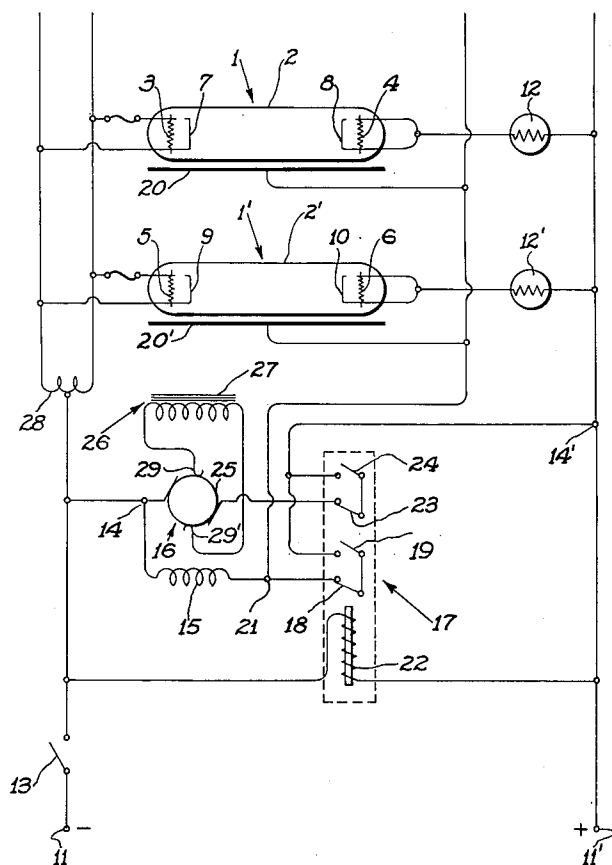


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P. WAGUET
STARTING AND OPERATING CIRCUIT AND DEVICE
FOR ELECTRIC DISCHARGE DEVICES
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Inventor:
Philippe Waguet,
by *Vernett C. Kauffman*
His Attorney

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STARTING AND OPERATING CIRCUIT AND
DEVICE FOR ELECTRIC DISCHARGE DE-
VICESPhilippe Wagnet, Paris, France, assignor to Gen-
eral Electric Company, a corporation of New
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3 Claims. (Cl. 315—165)

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This invention relates to electric discharge de-
vices of the type employing ionizable mediums
such as gases or vapors and more particularly
to starting and operating devices and circuits
therefor.

An object of my invention is to provide a new
and improved starting and operating circuit for
electric discharge devices energized from a direct
current source.

Another object of my invention is to provide
an improved and simplified operating circuit for
luminous electric discharge devices or fluores-
cent lamps energized from a direct current
source, and utilizing an auxiliary dependent al-
ternating voltage source for heating the elec-
trodes and starting the discharge in the lamps.

My invention is of general applicability wher-
ever it is desired to operate fluorescent lamps
from a direct current supply. It has been found
particularly useful in vehicles and railroad cars,
particularly in cars which are illuminated as a
unit and which do not require separate illumina-
tion for individual compartments.

A feature of my invention is the utilization of
an auxiliary direct-to-alternating current con-
verter for heating the filamentary electrodes in
the lamps, and also for starting the discharge.
This is achieved by means of a time-delay relay
which permits the utilization of the induced volt-
age, resulting from the rupture of the field wind-
ing circuit of the converter, as a starting impulse
for the lamps.

For a more complete discussion of various cir-
cuits which may be utilized in operating fluores-
cent lamps from a direct current supply, refer-
ence is made to my copending U. S. application
No. 28,223, filed May 20, 1948. Other applications
and improvements in such circuits are disclosed
in my copending U. S. applications Nos. 28,224,
28,225, and 28,226, filed May 20, 1948, and 33,386
and 33,387, filed June 16, 1948. All of the above
applications are assigned to the same assignee as
the present application.

For a better understanding of my invention,
reference may be had to the following descrip-
tion taken in connection with the accompanying
drawing and its scope will be pointed out in the
appended claims. The drawing is a diagram-
matic view of a plurality of electric discharge
devices connected in parallel and a starting and
operating device and circuit therefor incorporat-
ing my invention.

Referring to the drawing, I have there illus-
trated one embodiment of my invention as ap-
plied to electric discharge devices 1, 4'. The elec-

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tric discharge devices 1, 1', such as fluorescent
lamps therein illustrated comprise elongated tu-
bular or cylindrical envelopes 2, 2' having sealed
into the ends thereof filamentary electrodes 3, 4
and 5, 6. These filamentary electrodes may com-
prise coils, preferable in the form of coiled coils
of tungsten wire activated with oxides of alka-
line earth metals, such as a mixture of barium
and strontium oxides. The envelopes 2, 2' may
contain gaseous atmospheres such as a rare gas
like neon, argon or mixtures thereof at a pres-
sure of a few millimeters and a small quantity
of mercury which, during the operation of the
lamps, has a low pressure of the order of 10
microns. Devices 1, 1' may be low pressure posi-
tive column lamps of a fluorescent type provided
with a suitable phosphor or fluorescent coating.
This fluorescent coating upon excitation by the
radiation produced by an electric discharge be-
tween the electrodes, transforms a shorter wave
radiation due to the discharge into longer wave
radiation such as radiation within the visible
range. Metal cups 7, 8 and 9, 10 serve to inter-
cept the particles of emissive material sputtered
from electrodes 3, 4 and 5, 6, respectively. These
cups are usually tied by means of connections,
either outside or inside of the lamps, to the ex-
tremities of the electrodes. A number of advan-
tages result from the connections between the
electrodes and the corresponding cups, namely,
utilization of the cups 8 and 10 as anodes and
eliminating the disintegration by ionic bombard-
ment of electrodes 4 and 6, utilization of lamps
that are usually employed with alternating cur-
rent discharge circuits, reduction of operating
voltage, doubling the life of lamps by using suc-
cessively the two filamentary electrodes, i. e., by
turning the lamps around when one of the fila-
ments becomes inoperative.

Devices 1, 1' are connected across a suitable
direct current power supply circuit 11, 11' for
supplying current thereto through stabilizing res-
istances 12, 12'. Resistances 12, 12', for exam-
ple, may be iron or tungsten wire enclosed in
hydrogen. A manual make-and-break control
switch 13 may be used to connect devices 1, 1'
to the power supply 11, 11'. A starting and op-
erating circuit 14, 14' is connected across the
direct current supply 11, 11' and comprises a field
winding section 15 of a dynamoelectric machine
or rotary converter 16 and a switching means 17
comprising a normally closed contactor 18 and
a normally open contactor 19. Auxiliary elec-
trodes 20, 20' mounted adjacent devices 1, 1', re-
spectively, are connected to a common point 21

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intermediate field winding section 15 and contactors 18 and 19 of switching means 17. The time-delay relay or switching means 17 further comprises a coil 22 connected across the terminals of the direct current source 11, 11' through the manual make-and-break switch 13, and a normally closed contactor 23 and a normally open contactor 24 in series with an armature winding section 25 of the dynamoelectric machine 16 across the direct current supply 11, 11'.

A transformer 26 comprising a primary winding section 27 and a center-tapped secondary winding section 28 is connected across an alternating current supply 29, 29' produced by the dynamoelectric machine 16. The secondary winding section 28 of transformer 26 serves to heat filamentary electrodes 3 and 5 and to continue to heat these electrodes as long as primary winding section 27 is energized. The center-tap of the secondary winding section 28 is connected to the negative side of the direct current source 11, 11' by means of switch 13.

The circuit illustrated in the drawing operates as follows: In the rest or inactive position contactors 19 and 24 are open and contactors 18 and 23 are closed. As soon as switch 13 is closed, coil 22 of relay or switching means 17 is energized, contactor 19 closes and thus energizes field winding section 15 of the dynamoelectric machine 16; contactor 24 then closes with a time delay of a few tenths of a second with respect to the closing of contactor 19, and applies voltage to the armature winding section 25 of the dynamoelectric machine 16. Upon energization of the armature winding section 25, the dynamoelectric machine 16 begins to rotate and energizes transformer 26. Cathode filamentary electrodes 3 and 5 are then heated; after a few seconds, contactor 23 opens, breaking or interrupting the circuit of the armature winding section 25 and discontinues the heating of cathode filamentary electrodes 3 and 5. A few tenths of a second after the opening of the contactor 23, contactor 18 opens and interrupts the starting circuit 14, 14' which embodies the field winding section 15 of the dynamoelectric machine 16. The rate of change of current through the field winding section 15 creates a voltage impulse which is applied to point 21 and in turn imparted to the auxiliary electrodes 20, 20'. As a result of this impulse the discharge devices 1, 1' are ignited.

The retarded functioning of contactors 18, 19, 23 and 24 of relay or switching means 17 may be obtained, for example, by means of a mechanism which is actuated by coil 22 and which causes the tilting of two glass bulbs containing mercury whose flow is suitably slowed down by a capillary tube and thus serves to establish or break the contacts. Another manner of actuating contactors 18, 19, 23 and 24 in sequence may be obtained by varying the magnetic force required to actuate these contactors by space relationship of the contactors with relation to the coil 22 and by varying the tension with which each individual contactor is maintained either opened or closed, as the case may be.

While a certain specific embodiment has been shown and described, it will, of course, be understood that various modifications may be made without departing from the invention. Thus, whereas one particular type of converter has been described, other types may be used, providing they comprise the essential elements of an armature and a separately excited field winding. Likewise, various other switching devices, either

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mechanical or electrical, may be substituted for the time-delay relay which has been described. The appended claims are, therefore, intended to cover any such modifications coming within the true spirit and scope of the invention.

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

1. Apparatus for operating a gaseous luminous electric discharge device, of the type including a main thermionic electrode and a cooperating main electrode comprising: said device, a unidirectional voltage source, and a ballast resistance; a rotary converter having a direct current field winding, a direct current input winding, and an alternating current output winding; connections from said output winding to said thermionic electrode for heating same; a discharge circuit constituted by connecting said device, in series with said ballast resistance, across said source; a time-delay relay having two sets of contacts respectively connecting said field and input windings across said source, said relay operating to energize in sequence, first said field winding and then said input winding, and said relay then operating to de-energize in sequence after a predetermined time interval, first said input winding and then said field winding; and an auxiliary starting electrode on said device connected to the junction of said field winding with the associated contact of said relay.

2. Apparatus for operating a gaseous luminous electric discharge device, of the type including a main thermionic electrode, a co-operating main electrode, and an auxiliary starting electrode intermediate the ends thereof, comprising: said device, a unidirectional voltage source, and a ballast resistance; a rotary converter having a direct current field winding, a direct current input winding, and an alternating current output winding; connections from said output winding to said thermionic electrode for heating same; a discharge circuit constituted by connecting said device, in series with said ballast resistance, across said source; a time-delay relay having two sets of contacts respectively connecting said field and input windings across said source, said relay operating to energize, in sequence, first said field winding and then said input winding, and said relay then operating to de-energize in sequence after a predetermined time interval, first said input winding and then said field winding; and a connection from said auxiliary electrode to the junction of said field winding with the associated contact of said relay for applying the voltage induced in said field winding upon de-energizing, to said device as a starting impulse.

3. Apparatus for operating a plurality of fluorescent lamps, of the type including a main filamentary thermionic electrode and a cooperating main electrode, comprising: said devices, a unidirectional voltage source, and a plurality of ballast resistances; a dynamoelectric machine for converting direct current to alternating current, said machine comprising a field winding and an armature having direct current input terminals and alternating current output terminals; connections from said alternating current output terminals, through a transformer, to said filamentary electrodes for heating same; discharge circuits constituted by connecting said lamps, each in series with one of said ballast resistances, across said source; a time-delay relay having two sets of contacts respectively connecting said field winding and said input terminals across said source, said relay operating to energize, in se-

quence, first said field winding and then said armature, and said relay then operating to de-energize in sequence, after a predetermined time interval sufficient to permit heating of said filamentary electrodes, first said armature and then said field winding; and auxiliary starting electrodes, located intermediate the ends of said lamps, connected to the junction of said field winding with the associated contact of said relay.

PHILIPPE WAGUET. 10

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