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STARTING CIRCUIT FOR GAS FILLED DISCHARGE TUBES

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Fig. 1.

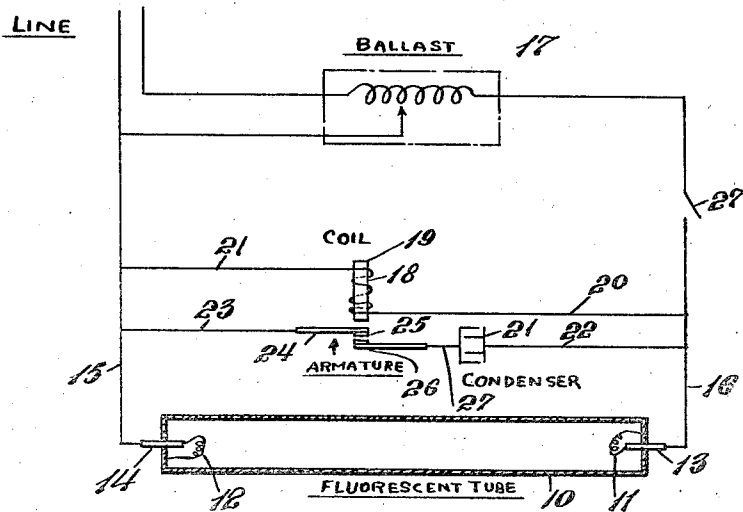
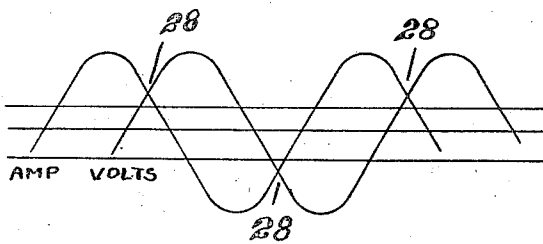


Fig. 2.



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STARTING CIRCUIT FOR GAS FILLED DISCHARGE TUBES

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3 Claims. (Cl. 315-98)

This invention relates to a circuit for the starting of a gas-filled electric discharge tube.

Gas-filled electric discharge tubes usually are provided with a pair of electrodes at each end of the tube extending from a filament within the envelope between the pair of electrodes. Such a tube requires some sort of starting device in order that it may function or be lighted when a voltage of a potential usually used for domestic purposes is applied to the electrodes at either end of the tube. The starting device which is utilized provides a definite limit to the useful life of a tube of such character, it having been found that a tube will operate if it can be started, but many times the starter will fail to light the tube after a part of its usefulness has been expended.

One of the objects of this invention is to provide a starting device which will enable an electric discharge tube to be used which will have a single starting electrode at each end of the tube although tubes which are provided with two electrodes may be equally well utilized in the circuit.

Another object of this invention is to provide a starting circuit which will be mechanical as distinguished from the gas or glow lamp starting device commonly utilized in the present day starters.

Another object of this invention is to provide a circuit which will cause an electric discharge tube to operate when the tube has passed beyond its usefulness with the usual form of starter which is common at the present time whereby a greater life or usefulness of the electric discharge tube may be had.

Another object of this invention is to provide a circuit which will cause the electric discharge tube to operate quickly and almost instantaneously when voltage is applied to the circuit.

Another object of the invention is to provide a starting circuit which will not only eliminate auxiliary starters but also sockets or supports and connections for the same.

Another object of the invention is to provide a circuit which, should the electric discharge lamp be extinguished by the turning off of the current, may be immediately again lighted without the necessity of waiting for thermostatic or thermionic elements to return to a temperature which will permit them to again function.

Another object of the invention is to provide a starting circuit which will not require abnormally high voltages for operation of the same.

With these and other objects in view, the invention consists of certain novel features of con-

struction, as will be more fully described and particularly pointed out in the appended claims.

In the accompanying drawing:

Fig. 1 is a diagrammatic view illustrating the circuit;

Fig. 2 is a diagram illustrating the lag between the current and voltage curves of the circuit;

With reference to the drawing 10 designates a gas-filled discharge tube, such for instance as a fluorescent tube used for commercial and domestic lighting, which comprises an envelope 10 containing a gas and filamentary electrodes 11 and 12 which have portions 13 and 14 extending through the gas envelope and sealed therein. This tube is connected across the line by leads 15 and 16 and in one of these leads a reactance or choke coil commonly called a ballast 17 of the auto-transformer type is provided in series with the discharge tube 10.

A coil 18 having an iron core 19 is connected across the line 15, 16 by leads 20, 21 so as to be in parallel with the gaseous discharge tube 10. Another part of my starting device consists of a condenser 21' also connected across the line by leads 22, 23 so as to be in parallel with the discharge tube 10 and in parallel with the coil 18. This condenser circuit has in it an armature 24 to break the circuit and has a contact 25 to engage a contact 26 connected as at 27 to the condenser so that when 25 and 26 are in engagement the condenser circuit will be closed and when these are separated the circuit will be broken or open. I so locate the armature 24 with reference to the coil 18 that when energy passes through the coil 18 the armature will be attracted toward the coil to cause the circuit to be broken. As alternating current is used the armature will be moved alternately toward and away from the coil 18.

The armature consists of a resilient arm which is so selected that a harmonic of its natural frequency of vibration will be the frequency of the alternating current which is used in the line. The armature is also so selected with reference to the coil and current impressed upon the line that the amplitude of its vibration when the current is passing through the coil, but not through the discharge tube 10, will be such that the armature will make and break the condenser circuit at the terminals 25 and 26 but the amplitude will be such that when the current is passing through the discharge tube the contacts 25 and 26 will not come into engagement. It will be apparent that the smaller amplitude will also be a function of resistance of the coil 18.

In operation, when the circuit is closed as at 27 current will initially pass through the line 20, coil 18, and lead 21, fully energizing the coil 18 and will attract and repel the armature 24 so as to cause it to engage and disengage contact 26, thereby intermittently establishing and breaking circuit through the condenser, the amplitude of the armature being such by reason of the selection of the armature and coil that this contact will be made and broken by oscillation of the armature. This making of the contact will occur at the point 28 (Fig. 2) where the current and voltage sine waves cross by reason of the lag back of the other.

Intermittent contacting at 25, 26 causes the effect of high frequency across the condenser 21, capacity increases as compared to normal in the sixty cycle wave of the line and commences to function as a condenser of high frequency because of the harmonic superimposed upon the sixty cycle wave. This high frequency effect causes the filaments in the discharge tube 10 to become very active and emit electrons which form a path through the gas in the tube 10 for an electric discharge through the tube. As the temperature in the tube increases or rises conductivity also increases, reducing the voltage across the coil 18, thus reducing the amplitude of the armature 24. When the voltage strikes across the tube 10 and current is conveyed through the tube and the current through the coil 18 becomes very much reduced and consequently the amplitude of the armature is so reduced as to cause the armature to be moved either not at all or so slightly that no repetition of contact occurs between the points 25 and 26. Thus, the starting device ceases to operate although it acts as a monitor for starting purposes or restarting the tube if the current is interrupted at any time. By this arrangement the starter is always ready to be used and there is no need for waiting to cool down any thermostatic or bi-metal before the starter can again operate.

I have found that with the usual ballast, which at 118 volts and .85 ampere will have a power factor of about 56%, and usual fluorescent tube for forty watts that the coil which I should select will have a resistance of about 4000 ohms while the condenser which I should use will be from

two to three microfarads. The armature is so selected that it will make contact at 25, 26 when coil 18 is energized with no current passing through the fluorescent tube but which will have an amplitude of vibration insufficient to cause repetition of contact when voltage has struck across the discharge tube and the relatively small amount of current is passing through the coil 18 because of the voltage drop across said coil when the tube is lighted.

I claim:

1. A starting and operating circuit for a gaseous electric discharge device having an envelope with an electric transmitting gas therein and electrodes in said gas and sealed in said envelope and extending therefrom, a supply circuit of alternating current for said electrodes, an inductive ballast in said supply circuit, a magnet coil of a higher resistance than said device while transmitting current from one electrode to another, connected across the electrodes of said device at all times, a condenser also connected across the electrodes of said device and in parallel with said coil, and a normally closed switch contact in series with said condenser, said switch including a portion of magnetic material and said switch being adapted to be opened by magnetic attraction of said coil to make and break said condenser circuit only prior to the passing of current through said device, the inductance of said ballast and capacitance of said condenser being such that a starting potential will be applied across said electrodes.

2. A starting and operating circuit for a gaseous electric discharge device as set forth in claim 1 wherein the said switch contact has an amplitude which is sufficient to make and break said circuit upon current being passed through the coil and prior to the current passing through said device and insufficient to make and break said circuit after current from said source is flowing between said electrodes.

3. A starting and operating circuit for a gaseous electric discharge device as set forth in claim 1 wherein said switch contact is responsive to the energy passed through said coil to make contact at the time of crossing of the voltage-ampere sine waves of the circuit.

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