June 20, 1950 S. EROS ET AL 2,512,268

PERMANENT MAGNET HOT WIRE STARTING DEVICE

Filed Oct. 29, 1947

Fig. 1

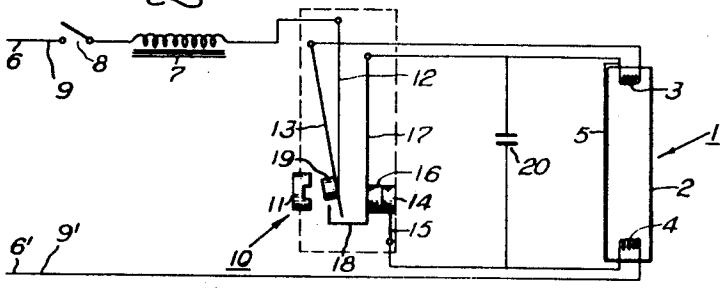


Fig. 2

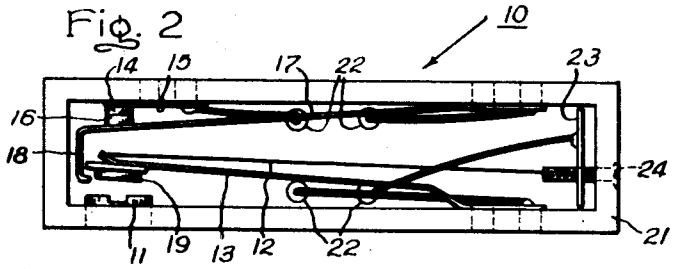
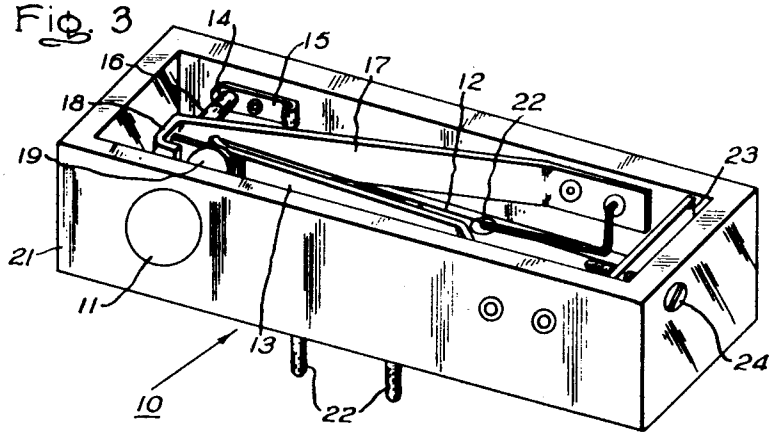


Fig. 3



Inventors:
Stephen Eros,
Herman E. Hermanson,
by Vernet C. Kauffman
Their Attorney.

Patented June 20, 1950

2,512,268

UNITED STATES PATENT OFFICE

2,512,268

PERMANENT MAGNET HOT-WIRE STARTING DEVICE

Stephen Eros, Cleveland, and Herman E. Hermanson, Mayfield Heights, Ohio, assignors to General Electric Company, a corporation of New York

Application October 29, 1947, Serial No. 782,798

1 Claim. (Cl. 200—113)

1

This invention relates to electric switches and more particularly to a starting and operating switch for electric discharge devices, such as fluorescent lamps, using filamentary electrodes.

Circuits now in wide use with fluorescent lamps are provided with means for heating the filamentary electrodes and for impressing a high voltage for a short duration across the electrodes for starting an electrical discharge therebetween. Some of these arrangements are provided with means 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, varying operating characteristics with age, and a slow reset operation for a recycle starting attempt.

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

Another object of our invention is to provide a new and improved means for impressing starting voltages across filamentary electrodes of an electric discharge device which after a predetermined interval of time after the initiation of current flow through the electrodes impresses an operating voltage thereacross.

A further object of our invention is to provide a new and improved starting device for electric discharge devices which after a complete starting cycle of operation rapidly resets itself for another starting cycle.

A still further object of our invention is to provide a new and improved starting device for electric discharge devices which embodies a permanent magnet accurately controlled by a hot-wire thermal element.

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

For a better understanding of our invention reference may be had to the following description taken in connection with the accompanying drawings 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 therefore incorporating my invention. Fig. 2 illustrates in more detail a plan view of the permanent magnet, hot-wire starting device shown in the starting and operating circuit of Fig. 1. Fig. 3 is a perspective view of the starting device shown in Fig. 2.

Referring to Fig. 1, we have there illustrated one embodiment of our invention as applied to

2

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 alkaline earth metals such as a mixture of barium or 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 a 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 our invention device 1 is connected across a suitable power supply circuit 6, 6' which for example may be a 115 volt, 60 cycle source for supplying current to device 1 through the usual ballast 7 which serves also as a starting inductance. A manual make-and-break control switch 8 may be used to connect device 1 to the power supply. A starting and operating circuit 9, 9' comprising a branch in series with device 1 and a branch in parallel with device 1 embodies a permanent magnet, hot-wire thermal snap-acting switch 10. Switch 10 comprises, in addition to a permanent magnet 11 and an expansible wire 12 having a high electrical resistivity and high coefficient of thermal expansion, a spring armature 13 pivoted to move to a position within the magnetic field of magnet 11. One end of spring armature 13 is secured to the movable end of wire 12. Switch 10 comprises in addition a stationary contact 14 mounted on a supporting element 15, a movable contact 16 secured to an armature 17 provided with a curved or bent extension 18 of substantially U-shape and having a leg portion lying within the path of spring armature 13. An iron disc 19 may be mounted on the end of spring armature 13 which is secured to wire 12 in a position to permit movement within the magnetic field of magnet 11.

Wire 12 is connected to spring armature 13 to oppose the bias of spring armature 13 when cold and to permit when hot spring armature 13 to move within the magnetic field of magnet 11. The series branch of the starting and operating circuit 9, 9' embodies ballast 7 in series with wire 12, spring armature 13 and filamentary electrodes 3 and 4 of discharge device 1. The parallel branch of circuit 9, 9', operating as a starting circuit embodying normally closed contacts 14 and 16 in series with filamentary electrodes 3 and 4, shunts device 1. A condenser 20 of a suitable value which for example, may be between 0.006 μf. and 0.05 μf. shunts device 1 and serves a dual function of preventing excessive arcing across contacts 14 and 16 upon opening thereof and reducing radio interference from device 1.

When the entire installation is energized by closing manual make-and-break switch 8 current flows through ballast 7, wire 12, spring armature 13, filamentary electrode 3, armature 17, movable contact 16, stationary contact 14, supporting element 15, and filamentary electrode 4. Wire 12 has a high electrical resistivity and high coefficient of thermal expansion and thus expands with the passage of current therethrough. Spring armature 13 and wire 12 together act as a bow. When wire 12 expands upon the passage of current therethrough the tension of spring 13 brings the iron disc 19 mounted thereon within the attraction range of the permanent magnet 11 which snaps disc 19 into contact therewith. As disc 19 snaps into contact with magnet 11, extension 18 is engaged by armature 13 which causes movable contact 16 to separate quickly from stationary contact 14. Wire 12 while heating may permit spring armature 13 to move freely a predetermined distance before it actuates extension 18 and moves within the field of magnet 11. At the time contacts 14 and 16 disengage each other filamentary electrodes 3 and 4 have reached the proper emission temperature and the interruption of the current flow through ballast 7 causes a voltage surge great enough to cause an arc discharge to occur between electrodes 3 and 4 of device 1.

The switch above described is selectively responsive to currents of two different predetermined values. For the smaller value of current, although wire 12 expands, it does not permit movement of the spring armature 13 to a position where the attractive force of the magnet 11 exceeds the restraining force due to wire 12. When the larger value of current is transmitted through the wire 12, the expansion of the wire is greater thereby permitting the spring armature to move to a position where the attraction force of the magnet is greater than the restraining force of the wire.

While an arc discharge occurs in device 1, lamp current will flow through wire 12. Usually, lamp current is less than preheat current, so that wire 12 will not be as hot as it was during the starting operation. Wire 12 will contract somewhat, but, with the proper proportions between wire 12, spring armature 13, and magnet 11, this contraction will be insufficient to pull spring armature 13 away from magnet 11, over the normal variations of lamp currents and line voltages encountered under normal operation. Contacts 14 and 16 are thus held open while device 1 is operating.

When the arc discharge in device 1 is interrupted by opening the manual make-and-break switch 8, or if an arc discharge does not occur upon the initial opening of contacts 14 and 16, current no longer flows through wire 12, and due to its low thermal inertia, wire 12 quickly cools, and in cooling contracts until the tension in wire 12 overcomes the magnetic attraction for disc 19. Starter 10 is then ready for another starting cycle.

The ignition or starting device and circuits may be adjusted to the discharge device 1 in such a manner that if device 1 is faulty or non-operative the permanent magnet hot-wire switch 10 may be provided with additional lock-out means to operate after a predetermined number of starting attempts. Although the "lock-out" arrangement is not herein shown or described it may be applied to this circuit.

Because of its low thermal inertia, a bare wire will usually expand too rapidly to allow proper preheat current to flow through electrodes 3 and 4 for a period of time long enough to provide adequate preheat. Improper preheating of the electrodes will shorten lamp life; therefore, we have found it desirable to coat wire 12 with an insulating material to increase its thermal inertia. A satisfactory combination for a 20-watt starting switch, for example, has been found to be a 5 mil nichrone wire with a 5 mil thick layer of glass fused thereto. If an 8 mil nichrome wire is used for a 20-watt starting switch, its thermal inertia would be satisfactory without insulating the wire.

It has been found desirable at times to decrease the ratio of holding force to pull-in force or magnetic attraction of magnet 12. This may be accomplished by applying a thin layer of non-magnetic low permeability material to the holding surface of magnet 11 or to disc 19. A transparent tape cemented to the holding surface of the magnet has been found to work satisfactorily.

Fig. 2 illustrates in more detail a plan view of the permanent magnet, hot wire starting device shown in the starting and operating circuit of Fig. 1. A support member 21 houses the components of the starting device. Contact terminals or pins 22, two of which are shown more clearly in Fig. 3 connect the starting device to the source of current and the lamp filamentary electrodes.

Fig. 3 is a perspective view of the starting device shown in Fig. 2. Support member 21 houses the component parts of switch 10 wherein spring armature 13 is secured at one end of support member 21 and pivoted to move within the magnetic field of magnet 11 which is supported on the opposite end of member 21. Armature 17 supporting movable contact 16 on one end thereof is secured to support member 21 on the same end as spring armature 13 and pivots to make and break contact with stationary contact 14 secured to support member 21 on the opposite end thereof. Wire 12 is connected to spring armature 13 to oppose the bias thereof and is secured to support member 21 by means of a bracket 23 and an adjustment screw 24 which is used for supplying the proper operating tension to wire 12.

In accordance with our invention, we provide a starting and operating device and circuit which will a predetermined interval of time after the initiation of current flow through the electrodes impress an operating voltage thereacross. Accordingly, we provide a permanent magnet, starting device accurately controlled by a hot-wire element. Furthermore, we provide a starting device which after a complete starting cycle

of operation rapidly resets itself for another starting attempt.

Lastly, we provide a snap-acting thermal switch of the hot-wire type which is selectively responsive to currents of two different predetermined values, such as the preheating and operating currents of electric discharge devices employing filamentary electrodes.

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

In a control switch, support means, a fixed contact mounted on said support means, a strip having one end anchored to said support means and carrying a movable contact adjacent its free end, said strip being biased to hold said movable contact in engagement with said fixed contact and having at its free end a substantially U-shaped extension, a thermal expansible wire and a spring armature member joined together at one end and having their other ends supported from said support means in fixed superposed relation, said armature extending in the same general direction as said strip and having at its free end an extension projecting into the U-shaped extension on said strip, a permanent magnet mounted on said support means adjacent the free end of said armature and at the opposite side of said

armature from said strip, said armature being normally held away from said magnet by said wire but being biased toward the magnet and positioned to engage the U-shaped end of said strip and effect a snap disengagement of said movable contact from said fixed contact only upon movement of said armature into the field of said magnet due to expansion of said wire.

STEPHEN EROS.
HERMAN E. HERMANSON.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,859,985	Riedel	May 24, 1932
2,133,309	Schmidinger	Oct. 18, 1938
2,213,890	Schaefer	Sept. 3, 1940
2,222,485	McCarthy	Nov. 19, 1940
2,243,563	Hottenroth, Jr.	May 27, 1941
2,319,241	Leuthold	May 18, 1943
2,338,875	Elkin	Sept. 7, 1943
2,340,099	Acly et al.	Jan. 25, 1944
2,374,967	Alexander	May 1, 1945