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AUTOMATIC TIME DELAY

Filed Oct. 21, 1936

Fig. 1.

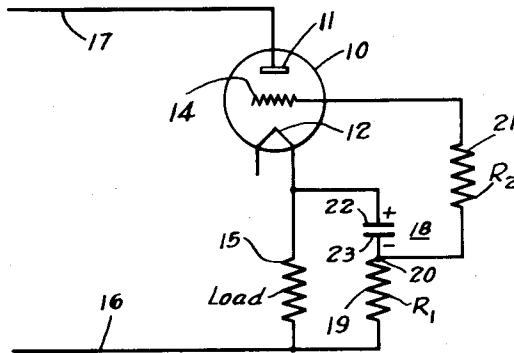
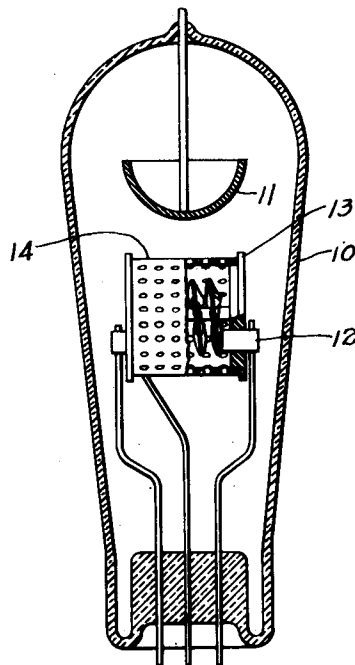


Fig. 2.



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AUTOMATIC TIME DELAY

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Application October 21, 1936, Serial No. 106,790

6 Claims. (Cl. 250—27)

My invention relates to circuits including elec-
tron discharge devices, and especially to such de-
vices utilizing an oxide coated cathode where a
time delay is necessary in establishing the anode-
cathode discharge until the oxide coating is suffi-
ciently electron-emissive.

This application is an improvement on the cir-
cuit arrangements disclosed in the copending ap-
plication of Erwin F. Lowry, Serial No. 43,347,
filed October 3, 1935, for Electron discharge ap-
paratus.

It is an object of my invention to provide means
for automatically delaying the establishment of
a discharge to an oxide coated cathode when the
tube has been recently ignited.

Other objects and advantages will be apparent
from the following description, taken in con-
junction with the accompanying drawing, in
which:

Fig. 1 is a diagrammatic view of a preferred
circuit arrangement, and

Fig. 2 is a view, partially in cross-section and
partially in elevation, of a preferred type of tube
diagrammatically illustrated in the circuit of
Fig. 1.

In the copending application of Erwin F. Lowry,
Serial No. 43,347, filed October 3, 1935, is described
a tube and circuits therefor designed to provide
an automatic time delay member within the tube
for the anode-cathode discharge. It is well
known that if the anode-cathode discharge is
established to an oxide coated cathode before this
cathode becomes sufficiently electron-emitting,
the discharge will seriously damage the coat-
ing. This is due to the fact that the positive ions
of the gaseous atmosphere meet little opposition
in traveling to the cathode. If the cathode is
emitting sufficient electrons, these electrons ap-
pear to have a cushioning effect upon the ions so
that the oxide coating is not damaged. Prior to
the invention of Erwin F. Lowry, described in the
above referred to copending application, it was
necessary to apply the heating current to the
cathode for a certain length of time before apply-
ing the anode-cathode voltage or to utilize elab-
orate and complicated auxiliary apparatus to pre-
vent the establishment of the anode-cathode dis-
charge until the cathode became sufficiently elec-
tron-emitting.

The invention described in Erwin F. Lowry's
copending application, however, provided auto-
matic means within the tube for providing an
automatic time lag for the discharge until the
cathode was properly electron-emitting. This
automatic means was substantially a perforated

member enclosing the cathode and when cold,
having a space charge that prevented the passage
of electrons through its openings. The heating
current through the cathode heated this member
until it became electron-emitting, and when hot,
this member permitted the establishment of the
discharge. The one difficulty with the tube was
that if the tube was reconnected in the circuit
almost immediately after the discharge had
stopped, the temperature of the member enclos-
ing the cathode and the vapor pressure would
not have decreased sufficiently for the member
to block the discharge. It is one of the purposes
of my invention to provide an automatic tem-
porary blocking charge on this member at the
cooling period following a discharge.

In Fig. 2, I have illustrated a tube of the pre-
ferred type illustrated in the copending Erwin F.
Lowry application Serial No. 43,347. This tube
comprises a glass casing 10 with an anode 11 and
an oxide coating directly heated cathode 12.
Surrounding this cathode 12 is preferably a cas-
ing 13 comprising a perforated metal screen 14.

When the heating current and cathode-anode
voltage is applied to the tube, the space charge
on the member 14 will prevent the passage of the
electrons therethrough. The heat developed by
the cathode 12 will raise the temperature of the
member 14 until it becomes electron-emitting, and
the space charge disappears, and the cathode-
anode discharge is established. Such a type of
tube I have indicated at 10 in Fig. 1 with the
corresponding anode 11, cathode 12 and perfo-
rated member 14 diagrammatically illustrated.

The load is illustrated at 15 in the cathode-
anode circuits 16 and 17 which is connected to
any desired electrical source. I connect a con-
denser 18 and a resistance R_1 or 19 in parallel
with the load. The intermediate point 20 be-
tween the condenser and this resistance is con-
nected to the control member 14 of the tube. In
case it is desired to use a protective resistance
to prevent burning out of the member 14 in case
of an arc between the member 14 and the cathode,
a resistance R_2 can be utilized at 21 between these
two members.

The desired cooling time of the member 14 be-
tween its hot emitting state and its cold blocking
state is calculated. The product of the capacity
of the condenser 18 in farads and the combined
resistance of the load and R_1 in ohms is taken as
equivalent to the value of the cooling time in
seconds.

As an example, suppose the cooling time of
screen 14 is that of five minutes or 300 seconds.

The capacity of the condenser may then be taken as a convenient one and the resistance calculated or the resistance taken and the capacity calculated. If it be assumed, for example, that it is desirable to utilize a 20 microfarad condenser, then the equation will be

$$20 \times 10^{-6} \times R = 300 \text{ seconds} \\ \text{or } R = 15 \text{ megohms}$$

10 In operation of the device, the discharge will charge up the cathode plate of the condenser 22 positive and the other plate 23 negative. When the discharge stops the negative charge will be 15 applied to the member 14 and will then gradually leak off as the member 14 cools to its discharge blocking state.

Accordingly, I have devised a system for placing a temporary blocking charge on the member 20 14, so that if the tube is reconnected prematurely in the circuit, the discharge will not be prematurely established, but this temporary blocking charge will delay the initiation of this discharge until the cathode 12 is sufficiently electron-emitting to protect its coating from ion 25 bombardment.

With my arrangement the member 14 prevents the discharge either when the member 14 is at cathode potential and the vapor pressure is low 30 and the cathode cold, or when the member 14 is negative with respect to the cathode and the tube is hot and the cathode cold. The member 14 permits the discharge when it is at cathode potential and the cathode is hot with vapor pressure high or low, and also permits the discharge 35 when the member 14 is negative with respect to the cathode and both the tube and cathode are hot. The hot cathode in these last conditions will not be deleteriously affected by the discharge. 40

While I have disclosed a preferred embodiment of my invention, it is apparent that many modifications thereof are possible. Accordingly, I desire only such limitations on the following 45 claims as is necessitated by the prior art.

I claim as my invention:

1. In combination, a discharge device having an anode and a heatable cathode and an electron emitting member adjacent said cathode preventing a discharge when cold and permitting the 50

discharge when hot and circuit means putting a temporary blocking charge on said member when the discharge stops.

2. In combination, a discharge device having an anode and a heatable cathode, and an electron emitting member adjacent said cathode preventing a discharge when cold and permitting the discharge when hot and circuit means putting a temporary blocking charge on said member during the time when said member is cooling 10 from its hot state to its cold blocking state.

3. In combination, a discharge device having an anode and a heatable cathode, and a member adjacent said cathode preventing the discharge when cold and permitting the discharge when 15 hot, and a condenser connected to said member charged by the discharge and applying a blocking charge to said member when the discharge stops.

4. In combination, a discharge device having an anode and a heatable cathode, and a member 20 adjacent said cathode preventing the discharge when cold and permitting the discharge when hot and a condenser connected to said member charged by the discharge and applying a blocking charge to said member when the discharge stops 25 for the cooling time of said member.

5. In combination, a discharge device having an anode and a heatable cathode, and a member adjacent said cathode preventing the discharge when cold and permitting the discharge when 30 hot, and a condenser connected to said member charged by the discharge and applying a blocking charge to said member when the discharge stops, and a leakage path for said charge for the cooling time of said member. 35

6. In combination, a discharge device and a circuit therefor, said device having an anode and a heatable cathode and a member adjacent said cathode preventing the discharge when cold and permitting the discharge when hot, said circuit 40 comprising a condenser charged by the discharge and applying a blocking charge to said member when the discharge stops, and resistance means providing a leakage path for said charge, the capacity of the condenser and the value of the 45 resistance means providing a leakage time for said charge substantially equivalent to the cooling time of said member of said discharge device.

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