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L. H. BEDFORD

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INDIRECTLY HEATED CATHODE

Filed March 16, 1931

FIG. 1

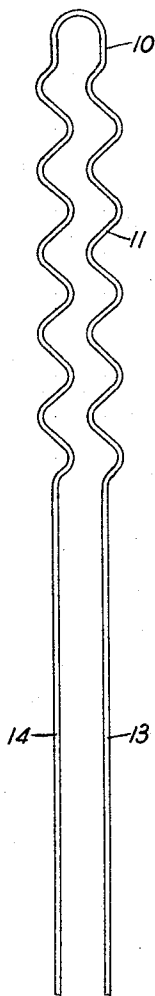


FIG. 2

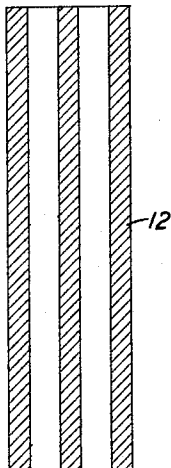


FIG. 3

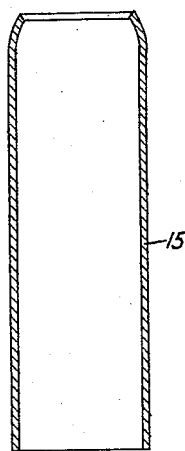


FIG. 5

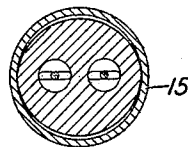
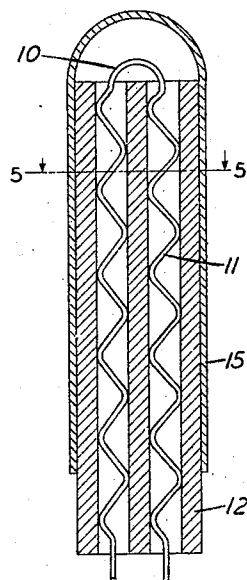


FIG. 4



INVENTOR
L. H. BEDFORD

BY
Walter C. Kiesel
ATTORNEY

UNITED STATES PATENT OFFICE

LESLIE HERBERT BEDFORD, OF LONDON, ENGLAND, ASSIGNOR TO WESTERN ELECTRIC COMPANY, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK

INDIRECTLY HEATED CATHODE

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This invention relates to indirectly heated cathodes for electron discharge devices.

Indirectly heated cathodes usually comprise a tungsten or other filament which may
5 be straight or of hairpin formation, located within a tube of insulating material, such as porcelain or silica, which is in turn surrounded by a metallic cathode sleeve.

Although cathodes of this type possess
10 many advantages over the usual form of directly heated cathodes it has been found that, unless there is good thermal contact between the component parts, difficulties are likely to arise and the chief object of the present invention is to provide for the obtaining of improved thermal contact between such parts.

According to the invention the residual spring or resiliency which remains in the filament and/or the cathode is utilized for
20 the purpose of improving the thermal contact between one or both of the elements and the insulating tube. This may be accomplished by shaping or forming the cathode and/or the filament so that one or both of
25 these elements is in the assembled position adapted to exert pressure on the insulating tube.

The invention will be more clearly understood from the following detailed description in connection with the accompanying drawing:

Fig. 1 shows the length of heater wire after crimping and bending with parallel terminating uncrimped portions.

35 Fig. 2 is a sectional view of a twin-bore insulating tube in which the heater is enclosed.

Fig. 3 illustrates in section the metallic cathode tube.

40 Fig. 4 illustrates in cross-section the complete assembly of the cathode in accordance with this invention.

Fig. 5 is a cross-sectional view of Fig. 4 on the line 5, 5.

45 In accordance with one feature of the invention, therefore, the filamentary heater 10 is formed with a series of crimps 11, or the like, having an initial amplitude which is greater than the diameter of the bores of the
50 insulating tube 12 shown in Fig. 2. The fila-

mentary heater 10 is preferably composed of a resilient metal such as tungsten, tantalum, molybdenum, or an alloy of tungsten and molybdenum, and the crimps or other deformations are such that the filament can be inserted in the insulating tube 12 of the cathode while under tension and when the tension is released will bind on the inner surface of the insulating tube 12, the pitch of the crimping being sufficiently fine to avoid the possibility
60 of hot spots between bearing points.

The heater element may be substantially straight or, if desired, it may take the form of a hairpin each length of which is formed with the crimps 11 or other deformations
65 and the two lengths being accommodated in a twin-bore insulating tube 12. In some instances the improved thermal contact between the filament and the insulating tube may be obtained by the use of a spiral or helical filament instead of a crimped filament, this method being theoretically superior as the filament should lie uniformly against the inner walls of the insulating tube without the free portions which are inevitable in a crimped filament. However, in the cases of the small cathode, the crimped
75 method has, up to the present, been found preferable in practice.

Where the insulating tube is composed of silica or a like material which may, for instance, be five to ten mils internal diameter, precaution must be taken in order to enable assembly of the filament in the tube to be effected without fracturing the tube. A convenient method of accomplishing this is to place the deformed filament under tension which is sufficient to reduce the amplitude of the crimps or the diameter of the heater to a value less than that of the internal diameter of its corresponding bore in the tube 12 and then place one within the other. For this purpose, straight or uncrimped lengths 13 and 14 of the filament may be left at each end thereof and these may be inserted through the silica tube leaving the crimped or deformed portion clear. The free end of the filament may then be gripped by a suitable form of tensioning means and when a predetermined tension has been applied thereto the
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silica tube may be slipped over the crimped or otherwise deformed filament so that when the tension is released the filament will bind on the inner walls of the tube 12.

5 In accordance with another feature of the invention, an improved thermal contact between the cathode and the insulating tube is obtained by suitably deforming or shaping the cathode tube. In the case of a cathode
10 15 of circular or annular cross-section, the cathode tube may be first pressed so that it is caused to assume a slightly elliptical cross-section. The cathode is then repressed between a pair of suitable semi-circular jaws
15 until it returns to its original shape and the insulator 12 is then placed in position therein. On releasing the jaws the cathode tube 15 springs back to its slightly elliptical form and grips the insulator tube 12 around a large
20 portion of its circumference thus establishing an adequate thermal contact.

The advantages obtainable by improving the thermal contact between the component parts of an indirectly heated cathode are
25 many among which may be mentioned, the filament and consequently the insulator temperature is lower for a given wattage, hot spots on the filament and/or the insulator are avoided with a consequent diminution in the
30 chances of the burning out of the filament, and the filament resistance is maintained constant. It will also be observed that the construction described also provides an efficient method of absorbing differences of ex-
35 pansion between the elements and is consequently superior to those in which the elements or certain of them are cemented.

What is claimed is:

1. An indirectly heated cathode for an
40 electron discharge device comprising a twin bore insulating tube, a hairpin heater element within said tube, and a metallic electron emitting sleeve surrounding said tube, each
45 of the legs of said hairpin heater element having deformed portions frictionally engaging a wall of a bore of said twin bore tube.

2. An indirectly heated cathode for an electron discharge device comprising a twin
50 bore insulating tube, a hairpin heater element within said tube, and a metallic electron emitting sleeve surrounding said tube, each of the legs of said hairpin heater element having oppositely directed crimp portions frictionally engaging a wall of a bore of said
55 twin bore tube.

3. An indirectly heated cathode for an electron discharge device comprising a twin
60 bore insulating tube, a hairpin heater element having crimp portions exerting expansional force on the inner walls of said twin bore tube, and a metallic electron emitting sleeve exerting compressional force on the outer wall of said insulating tube.

4. An indirectly heated cathode, according
65 to claim 3, in which the forces exerted by said

heating element and metallic sleeve are applied along one diameter of said tube.

5. An indirectly heated cathode for an electron discharge device comprising a twin
70 bore insulating tube, a hairpin heater element within said tube, and a metallic electron emitting sleeve surrounding said tube, said sleeve exerting inward pressure on diametrically opposed outer portions of said
75 insulating tube and laterally opposed outer portions of said tube being spaced from said metallic sleeve.

6. A method of assembling a heater type cathode comprising a twin bore insulator, a hairpin heater element and a metallic cathode
80 sleeve, which comprises crimping the legs of said hairpin heater so that the initial amplitude of the crimps is greater than the diameter of each bore in said insulator, applying said twin bore insulator to straight
85 portions of said hairpin heater element, tensioning said hairpin heater element, sliding said insulator along the crimped legs of said heater, and relieving the tension of said
90 heater element.

7. The method of assembling a heater type cathode comprising a cylindrical insulator and a tubular metallic cathode, sleeve which
95 comprises deforming said sleeve to an elliptical shape, pressing the sides of said sleeve to return said sleeve to a cylindrical shape, inserting the insulator within said sleeve, and removing the pressure on the sides of said sleeve.

8. The method of assembling a heater type
100 cathode comprising a twin bore insulating tube, a hairpin heater element, and a cathode sleeve, which comprises initially deforming said heater element and cathode sleeve, applying said heater element and cathode
105 sleeve to said insulating tube, and releasing said heater element and sleeve to frictionally connect said heater element and sleeve to the walls of said insulating tube.

In witness whereof, I hereunto subscribe
110 my name, this 11th day of February, 1931.

LESLIE HERBERT BEDFORD.

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