July 28, 1942. A. SIMMON 2,291,355

STARTING CIRCUITS FOR ELECTRIC VAPOR LAMPS

Filed Sept. 20, 1940

Fig: 1

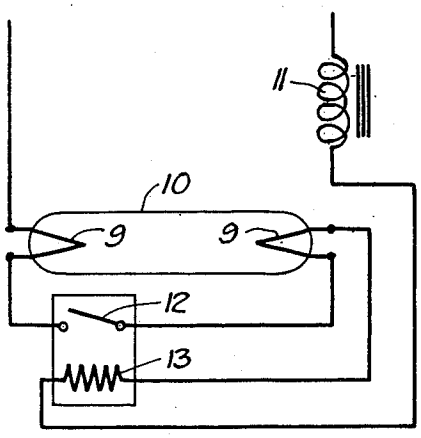


Fig: 2

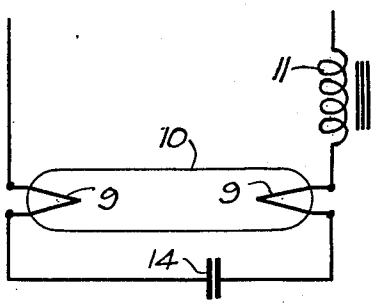
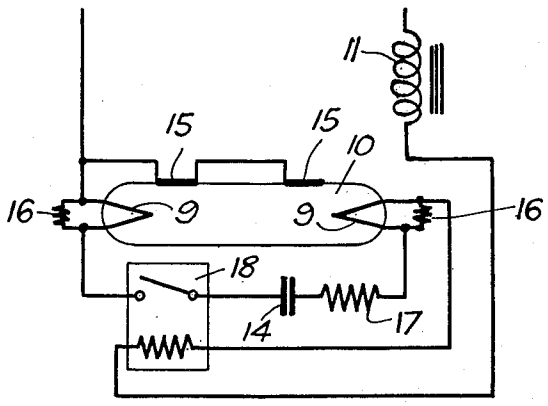


Fig: 3



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Patented July 28, 1942

2,291,355

UNITED STATES PATENT OFFICE

2,291,355

STARTING CIRCUIT FOR ELECTRIC VAPOR LAMPS

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Application September 20, 1940, Serial No. 357,568

4 Claims. (Cl. 176—124)

This invention relates to electric circuits adapted to light fluorescent lamps and make their application especially suitable for use in connection with photographic enlargers.

Fluorescent lamps consist of a glass tube which is closed at both ends. The tube which is coated on its inside with a fluorescent substance and from which the air is exhausted, is filled with an inert gas, usually argon. An incandescent lamp filament is inserted through each end of the tube and connected to opposite poles of an alternating current electric circuit. Fluorescent lamps emit less heat than other types of electric lamps and have the further advantage that more light can be concentrated upon a given area so that, when used in photographic enlargers for instance, the use of condenser lens may be eliminated.

In order to start the lamps, it is necessary first to heat the filaments and then to supply a sufficiently high starting voltage of 200 to 400 volts for establishment of an arc depending upon the length of the tube or tubes and the design of the lamp. When the arc is established, the voltage drops to approximately 30 volts. Like all gaseous conductor lamps, they must be used in series with a current limiting device, such as a resistor or a choke coil.

Heretofore fluorescent lamps could not be used in photographic enlarging apparatus because of the fact that the above described circuits would not permit the lamps to be lit practically instantly, but a variable time lag occurred between the closing of a switch and the actual lighting up of the lamps. The instant application has for one of its principal objects the provision of an electric circuit which is adapted to start the lamp or lamps instantly with full light emission and to keep the same burning uniformly and constantly.

Other objects and the novel combination of parts in which the invention resides will become apparent after a perusal of the following specification in connection with the accompanying drawing, in which

Fig. 1 shows a circuit diagram of a fluorescent lamp as now in general use;

Fig. 2 illustrates a circuit diagram of a fluorescent lamp embodying the basic principles of my invention; and

Fig. 3 shows a diagram similar to the one illustrated in Fig. 2, but having added to it certain refinements making the use of fluorescent lamps particularly applicable to photographic enlargers.

Like characters of reference denote similar parts throughout the several figures.

Referring to Fig. 1 of the drawing, 10 represents a fluorescent lamp with filaments 9—9 therein. A choke coil is shown at 11, and a time delay switch which includes a bimetal strip 12 and a heating coil 13. The strip 12 is heated by the coil 13 and is caused thereby to bend to open the circuit after a predetermined time. This interruption of the circuit sets up a surge high enough to provide the starting voltage to form an arc between the two filaments and to light the lamp. The maximum surge is obtained when the switch opens at the height of one of the 60 cycle waves and no surge at all is obtained when the switch happens to open when the current passes through the bottom of the curve at zero point. It is therefore not at all certain that the first opening of the switch will ignite the lamp and several attempts may be necessary to establish the arc. Therefore, a delay from 1 to 10 seconds may occur before the lamp lights up. While this is of no consequence for ordinary applications it is obvious that a circuit of this type cannot be used for photographic applications and particularly for enlargers where the time of exposure must be accurately determined.

My novel circuit as shown in Fig. 2 includes with the choke coil 11, the fluorescent lamp 10 with filaments 9, a condenser 14. The choke coil 11 has substantially a 90 degree lagging power factor and since the condenser has a 90 degree leading power factor, the voltage across the condenser terminals equals almost the sum of the line voltage plus the voltage across the choke coil terminals. If the electrical dimensions of the choke coil and the condenser are chosen properly, it is possible to obtain 200 or more volts across the condenser which, under certain conditions, is enough to start the lamp. As soon as an arc is established the current passing through the lamp is in effect parallel to the current passing the condenser and, therefore, the voltage across the lamp will drop considerably.

However a number of refinements are necessary to make this simple circuit work most dependably in operation. A circuit embodying these refinements is illustrated in Fig. 3 and comprises principally the following:

1. The current which passes through the condenser before the lamp starts is usually in excess of the current that the filament may safely withstand. It is therefore advisable to provide two small shunt resistors 16 which are shown in Fig. 3.

2. Practice with these lamps has shown that some of them become unstable under the above conditions which is apparently due to the fact that the lamp may temporarily lose its resistance entirely and that then the electrical energy stored in the condenser may pass through the lamp at

a very high rate of speed. This condition is overcome by connecting a resistor 17 of approximately 100 ohms in series with the condenser which slows down the discharge.

3. It has been previously stated that as soon as an arc is established in the lamp, the voltage across the filaments drops considerably. If the current passing through the condenser were negligibly small as compared to the current passing through the lamp, the lamp would assume substantially its normal operating voltage. This however, is not quite the case and therefore, the voltage impressed upon the lamp will be higher than desirable (approximately 70 volts instead of 30 volts). It is therefore advisable to provide a switch in series with the condenser which disconnects the condenser when the lamp has started. This switch may again be a time delay switch 18 and its heater coil may be either in series or in parallel with the lamp. While this circuit as shown in Fig. 3 has a certain similarity with the one shown in Fig. 1 it must me emphasized that this lamp starts within approximately one-tenth of one second entirely independent of the time delay switch and that the time delay switch is not called upon to supply a surge for starting the lamp. The starting voltage is supplied by the condenser alone and the switch merely disconnects the condenser after it has applied the starting voltage.

4. The starting voltage of these lamps has been found to be about 400 volts. This is apparently due to the fact that a static charge accumulates on the glass wall, which is undesirable since it necessitates suitable insulation and since high starting voltages are difficult to obtain by simple means. This condition has been overcome in my improved circuit by providing auxiliary electrodes or shields on the outside surface of the glass and by connecting these electrodes either to the ground, to one side of the line or to any point of the electrical circuit. These auxiliary electrodes may be of any suitable shape, such as a spiral of thin wire wound around the glass tube, or rings or other suitable configurations may be painted upon the side of the tubes with a conducting paint. Graphite with a suitable binder will answer the purpose satisfactorily. These electrodes should, of course, be arranged in such a manner as to interfere as little as possible with the light emission of the lamp. By these means the starting voltage of the lamp can be reduced to less than 200 volts.

It is obvious, of course, that various changes in the minor details and disposition of parts of the circuit may be resorted to without departing from the principles or sacrificing any of the advantages of the invention as defined in the appended claims.

What I claim as new is:

1. A low voltage, tubular, fluorescent, gaseous discharge lamp having electrodes consisting of low voltage incandescent electron emitting filaments, one at each end of the tube, and a gaseous discharge path between the filaments; in combination with an instantaneous starting circuit therefor including an inductance in series with said filaments and said discharge path, and a condenser in series with said filaments and in parallel with said discharge path and a resistance having a positive temperature coefficient in series with the condenser and cooperating therewith to minimize the starting time of the lamp.

2. A low voltage, tubular, fluorescent, gaseous discharge lamp having electrodes consisting of low voltage incandescent, electron emitting filaments, one at each end of the tube, a gaseous discharge path between the filaments, an inductance and a heating coil in series with the filaments and said discharge path; in combination with an auxiliary starting circuit in series with the filaments and in parallel with said discharge path and including a condenser, a stabilizing resistance having a positive temperature coefficient and cooperating with the condenser to minimize the starting time of the lamp, and a switch operating as a time delay switch in response to the heating coil to disconnect the condenser after the lamp is started.

3. A low voltage, tubular, fluorescent, gaseous discharge lamp and an electric system therefor providing an operating circuit and a starting circuit, the operating circuit being a series circuit and including an inductance, a heating coil, a pair of incandescent electron emitting filaments and a gaseous discharge path between the filaments; and the starting circuit including the above operating circuit and in addition also including circuit means in series with the filaments and in parallel with the discharge path, said circuit means comprising a condenser serving to cooperate with the inductance and filaments to provide the necessary starting voltage and to minimize the starting time of the lamp, a resistance having a positive temperature coefficient in series with the condenser to stabilize the starting current, and a switch operable by said heating coil to disconnect the circuit means from the operating circuit when normal operation of the lamp is established.

4. A low voltage, tubular, fluorescent, gaseous discharge lamp and an electric system therefor providing an operating circuit and a starting circuit, the operating circuit being a series circuit and including an inductance, a pair of incandescent electron emitting filaments and a gaseous discharge path between the filaments; and the starting circuit including the above operating circuit and in addition also including circuit means in series with the filaments and in parallel with the discharge path, said circuit means comprising a condenser serving to cooperate with the inductance and filaments to provide the necessary starting voltage and to minimize the starting time of the lamp, a resistance having a positive temperature coefficient in series with the condenser to stabilize the starting current, and a time delay switch operable to disconnect the circuit means from the operating circuit when normal operation of the lamp is established.

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