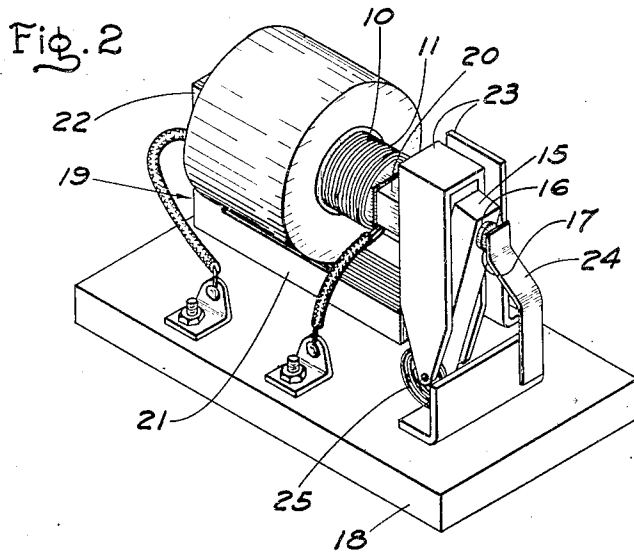
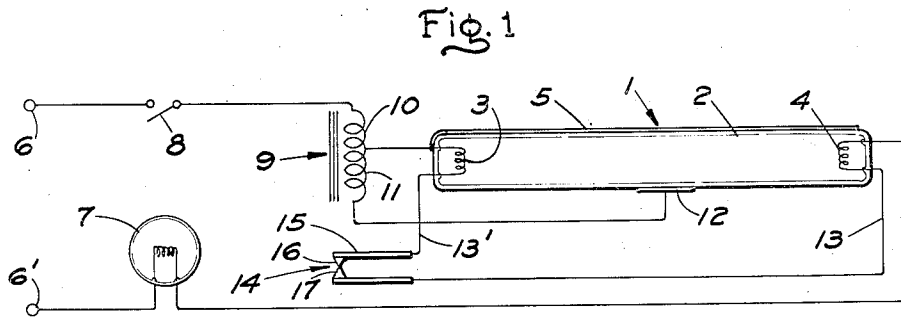


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J. H. CAMPBELL
PULSE STARTING CIRCUIT FOR
ELECTRIC DISCHARGE DEVICES
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Inventor:
John H. Campbell,
by Vernet C. Tauffman
His Attorney

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PULSE STARTING CIRCUIT FOR ELECTRIC DISCHARGE DEVICES

John H. Campbell, Mentor Headlands, Ohio, assignor to General Electric Company, a corporation of New York

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This invention relates to electric discharge devices of the type employing ionizable mediums such as gases or vapors, and more particularly to an improvement in the circuit and apparatus described in application Serial No. 528,535 of John H. Campbell, filed March 29, 1944, now Patent No. 2,456,859, and which is assigned to the assignee of this application.

Circuits now in wide use with fluorescent lamps are provided with means for heating the filamentary electrodes and for impressing a high voltage of short duration across the electrodes for starting an electrical discharge therebetween. Some of these arrangements are provided to delay the application of the high voltage until the electrodes have reached the desired electron emitting temperature. In prior art arrangements the delay means or switch provided relatively slow starting occasioned by lingering preheating periods, and varying operating characteristics with age.

An object of my invention is to provide a new and improved circuit for starting and operating electric discharge devices employing filamentary electrodes.

Another object of my invention is to provide a new and improved means for an electric discharge device which means function independently of the ballast employed.

A further object of my invention is to provide a new and improved means for impressing starting voltages across filamentary electrodes of an electric discharge device after an accurately determined period of electrode preheating which is reduced to a minimum or optimum value without sacrificing adequate preheating of the electrodes.

A still further object of my invention is to provide an improved apparatus for the operation of an electric discharge device which apparatus involves a high degree of simplicity and which can be produced at a relatively low cost.

Further features and advantages of my invention will appear from the following description of species thereof.

For a better understanding of my invention reference may be had to the following description taken in connection with the accompanying drawing and its scope will be pointed out in the appended claims. Fig. 1 is a diagrammatic view of an electric discharge device and a starting and operating circuit therefor incorporating my invention. Fig. 2 illustrates an embodiment of the starting apparatus illustrated in Fig. 1 incorporating certain aspects of my invention.

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Referring to Fig. 1, I have there illustrated one embodiment of my invention as applied to an electric discharge device 1. The electric discharge device 1, such as a fluorescent lamp, therein illustrated comprises an elongated tubular or cylindrical envelope 2 having sealed into the ends thereof filamentary electrodes 3 and 4, each herein illustrated as comprising a coil, preferably in the form of a coiled coil of tungsten wire activated with oxides of alkali earth metals such as a mixture of barium and strontium oxides. The envelope 2 contains a gaseous atmosphere such as a rare gas like neon, argon or mixtures thereof at a pressure of a few millimeters and a small quantity of mercury which, during the operation of the lamps, has a low pressure of the order of 10 microns. The device 1 may be a low pressure positive column lamp of the fluorescent type provided with a suitable phosphor or fluorescent coating. This fluorescent coating upon excitation by the radiation produced by an electric discharge between the electrodes, transforms a shorter wave radiation due to the discharge into longer wave radiation such as radiation within the visible range. For ease of starting a stripe or strip 5 of conductive material which, for example, may be a metallic paint or graphite mixed with potassium silicate, may be applied to the surface of device 1. The starting strip 5 may be connected to one or both of the electrodes.

In accordance with my invention device 1 is connected across a suitable power supply circuit 6, 6' which for example may be a 115 volt, 60 cycle alternating current source, or a 115 volt direct current circuit, for supplying current to device 1 through a ballast 7 which, for example, may be 50 volt 0.6 ampere incandescent lamp. The ballast lamp 7 serves as a resistor which has a high positive temperature resistance coefficient and which operates on the steep part of its temperature-resistance curve. Although the discharge device has a negative impedance-current characteristic, the effect of the ballast predominates over that of the device; hence the circuit is stable. A convenient form of ballast resistor is a small tungsten filament incandescent lamp whose rated voltage is appreciably higher than the small difference between the source voltage and the operating voltage of the device. The filament of the ballast lamp therefore operates at a temperature materially lower than that for which it is designed to operate as a light source, thus greatly increasing the life of the lamp 7. This ballast lamp, however, may serve a dual function, namely as a ballast for the electric discharge

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device and as an individual light source. A manual make and break control switch 8 may be used to connect device 1 to the power supply circuit.

The starting apparatus comprises an inductive device, or auto-transformer 9 responsive to the current conducted by device 1 and whose primary winding 10 is connected to the source 3, 3' and its secondary winding 11 is connected between filamentary electrode 3 and a point of device 1 intermediate its filamentary electrodes 3 and 4. It is preferable that the end of the secondary winding connects with a metal clamp or other conductor shown at 12 on or close to the wall of device 1, for example connected to the commonly employed reflector. An electrode preheating circuit 12, 13' shunts device 1 but includes the filamentary electrodes 3 and 4 in series therewith. The electrode preheating circuit 12, 13' connected in shunt with device 1, includes a magnetic vibratory switch 14, having an armature 15, and a pair of normally closed contacts 16 and 17. The magnetic field of the auto-transformer 9 serves to actuate armature 15 and cause vibratory movement thereof upon energization of auto-transformer 9.

When the entire installation is energized by closing switch 8, current flows through the primary winding 10 of the auto-transformer 9, filamentary electrode 3, armature 15 and contacts 16 and 17 of magnetic vibratory switch 14, filamentary electrode 4, and ballast 7. The primary winding 10 of auto-transformer 9 actuates the armature 15 substantially instantaneously so that the normally closed contacts 16 and 17 open. At the instant contacts 16 and 17 disengage each other, whether the source of current supply is direct or alternating, the combined effect of the voltage impulse impressed by the transformer and the heated condition of the electrodes causes the gas in the device to ionize whereupon the device starts. Having thus started the discharge current continues to flow through the primary winding 10 of the auto-transformer and the magnetic flux generated by this winding is adequate to retain the contacts 16 and 17 in the open position. If device 1 does not ignite at the first opening of the contacts 16 and 17 of the repetitive magnetic switch 14, current again flows through primary winding 10, electrode 3, armature 15 and contacts 16 and 17 of switch 14, electrode 4, and ballast 7. Armature 15 is again actuated substantially instantaneously, contacts 16 and 17 disengage each other, and a voltage impulse is again impressed across the electrode 3 and contact 12. Thus, the electromagnetic switch operates as a repetitive magnetic switch until the discharge device 1 ignites.

The ignition or starting devices and circuits may be adjusted to the discharge device 1 in such a manner that if the device 1 is faulty or non-operative the repetitive magnetic switch 13 will cease to operate after a predetermined number of starting attempts. This is commonly known as the "lock-out" arrangements in the prior art. Although the "lock-out" arrangement is not herein shown or described it may be applied to this circuit.

Fig. 2 illustrates an embodiment of my invention comprising an insulating base member 18, a core structure 19 supported by member 18 and comprising horizontal magnetic members 20 and 21 and a vertical magnetic member 22, a vertical armature 15 supported by a non-magnetic structure 23 mounted on member 18 and supporting

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at one end thereof the movable contact 16, contact 17, and primary and secondary windings 10 and 11 wound about horizontal member 20. Contact 17 is mounted on a resilient arm 24 which affords a counter-acting force to the movable contact 16 and causes contact 17 to remain in engagement with contact 16 during part of its opening movement. A coil spring 25 holds contacts 16 and 17 in a normally closed position.

In accordance with my invention, I provide a starting and operating device and circuit which will after a predetermined interval of time after the initiation of current flow through the electrodes impress an operating voltage thereacross. Accordingly, I provide a repetitive magnetic switch of the vibratory type accurately controlled by an inductive element functioning independently of the ballast employed. Generally speaking, I provide an improved apparatus for the operation of an electric discharge device which apparatus involves a high degree of simplicity and which can be manufactured at a relatively low cost.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. In combination, an electric discharge lamp having spaced electrodes at least one of which is of the filamentary type, means including a ballast impedance connected between said device and a source of current, inductive means comprising a primary winding means and secondary winding means, a vibratory magnetic switch having an armature responsive to the magnetization of said inductive means and normally closed contacts connected in series relation in a preheating circuit comprising said electrode of the filamentary type and said primary winding means, and said secondary winding means being connected to said discharge device to apply a starting voltage thereto.

2. In combination, an electric discharge device having spaced electrodes and an electrode preheating circuit connected in shunt therewith and including a magnetic vibratory starting switch having normally closed contacts, means including a ballast impedance for connecting said device to a source of current, and a step-up transformer having its primary winding connected to be energized from said source in series relation with said contacts and its secondary winding connected to apply a starting voltage to said device, said switch being responsive to the magnetization of said transformer.

3. In combination, an electric discharge device having spaced electrodes and an electrode preheating circuit connected in shunt therewith and including a switch having an armature and a pair of normally closed contacts, means including a ballast impedance connected between said device and a source of current, and a step-up transformer having its primary winding connected to said source and its secondary winding connected between one of said electrodes and a point of said device intermediate its electrode, the magnetic field of said transformer serving to actuate said armature and to cause vibratory movement of said armature upon energization of said transformer.

4. In combination, an electric discharge device having spaced electrodes and an electrode preheating circuit connected in shunt therewith and including a switch having an armature and a pair of normally closed contacts, means including a ballast impedance connected between said device and a source of current, and a step-up

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transformer having its primary winding connected to said source and its secondary winding connected to said discharge device to supply a starting voltage thereto, the magnetic field of said transformer serving to actuate said armature and to cause vibratory movement of said armature upon energization of said transformer.

5. In combination, a source of current supply, a gaseous electric discharge device having spaced electrodes adapted to be initially heated to an electron emitting temperature, connections between one end of each of said electrodes and said source, a switch having an armature and a pair of normally closed contacts connecting the other ends of said electrodes, a voltage step-up autotransformer having its primary in one of said connections and having its secondary connected to a point on said discharge device intermediate said electrodes for application thereto of a starting voltage impulse, said armature being respon-

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sive to the magnetic field of said transformer whereby to cause said switch contacts to open and a starting voltage impulse to be applied to said device from said transformer secondary upon flow of current through said transformer primary.

JOHN H. CAMPBELL.

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