

Oct. 14, 1952

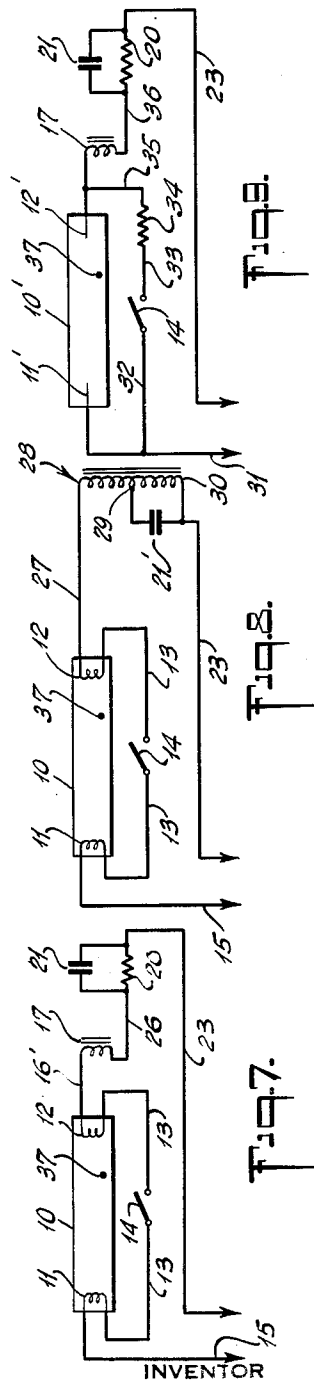
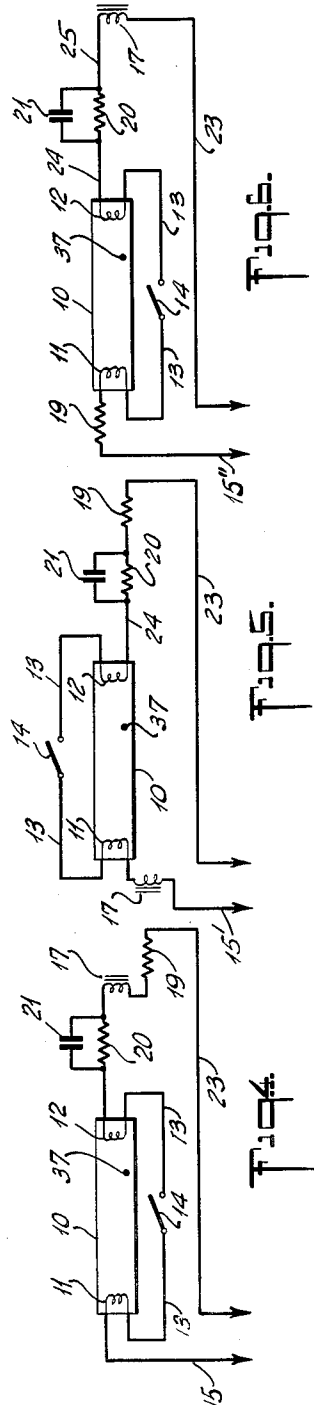
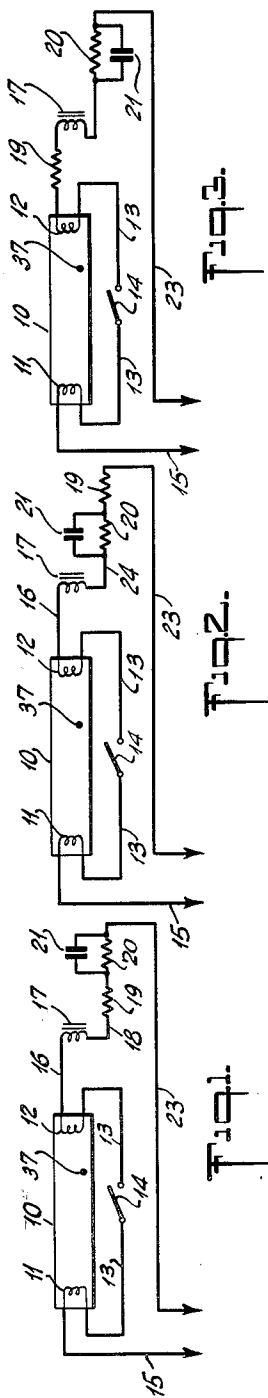
N. O. CLARK

2,614,243

GASEOUS ELECTRIC DISCHARGE DEVICE CIRCUITS

Filed Nov. 8, 1950

2 SHEETS—SHEET 1



INVENTOR
NELSON O. CLARK.
BY *Randolph Klein*
ATTORNEY

Oct. 14, 1952

N. O. CLARK

2,614,243

GASEOUS ELECTRIC DISCHARGE DEVICE CIRCUITS

Filed Nov. 8, 1950

2 SHEETS—SHEET 2

Fig. 10.

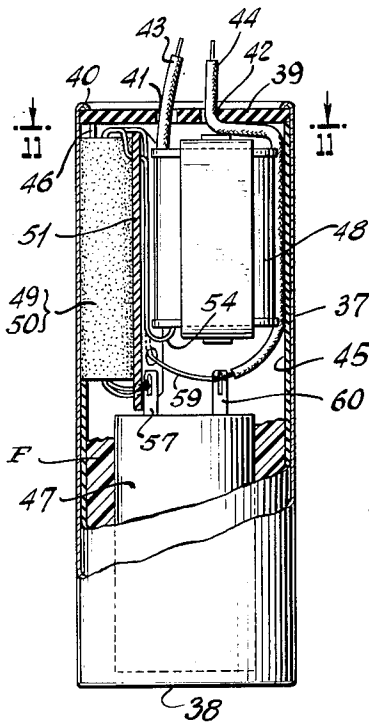


Fig. 12.

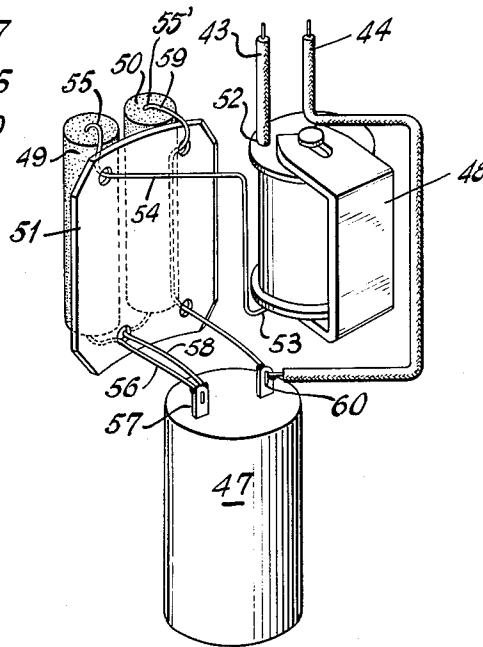
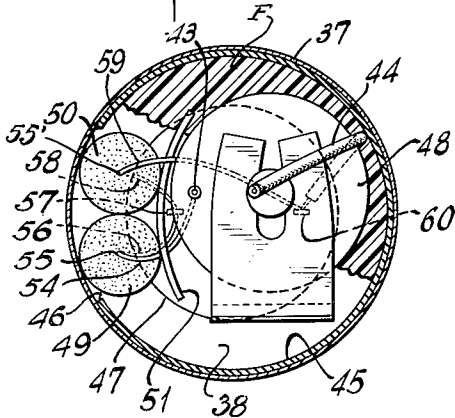


Fig. 11.



INVENTOR
NELSON O. CLARK.
BY *Rent Klein*
ATTORNEY

UNITED STATES PATENT OFFICE

2,614,243

GASEOUS ELECTRIC DISCHARGE DEVICE
CIRCUITS

Nelson O. Clark, Winthrop, Mass., assignor, by
mesne assignments, to C-Eight Laboratories,
New Bedford, Mass., a partnership

Application November 8, 1950, Serial No. 194,649

3 Claims. (Cl. 323-77)

1

This invention relates generally to gaseous electric discharge devices, employing electrodes of either the hot or cold cathode types, and especially deals with an improved system of electric circuits for satisfactory starting and maintaining such devices in operation irrespective of whether energized by either A. C. or D. C. current, and in which circuits is employed a novel ballast arrangement in series with such devices.

It is well known that the operation of gaseous electric discharge devices, commonly designated as fluorescent lamps or tubes, is based upon emission of electrons between two or more electrodes or cathodes in a gaseous or vapor atmosphere confined in a closed chamber, the wall of which is preferably coated internally with a fluorescent film, and which electronic emissions commence and continue after an initial "starting" period during which the electrodes or cathodes are subjected to relatively high heat by either the current momentarily passed through them, or by way of auxiliary heating means, to render them emissive, until the emission itself maintains them at a sufficient heat to assure continuous operation.

It is also well known that fluorescent lamps or tubes are primarily designed for operation with A. C. current, and that they will not operate satisfactorily with D. C. current without considerable changes in the wiring circuits, including the ballast.

The present invention contemplates the provision of a universal system of electric circuits adapted to facilitate satisfactory operation of gaseous electric discharge devices with either A. C. or D. C. current without the necessity of making any changes in the circuits for such devices, and in which circuits is employed a combination of individual elements, such as inductances or chokes, resistances and capacitances, and which combination of elements may be designated by the general term "universal ballast," and wherein all of the elements of such ballast in the electric circuits of the instant universal system are always placed in series with the said gaseous electric discharge devices and, in certain embodiments of the circuits, in series with each other.

The prime object of the present invention, therefore, is the provision of a universal system of circuits for effectively starting and maintaining the operation of gaseous electric discharge devices at A. C. or D. C. current.

Another important object of this invention is the provision in the aforesaid system of electric circuits of a universal ballast in series with said devices, and wherein such ballast comprises an inductance or choke or its equivalent, at least one resistance and at least one capacitance, and wherein at least one resistance or a portion of the inductance is shunted by said capacitance.

Another object of this invention is the provi-

2

sion of a simplified, relatively inexpensively achieved and just as inexpensively maintainable electric circuit for the operation of gaseous electric discharge devices, wherein a universal ballast is arranged in series with the latter and contains as one of its parts a condenser-shunted resistance.

Another object of this invention is the provision of a universal fluorescent lamp and ballast circuit for use with either A. C. or D. C. current, wherein is employed an inductance for providing starting voltage, and one or more resistances in series with the inductance and in series with the lamp, and wherein either at least one of the resistances or a part of the inductance is shunted by a by-pass condenser of a relatively high capacity, said shunted resistance or said shunted inductance serving to produce the required voltage drop for D. C. operation; said by-pass condenser serving for the reduction of impedance across either all or a portion of said resistance or part of said inductance for A. C. operation, thereby compensating for the increased impedance by said inductance and by the resistance or resistances for D. C. operation, the circuit thus providing for normal flow of either A. C. or D. C. current through the lamp, and which circuit includes either a manual or automatically operable starting device for, first, closing the circuit to provide an initial current flow through the cathodes of the lamp until they are heated sufficiently to produce emission, and, secondly, for quickly opening the circuit to supply the required voltage surge between the cathodes to induce discharge.

A further object of this invention is the provision of what may be termed a universal ballast forming an essential part of an electric circuit for operating fluorescent lamps with either A. C. or D. C. current, said ballast being adapted to be placed in series with such fluorescent lamps, and comprising a compact arrangement of an inductance or choke coil, at least one resistance or the equivalent thereof, and a condenser shunted across a resistance.

A more specific object of this invention is the provision of a ballast construction composed of several elements, to wit, a choke, two ceramic-encased resistances and a by-pass condenser, the latter shunting one of the resistances, and wherein all of the elements of the ballast are placed and arranged within a metallic container adapted to dissipate heat generated by the elements when in operation.

The foregoing and numerous other important objects and additional advantages of the present invention will become more clearly understood from the ensuing description in conjunction with the accompanying drawings, wherein:

Figs. 1 to 8 represent various electric circuits for gaseous electric discharge devices employing hot cathodes;

3

Fig. 9 is a diagram of a similar circuit employed with a cold cathode tube;

Fig. 10 is a vertical elevation, partly in section, of a universal ballast in accordance with the present invention;

Fig. 11 is an enlarged horizontal sectional view taken approximately along line 11—11 of Fig. 10; and

Fig. 12 illustrates a connecting diagram of the elements of the ballast.

In Figs. 1 to 8, numeral 10 denotes a fluorescent lamp provided with electrodes 11 and 12 of the hot cathode type, one terminal of which cathodes are connected by leads 13 extending to a starting device 14, which latter may be operated either manually or automatically. Automatic starting devices being well known, they are not shown.

In Fig. 1 the upper terminal of cathode 11 is connected to power line 15, while from the upper terminal of cathode 12 extends lead 16 to an inductance 17, from where lead 18 passes to resistance 19, which latter is connected to another resistance 20, by-passed by condenser 21. Resistance 20 is connected to power line 23.

In Fig. 2 the upper terminal of cathode 11 is again connected to a power line lead 15, while lead 16 passes from the upper terminal of cathode 12 to inductance or choke 17, from which lead 24 extends to resistance 20 shunted by condenser 21. Resistance 20 is connected to resistance 19, from which latter again extends power line 23.

A similar arrangement is shown in Fig. 3 where resistance 19 precedes choke 17, which latter is connected to resistance 20, bridged by condenser 21, and from resistance 20 extends power line 23.

In Fig. 4 resistance 20, bridged by condenser 21, precedes inductance or choke 17, to which is connected resistance 19, from which extends power line 23.

Fig. 5 discloses power line 15' leading to inductance 17, which latter is connected with the lower terminal of cathode 11, while the upper terminals of cathodes 11' and 12 are connected by leads 13 and switch 14. From the lower terminal of cathode 12 extends lead 24 to resistance 20, bridged by condenser 21, and that resistance is again connected with resistance 19, from which latter extends power line 23.

In the arrangement in Fig. 6 is shown a power lead 15'' connected to resistance 19, which latter connects with the upper terminal of cathode 11. From upper terminal of cathode 12 lead 24 passes to resistance 20, bridged by condenser 21, and from resistance 20 extends lead 25 to inductance 17, connected with power line 23.

In Fig. 7 power lead 15 passes to the upper terminal of cathode 11, whereas from the upper terminal of cathode 12 lead 16' extends to inductance 17, connected by lead 26 to resistance 20, bridged by condenser 21. Resistance 20 is again connected with power line 23. It will be noted that resistance 19, shown in Figs. 1 to 6, is omitted in this diagram.

A modified arrangement of a universal ballast is disclosed in Fig. 8. There again power lead 15 extends to the upper terminal of cathode 11 and the upper terminal of cathode 12 is connected by lead 27 to a combination inductance and resistance 28, which latter is tapped at 29. The portion of the inductance between tap 29 and the lower end 30 thereof is bridged by condenser 21', and from lower end 30 extends power line 23.

In the diagram disclosed in Fig. 9 a cold cath-

4

ode tube 10' is illustrated, into which project cold cathodes 11' and 12'. Cathode 11' is supplied by power line 31 from which extends a lead 32 to a starting device 14. The latter is connected by lead 33 over resistance 34 and lead 35 with cathode 12' and with inductance 17, from which latter extends lead 36 to resistance 20, bridged by condenser 21, and which resistance is connected to power line 23. It will be noted that resistance 19 is omitted in this diagram as is the case in Fig. 7.

The arrangement of a resistance in the starting circuit, such as resistance 34 of diagram 9, may be advantageously employed in any one of the starting circuits disclosed in Figs. 1 to 8. In all of the diagrams 1 to 9 there will be noted in the fluorescent lamps a dot 37, which is intended to indicate a drop of mercury exceeding the amount of mercury vaporized during the operation of the lamps.

In all of the circuit diagrams illustrated in Figs. 1 to 9, it is to be noted that all the elements of the universal ballast, which comprise an inductance, and at least one resistance shunted by a condenser, are arranged in series with the fluorescent lamps. It will be further noted that in all of the diagrams 1 to 4 all of the ballast elements are arranged in series with cathode 12 of the lamps, whereas in Fig. 5 choke 17 is placed in series with cathode 11, and resistances 19 and 20 are in series with cathode 12. In the diagram of Fig. 6, on the other hand, resistance 19 is placed in series with cathode 11, whereas the rest of the ballast elements are in series with cathode 12.

As stated above, the diagrams in Figs. 7 and 9 omit the use of an unbridged resistance in series with the lamps, and chokes 17 are so designed as to permit the elimination of such second resistance. However, the one resistance 20 bridged by condenser 21 is represented in all of the diagrams. That also applies to the diagram in Fig. 8 wherein individual resistances are eliminated and the combination choke takes their place.

The ballast

The physical embodiment of a universal ballast arrangement as employed in connection with the various circuits illustrated is shown in detail in Figs. 10 to 12. It is preferred to construct the ballast in the form of a single unit in which all of the ballast elements are contained. Inasmuch as such unit is bound to become heated during operation, it is proposed to employ a heat-dissipating container made, for instance, from aluminum. Such container is indicated at 37 in Figs. 10 and 11. It comprises a one-piece cylinder closed at its bottom 38 and provided with a dielectric closure 39 at its open end, held in place by the turned-over peripheral edge 40 of the cylinder. Closure 39 is preferably made of a phenolic plastic and is provided with two apertures 41 and 42 for accommodating leads 43 and 44 extending through the apertures from within the container.

Placed within container 37 is a fibre board liner 45 which is preferably cut out as indicated at 46 in Fig. 11, the purpose of which cut-out will be presently explained. Inserted in the container is an electrolytic condenser 47 extending toward the bottom 38 but not touching the same. Arranged above the condenser is a choke coil 48 and two resistors 49 and 50. These resistors are spaced from choke 48 and are insulated by

a suitable fibre board 51 which extends between the upper face of condenser 47 and closure 39, thus locating the condenser.

As will be seen in the diagram of Fig. 12, lead 43 extends from the upper terminal 52 of choke 48, while its lower terminal 53 is connected by a lead 54 to the upper terminal 55 of resistance 49. From the lower terminal of the resistance extends lead 56 to one terminal 57 of condenser 47, and lead 58 extends from terminal 57 to the lower terminal of resistance 50. The upper terminal 55' of resistance 50 is connected by lead 59 to the second terminal 60 of condenser 47, and from that terminal extends lead 44, as also seen in Figs. 10 and 11. Thus it will be observed, by following leads 43 and 44 in Fig. 12, that choke 48 is connected in series with resistance 49 by lead 54, that resistance 49 is connected through leads 56 and 58 in series with resistance 50, the latter being shunted by condenser 47, and that terminal 60 of the condenser forms the connecting point for leads 59 and 44.

As stated previously, lining 45 placed against the interior face of container 37 has a spare-out 46. By consulting Fig. 11 it will be noted that resistances 49 and 50, encased preferably in ceramic material, are located in the spare-out so that the ceramic bodies of the resistances may directly touch casing 47, whereby heat from the resistances is directly transferred to the casing for dissipation. Spare-out 46 also serves for localizing resistances 49 and 50 within the casing.

In order to prevent movement of the several elements of the ballast within the casing it is preferred to fill all the spaces between these elements by a polyester styrene resin "F," introduced into the container under vacuum. When the container is thus filled, its cover 39 is attached and the container is placed into an oven for a sufficient period of time to cure the resin until it hardens and forms a substantially rubber-like, heat- and impact-resistant solid.

The arrangement of the ballast construction shown in Figs. 10, 11 and 12 is useable with any one of the wiring diagrams shown in Figs. 1 to 4, however, with a few changes or modifications in the connection between the ballast elements the same ballast structure can be used with the wiring arrangements illustrated in Figs. 5 to 9. Such changes being obvious, specific ballast structures for each of the wiring diagrams shown in these figures are omitted from the drawings, it being understood that, in accordance with the present invention, any ballast structure used must contain at least one condenser-bridged resistance or its equivalent, and the elements of the ballast, including such bridged resistance, must be placed in series with the gaseous electric discharge devices with which they are employed in order to render such devices operative with either A. C. or D. C. current without resorting to the use of auxiliary devices for effecting D. C. operation as heretofore employed.

As proof of the practicability of the present invention the following description of a working example will be of interest. It concerns a universal ballast for an 8 watt 117 volt standard commercial fluorescent lamp. In this ballast were employed two ceramic-encased 220 ohm resistors with a rating of 10 watts, and an electrolytic A. C. type 47-58 mfd. 25 volt condenser and a choke consisting of an inductance coil wound with size 31 nylon covered, enameled

copper wire with 2,100 turns on a fibre spool, and having a resistance of approximately 55 ohms at room temperature. The core for the coil was made of solid relay iron, held in a U-shaped yoke. The ballast with its elements connected in the manner shown in Fig. 12 was placed in series with the 8 watt lamp and produced equally satisfactory lighting effects with either A. C. or D. C. current.

Obviously for larger fluorescent tubes the values of the resistances as well as of the condenser and of the choke will require modification. By the same token changes and rearrangements in the position of the various elements of the ballast are contemplated for different applications, and such changes and modifications are deemed to reside within the broad scope of the present invention as defined in the annexed claims.

What is claimed as new is:

1. A universal ballast for electric circuits designed for operating fluorescent lamps on A. C. or D. C. current without requiring changes in the wiring, said ballast comprising a heat-dissipating, one-piece container having a dielectric, sealed closure at one end for accommodating projecting leads, and a plurality of ballast elements including a pair of ceramic-encased resistances in physical contact with the container, an inductance and a condenser separated from each other and from said resistances; a dielectric insulating member placed against the interior face of the container, but being spared out in the vicinity of the resistances, another dielectric member disposed between the inductance and said resistances, and a heat- and impact-resistant, dielectric substance filling the spaces between the ballast elements.

2. In a ballast for fluorescent lamps, a heat-conductive container, an insulating member placed against the interior face thereof but having a spare-out, a plurality of ballast elements in the container including a condenser, an inductance and a pair of ceramic-encased resistances, said resistances being disposed in the spare-out of the insulating member to effect contact with the container, dielectric, heat- and impact-resistant means filling the spaces between the several ballast elements within the container and serving for localizing and separating said elements, said condenser shunting one of the resistances, said resistances and the inductance being connected in series with one another, a dielectric closure for the container and a pair of leads extending from the end elements of the series-connected elements and projecting through the closure.

3. In a ballast according to claim 2, said dielectric, heat- and impact-resistant space-filling means comprising a polyester styrene resin placed into the container under vacuum and heat-cured therein to a relatively hard, rubber-like solid.

NELSON O. CLARK.

REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
2,020,786	Klinkhamer	Nov. 12, 1935
2,298,935	Freeman	Oct. 13, 1942
2,327,755	Abernathy	Aug. 24, 1943
2,461,957	Berger	Feb. 15, 1949
2,472,882	Berger	June 14, 1949