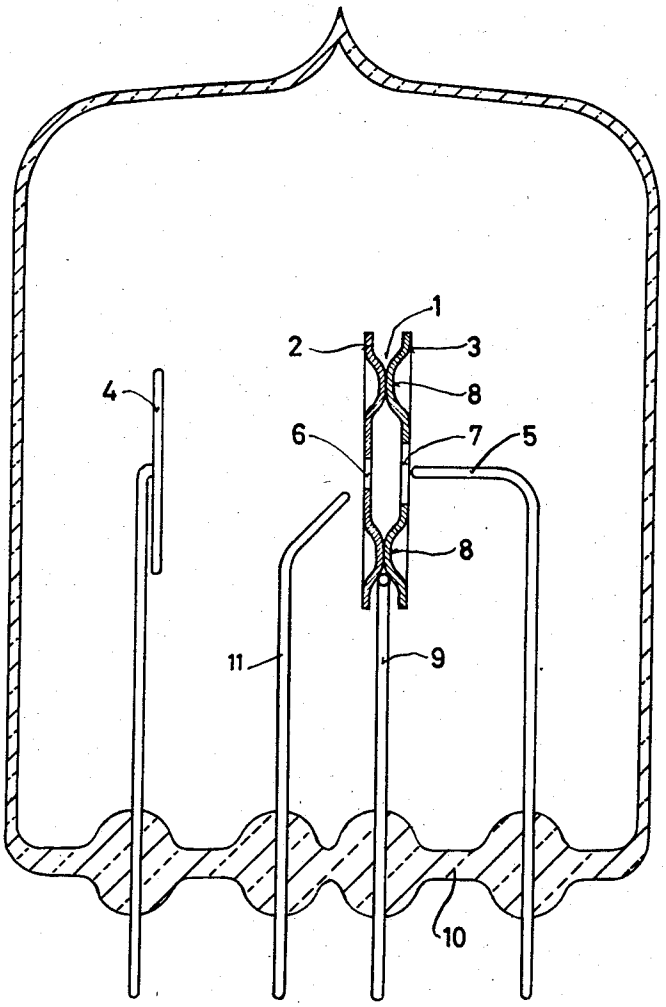
March 8, 1960 H. GAWEHN 2,928,013

ELECTRICAL DISCHARGE DEVICE

Filed Nov. 16, 1955



Inventor
Herbert Gawehn
By [signature] Atty.

United States Patent Office 2,928,013 Patented Mar. 8, 1960

2,928,013

ELECTRICAL DISCHARGE DEVICE

Herbert Gawehn, Munich, Germany, assignor to Siemens & Halske Aktiengesellschaft, Munich and Berlin, Germany, a German corporation

Application November 16, 1955, Serial No. 547,247

Claims priority, application Germany December 23, 1954

16 Claims. (Cl. 313—30)

The present invention relates to a gas- or vapor-filled electrical discharge device operating as a switching tube or the like and comprising at least one unheated hollow cathode and electrodes to form in coaction with the cathode a main discharge path and at least one auxiliary discharge path.

The use in gas- or vapor-filled discharge devices of a hollow cathode is broadly speaking known. The invention proposes to provide for the stated purpose a hollow cathode comprising annular or framelike elements forming an annular cavity extending in the manner of a narrow gap perpendicular to the axis of an opening or openings formed in said elements.

The cathode comprises at least two annular or framelike elements or parts connected together so as to form the opposite ends and inner walls of the cathode, such walls or parts thereof being provided with openings. The indicated parts are shaped so as to form an inner or an outer annular gap or both an inner and outer annular gap. The two cathode parts may in known manner be shaped by pressing, drawing, stamping or the like. They may be fastened to each other along an annular zone by welding, soldering and the like.

The corresponding cathode parts may be shaped so as to form an annular active inner gap and an outer cooling gap forming wide peripherally extending cooling surfaces. The aperture width of the inner recess or cavity formed may be variously dimensioned by correspondingly dimensioning the size of the front and rear openings provided in the cathode-forming parts. One of the openings may be made particularly small or may be entirely closed or omitted.

The cathode parts may be made of pure metal or metals, in particular molybdenum, tantalum or the like. Furthermore, the cathode may be provided, particularly in the active or working gap, with an emitting substance.

The invention will be explained with reference to the accompanying drawing showing in diagrammatic simplified representation essential parts of one embodiment thereof.

In the embodiment shown, the cathode **1** comprises two annular disks **2** and **3** forming both the cathode for a main discharge and for an auxiliary discharge. The main discharge occurs on the left hand side of the cathode where an anode **4** is provided at a given distance from the cathode. On the opposite side there is disposed an anode **5** for the auxiliary discharge path, such anode being made in the form of a pin extending symmetrical to the cathode axis.

As indicated before, the two annular disks **2** and **3** may be made by embossing, pressing, drawing and the like, and two openings **6** and **7** formed therein, made of different size. The two disks may be connected together by welding along an annular zone **8**. The disks form an inner active or working gap for the discharges, and also a widened outer gap for more efficient dissipation of heat. The widths and diameter of the outer gap may be made as large as desired, to provide for efficient

cooling, without detrimentally affecting the discharge properties.

The cathode is fastened to the tube wall **10** by means of a supporting pin **9** which engages the outer gap.

It is possible to form with proper and suitable spacing of the individual electrodes an auxiliary discharge between the cathode and the anode **5**, in a suitable circuit supplying voltage over a sufficiently high series resistance, which burns in the region of dark, presparking current, and to produce, by known application of suitable control voltages, for instance pulse voltages or voltage increases of similar action, to the starter electrode **11**, an ignition or at least sufficiently strong preionization to the cathode so as to excite the main discharge along the path to the anode **4**.

The starter electrode **11** for the main discharge and the anode **5** of the auxiliary discharge path are in the illustrated embodiment disposed on opposite sides of the cathode which is thus common to these discharge paths. The starter electrode **11** need not be arranged between the cathode and main anode **4**; it is possible to dispose it so that it extends from the rear axially symmetrically into the cathode opening in a manner similar to the anode **5** for the auxiliary discharge path. It is also possible to combine the starter electrode and the anode for the auxiliary discharge path in a single electrode.

Circuit details may be arranged in accordance with known practice and means; and structural details not specifically described may likewise be provided in accordance with known practice.

Changes may be made within the scope and spirit of the appended claims.

I claim:

1. In a gaseous electrical discharge tube, an unheated hollow cathode comprising two disk-shaped parts each having an annular portion rising from the general plane of the corresponding part, said parts being assembled with said annular rising portions fastened together to form respectively an inner annular cavity and a peripherally extending annular radially outwardly facing gap, supporting means for said cathode disposed in said gap, openings of respectively different size being formed in the walls of said parts defining said inner cavity, a main anode disposed on one side of said cathode spaced therefrom to provide for a main discharge therebetween an auxiliary anode disposed on the other side of said cathode and differently spaced therefrom to provide for an auxiliary discharge therebetween, a starter electrode terminating relatively close to the opening formed in one of said walls, and circuit connecting means for said cathode and anodes and starter electrode respectively.

2. A structure and cooperation of parts according to claim 1, wherein said anodes extend symmetrical to the axis of said cathode.

3. A structure and cooperation of parts according to claim 2, comprising an emitting substance carried by at least one of said parts within said cavity.

4. In a gaseous electron discharge device, the combination of a hollow cold cathode and an anode spaced from said cathode to provide a main discharge path therebetween, said cathode comprising a generally annular hollow disklike member, the axis of which extends along the line of said main discharge, and auxiliary anode means cooperable with said cathode to produce an auxiliary discharge confined to the interior of the latter.

5. A discharge device according to claim 4 comprising two annular disk-shaped parts connected together to form said hollow cathode, an opening being formed in at least one of said walls centrally thereof.

6. A discharge device according to claim 4 comprising

marginal extensions carried by said disk-shaped parts and forming cooling surfaces for the cathode formed thereby.

7. A discharge device according to claim 4, wherein said cathode body is made of molybdenum.

8. A discharge device according to claim 4, wherein said cathode body is made of tantalum.

9. A discharge device according to claim 4, comprising an emitting substance carried by said cathode within the hollow space thereof.

10. A discharge device according to claim 5, wherein said auxiliary anode means comprises a second anode extending substantially symmetrical to the axis of said opening.

11. A discharge device according to claim 10, comprising means forming a control electrode terminating in the vicinity of said opening.

12. A discharge device according to claim 5, wherein said connected cathode parts form a generally annular gap therebetween.

13. A discharge device according to claim 5, wherein an opening is formed in each of said walls, said openings being of different size.

14. A discharge device according to claim 13, wherein one of said openings is very small as compared with the other opening.

15. A discharge device according to claim 5, wherein said connected cathode parts form said interior space constituting an annular inner working gap, and marginal extensions carried by said parts forming cooling surfaces defining an outer gap.

16. A discharge device according to claim 12, wherein said cathode parts form generally annularly extending mutually engaging connecting portions which are fastened together.

References Cited in the file of this patent

UNITED STATES PATENTS

2,123,386	Stansbury	July 12, 1938
2,125,279	Bieling	Aug. 2, 1938
2,189,636	Knowles	Feb. 6, 1940
2,304,412	Kern	Dec. 8, 1942
2,459,997	Edwards	Jan. 25, 1949
2,543,728	Lemmens	Feb. 27, 1951
2,624,024	Jansen	Dec. 30, 1952
2,737,607	Lemmens	Mar. 6, 1956