March 13, 1951 B. K. NASTER 2,545,164

INSTANT-START DEVICE FOR ENERGIZING
A PAIR OF FLUORESCENT LAMPS
Filed July 30, 1948

Fig. 1

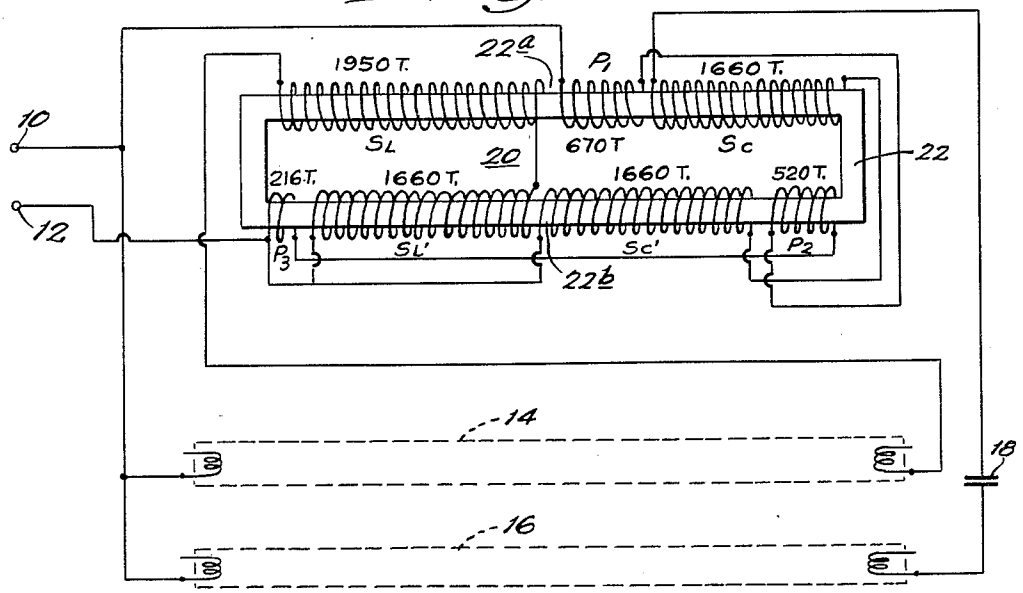


Fig. 2

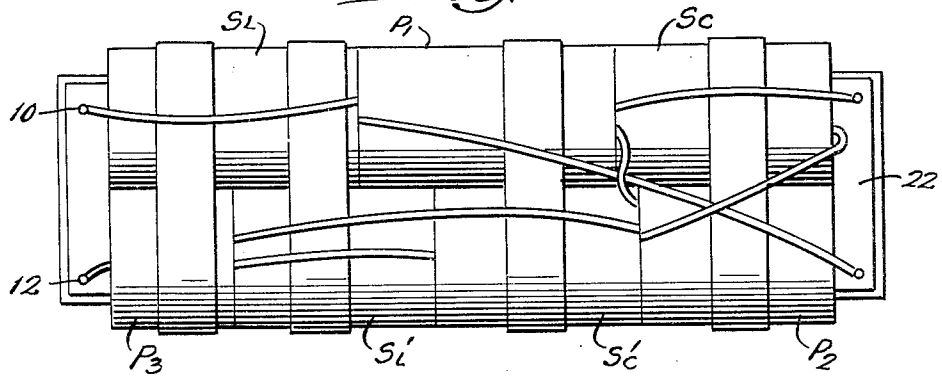


Fig. 3

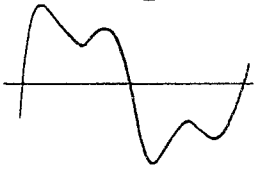
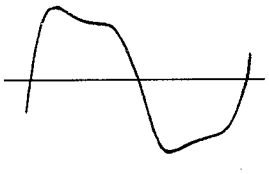


Fig. 4



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Patented Mar. 13, 1951 2,545,164

UNITED STATES PATENT OFFICE

2,545,164

INSTANT-START DEVICE FOR ENERGIZING A PAIR OF FLUORESCENT LAMPS

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Application July 30, 1948, Serial No. 41,596

1 Claim. (Cl. 315—257)

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My invention relates to an improved instant-start device for energizing a pair of fluorescent lamps.

In one method of instantaneously starting fluorescent lamps, the lamps are energized through a transformer with a sufficient number of secondary turns to provide a secondary voltage of approximately 450 volts to achieve instant starting and a large leakage reactance to reduce that voltage to an effective value of approximately 105 volts during operation.

However, if a conventional double-secondary transformer is used as an instant-start device for a two-lamp unit of the type having one lamp energized through a capacitor, the wave form and resultant current flow through the lamps will contain strong third harmonic components of phase so related to the fundamental wave as to produce a peaked wave capable of producing only limited light output and requiring an excessive value of effective current flow to secure full illumination.

In accordance with the present invention, the lamps of a two-lamp fluorescent lamp assembly are energized through a transformer having a core defining a pair of spaced elongated legs. On one leg, the primary winding is interposed between the secondary windings for each lamp, and on the other leg the primary winding is divided into two sections, one on each end of the leg and the two secondaries placed between the primary windings. With appropriate choice of turns and coupling values, the two lamps start instantaneously and, in addition, operate with full brilliance without excessive values of effective current flow.

It is accordingly a general object of the present invention to provide an improved device capable of energizing a pair of fluorescent lamps to full brilliance without excessive effective current flow.

Further it is an object of the present invention to provide an improved instant-start device for fluorescent lamps having ample starting vo'tage, suitable running voltage, and good wave form and which is suitable for a fluorescent lamp unit of the type in which one fluorescent lamp of a pair is energized through a phase-shifting capacitor.

It is yet another object of the present invention to provide an improved instant-start device for energizing a pair of fluorescent lamps and which is characterized by efficient utilization of materials and ease of manufacture.

The novel features which I believe to be characteristic of my invention are set forth with

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particularity in the appended claim. My invention itself, however, both as to its organization and method of operation, together with further objects and advantages thereof, may best be understood by reference to the following description taken in connection with the accompanying drawing in which:

Figure 1 is a wiring diagram showing the device of the present invention connected to energize a pair of fluorescent lamps;

Figure 2 is a plan view of the device of the present invention; and,

Figures 3 and 4 are diagrams showing wave forms when another type of unit is emp'oyed and the unit of the present invention is employed, respectively.

Referring now to Figure 1, there is shown at 10 and 12 a pair of terminals to which a source of alternating voltage is connected. These terminals are connected to the transformer unit indicated generally at 20 as well as to the fluorescent lamps indicated at 14 and 16. The former lamp is connected directly to the transformer and to terminal 10 whereas the latter lamp is connected to the terminal 10 and transformer 20 by the phase-shifting capacitor 18.

The transformer 20 comprises a core 22 defining a pair of leg portions 22*a* and 22*b*, each of which carries a plurality of windings. The leg 22*a* sustains a centrally disposed primary winding P_1 and the secondary windings S_C and S_L on opposite sides thereof. The leg 22*b* sustains the centrally disposed secondary windings S_L' and S_C' which are disposed between the primary windings P_2 and P_3 as shown.

The electric circuit for energizing the primary windings of the transformer 20 may be traced from terminal 12 through winding P_3, winding P_2, winding P_1 and back to terminal 10. The energizing circuit for fluorescent lamp circuit 14 may be traced from terminal 10 through lamp 14, secondary winding S_L, secondary winding S_L', and back to the terminal 12. The energizing circuit for fluorescent lamp 16 may be traced from terminal 10 through lamp 16, capacitor 18, secondary winding S_C, secondary winding S_C', and back to the terminal 12.

It will be observed that the lamps 14 and 16 each receive the full voltage across the terminals 10 and 12 plus the voltage developed across the terminals of the corresponding secondary winding.

The core 22 preferably is made up of rectangular sheets or laminations of low loss silicon steel having a rectangular window as shown to

define the legs 22*a* and 22*b*. The windings P_1, P_2, P_3, S_c, S_c', S_L, and S_L' are wound about suitable fiber tubes or bobbins capable of being received on these legs and are covered with a suitable insulating paper or cloth as shown in Figure 2 to make up the complete energizing structure.

In accordance with the present invention the windings on the transformer 20 are oriented relative to each other to provide a flat topped voltage wave capable of giving most effective operation of both lamps. This structure is quite critical and relatively small departures from the optimum conditions can cause unsatisfactory operation. In a specific device constructed in accordance with this invention and found to operate satisfactorily, the following dimensions and constants were used to energize a pair of 40 watt fluorescent lamps through a capacitor 18 of 1.5 microfarads:

Core 20:
Silicon steel laminations 7/8" deep, 8¼" long and ½" wide, defining a centrally disposed window 7¼" long and ½" wide.
Windings:
S_L 2000 turns, #28 wire
P_1 690 turns, #23 wire
S_c 1700 turns, #28 wire
P_2 464 turns, #23 wire
S_c' 1700 turns, #28 wire
S_L' 1700 turns, #28 wire
P_3 280 turns, #23 wire

Successful operation of an instant-start fluorescent lamp energizing device demands that high voltage be initially placed across the fluorescent lamps to cause an instant start and that a relatively flat topped voltage wave having the normal running value be applied while the device is operating.

In the device above described the open circuit voltage has an effective value of approximately 450 volts whereas the running voltage across the lamps 14 and 16 has an effective value of approximately 105 volts when 120 volts is applied across terminals 10 and 12.

If a conventional two-lamp ballast is simply rewound to provide these voltages, the voltage appearing across the capacitor lamp 16 will tend to include a strong third harmonic component of phase position such as to give a wave having spaced peaks as indicated in Figure 3. Since the illumination depends on the time over which a relatively high voltage value is applied to the lamp, this wave is relatively ineffective in providing good lamp operation and if normal brilliancy is to be achieved the peak value of the wave must be considerably greater than would be required of a more flat topped wave. Use of a peak wave of high value is not only wasteful of power but also contributes to the early blackening and burn-out of the lamp.

With the device of the present invention the foregoing peak wave is avoided and a more nearly flat topped wave, such as that of Figure 4, is applied to the lamps. This wave remains at the high values a relatively long time with the consequence that the lamp operates efficiently and there is little tendency for it to blacken.

It will be observed that on leg 22*a* the secondary windings S_c and S_L are coupled to the primary winding P_1 to substantially the same degree but that the secondary winding S_L which energizes lamp 14 has approximately 20% more turns than does the secondary winding S_c. On the other hand, the secondary windings S_c' and S_L' on the leg 22*b* are of the same number of turns but are unequally coupled to the primary windings P_2 and P_3. Since the primary winding P_3 has approximately 60% of the turns of primary winding P_2, the secondary winding S_L' is less closely coupled to the primary winding than is the secondary winding S_c', thus energizing the lamp 14 through a winding less closely coupled to the primary than the corresponding winding energizing lamp 16.

The purpose of capacitor 18 is to shift the phase of the current flow through lamp 16 relative to the current flow through lamp 14. This overcomes the stroboscopic effects otherwise associated with energization of fluorescent lamps by alternating current.

In the appended claim and the foregoing specification I have used the term "effective value" of a wave to indicate a value such as the root-mean-square value which measures the heating effect of the waves and the tendency of that wave to blacken fluorescent lamps.

While I have shown and described a specific embodiment of the present invention it will, of course, be understood that I do not wish to be limited thereto. I therefore intend by the appended claim to cover all such variations and modifications as fall within the true spirit and scope of my invention.

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

In combination, for use with a source of alternating e. m. f., a pair of low-pressure, gas-discharge lamps, a high-voltage, step-up transformer comprising an elongated substantially rectangular magnetic core having a primary winding centrally disposed on one leg, a secondary winding on each side of said primary winding, one of said secondary windings having greater turns than the other, a pair of adjacent secondary windings having substantially equal numbers of turns centrally disposed on the other leg of said core, and a pair of primary windings on said last leg near the ends thereof, the primary on the end corresponding to said one secondary winding having fewer turns than the other primary of said pair, a capacitor, means defining an electric circuit through said capacitor, one of said lamps, the secondary on said first leg having the smaller number of turns, and the secondary on said second leg adjacent the primary winding having greater turns, and means defining an electric circuit through said other lamp and the others of said secondaries.

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