June 15, 1948. H. R. YATES 2,443,490

PARALLEL NEON BULB CIRCUIT

Filed April 22, 1947 2 Sheets-Sheet 1

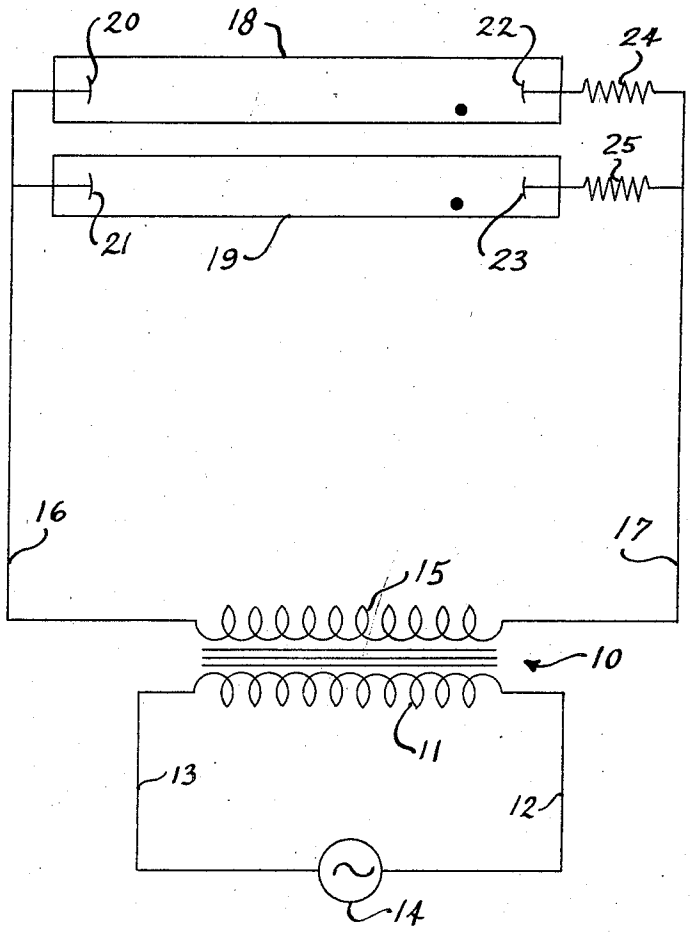

Fig. 1

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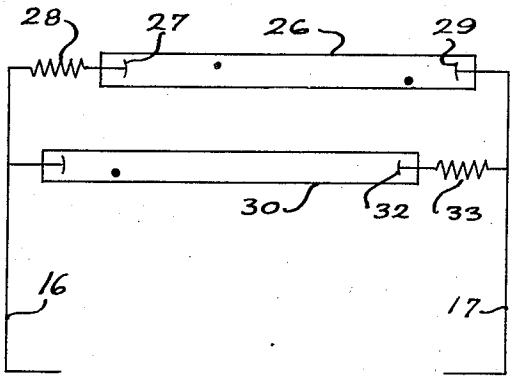

Fig. 2

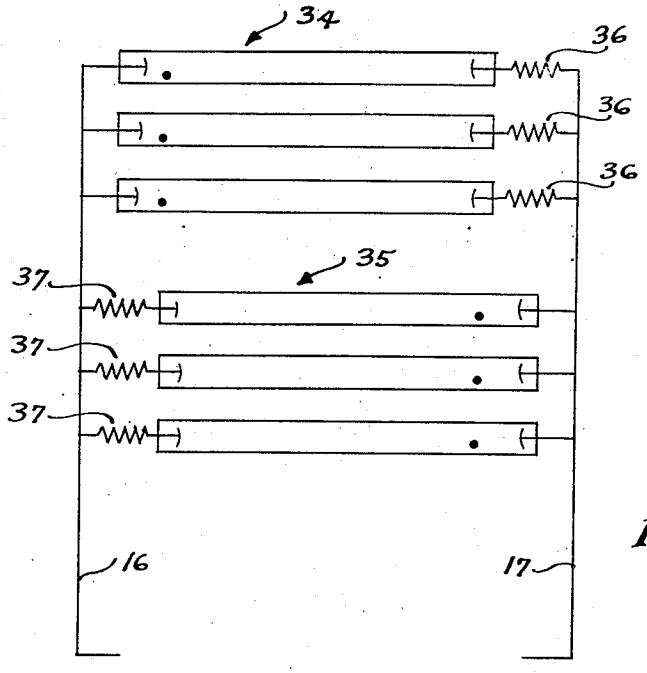

Fig. 3

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Patented June 15, 1948 2,443,490

UNITED STATES PATENT OFFICE

2,443,490

PARALLEL NEON BULB CIRCUIT

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Application April 22, 1947, Serial No. 743,144

2 Claims. (Cl. 315—324)

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This invention relates to an electrical circuit for connecting discharge tubes in parallel.

Many attempts have been made to mount neon discharge tubes in parallel without any success whatever except where the tubes are adjusted to present the same internal resistance across the line. This latter method has only been utilized with respect to two tubes where it was found necessary to change their internal structures in some particulars. It is, of course, advantageous to mount neon tubes in parallel because when mounted in series a high reactance transformer is required in order to develop sufficient voltage to fire the device. Once the striking voltage is applied, the device will light up and the high voltage drops to about half its initial value.

It is obvious, therefore, that if an attempt is made to operate discharge tubes in parallel, using a high reactance transformer in the circuit, the tubes will be fired by the voltage impressed thereon, but that, since the voltage is not maintained in a high reactance type of transformer, the device will shut off shortly after initiation.

It is further notable that to accomplish the lighting of neon tubes in parallel by ordinary means, it would be necessary to connect the secondaries of a plurality of high reactance transformers in series, which, of course, would necessitate clumsy equipment and an ineffective arrangement in all.

A comparison of a series arrangement versus a parallel arrangement of tubes results in conditions which favour a parallel disposition of the tubes in a circuit. Thus, if a transformer will deliver 1500 volts, it will only be capable of firing a certain limited number of neon tubes according to the sum of their striking voltages. If, however, the tubes are connected in parallel, it is obvious that the number of tubes which may be lighted only depends on the current drawn from the transformer.

It is the main object of the present invention to provide an electrical circuit containing a plurality of discharge tubes connectable in parallel relation across a source of voltage.

A further object of the present invention is to provide a circuit of this type wherein the source of voltage comprises the secondary of a low reactance transformer.

A still further object of the present invention is to provide an electrical circuit arrangement including a plurality of discharge tubes in parallel, resistor means being disposed between one electrode of each of said tubes and one side of a secondary of a low reactance transformer, the other electrode being connected to the other side of said secondary.

A still further object of the present invention is to provide an electrical circuit containing a plurality of discharge tubes in series with cooperating resistors and disposed parallelly with relation to a low reactance transformer, the resistors being included to control striking voltage applied to said tubes, whereby all of said tubes are actuated in the same instant.

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A still further object of the present invention is to provide an electrical circuit as before, whereby a greater footage of neon tubing may be lighted with a smaller value of striking voltage than has formerly been required for series connections containing the same total length of tubing.

With these and other objects in view, the present invention generally comprises an electrical circuit containing a low reactance transformer having its primary connectable to a source of alternating current. Each of a plurality of gaseous discharge tubes has one of its electrodes connected to one side of the secondary coil of the transformer. Another electrode of each discharge tube is connected through impedance means to the other side of the secondary of the transformer. The impedance means chosen should substantially match the impedance of the discharge tube. Various impedance devices may be employed such as a condenser or inductance, the preferred means being a conventional electrical resistor, which was chosen for production reasons.

Other objects of the present invention will be revealed by a study of the following specification taken in conjunction with the accompanying drawings.

In the drawings:

Fig. 1 reveals a simple disposition of discharge tubes in parallel with a source of voltage.

Fig. 2 reveals an alternative arrangement of the tubes in parallel across the source of voltage.

Fig. 3 reveals the method of mounting tubes in bank formation in parallel, an alternate arrangement of the banks being preferred in this instance.

Referring to the drawings, the low reactance transformer 10 is shown having its primary 11 connected by the lines 12 and 13 to a source of alternating currents 14. The secondary 15 of the transformer 10 has leads 16 and 17 extending therefrom toward a plurality of discharge tubes. In Figure 1 it will be observed that gaseous discharge tubes 18 and 19 are connected by their electrodes 20 and 21 directly to the line 16. Other electrodes 22 and 23 connected through resistors 24 and 25, respectively, to the other side of the transformer in the line 17.

It has been found necessary to include the resistors in the circuit so described in order to adjust the striking voltage of the various tubes. Due to the parallel relation and disposition of the tubes in the circuit, it will be obvious that a high voltage is not required as is necessary when such tubes are connected in series. In the present instance, a voltage in the order of 1500 volts, developed by the secondary 15 of the transformer

18, has been found sufficient but, of course, this depends on the order of magnitude of the striking voltage of each tube.

The transformer 10 is of a low reactance type which must deliver a current substantially equal to the current drain of one discharge tube 19 multiplied by the number of tubes connected in the circuit and features a constant power factor. In comparison with the transformers formerly used in series circuits, it will be realized that the present type, being connected in the proposed parallel circuit arrangement, allows more footage of tube to be mounted therein, since the only limitation is current drain and not voltage. It is well known that a transformer may be constructed more efficiently with respect to current output than to voltage output and the adoption of the former here results in a system of improved economy. Of course, if an attempt were made to utilize a high reactance transformer in the present circuit, the result would be substantially ineffective, since the secondary voltage would drop to a portion of its initial striking value disenabling the tubes in their lighting function.

It may be preferable in some instances to alternately dispose the discharge tubes in parallel substantially as revealed in Figure 2. In this circuit arrangement a gaseous discharge tube 26 is shown having its electrode 27 connected to the line 16 through a resistor 28. The other electrode 29 of the tube 26 is connected directly to the other side of the transformer in the line 17. A parallelly disposed discharge tube 30 is shown having its electrode 31 connected directly to the line 16 whereas the electrode 32 is connected through a suitable resistor 33 to the line 17. It has been observed that this latter circuit is a substantial equivalent of the circuit of Figure 1 insofar as operation of the tubes is concerned, particularly with respect to a small number of tubes. If, however, it is found necessary to mount a large plurality of tubes in parallel in order to develop sufficient light, neither of the methods revealed in Figures 1 and 2 will ensure operation of the discharge tubes.

It is important to note that when a gaseous discharge tube is operating and emitting light a field potential of variable intensity exists across the whole tube. It is well known that gaseous discharge tubes operating under certain conditions evidence a flickering of the light emitting therefrom, or a deadening of the discharge effect altogether. If a small number of tubes are placed in parallel relation in a circuit as indicated in Figures 1 and 2, it has been found that in the normal instance the field potential does not interfere in any manner whatsoever. When a great number of tubes are placed in parallel, however, a phenomena arises in the cumulative effect of the field potential of all the tubes, resulting in an interruption and flickering of the light emitted from the tubes which is possibly due to oscillation both within and between the various tubes due in some respect to their close proximity. In order to overcome this difficulty, which it is suggested is due to oscillation derived from cumulative field potential across a plurality of tubes disposed in parallel, an arrangement is proposed as in Figure 3.

Referring to the latter figure, it will be noted that a first bank or primary bank of discharge tubes 34 is connected alternately in parallel with a further bank 35 across the lines 16 and 17 of the transformer. The term "alternately," of course, applies as before to the disposition of resistors 36 at the same ends of the tubes of the bank 34 and the resistors 37 disposed at the other end of the tubes of the bank 35. For purposes of clarity this arrangement is termed "an alternate parallel arrangement of the banks." It will be observed that since the resistor means 36 and 37 are disposed on and connected to different lines, the field potential across the bank 34 and the bank 35 will not be the same on any right plane taken through them. I present the supposition that it is this factor which prevents oscillation between the banks and permits them to operate, emitting a full value of light.

I have thus provided electrical circuit means including resistor means and a low reactance type of transformer which makes possible the connection of gaseous discharge tubes in parallel across a source of voltage whereby a greater footage of tube may be lighted than was formerly possible with a single transformer of substantially the same dimensional characteristics.

What I claim as my invention is:

1. An electrical circuit comprising a plurality of elongated linear gaseous discharge tubes having an electrode at each end thereof arranged in parallel spaced apart relation to each other, each of said tubes having an electrical resistance series connected to one end thereof to form a tube unit, each of said resistances being of the same value, said tube units being arranged in at least two similar banks, the resistance end of each tube unit in each bank being connected to the same side of the bank as the other resistance ends of the other tube units in the same bank, said banks being electrically connected in parallel and adapted for electrical connection to a source of power, the resistance units of each bank being at the opposite side of said latter mentioned parallel connection to the resistance units of the banks adjacent thereto.

2. An electrical circuit comprising a plurality of elongated linear gaseous discharge tubes having an electrode at each end thereof arranged in parallel spaced apart relation to each other, each of said tubes having an electrical resistance series connected to one end thereof to form a tube unit, each of said resistances having the same value, said tube units being arranged in two similar banks, the resistance end of each tube unit in each bank being connected to the same side of the bank as the other resistance ends of the other tube units in the same bank, said banks being electrically connected in parallel and adapted for electrical connection to a source of power, the resistance units of one bank being at the opposite side of said latter mentioned parallel connection to the resistance units of the other bank.

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