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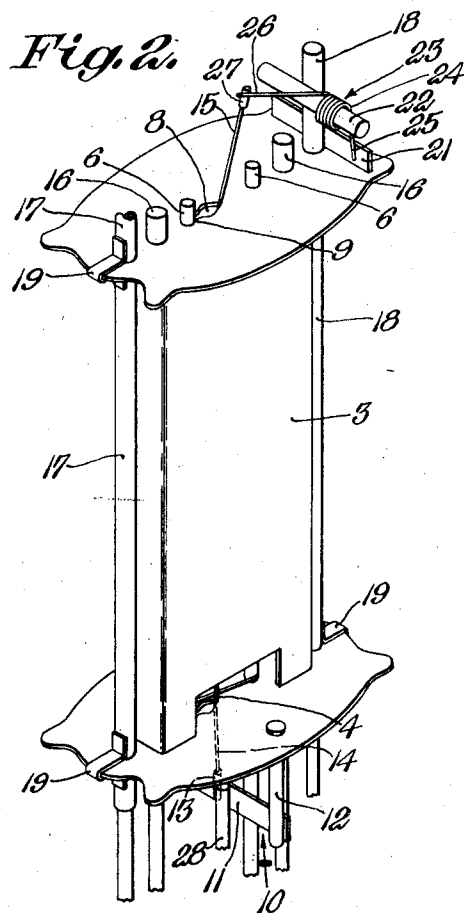
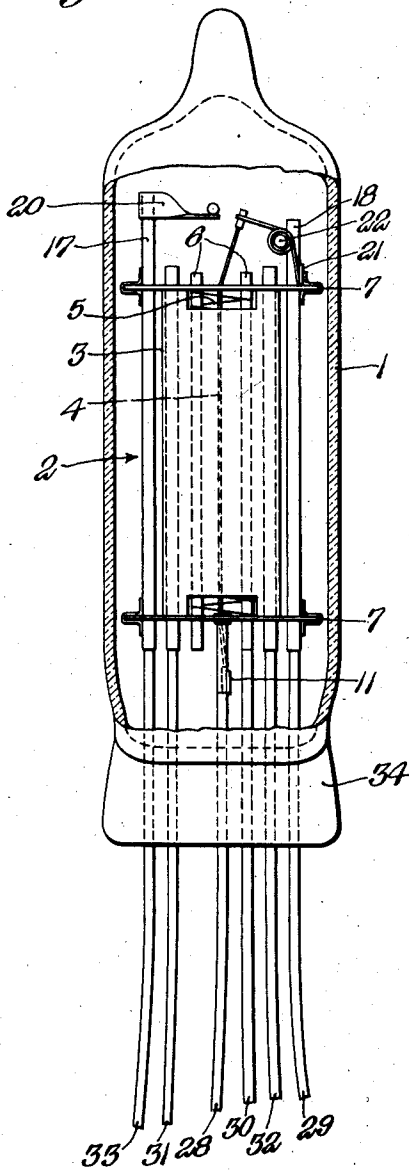
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FILAMENTARY CATHODE SUSPENSION

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Fig. 1.



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FILAMENTARY CATHODE SUSPENSION

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2 Claims. (Cl. 250—27.5)

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This invention relates generally to electrical space discharge devices of the type employing filamentary cathodes, and more particularly to the arrangement and support of such cathodes therein.

In such electrical space discharge devices, failure to operate or irregularity and non-uniformity in operation are frequently due to improper spacing and sagging of the cathode. If such cathodes are maintained under tension, another difficulty arises. Microphonic and other disturbances tend to produce vibration of the cathode and of elements mechanically connected thereto with consequent interference with normal operation. The cathode and said associated element tend to vibrate at a resonant period which is dependent upon the tension and the dimensions of the cathode system.

The aforesaid deleterious conditions are considerably aggravated when tubes of relatively small dimensions are employed. Furthermore, in addition to the foregoing difficulties, arrangement of the cathode in the tube becomes so difficult as to frequently require an extremely high order of skill.

Where such devices are intended to undergo an extremely high rate of acceleration, the problems presented in achieving proper cathode arrangement are much greater. The effect of vibration of the cathode system is increased to a point where not only is interference with normal operation produced, but the cathode filament itself breaks. This breakage may be caused not only by the vibration of the cathode system, but also by the mass of the tension member and its consequent inertia.

An object of the present invention is the provision of a suspension for filamentary cathodes, whereby said cathodes are maintained in fixed position without sagging thereof.

Another object of the present invention is the provision of a suspension for filamentary cathodes, whereby said cathodes are maintained under uniform tension. A feature of this invention is the provision of tensioning means which will damp vibrations of the cathode.

Still another object of the present invention is the provision of an arrangement and suspension for filamentary cathodes in electrical space discharge devices of relatively small dimensions which may be readily constructed and assembled.

A still further object of the present invention is the provision of a filamentary cathode and an arrangement thereof, in a device adapted to be accelerated at an extremely high rate, which will not break under the condition indicated.

Still another object of the present invention is the provision of an electrical space discharge device which is sturdy in construction and readily assembled.

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Other and further objects of the present invention will become apparent, and the foregoing will be best understood, from the following description of an exemplification thereof, in which

Fig. 1 is a front elevational view of a tube exemplifying my invention, the envelope being broken away to reveal the electrode assembly; and

Fig. 2 is a perspective view of the electrode assembly.

The tube illustrated in the drawing is adapted to be rapidly accelerated in a downward direction, as viewed in said drawing. The tube may be of extremely small dimensions. Typical dimensions of said tube and the conditions of acceleration to which said tube may be subjected will be given hereinafter.

The tube illustrated comprises an envelope 1 in which an electrode assembly 2 is arranged. The electrode assembly 2 consists of an anode 3, a filamentary cathode 4, and a grid 5. The grid is wound upon suitable grid rods 6, and is supported thereby. Proper spacing and support of the electrodes are provided by upper and lower insulating spacers 7, preferably of mica. The spacers 7 are each provided with an angular slot 8 having a recess 9 in the base thereof in order to receive and support one of the grid rods 6.

The filamentary cathode 4 is retained in the apex of each of the angular slots 8. In order to support the lower end of the filamentary cathode 4, a U-bracket 10 is secured to the lower spacer 7 and projects from the lower side thereof. The bracket 10 comprises a pair of rods 12 each having one end thereof secured to the lower spacer 7, and a fastening bar 11 arranged across the lower end of the rods 12. The lower end 14 of the filamentary cathode is welded to a tab 13 which in turn is welded to the bracket 10. Thus the bracket serves as a mechanical support and an electrical connector for the cathode. The upper end 15 of the filamentary cathode 4 is secured in a manner which will be described hereinafter.

To provide the desired sturdy structure and for the purpose of making electrical connection to the anode, a pair of conducting anode rods 16 is arranged inside the anode at opposite ends thereof, and are welded to the walls of said anode.

A pair of support rods 17 and 18 is arranged on opposite sides of the anode 3 in line with the anode rods 16. To secure the spacers to the support rods 17 and 18, I prefer to provide a plurality of straps 19. Each of said straps is bent at a central portion thereof over the edge of its associated spacer and has its edges secured to the support rod, as by welding, on opposite sides of the spacer.

A getter member 20 having a quantity of getter material arranged thereon, for example in the

form of a pellet, may be secured to the top of the support rod 17.

A crossbar 21 is arranged across the top of the upper spacer adjacent support rod 18, and may be welded to said support rod. This crossbar aids in retaining the upper spacer in position.

A cross-rod 22 is secured adjacent the top of the support rod 18, as by welding. A coiled spring 23 of conducting material is loosely arranged on the cross-rod 22. The spring 23 consists of a coil 24 loosely arranged over the cross-rod 22 and a stationary arm 25 secured to the crossbar 21. A tensioning arm 26 extends from the end of the coil 24, and is adapted to be secured by means of a tab 27 to the upper end 15 of the cathode 4. Tabs 13 and 27 may be made in the form of small nickel sleeves which are slipped over the respective ends of the filamentary cathodes, and are thereafter welded to said ends and to the bar 11 and the tensioning arm 26, respectively.

The spring 23 is made of a suitable resilient material, such as, for example, tungsten. The spring may be formed from a round wire. The filamentary cathode is preferably made of tungsten to provide additional strength, and may be coated with a suitable thermionically electron-emissive coating.

It is to be noted that the end of the tensioning arm and the lower end of the cathode are in a line laterally displaced from the line passing through the apexes of the slots 8. The spring thus holds the cathode under tension in the apex of each of the triangular slots.

In arranging the filamentary cathode 4 in the electrode assembly, tabs or connectors 13 and 27 are first welded to the filament. Tab 27 is then welded to tensioning arm 26 of spring 23. The lower end of the filament is inserted through the top of the assembly through slots 8 in the upper and lower spacers so that tab 13 extends below the bottom spacer. Spring 23 is then slipped over the cross-rod 22 and stationary arm 25 is welded to crossbar 21. Tensioning arm 26 is then deflected through about 70° and tab 13 is welded to bar 11. This long swing of the arm tends to facilitate the production of uniformity of tension of said cathode. If a short cantilever spring arm were used to provide the desired tension, it would swing through a smaller distance, and slight variations in the amount of deflection of the spring arm would produce large and undesirable variations in the tensioning of the arm.

The spring is loosely arranged on cross-rod 22 so that snubbing thereof will not occur. Because of its arrangement and form, the spring has no definite period of vibration, and vibrations of the spring and the filament are quickly damped out.

Lead-in and supporting conductors for the electrode assembly are provided as follows. Lead-in 28 is connected to the bar 11 and thereby to the lower end of the cathode. Lead-in 29 is connected to the supporting rod 18 and through the spring 23 to the upper end 15 of the cathode. Lead-in 30 is connected to one of the grid rods 6. In order to provide a more sturdy structure, I prefer to provide two lead-in conductors 31 and 32 for the anode, each of said lead-in conductors being connected to the lower ends of the anode rods 16. A lead-in conductor 33 is also secured to the lower end of support rod 17, and further helps in providing a sturdy assembly. The lead-ins are secured to the various rods. These lead-

ins are secured in a stem press 34 provided at the bottom of the envelope 1.

Tubes of the type hereinbefore described were manufactured and had the following dimensions and characteristics. The tubes were approximately 1 3/8" high, 3/8" wide, and 1/4" thick. These tubes were adapted to be accelerated. The weight of each of said tubes at rest was 2 grams and they were accelerated so as to exert a force of 40,000 grams. The filamentary cathodes were made of tungsten wire having a cross-sectional diameter of .0008". These were coated with a suitable metallic oxide. The spring 23 was made of tungsten wire having a cross-sectional diameter of .005" and exercising a 20-gram pull upon the cathode. The coil of the spring consisted of five turns. The coil had an inside diameter of from .021" to .023" and was arranged on a cross-rod having a length of about .080" and was swung through about 70° when it was fastened to the upper end of the cathode.

The filamentary cathodes arranged in such tubes and the particular arrangement thereof proved highly successful in operation. The filaments were readily arranged in the tubes by comparatively unskilled operators. The tension of the filaments was quite uniform despite mass production. When such tubes were tested with high acceleration as indicated hereinabove, the filaments were unbroken.

While I have described a specific embodiment of my invention, certain modifications may be made without departing from the teachings thereof. For example, the arrangement of the other electrodes in the device might be changed; the filamentary cathode might be positioned by other means than the triangular slots. Other modifications will also be readily apparent to one versed in the art. Therefore, it is accordingly desired that the appended claims be given a broad interpretation commensurate with the scope of the invention within the art.

What is claimed is:

1. In an electrical space discharge device, the combination of a filamentary cathode, means for supporting said cathode under tension, including a coil spring having a plurality of turns, a fixed rod around which the turns of said spring are arranged, the diameter of said rod being substantially smaller than the inner diameter of said coil whereby said coil is loosely arranged around said rod, one end of said coil being fixed with respect to said rod, the other end of said coil terminating in an arm extending over one side of said rod the outer end of said arm being attached to said cathode under tension, said cathode extending to said arm from the other side of said rod.

2. In an electrical space discharge device, the combination of a filamentary cathode having one end thereof fixedly arranged in said device, and self-damping means for supporting said cathode, including a coil spring having a plurality of turns, a fixed rod around which the turns of said spring are arranged, the diameter of said rod being substantially smaller than the inner diameter of said coil whereby said coil is loosely arranged around said rod, one end of said coil being fixed with respect to said end, the other end of said coil terminating in an arm extending over one side of said rod, the outer end of said arm being attached to said cathode under tension, said cathode extending away from said arm in a direction to pull said arm toward said rod.

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