May 18, 1943 E. J. LEUTHOLD 2,319,241

STARTING SYSTEM AND MECHANISM FOR GASEOUS DISCHARGE LAMPS

Filed May 11, 1940 2 Sheets-Sheet 1

Fig. 1.

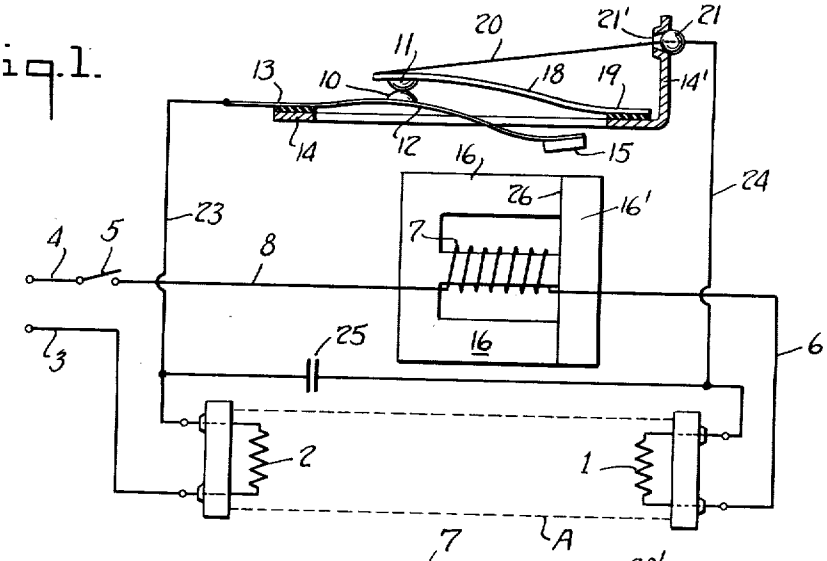
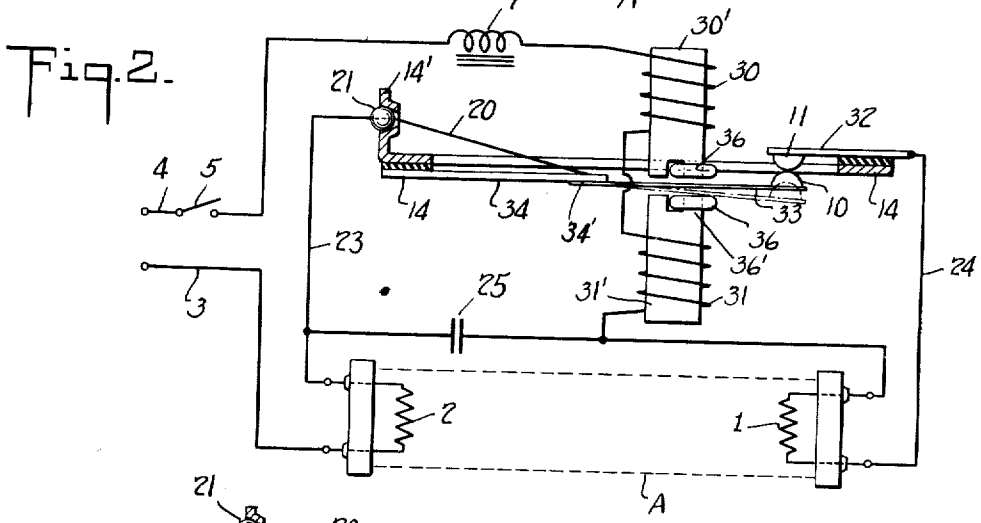


Fig. 2.



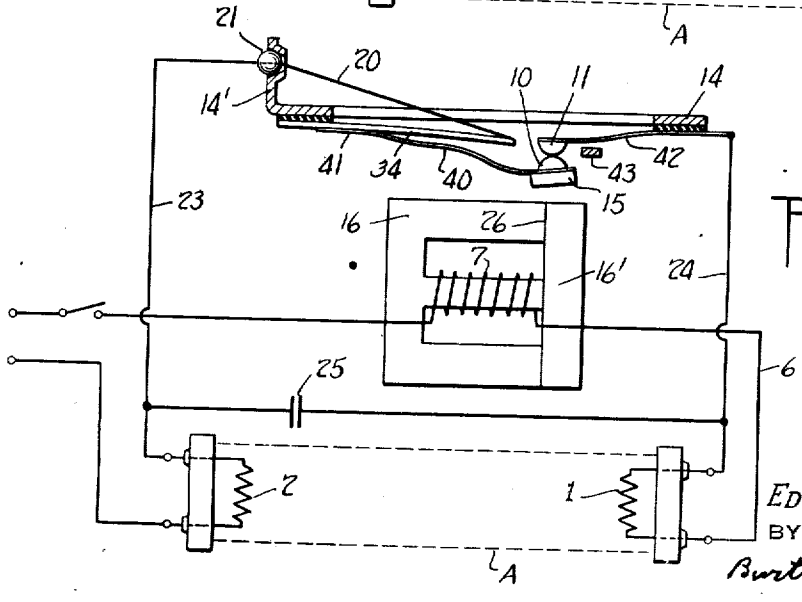


Fig. 3.

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Fig. 4.

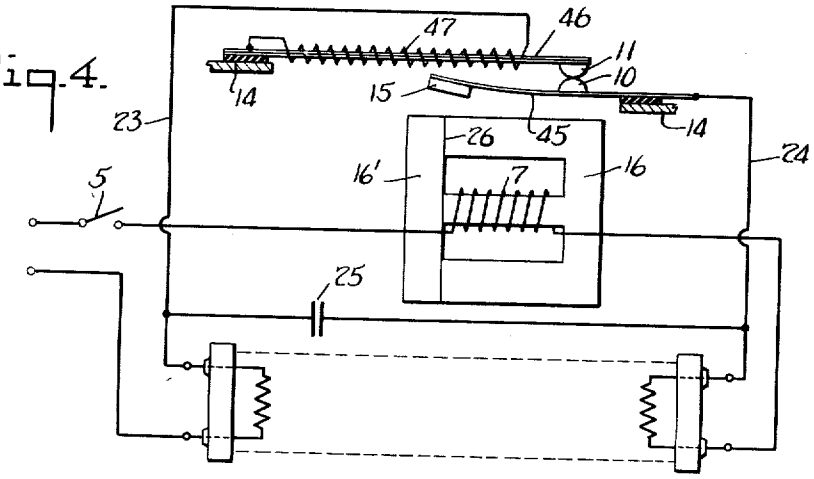


Fig. 5.

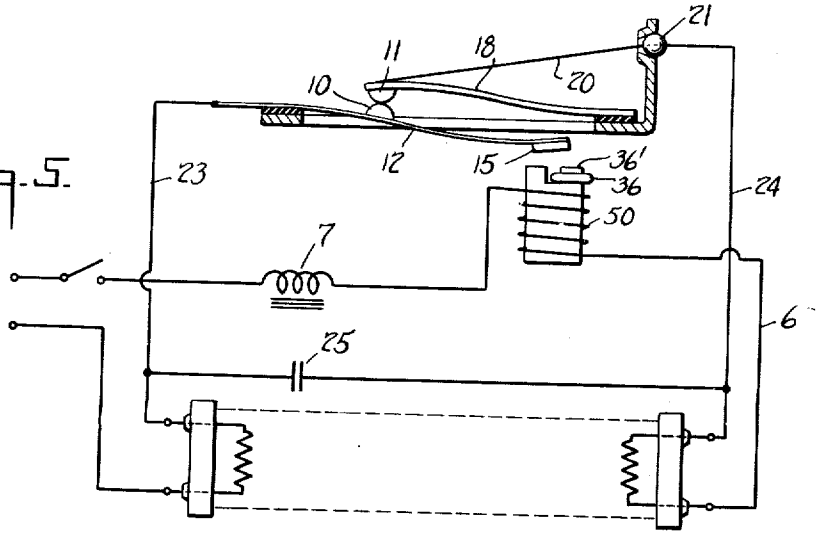
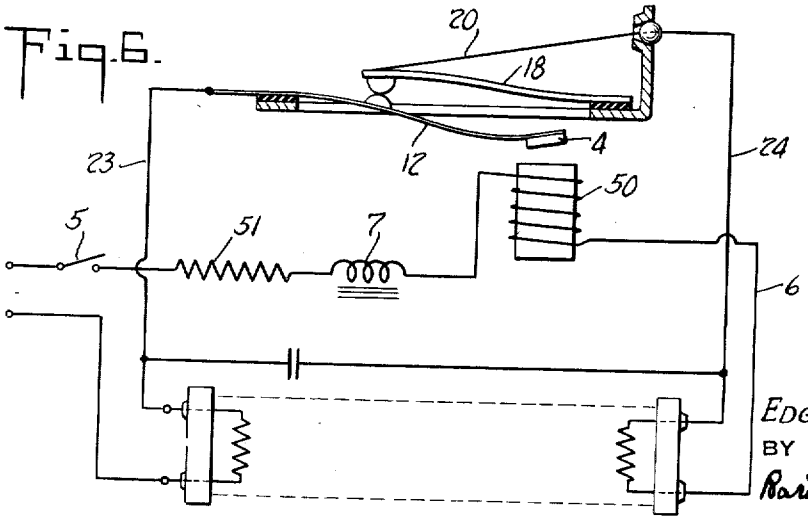


Fig. 6.



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STARTING SYSTEM AND MECHANISM FOR GASEOUS DISCHARGE LAMPS

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Application May 11, 1940, Serial No. 334,525

14 Claims. (Cl. 176—124)

The invention relates to gaseous discharge lamps and the like and particularly to a starting mechanism and system therefor.

The starting mechanism and system of the invention is particularly adapted for use with fluorescent lamps now in commercial use, embodying filamentary heaters which are momentarily heated at the starting of the lamp to assist in striking the discharge between the electrodes, and the embodiments of the invention herein disclosed include such a lamp, although certain features of the invention are of broader application.

An object of the invention is a starting mechanism and system in which any predetermined time delay for heating the filaments may be obtained at will and the starting may be effected with certainty and with a minimum of delay upon the closing of the master switch.

A further object of the invention is such a mechanism and system which is characterized by the simplicity of the construction of its parts and devices and by the economy with which it may be manufactured and assembled.

Further objects of the invention will hereinafter appear.

For a better understanding of the invention reference may be had to the accompanying drawings forming a part of this application wherein—

Fig. 1 illustrates one embodiment of the invention; and

Figs. 2 to 6 illustrate further embodiments of the invention.

Referring to Fig. 1, the invention is embodied in a system including a fluorescent lamp A having electrodes 1 and 2 therein in the form of filaments to be heated. The lamp A is supplied with electric current from the line conductors 3 and 4 and a master switch 5. When the lamp is operating the current flows through the line 3, the electrode 2, the gas contained in the lamp, the electrode 1, the conductor 6, a choke coil 7, and conductor 8 to the master switch 5.

The system comprises a starting mechanism having controllable contacts 10 and 11. The contact 10 is carried by a spring arm 12 insulatedly mounted at 13 upon a frame 14. This spring arm 12 is mounted so as to have an inherent bias in an upward direction to cause the contact 10 to contact with the contact 11; and this spring arm 12 carries an armature 15 which co-operates with the core 16, 16' of the choke coil 7, the armature 15 being energized by the magnetic flux of the core for movement of the contact 10 as described below. The contact 11 is carried by a spring arm 18, which is insulatedly mounted at 19 upon the frame 14. This arm 18 is a spring arm and is inherently biased in a downward direction from that illustrated in Fig. 1 against an expansible wire 20, which is fastened at one end in any suitable manner to the spring arm 18 at a point adjacent the free end thereof, and is anchored by a glass or other insulating bead 21 in an eyelet formed on an upwardly projecting member 14', which is integrally formed with or fastened to the frame 14. The spring arm 18 is a stronger and more powerful spring than the spring 12 and, accordingly, when the wire 20 is expanded by the heating thereof the spring 18 overpowers the spring 12 through engagement at the contacts 10 and 11 and moves the spring 12 with its armature 15 downwardly. In the position shown in Fig. 1 the gap between the armature 15 and the core 16, 16' of the choke coil is so large that the armature cannot be operated by the choke. It is only when the armature 15 is brought nearer to the core by the operation of the overpowering spring arm 18 that the flux energizing the armature 15 from the core is sufficient to pull the armature 15 toward the core and hold it thereagainst.

The spring arm 12 is connected by means of a conductor 23 with the end of the filament 2 opposite the end to which the line conductor 3 is connected, and the expansible wire 20 is connected by a wire 24 with the end of the filament 1 opposite the end thereof to which the wire 6 is connected. The wires 23 and 24 are shunted through a suitable condenser 25 for the purpose of assisting in the starting operation and also of minimizing the sparking at the contacts 10 and 11.

The operation is as follows: Starting with the fluorescent lamp A cold, the master switch 5 is closed and the circuit completed through the electrode filaments 1 and 2 as follows: line 3, filament 2, wire 23, spring arm 12, contacts 10 and 11, expansible wire 20, wire 24, electrode filament 1, wire 6, choke coil 7, and wire 8 to line 4. Upon the initial closure of the master switch 5 and prior to the heating of the expansible wire 20, the armature 15 is too far away from the core 16, 16' to be operated thereby, but the heating of the wire 20 permits the heavier and stronger spring arm 18 to overpower the lighter spring 12 thereby bringing the armature 15 within the field of the core 16, 16'. The armature 15 is thereupon operated with a snap action to break the circuit of the contacts 10 and 11. The circuit through the filaments 1 and 2 is maintained

long enough, however, prior to the breaking of the circuit at contacts 10 and 11, to heat up the filaments 1 and 2 sufficiently to cause a discharge directly through the gaseous tube. This discharge through the tube is sufficient to keep the choke coil 7, 16, 16' energized, whereby the armature 15 is held in its lowermost position in contact with or adjacent to the core. The wire 20 is thereby maintained out of circuit during the normal operation of the tube. If the discharge should fail to take place at the first operation of the device, the above operation is repeated by the release of the armature 15 from the deenergized core 16, 16'. The time interval for maintaining the filaments 1 and 2 in the circuit through the contacts 10 and 11 may be varied by adjusting the tension of the expansible wire 20 or by adjusting the bias of the springs 12 and 18 relatively to each other, or by adjusting the distance of the armature 15 from the core of the choke coil, or two or more of these adjustments may be utilized for this purpose. The tension of the expansible wire 20, for example, may be varied by bending the support 14' towards or away from the contact 11 and any suitable means may be provided for adjusting the bias of the springs 12 and 18 and of the spacing of the armature 15 from the core, these means being omitted for convenience in illustration.

The armature 15 overlaps the juncture 26 between the two elements 16 and 16' of the magnetic structure of the choke coil 7. This positioning has the advantage, among others, of the operation of the armature by leakage flux, but it is understood that the armature 15 may be positioned at other points of the core.

The system of Fig. 1 has the advantage that the conventional choke coil 7 in fluorescent lamp circuits is used as the electromagnet for the armature 15; any predetermined time delay for heating the filaments 1 and 2 may be obtained; there is a quick break of the circuit at the contacts 10 and 11; the expansible wire 20 begins to cool immediately upon opening of the circuit at contacts 10 and 11 and is almost instantly ready for repeated operation, if necessary, for starting; the armature 15 is normally held down against the core of the choke coil by the running current of the lamp with instantaneous reset upon opening of the circuit, and the switch element of the system is of very simple construction and operation and there are only two connections which need to be made.

In the embodiment of Fig. 2 a separate electromagnetic structure 30, 31 from the choke coil 7 is provided and connected in series with the choke coil 7 for assisting in the control of the starting contacts 10 and 11. The contact 11 is carried by an arm 32 which is insulatedly supported by the frame 14. The contact 10 is carried by a light spring 33 which is, in turn, carried by a heavier spring 34, the two spring arms 33 and 34 being fastened together in any suitable manner at 34'. The spring 34 is biased to move in a downward direction from that indicated in full lines in Fig. 2 and the expansible wire 20 is fastened at one end to this heavy spring 34. The spring member 33 forms an armature disposed between the cores 30' and 31' of the solenoids 30 and 31 and is biased in the upward direction so as to tend to keep the contacts 10 and 11 closed. The full line position shown in Fig. 2 corresponds to the open circuit condition at the switch 5 or the interrupted flow of current through the tube A. With the switch 5 closed and current flowing through the tube A, during operation of the tube the core 31' of the magnet 31 holds the spring armature 33 in the dotted position shown so as to keep the contacts 10 and 11 out of engagement with each other while the tube A is operating. Upon the closure of the master switch 5, contacts 10 and 11 are maintained closed long enough to heat the filaments 1 and 2 up to the desired point for starting, whereupon due to the expansion of the wire 20 and the downward bending of the spring arm 34 the part of the spring 33 which serves as an armature is forcibly moved downwardly to open the circuit at the contacts 10 and 11. This opening of the circuit at the contacts is a snap action due to the sudden release of the spring armature 33 from the pull of the core 30' and also the armature 33 is now brought close enough to the core 31' to be influenced by the latter. As long as current flows in the circuit the core 31' holds the armature 33 in the downward position indicated in dotted lines to hold the contact 10 out of engagement with the contact 11. The moment the tube A discontinues operation however, the armature 33 is released to reclose the contacts 10 and 11. Shading coils 36 are illustrated as mounted on the faces of the cores 30' and 31' around the core legs 36' to avoid chattering of the armature 33.

In the embodiment of Fig. 3 the choke coil structure 7 of the circuit is utilized as the electromagnet for operating the armature 15. In this case the armature 15 is carried by a light spring 40, which is fastened at 41 to the heavy spring 34 whose bias is opposed by the expansion wire 20. This light spring 40 carries the contact 10 and the cooperating contact 11 is also carried by a light spring arm 42 which is suitably fastened in an insulated manner to the frame 14. This spring arm 42 has a bias in the downward direction and its downward movement is arrested by a stop 43. The operation here is similar to that of Fig. 1. Upon the heating of the expansible wire 20 at the initial closure of the circuit at the switch 5 the heavy spring 34 is permitted by the expanding wire 20 to move the armature 4 downwardly to a position where it can be actuated by the magnetic flux of the choke coil, whereupon the contacts 10 and 11 are opened with a snap action. The spring arm 42 follows the moving contact 10 to keep the contacts closed until the snap opening action is effected.

In the embodiment of Fig. 4 the choke coil structure 7 of the circuit is employed as the electro-magnet for operating the armature 4 as in Fig. 1. The armature 15 and contact 10 are carried by a spring arm 45 which is biased to move in the upper direction about its point of support on the frame 14. The contact 11 is carried by a bi-metallic thermostatic member 46 which is heated by a heating coil 47 coiled therearound, the circuit through the coil 47 being in series with the contacts 10 and 11. Upon the initial closure of the master switch 5, a circuit is completed through the thermostatic coil 47, the contacts 10 and 11 and the filaments 1 and 2. The bi-metallic member 46 thereupon bends downwardly to move the arm 46 in a downward direction with the armature 15 until the latter is operated by the flux of the core, similarly as described with respect to Fig. 1.

The embodiment of Fig. 5 is somewhat similar

to the embodiment of Fig. 2, a separate electromagnet being provided and connected in series with the choke 7 for actuating the armature 15. The contact 10 is carried by a spring arm 12 similar to that shown in Fig. 1 and a contact 11 is carried by a heavier spring arm 18 similar to that shown in Fig. 1, the bias of these spring arms 12 and 18 being opposed to each other. The operation is similar to that described above in connection with Fig. 1.

Fig. 6 is similar to the modification of Fig. 5, but adapted for direct current operation. A resistor or resistance 51 is illustrated as connected in series with the choke 7 and the electro-magnet 50. The operation is similar to that described above with respect to Figs. 1 and 5.

In the modifications of Figs. 2, 3, 5 and 6 the time element for heating the filaments 1 and 2 at starting before the breaking of the circuit at the contacts 10 and 11 may be adjusted as described with respect to the modification of Fig. 1. Also, similarly, with respect to the modification of Fig. 4, except that here the mounting of the bi-metallic strip 46 may be adjusted in any suitable manner, not shown, together with the adjustment of the bias of the arm 45 and the spacing of the armature 4 from the core.

I claim:

1. The combination comprising a gaseous lighting device having heater electrodes therein, a circuit for supplying electrical energy to said electrodes, an electromagnet energized by said circuit, a second circuit connecting said heater electrodes in series with the first mentioned circuit, a pair of separable contacts in said second circuit, an armature controlling one of said contacts and adapted to occupy alternative positions, one position wherein it is not operable by said electromagnet and in another position wherein it is operable thereby, a spring member carrying the other of said contacts and biased in one direction to close the contacts and to move said armature, the bias of said spring member being opposed by an expansible wire which is heated by the current of said second circuit.

2. The combination with an electromagnet in the operating circuit of a gaseous discharge tube, of a control switch in the starting circuit for the heater electrodes of the tube, said switch comprising a pair of contacts, a spring armature associated with said electromagnet and carrying one of said contacts, said armature being biased to contact closing position and to a position at which it is not operable by said electromagnet, a spring member biased to oppose and overcome the bias of said armature, and an expansible wire connected to said spring member and connected in series with said contacts in the starting circuit of the tube, the tension of said wire when cold preventing said spring member from moving said armature into a position to be operated upon by the electromagnet.

3. The combination according to claim 16 wherein said spring member carries the other of said contacts whereby upon expansion of said wire due to passage of current through said starting circuit, said contacts remain in engagement until said armature is moved into position to be operated upon by electromagnet and then open with a snap action as the armature is attracted by the electromagnet.

4. The combination according to claim 16 including an additional spring member carrying the other contact and a stop limiting the movement thereof, said last mentioned member being biased toward contact closing position whereby said contacts stay in engagement during movement of said armature to the position where it is operable by the electromagnet.

5. In a control switch for the starting circuit of the heater electrodes of a gaseous lighting tube of the type having a movable member adapted to be operated by an electromagnet in the operating circuit of the tube, the combination comprising a pair of contacts in the starting circuit, one of said contacts being carried by said member, means responsive to current flowing in the starting circuit for moving said member into position to be operated by the electromagnet and spring biasing means for keeping said contacts in engagement during movement of said member by said current responsive means and for giving a snap action opening thereto upon operation of the member by the electromagnet, said current responsive means comprising an expansible wire connected in series with the contacts in the starting circuit and tensioned when cold to prevent movement of said member to position for operation by the electromagnet.

6. In a control switch for the starting circuit of the heater electrodes of a gaseous lighting tube of the type having a movable member adapted to be operated by an electromagnet in the operating circuit of the tube, the combination comprising a pair of contacts in the starting circuit, one of said contacts being carried by said member, means responsive to current flowing in the starting circuit for moving said member into position to be operated by the electromagnet and spring biasing means for keeping said contacts in engagement during movement of said member by said current responsive means and for giving a snap action opening thereto upon operation of the member by the electromagnet, said spring biasing means including two oppositely biased members of which one is said movable switch member and the other carries the other contact, said members being biased toward contact closing position.

7. In a control switch for the starting circuit of the heater electrodes of a gaseous lighting tube of the type having a movable member adapted to be operated by a choke coil in the operating circuit of the tube, the combination comprising a pair of contacts in the starting circuit, one of said contacts being carried by said member, means responsive to current flowing in the starting circuit for moving said member into position to be operated by the leakage flux of said choke coil and spring biasing means for keeping said contacts in engagement during movement of said member by said current responsive means and for giving a snap action opening thereto upon operation of the member by the choke coil, said current responsive means comprising an expansible wire connected in series with the contacts in the starting circuit and tensioned when cold to prevent movement of said member to position for operation by the leakage flux of the choke coil.

8. The combination comprising a gaseous lighting device having heater electrodes therein, a circuit for supplying electrical energy to said electrodes, an electromagnet energized by said circuit, a starting circuit connecting said heater electrodes in series with the first mentioned circuit, a pair of separable contacts in the starting circuit spring-biased toward engagement, an armature carrying one of said contacts and adapted to occupy alternative positions, one position wherein it is not operable by said electro-

magnet and the other position wherein it is operable thereby, and means responsive to the current in the starting circuit for moving said armature into position to be operated upon by said electromagnet, said current responsive means carrying said other contact and moving said armature through the intermediary of said contacts whereby pressure between said contacts increases during movement of said armature from said first alternative position to said second alternative position.

9. The combination comprising a gaseous lighting device having heater electrodes therein, a circuit for supplying electrical energy to said electrodes, an electromagnet energized by said circuit, a starting circuit connecting said heater electrodes in series with the first mentioned circuit; a pair of separable contacts in the starting circuit, an armature carrying one of said contacts and adapted to occupy alternative positions, one position wherein it is not operable by said electromagnet and another position wherein it is operable thereby, means responsive to the current in the starting circuit for moving said armature into position to be operated upon by said electromagnet, and at least one of said separable contacts being spring-biased toward engagement with the other contact for maintaining the contacts in firm engagement during the movement of the armature to its alternative position wherein it is under the influence of said electromagnet and operable thereby for snap opening.

10. The combination comprising a gaseous lighting device having heater electrodes therein, a circuit for supplying electrical energy to said electrodes, an electromagnet in series with and energized by said circuit, a starting circuit connecting said heater electrodes in series with the first mentioned circuit, a pair of separable contacts in the starting circuit, an armature carrying one of said contacts and adapted to occupy alternative positions, one position wherein it is not operable by said electro-magnet and another position wherein it is operable thereby, means responsive to the current in the starting circuit for moving said armature into position to be operated upon by said electromagnet, and at least one of said contacts being spring-biased toward engagement with the other contact for maintaining the contacts closed while the armature is being moved to its position wherein it is under the influence of said electromagnet and operable thereby for snap opening of the contacts.

11. In a control switch for the starting circuit of heater electrodes of a gaseous lighting tube of the type having a movable member adapted to be operated by an electromagnet in the operating circuit of the tube, the combination comprising a pair of contacts in said starting circuit, one of said contacts being carried by said member, means responsive to current flowing in the starting circuit for moving said member into position to be operated by the flux of said electromagnet and spring-biasing means for keeping said contacts in engagement during movement of said member by said current responsive means but permitting snap opening of the contacts by the electromagnet after movement of said member, said current responsive means comprising a thermostat connected in series with the contacts in the starting circuit and being ineffective when cold to move said member to position for operation by said magnet.

12. In a starting control for a gaseous lighting tube having heating electrodes therein and means for connecting the tube across a supply line, the combination of an electromagnet in series with the supply line and a starting circuit for said gaseous lighting device comprising said electromagnet, a pair of contacts and thermal responsive means, an armature for said electromagnet adapted to occupy one position in which it is not operable by said magnet and a second position in which it is operable by said magnet, said armature being carried by a spring arm biased against the pull of the magnet and tending to keep the contacts closed, and a second spring arm biased to oppose the bias of the first spring arm and tending to move the armature to a position in which it is operable by the magnet, said last named spring arm being opposed by said thermal responsive means.

13. In a starting control for a gaseous lighting tube having heating electrodes therein and means for connecting the tube across a supply line, the combination of an electromagnet in series with the supply line and a starting circuit for said gaseous lighting device comprising said electromagnet, a pair of contacts and thermal responsive means, an armature for said electromagnet adapted to occupy one position in which it is not operable by said magnet and a second position in which it is operable by said magnet, said armature being carried by a spring arm biased against the pull of the magnet and yieldingly holding the contacts closed during the movement of the armature from the position in which it is not operable by the magnet to the position in which it is operable by the magnet, and a member for actuating said spring arm together with its armature to a position in which it is operable by the magnet to effect a snap opening, said member being controlled by said thermal responsive means.

14. In a starting control for a gaseous lighting tube having heating electrodes therein and means for connecting the tube across a supply line, the combination of an electromagnet in the supply circuit and a starting circuit comprising a pair of separable contacts and a thermal responsive means, an armature for said electromagnet occupying one position in which it is not operable by said magnet and a second position in which it is operable by said magnet, said armature being biased to close the contacts during the movement from one position to the other, and spring means biased to move said armature into a position to be operated by said electromagnet but being prevented by said thermal responsive means when cold from moving said armature.

EDGAR J. LEUTHOLD.

CERTIFICATE OF CORRECTION.

Patent No. 2,319,241. May 18, 1943.

EDGAR J. LEUTHOLD.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 3, first column, lines 63 and 72, for "claim 16" read --claim 2--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office

Signed and sealed this 7th day of September, A. D. 1943.

(Seal)

Henry Van Arsdale,
Acting Commissioner of Patents.