315/60, 315/61, 315/261

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H01j 61/56, H05b 41/19

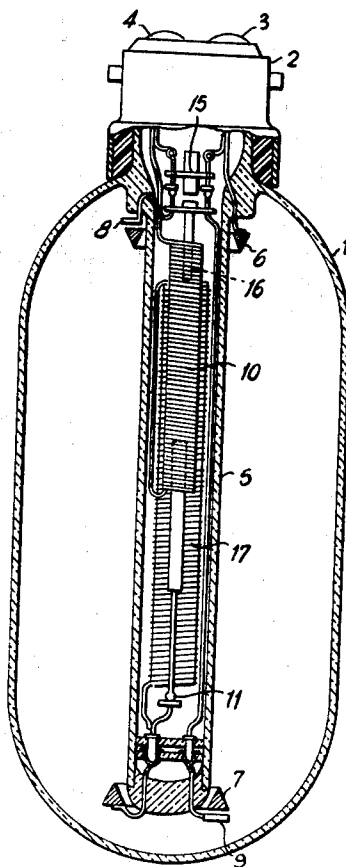
[50] Field of Search..... 315/49, 56,  
58, 98, 60, 100U, 61, 100H, 261

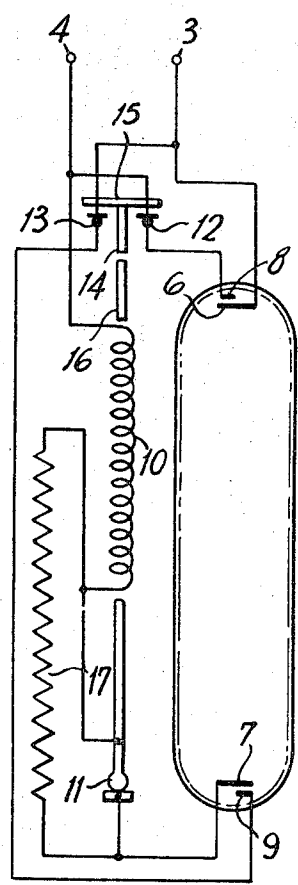
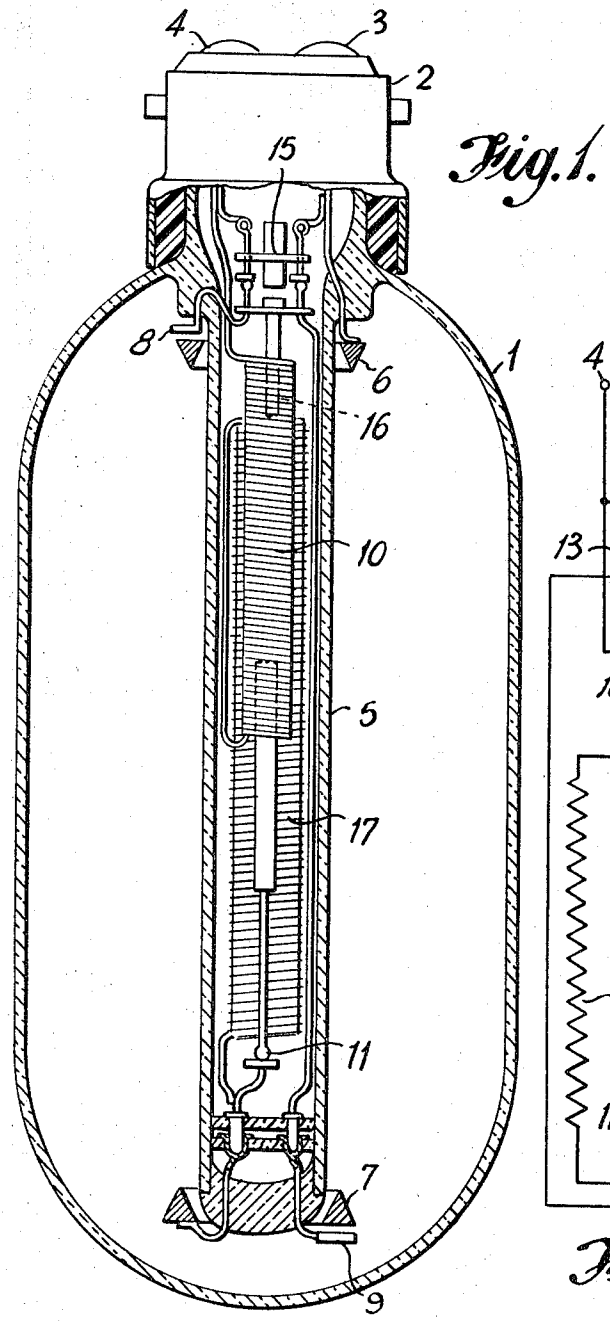
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**ABSTRACT:** A fluorescent lamp has two external terminals only. The envelope contains a pair of main electrodes at its opposite ends and a pair of starter electrodes each close to a main electrode. On switching on the lamp discharges are struck between each main electrode and its adjacent starter electrode and current-operated relays within the envelope function to switch the supply voltage across the main electrodes when the initial discharges reach sufficient magnitudes. This causes the main discharge to strike. A ballast resistor switched in by another relay can also be included within the envelope thus enabling the external terminals to be connected directly to a mains supply.





## DISCHARGE LAMP WITH CIRCUIT ELEMENTS INCORPORATED IN THE ENVELOPE

This invention relates to discharge lamps, particularly fluorescent discharge lamps.

Fluorescent lamps comprise a pair of electrodes provided within an envelope containing an appropriate gaseous atmosphere and having a fluorescent coating. In operation a discharge is struck between the electrodes which excites the coating to emit light of wavelengths dependent on the composition of the coating.

Due to the characteristics of the discharge a ballast impedance is required in series with the electrodes to limit the current. In addition some means of initiating the discharge is required. This usually involves passing an initial starting current through the electrodes to heat them and thereby produce thermionic ions and then breaking this current by means of a starter switch and causing a sufficient voltage to strike the discharge to be applied between the electrodes. It is therefore normal practice to provide a fluorescent lamp with two pairs of external terminals, each electrode being connected to a pair of terminals and external ballast and switching components are connected in circuit with the lamp and the electricity supply. In contradistinction an incandescent lamp requires only one pair of external terminals which are directly connected to the mains electricity supply to energize the lamp without requiring an external auxiliary component.

It is an object of the invention to provide a fluorescent discharge lamp having only one pair of external terminals.

The present invention accordingly comprises a fluorescent discharge lamp having a pair of external terminals in which an initial discharge is struck when an operating potential is applied between the lamp terminals, which initial discharge is switched when the initial discharge current reaches a set value to cause the main discharge to strike.

In carrying out the invention there may be provided a pair of main electrodes between which the main discharge occurs and at least one and preferably a pair of starter electrodes each positioned close to a respective main electrode and between which and the main electrodes initial discharges are struck.

A lamp embodying the invention may include connections from the terminals to each main electrode, further connections including switch means from the terminals to each starter electrode whereby the application of an operating potential to the terminals causes initial discharges to be struck between each main electrode and its associated starter electrode, the switch means acting to open when the initial discharge current reaches a set value and thereby cause the discharge to be transferred to between the main electrodes.

The switch means may comprise a two-pole switch the poles of which are included in the respective connections to the starter electrodes and which is operated by a relay coil and an armature, the relay coil being included in one of the connections to a main electrode, which connection may also include current limiting means in the form of a ballast resistance, the current limiting means being short-circuited by a switch which is opened by the action of the current through the relay coil when the main discharge is struck. The lamp terminals can then be directly connected to an appropriate electrical supply.

Preferably the ballast resistance and the switch means are all contained within a tube located centrally of the envelope of the lamp and the main electrodes are annular in shape and surround the tube.

In order that the invention may be more fully understood reference will now be made to the accompanying drawing in which:

FIG. 1 illustrates in cross section a lamp embodying the invention, and

FIG. 2 is a circuit diagram which more clearly illustrates the auxiliary components contained within the lamp.

Referring now to the FIGS. a fluorescent discharge lamp comprises a glass envelope 1 and a cap 2 having a pair of external terminals 3 and 4. Cap 2 is illustrated as a standard bay-

onet-type cap, but clearly any other cap having a pair of terminals can equally well be used, for example an Edison screw cap. Located within envelope 1 is a tube 5 containing various auxiliary components which will be described in more detail below. Surrounding tube 5 and spaced apart from each other by about 10 cms., are a pair of annular main electrodes 6 and 7. These electrodes have a triangular cross section with the apexes of the triangles facing each other and are formed of solid tungsten. The space within envelope 1 and outside tube 5 is filled with a suitable gas at an appropriate pressure, for example, argon at a pressure of 4.5 mm. Hg with a small amount of mercury sufficient to coat the inner surface of envelope 1. In addition to electrodes 6 and 7, two starter electrodes 8 and 9 are provided, the starter electrodes being positioned behind the main electrodes 6 and 7 and in close spaced apart relationship thereto. For a lamp designed for a mains voltage of 220 v. the spacing between a starter electrode and its associated main electrode is 2.5 mm., while for a lamp designed to operate at 110 v., the spacing is 1.5 mm. The starter electrodes preferably have a length of about 4 mm. and are positioned respectively on diametrically opposite sides of tube 5.

All the auxiliary components for ballast and starting purposes are located within tube 5. These components are more clearly illustrated in FIG. 2. They comprise a relay coil 10 through which the lamp current flows and which controls on the one hand a switch contact 11 which is held closed by a spring (not shown) until a predetermined current flows through coil 10 and on the other hand a pair of switch contacts 12 and 13 which are each held closed by a magnet 14 to which is secured a cross piece 15 which presses against the contacts 12 and 13. An iron bar 16 is positioned in close proximity to magnet 14 and in a position to be influenced by the current through coil 10 such that when the current through coil 10 exceeds a particular value, bar 16 is magnetized to repel magnet 14 and thus allow switch contacts 12 and 13 to open. The lamp terminal 3 is directly connected to electrode 6 and through contacts 13 to starter electrode 9, lamp terminal 4 is directly connected through coil 10 and contact 11 to main electrode 7 and also through contacts 12 to starter electrode 8. A ballast resistance 17 is connected across switch contact 11.

When a mains voltage is initially applied between terminals 3 and 4 as by plugging in a lamp or by operating an external switch. Contacts 11, 12 and 13 are all initially closed. It will thus be seen that the full mains voltage is applied between main electrode 6 and its associated starter electrode 8 and similarly through coil 10 between main electrode 7 and its associated starter electrode 9. The application of these voltages causes an initial discharge to be struck between each main electrode and its associated starter electrode and a small current flows. The current between electrodes 7 and 9 passes through coil 10 and this initial current polarizes bar 16 sufficiently to cause it to repel magnet 14 and thus break contacts 12 and 13. The breaking of these contacts removes the supply voltage from starter electrodes 8 and 9 and the agitation of the ions generated by the initial discharge is sufficient to allow the main discharge between electrodes 6 and 7 to be struck. The rise in current that takes place on the striking of the main discharge opens contact 11 and thereby inserts ballast resistance 17 in series with the main discharge between electrodes 6 and 7 to prevent an excessive rise of current.

Envelope 1 can be provided with any suitable internal fluorescent coating. Electrodes 6 and 7 may conveniently be coated with a mixture of calcium triple carbonate and zirconium in the proportion of 60 percent of the former and 40 percent of the latter baked in at a temperature of 1,500° C. for 2½ hours.

To simplify the process of manufacturing the lamp the lead wires to electrodes 7 and 9 may be terminated at pins sealed in the end face of tube 5. It is thus possible to complete the construction of all the auxiliary components which are required to be located within tube 5 separately from the lamp and then insert these components as a complete unit into tube 5 with the

two end leads terminating in sockets which enter the pins in the end seal of the tube.

While the lamp ballast is illustrated as comprising a resistance 17 provided within the lamp envelope it will be understood that it is possible to provide current limiting means externally of the lamp without departing from the invention. With such an arrangement switch 11 and resistance 17 are dispensed with and relay coil 10 is directly connected to main electrode 7. Current limiting means is provided between one or other of terminals 3 and 4 and the supply and may comprise a resistance or a choke. In such a case the current limiting means is permanently connected in the circuit.

It will be understood that the dimensions for the electrode structure are quoted by way of example only and may be varied without departing from the invention. Equally the envelope may have any shape of a decorative nature consistent with functional requirements and the shape is in no way limited to the illustrated example.

I claim:

1. A fluorescent discharge lamp comprising: a pair of external terminals, a first and a second main electrode spaced apart from each other, a first starter electrode positioned adjacent said first main electrode, a second starter electrode positioned adjacent said first main electrode, a second starter electrode adjacent said second main electrode;  
a first of said pair of external terminals being connected directly to a first of said pair of main electrodes;  
said first of said pair of terminals being connected through a first pair of contacts directly to said second starter electrode;  
the second of said pair of terminals being connected through a second pair of contacts directly to said first starter electrode;  
said second main electrode being connected through a third pair of contacts to the second of said pair of terminals;  
the only electrical coupling within the lamp of said first and said second terminals being either from said starter electrodes to said adjacent main electrodes or from said first main electrode to said second main electrode; and  
switch means in series with said third pair of contacts for operating said first, second and third contacts from a normally closed position to an open position responsive to a certain current amplitude through said switch means to terminate current flow from the starter electrodes to the adjacent main electrode while maintaining current flow

across the main electrodes.

2. The fluorescent discharge lamp of claim 1, Wherein: said switch means comprises relay means, armature means in said relay means for operating said first and second pair of contacts responsive to said certain current amplitude;

said armature means coupled to one each of said first and second pair of contacts;

means for actuating said armature means to move responsive to said certain current amplitude flowing through the coil of said relay means.

3. The lamp as claimed in claim 1 in which an insulating housing is provided within the lamp envelope within which housing the switch means is located.

4. The lamp of claim 3, wherein current limiting means are connected across said third pair of contacts, whereby said current limiting means are included in at least one of the connections from the terminals to the main electrodes after said third pair of contacts open.

5. The lamp as claimed in claim 4 in which a switch is connected to enable the current limiting means to be short-circuited.

6. The lamp as claimed in claim 4 in which the current limiting means is located within the said housing.

7. The lamp as claimed in claim 1 in which the starter electrodes are positioned on opposite sides of the main electrodes to the path of the main discharge.

8. A fluorescent discharge lamp comprising: a pair of external terminals, a pair of main electrodes, a pair of starter electrodes each positioned adjacent a main electrode, connections including switch means from the terminals to the main electrodes and to the starter electrodes for applying any voltage that is between the terminals to between each main electrode and its adjacent starter electrode to cause initial discharges to strike;

insulating housing means provided within the lamp envelope within which housing said switch means is located; said housing being positioned centrally of the lamp; said main electrodes being annular in shape and each surrounding the housing in spaced apart relationship to each other; and

said switch means operated when the initial discharge current reaches a set value to remove such value voltage from the starter electrodes but to maintain the voltage across the main electrodes to cause a main discharge to strike.