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J. JONAS

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ELECTRON DISCHARGE DEVICE

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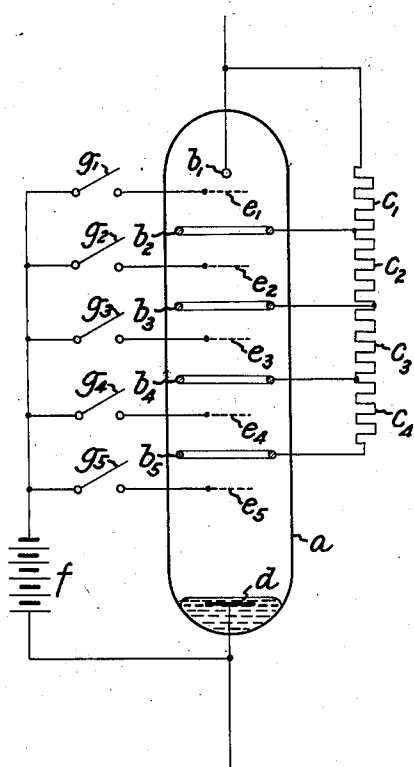


Fig. 1.

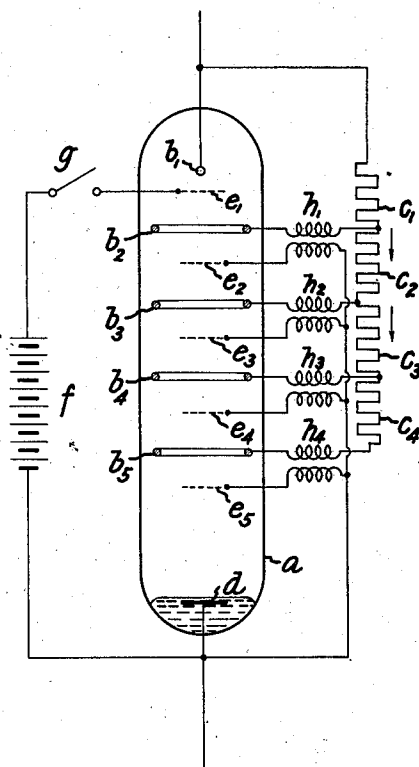


Fig. 2.

Inventor:

Julius Jonas,

By

Pierce & Schreffler,
Attorneys.

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ELECTRON DISCHARGE DEVICE

Julius Jonas, Zurich, Switzerland, assignor to
Aktiengesellschaft Brown, Boveri & Cie., Baden,
Switzerland, a joint-stock company

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It is known that in electron discharge devices where the current is conducted through a gas or vapour the arc can be prematurely extinguished by means of so-called extinguishing grids at any instant during the time it is burning. U. S. A. Patent No. 2,097,490. When the arc in a discharge device is, however, extinguished by means of such grids certain undesirable phenomena occur because the extinguishing process only takes an extremely short time, namely about 10^{-7} seconds. With higher currents this method of extinguishing the arc causes high excess voltages and in order to prevent the occurrence of these voltages it is necessary to connect large capacities parallel to the arc path. These capacities are of a considerable size and are not entirely adequate, however, when the discharge device is used to interrupt a circuit because the stored-up energy in the circuit is not dissipated.

The present invention concerns a single or polyphase electron discharge device with gas or vapour discharge path and several anodes per phase, the aforementioned disadvantages being avoided according to the invention by connecting the anodes of each phase in series over a resistance, the current being supplied to the first anode of the series, and by each anode having a device associated with it which is controllable and influences the resistance of the arc path.

Two constructional examples of the invention are illustrated diagrammatically in Figs. 1 and 2 of the accompanying drawing.

The discharge tube *a* shown in Fig. 1 contains the anodes *b*₁, *b*₂, *b*₃, *b*₄, *b*₅ which are connected together in series over the ohmic resistances *c*₁ to *c*₄, and the mercury cathode *d*. At least the anodes *b*₂ to *b*₅ are constructed as ring anodes and are located in the path of the arc from the anode *b*₁ which forms the first of the series and to which current is supplied. In front of each anode *b*₁ to *b*₅ is an extinguishing grid *e*₁ to *e*₅ respectively of the kind already mentioned and to which a negative blocking voltage from the voltage source *f* is applied. Switches *g*₁ to *g*₅ which are actuated one after the other are arranged in the leads to the extinguishing grids.

In order to extinguish the arc which normally burns between anode *b*₁ and cathode *d* first of all the arc path of the first anode *b*₁ is blocked by means of grid *e*₁ by applying to this latter the blocking potential from the grid voltage source *f* by closing switch *g*₁. The current then flows through resistance *c*₁ and the arc then burns from the next anode *b*₂. By blocking the arc path of the subsequent anodes *b*₂, *b*₃ and *b*₄ with

the extinguishing grids *e*₂, *e*₃ and *e*₄ respectively by closing the corresponding switches *g*₂, *g*₃ and *g*₄ one after the other, the arc finally reaches the last anode *b*₅ of the series. The operating current flowing over the resistances *c*₁ to *c*₄ is thus damped to such a degree that undesirable excess voltages no longer occur when the arc burning between the anode *b*₅ and cathode *d* is extinguished.

The arrangement described can be modified so that the current flowing through the resistance joining two anodes controls a device associated with one of the following anodes in order to influence the resistance of its arc path.

The constructional example in Fig. 2 shows devices which supply the control currents successively to the means employed for control purposes in such a manner that first of all the arc path of the first anode and then one after the other the arc paths of the following anodes are blocked. The extinguishing grid *e*₁ located in front of the first anode *b*₁ is thus merely connected to the bias voltage *f* by closing switch *g*. The extinguishing grids of the subsequent anodes *b*₂ to *b*₅ are, however, controlled by means of the current flowing over the resistances *c*₁ to *c*₄ connecting these anodes. For this purpose transformers *h*₁ to *h*₄ respectively are provided, the primary windings of which lie in the connections between the resistances and the anodes whilst the secondary windings are mutually connected in parallel and supply the extinguishing grids of the subsequent anodes. When the arc path of the first anode *b*₁ is blocked by the grid *e*₁ after the switch *g* is closed, the operating current flows over resistance *c*₁ and the working arc passes to the next anode *b*₂. The necessary blocking voltage for the extinguishing grid *e*₂ is then produced in the secondary winding of transformer *h*₁ whereby the arc path of anode *b*₂ is blocked. The arc paths of the remaining anodes of the series are then successively blocked in an analogous manner.

The arrangement according to the invention is particularly suitable for interrupting high-voltage direct current and in this case it is an advantage to locate a supplementary switching device, for instance a gas blast circuit breaker with multiple break, in series with the discharge device. Interruption is then achieved in such a manner that by means of the discharge device the operating current is reduced to a fraction of its initial value and the remaining residual current is then completely interrupted by the supplementary switching device.

I claim:

1. An electron discharge device comprising an envelope, a vaporizable cathode, a first anode, a plurality of additional anodes along the arc path from said cathode to the first anode, resistance means connecting said additional anodes to said first anode, and means for blocking arcing conduction to said first anode and thereafter progressively to said auxiliary anodes; said blocking means comprising control devices associated with said first anode and with each additional anode, each said device controlling arcing conduction to its associated anode in accordance with the potentials impressed upon that device.

2. An electron discharge device as recited in claim 1 wherein said resistance means comprises ohmic resistance connecting said additional anodes in series.

3. An electron discharge device as recited in claim 1, wherein the control device associated with the first anode is a controllable arc-extinguishing grid between the first anode and the adjacent one of said additional anodes.

4. An electron discharge device as recited in claim 1, wherein each of said control devices is a controllable arc-extinguishing grid.

5. An electron discharge device as recited in claim 1, in combination with means responsive to current flowing in the resistance means between one of said additional anodes and said first anode to alter the energization of a control device that affects arcing conduction to that said additional anode.

6. An electron discharge device comprising an envelope, a vaporizable cathode, a first anode, a plurality of additional anodes spaced along the arc path to said first anode, resistances connecting said additional anodes in series with each other and with said first anode, a control device for blocking conduction along the portion of the arc path between said first anode and the adjacent additional anode, and means responsive to such blocking for progressively blocking conduction along portions of the arc path between adjacent additional anodes.

7. An electron discharge device as recited in claim 6, wherein said last means comprises a control device for each of said additional anodes, and a transformer coupling between each additional anode and its associated control device.

JULIUS JONAS.