

Jan. 18, 1944.

A. WARSHER ET AL
STARTING AND OPERATING CIRCUIT FOR GASEOUS
ELECTRIC DISCHARGE DEVICES
Filed Jan. 8, 1941

2,339,307

Fig. 1.

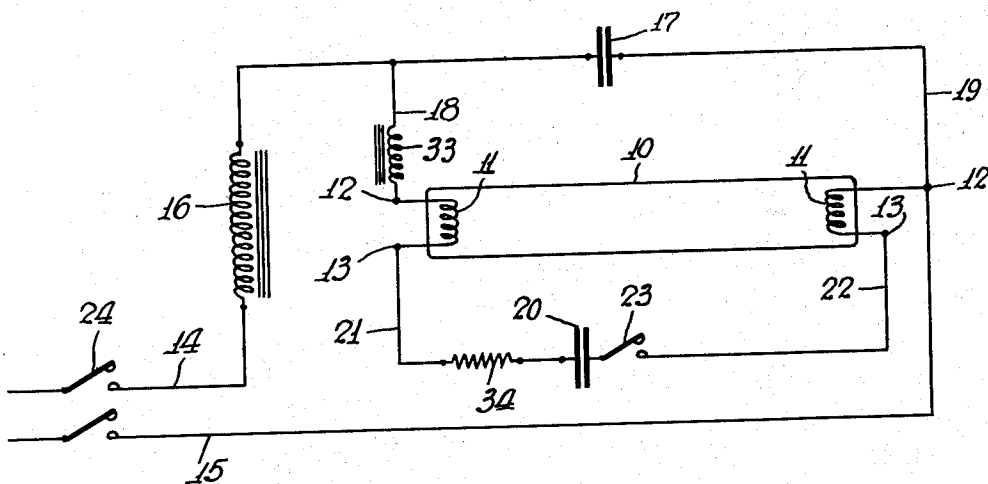
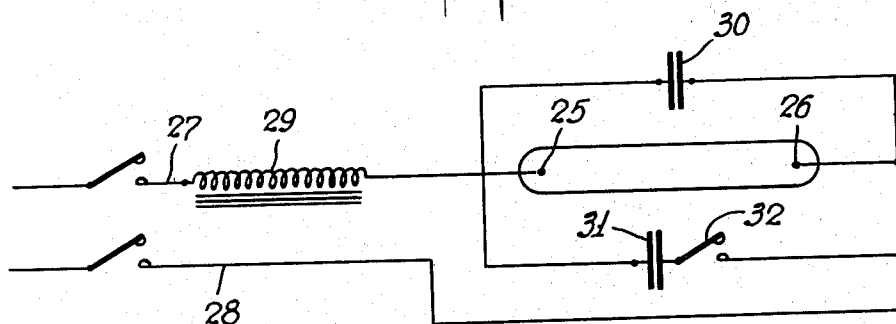


Fig. 2.



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2,339,307

STARTING AND OPERATING CIRCUIT FOR
GASEOUS ELECTRIC DISCHARGE DE-
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Application January 8, 1941, Serial No. 373,570

7 Claims. (Cl. 176-124)

The present invention relates primarily to gaseous electric discharge devices such as fluorescent lamps and more especially to means and methods for starting and operating the same.

Among the objects of the invention are to provide starting means for discharge devices and more especially for lamps of the above type, which shall be economical both in initial cost and in power consumption and which shall effect the necessary step up of voltage thereacross to start even large or long lamps and that, without resort to transformers or auto transformers for the purpose, and which shall inherently operate with the desired high power factor and without the need for special compensating equipment for the purpose.

In the accompanying drawing in which are shown one or more of various possible embodiments of the several features of the invention,

Fig. 1 is a diagrammatic view of the circuit as used for a hot cathode lamp, and

Fig. 2 is a diagrammatic view similar to Fig. 1 showing the general application to a lamp of the cold cathode type.

Referring now to the drawing, there is shown in Fig. 1 a gaseous electric discharge device 10 which may be of entirely conventional construction. In the lamp embodiment shown, the device comprises a glass tube carrying at its opposite ends heater filaments 11, each with terminals 12 and 13, each of said filaments being coated with electron emissive material, such as barium oxide. The tube is evacuated and charged with neon gas or the like, which in the fluorescent embodiment is admixed with a small amount of mercury vapor.

The lamp is shown in Fig. 1 connected across the alternating current mains 14 and 15, one of which has an inductive reactance ballast or choke coil 16 therein. Across or in parallel with the lamp there is a fixed electric condenser 17. Desirably the condenser 17 is connected by leads 18 and 19 to terminals 12 of the respective filaments 11.

Connecting the heater filaments 11 in series is a second electric condenser 20. To this end, condenser 20 is preferably connected by leads 21 and 22 to terminals 13 of the respective heater filaments 11. In series with condenser 20 is a switch 23. This switch may be of any of numerous well known types. It may be manually operated, it may be a gaseous valve or a thermally operated switch of any of the various bi-metallic types, or an electromagnetic switch operated

either by a separate coil (not shown) in main 15, or, if desired, by flux from the choke coil 16, substantially as in the prior Patent No. 2,155,816, of Maynard A. Babb, issued April 25, 1939.

The switch 23 is arranged to remain closed only during the short time necessary after closing the main switch 24, for bringing the filament current to a magnitude sufficient to heat the filaments to the required temperature, whereupon said switch is to open. The condenser 20 thus remains in circuit at each start for but so short a time that an electrolytic condenser of the type commonly used for splitting phase in starting of small alternating current motors is entirely feasible. Its use effects considerable saving as compared to the cost of an electrostatic condenser of corresponding capacitance made with impregnated paper dielectric or as compared with that of other types of condenser suitable for permanent rather than mere starting connection in alternating current circuits. Thus condenser 20 which remains in circuit only during starting would be of the inexpensive electrolytic type, and only condenser 17 which is of relatively small capacitance would be of the more expensive type.

The switch 23 remains closed while the system is out of operation. When the main switch 24 is thrown, the condenser 20 is in circuit, current passing through choke coil 16, lead 18, one heater filament 11, lead 21 and by way of condenser 20 and closed switch 23 and lead 22 through the other filament 11 to the opposite main. At the same time, a potential is imposed across the lamp terminals and the condenser 17. In a generic sense, both condensers bridge across the electrodes of the lamp prior to arcing, the condenser 17 bridging across the arc of the lamp, while condenser 20 intervenes between and is in series with the filaments. Condenser 17 thus increases the effective voltage available across the terminals of the lamp. The condenser 20 is of such capacitance, that in the circuit set forth, the filament current will rapidly build up to the required value. When the filament current has reached a value to produce the desired heating of the filaments, switch 23 is opened with removal of the electrolytic condenser 20 from the circuit. The voltage built up across the lamp terminals by condenser 17 in conjunction with the kick from the choke coil 16 gives the high voltage starting impulse across the now heated filaments 11 to cause lamp 10 to arc over or fire.

It will be understood that the capacitive reactance of the condenser 17 having in parallel

therewith the combination of condenser 20 and filaments 11 is designed so that the impedance of the entire circuit limits the current to the proper filament heating current. As a consequence the voltage across the lamp builds up to high values to assure arcing over in starting. After the arc has struck, the operation proceeds on high power factor, since the ohmic resistance of the lamp with the condenser 17 in parallel therewith, corrects the low power factor resulting from the inductive ballast 16 for the electric discharge.

While the invention lends itself to use with a wide variety of gaseous electric discharge devices of all sizes, and especially to lamps (including those used for illumination and those for advertising, such as neon lamps) it has particular utility where these lamps are of considerable length and wattage such as lamps of 30 watts or more. In one illustrative embodiment of many that are possible, a 40 watt lamp four feet long operated from a 60 cycle alternating current line of 110 volts, could have a choke of 0.4 henrys, an electrostatic condenser across the lamp of 1.25 microfarads and an electrolytic condenser between the filaments of 4.4 microfarads, and the heater filaments might pass .8 ampere when the arc is about to strike. The operating current of the lamp would be about .4 ampere.

The initial cost of equipment for the circuit is seen to be relatively low, since the high capacitance used only in completing the starting circuit through the heater filaments may be and is of the relatively inexpensive electrolytic type. The permanent capacitance used to maintain the voltage across the lamp is of relatively small capacity and its cost therefore is moderate even if it be of the impregnated paper dielectric type. The choke coil is of cost but a fraction of that of transformers or auto-transformers of the type used to step up voltage and its operating cost also is less because of lesser wattage loss. Yet the circuit set forth accomplishes all of the objectives above indicated. It inherently affords a step up of voltage across the lamp to permit starting, and the circuit inherently operates on the desired high power factor, and it does this in the absence of special costly devices for power factor correction, such as for instance a high capacity electrostatic condenser which is put across the line and must remain permanently in circuit.

If desired the circuit may have an inductive reactance 33 in lead 18 to reduce the ratio of peak to R. M. S. current through the lamp in operation. It is also optional to include a resistance 34 in the lead 21 to attain any desired circuit-time constant.

In Fig. 2 is shown an application of the invention to a cold cathode lamp. Here the cathodes 25 and 26 at the ends of the lamp are connected to the respective mains 27 and 28 in one of which is the inductive or choke coil 29. The electric condenser 30 is connected across the electrodes 25 and 26, and the electrolytic condenser 31 of higher capacitance is likewise connected across said electrodes and has the switch 32 (corresponding to switch 23 of Fig. 1) in series therewith.

As in the embodiment of Fig. 1 condenser 30 determines the available voltage across the terminals of the lamp in operation, while condenser 31 increases the voltage to the value necessary in order to start the lamp. As a consequence, the voltage across the cold cathodes promptly

builds up to such tremendous values, as to cause the arc to strike across the cold cathodes. After the arc has struck, the operation continues on higher power factor, since the ohmic resistance of the lamp replaces the capacitance of the electrolytic condenser which latter is removed from circuit by opening of switch 32.

An inductance 33 or a resistance 34 or both, such as shown in Fig. 1 may be used for the same purpose, if desired, in the embodiment of Fig. 2.

As many changes could be made in the above circuit, and many apparently widely different embodiments of this invention could be made without departing from the scope of the claims, it is intended that all matter contained in the above description or shown in the accompanying drawing shall be interpreted as illustrative and not in a limiting sense.

Having thus described our invention, what we claim as new and desire to secure by Letters Patent is:

1. A starting and operating circuit for gaseous electric discharge devices equipped with spaced electrodes, comprising an electric condenser bridging across said electrodes, an electrolytic condenser having a switch in series therewith and bridging across said electrodes, and an inductance in series with the discharge device.

2. A starting and operating circuit for gaseous electric discharge devices equipped with spaced electrodes, comprising an electric condenser bridging across said electrodes, an electrolytic condenser having a switch in series therewith and bridging across said electrodes and an inductance in series with the discharge device, and means for opening said switch when the circuit current has sufficiently built up to permit the discharge device to arc over.

3. A starting and operating circuit for gaseous electric discharge devices equipped with spaced electrodes, comprising the combination of an electric condenser across said electrodes, an electrolytic condenser of higher capacitance having a switch in series therewith and connected across said discharge device, and a ballast coil in series with said device.

4. A starting and operating circuit for gaseous electric discharge devices having a pair of cathodes equipped with heater filaments, an inductive reactance in series with said discharge device, a condenser connected across said discharge device, and a second condenser having a switch in series therewith and connecting said filaments in series, said first condenser being of the paper dielectric type and said second condenser being of the electrolytic type, and means responsive to current flowing through the filaments for opening said switch.

5. A starting and operating circuit for a gaseous electric discharge device of the cold cathode type comprising an inductive reactance in series with said discharge device, and a pair of condensers connected in parallel and bridging across said cathodes, one of said condensers being of the paper dielectric type and the other being of higher capacitance and of the electrolytic type, and a switch responsive to a predetermined current and in series with the latter condenser.

6. A starting and operating circuit for gaseous electric discharge devices equipped with spaced electrodes, comprising the combination of an electric condenser across said electrodes, an electrolytic condenser of higher capacitance having a switch in series therewith and connected across

said discharge device, a ballast coil in series with said device and an inductance interposed between said electric condenser and one of said electrodes.

7. A starting and operating circuit for gaseous electric discharge devices equipped with spaced electrodes, comprising the combination of an

electric condenser across said electrodes, an electrolytic condenser of higher capacitance having a switch and a resistance in series therewith and connected across said discharge device, and a ballast coil in series with said device.

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