for supplying strong gas to the heating-flues independently of the regenerators; and cross-under ducts disposed longitudinally of said row under the coking-chambers and connecting the sets of heating-flues, said ducts connecting the flues at their lower parts and being adapted to withdraw portions of downflowing combustion-products from the heating-flues of one set of each heating-wall and discharge such combustion-products into the heating-flues of the other set in another heating-wall, and thereby act to dilute and extend combustion in the other set of heating-flues.

17. In a coking retort oven, the combination as claimed in claim 15 and having the conduits for strong gas leading downward to gas-mains underneath the oven, such conduits being placed in supporting walls that are immediately between regenerators adapted to operate for up-flow concurrently with gas up-flow through said conduits.

18. In a coking retort oven, the combination as claimed in claim 16 and having the conduits for strong gas leading downward to gas-mains underneath the oven, such conduits being placed in supporting walls that separate the groups of regenerators.

19. In a coking retort oven, in combination: a series of alternate coking-chambers and intermediate heating-walls therefor arranged side-by-side in a row, each of said heating-walls comprising vertical heating-flues, the heating-flues of said heating-walls being mutually communicably connected so as to provide two sets of flues that are communicably connected together and operable for concurrent in-flow of burning gases in one of the sets and off-flow of combustion products therefrom in alternation with each other, with flues of one set in some of the heating-walls and flues of the other set in others of the heating-walls operable concurrently with each other; regenerators communicating with said sets of heating-flues and adapted to serve in alternation for supplying preheated combustion-medium to and withdrawing combustion-products from said two sets respectively; and cross-around ducts disposed longitudinally of said row of coking chambers and connecting the flues of one set with the flues of the other set of the two sets of heating-flues that are on opposite sides of the coking-chambers crossed around by said ducts, said ducts being adapted to withdraw portions of the off-flowing combustion-products from each of the sets of heating-flues when operable for off-flow of combustion-products and discharge such combustion-products into the other set of heating-flues that is then concurrently operable for burning in-flowing gases, and thereby act to dilute and extend the combustion in the then burning heating-flues.

20. In a coking retort oven, in combination: a series of alternate coking-chambers and intermediate heating-walls therefor arranged side-by-side in a row, each of said heating-walls comprising vertical combustion-flues, the flame-flues being communicably connected together at their upper parts into pairs of groups for upflow combustion in one member of the pair or group and downflow of combustion-products therefrom in the other member of the pair or group in alternation, each member of each pair lying on the opposite side of a coking-chamber from the other member of the same pair, regenerators communicating with the combustion-flues at the lower parts thereof, and cross-under ducts communicably connecting the lower parts of flues of each group of a pair of groups with the lower parts of the flues of the other group of the same pair, said cross-under ducts crossing under coking-chambers intervening the groups connected by the cross-under ducts and said cross-under ducts being adapted to withdraw portions of the products of combustion from some of the groups of flues when operable for upflow combustion and discharge such combustion-products into the flues of the other groups connected therewith by the cross-under ducts and concurrently operable for upflow combustion and thereby act to dilute and extend the combustion in the flues when operable for upflow combustion.

21. In a coking retort oven, in combination: a series of alternate coking-chambers and intermediate heating-walls therefor arranged side-by-side in a row, each of said heating-walls comprising vertical combustion-flues, the flame-flues being communicably connected together at their upper parts into pairs of groups for upflow combustion in one member of the pair or group and downflow of combustion-products therefrom in the other member of the pair or group in alternation, each member of each pair lying on the opposite side of a coking-chamber from the other member of the same pair, regenerators communicating with the combustion-flues at the lower parts thereof, and cross-under ducts communicably connecting the lower parts of flues of each group of a pair of groups with the lower parts of the flues of a group operable for concurrent gas flow in reverse direction, said cross-under ducts crossing under coking-chambers intervening the groups connected by the cross-under ducts and said cross-under ducts being adapted to withdraw portions of the products of combustion from some of the groups of flues when operable for upflow combustion and discharge such combustion products into the flues of the other groups connected therewith by the cross-under ducts and concurrently operable for upflow combustion and thereby act to dilute and extend the combustion in the flues when operable for upflow combustion.

22. In a coking retort oven, a coking-chamber, combustion heating means therefor comprising vertical combustion flues operable in alternation for upflow of combustion of gas and air and downflow of off-flow waste gas, the combustion flues being operatively disposed in groups with communicable connections at their upper and lower ends in such manner that part of the flues of each group are operable for upflow combustion while the remaining flues of the same groups are operable to receive and flow the waste gas thereof downwardly, and part of the waste gas may pass through the lower communicable connections of a group from the flues operable for downflow into the flues of the groups operable for upflow while the remaining part of the waste gas is exhausted from the groups, said lower communicable connections comprising ducts in the bottoms of the vertical flues and opening into the vertical flues in a substantially vertical direction.

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ELECTRON DISCHARGE DEVICE

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8 Claims. (Cl. 250—27.5)

This invention relates to electron discharge devices and more particularly to a supporting assembly for applying tension to a filamentary cathode.

In electron discharge devices, the cathode is commonly a folded filament having a series of V-shaped sections and supported from an insulating member at one end of the output electrode. In order to maintain the cathode uniformly in the medial plane of the anode and grid or other cooperating electrode associated with the cathode, it is customary to apply sufficient tension to the filamentary sections by suitable springs which carry hooks engaging the filament. These springs may assume several forms, and may produce tension in the several sections of the cathode by either their resistance to compression or to expansion. The compression type spring is more practical inasmuch as it may be mounted in such a position in the electrode unit that it is not subjected to the intense heat generated by the filamentary cathode. However, the compression of the spring due to the tensional force of the cathode usually causes the turns of the spring nearest the supporting insulator to engage or contact with each other and thereby to form a closed coil at the end of the spring.

When high frequency heating apparatus is employed for heating the electrodes by induction during the evacuation treatment to remove occluded gases, the contacting or engaging turns of the spring are likewise heated to an intense degree due to the current induced in the coil formed by the contacting turns. The intense heat generated in these turns is conveyed by conduction to the other turns of the spring and, as a result, the spring becomes hard and brittle to such an extent that it loses its resiliency and fails to maintain the proper tension in the filamentary sections. Consequently, any change in the expansion and contraction of the series of filamentary sections during operation is not equalized in the springs with the result that the filamentary strands may break or the space relation of the filament with respect to other electrodes, such as the grid and anode, may be altered and cause variations in the static characteristics of the device.

One object of this invention is to overcome the above defects whereby the tensioning supports retain their resiliency under adverse heating conditions.

Another object of this invention is to maintain the filamentary sections in the medial plane of the cooperating electrodes.

In accordance with this invention, the tension supporting springs for the filamentary sections are arranged in position on the insulating member above the anode and each spring is provided with an insulating disc having a central aperture for the passage of the filament supporting hook. The insulating disc is seated in the bottom of the spring helix so that the disc is interposed between two turns at the end of the helix and, therefore, insulates these turns to prevent the establishment of a closed electrical circuit in the turns of the springs, thereby avoiding excessive heating which would cause deterioration of the springs.

A feature of this assembly is the alignment of the filament hook within the spring due to the guiding function of the insulating disc held rigidly in the end of the spring. Another feature is that the insulating disc serves as a barrier and prevents deposition of active material from the filament on the tension springs, and thereby preserves the resiliency of the springs.

The invention and the features thereof will be understood more clearly and fully from the following detailed description with reference to the accompanying drawing, in which:

Fig. 1 is a perspective view of an electron discharge device illustrative of one embodiment of this invention, portions of the enclosing vessel and of the anode being broken away to show the inner electrodes more clearly;

Fig. 2 is an enlarged detail view partly in cross-section showing the position of the filament supporting springs on the insulating member above the anode; and

Fig. 3 is another enlarged detail view partly in cross-section showing a filament supporting spring provided with an insulating barrier disc in accordance with this invention.

Referring now to the drawing, the electron discharge device shown therein is similar in general structure to the device disclosed in Patent 1,984,992, granted December 18, 1934 to Victor L. Ronci and myself, and comprises an enclosing vessel 10 having a reentrant stem 11 at one end, the vessel being suitably secured, as by cementing, to a base 12 carrying terminal prongs 13 for associating the electrodes of the device with an electrical circuit. The stem 11 has clamped thereabout a metallic band or collar 14 which has secured thereto, as by welding, a pair of parallel rigid hairpin-shaped supports or wires 15. Each of the supports or wires 15 has secured thereto a rigid cross-piece or wire 16 which carries an upright rod 17. A cross-shaped insulating member

is seated upon the cross-pieces or wires 16 and has arms 18 through which the uprights or rods 17 extend and other arms 19 disposed at right angles to the arms 18. An anode, which may be of carbon, includes a flat, cylindrical portion 20 and oppositely disposed integral flanges 21 provided with bores for receiving the uprights or rods 17. The flanges 21 are provided with openings through which the supports or wires 15 pass, and are seated upon tubular insulators 22 encompassing the uprights or rods 17 and seated upon the arms 18. Other tubular insulators 23, also encompassing the rods or uprights 17 are seated upon the upper end of the flanges 21 and carry a cross-shaped insulator having arms 24 provided with apertures for receiving the uprights or rods 17 and having other arms 25 at right angles to the arms 24. The anode and insulators are securely held upon the cross-pieces or wires 16 by stubs 26 secured, as by welding, to the free ends of the uprights or rods 17. The anode may be electrically associated with one of the terminal prongs by a conductor 27 sealed in the stem 11 and connected to one of the supports or wires 15.

A helical grid 28 is disposed within the anode and uniformly spaced from the inner wall thereof, and is carried by two rods or wires 29 and 30, each turn or a suitable number of turns of the helical grid being secured, as by welding, to the rods or wires. The rod or wire 29 extends loosely through apertures in one of each of the arms 19 and 25 and is suitably secured to a rigid metallic stub or wire 31 embedded in the stem. The other grid supporting rod 30 is loosely disposed in slots or grooves in the other of the arms 19 and 25. This construction allows both lateral and longitudinal expansion and contraction of the helical grid so that the proper space relation between the grid and other electrodes of the device is maintained. The grid may be electrically connected to one of the terminal prongs 13 by a conductor 35 connected to the stub or wire 31.

An M-shaped filamentary cathode 36 is disposed within the helical grid 29 and lies substantially in the medial plane of the grid. The ends of the filamentary cathode are secured to rigid wires 37 sealed in the stem 11 and extending through the arms 19 of the lower insulator, the wires 37 being electrically connected to two of the terminal prongs 13 by conductors 38. The midpoint of the cathode 36 is positioned by a hook member 39 carried by a rigid stub 40 embedded in the lower cross-shaped insulator. The apices or bights of the filamentary cathode 36 are engaged by hook members 41 each of which is supported by a spring 42 seated in a countersunk aperture 43 in the arms 25 of the top insulator. The springs 41 are compressed initially to a predetermined degree in order to maintain a desired tension in the sections of the filamentary cathode, so that the proper position of the cathode with respect to the grid and anode is maintained during the operation of the device.

When the springs are thus compressed, the end turns thereof toward the apices of the filamentary cathode engage and make contact with each other and thereby form a closed loop. During the heating of the electrode assemblies by a high frequency magnetic field to remove occluded gases therefrom, it has been found that an appreciable electric current is produced in this closed loop. As a result of this current, the springs 42 become heated to an unduly high degree, so that they become hard and brittle and fail to maintain the proper tension in the filamentary cathode.

In accordance with this invention these defects are overcome by providing an insulating member 45, such as a mica disc, between the two turns at the lower end of the springs 42. This insulating member prevents the establishment of a closed metallic loop in the springs 42 and thereby prevents the inducing of an objectionable current in the springs so that deleterious heating and deterioration of the springs is eliminated. Each of the insulating members 45 is provided with an aperture through which the shank of the hook members 41 extends loosely and thereby acts as a guide for the hook member and maintains the bights or apices of the cathode in the desired position. Furthermore, the insulating member serves as a barrier to prevent the deposition of active material from the cathode upon the springs 42 and thereby serves to preserve the resiliency of the springs.

Although a specific embodiment of the invention has been shown and described, it will be understood, of course, that modifications may be made therein without departing from the scope and spirit of this invention as defined in the appended claims.

What is claimed is:

1. An electrode assembly for electron discharge devices comprising a support, a helical spring having a plurality of closely adjacent turns, carried by said support, an electrode suspended from said spring, and insulating means between said closely adjacent turns of said spring.

2. An electrode assembly for electron discharge devices, comprising a filamentary electrode, a support, a tubular spring seated on said support, a member carried by said spring and coupled to said electrode, and a barrier frictionally engaging said spring and having an aperture for guiding said member.

3. In an electron discharge device including a plurality of electrodes, supporting means for one of said electrodes comprising a rigid member mounted on another electrode, a helical spring seated on said rigid member, a hook member suspended from said spring and coupled to said one electrode, and a barrier member carried by said spring and having an aperture for guiding said hook member.

4. In an electron discharge device including an anode and a filamentary cathode, supporting means for said cathode comprising an insulating member coupled to said anode, a helical spring seated on said insulating member, a hook member carried by said spring and engaging said cathode, and an insulating disc carried by said spring and having an aperture for guiding said hook member.

5. In an electron discharge device including an anode and a cathode, a supporting system beyond said anode from which the cathode is suspended including a support and a spring having a plurality of turns in close relation seated on said support, and an insulating member spacing the close turns of said spring for preventing heating of said spring by induced current.

6. In an electron discharge device including an anode and a cathode, a support beyond said anode from which the cathode is suspended, a helical spring seated on said support, a hook member within said spring and attached thereto at one end, said hook member engaging said cathode, and a guiding disc of insulating material at the other end of said spring for maintaining said hook axially within said spring.

7. An electrode assembly for electron discharge devices comprising an insulating member having

a countersunk aperture therein, a filamentary electrode, a helical spring seated in said aperture, a hook member carried by said spring, extending through said aperture and engaging said electrode, and an insulating member carried by said spring and disposed within said countersunk aperture, said insulating member having an opening for guiding said hook member.

8. An electron discharge device comprising a cylindrical anode, an insulating member mounted upon one end of said anode and having a plurality of countersunk apertures, an M-shaped filamentary cathode within said anode and having its apices adjacent said insulating member, helical springs seated in said apertures, a hook member supported from each of said springs and engaging said apices, and insulating discs spacing adjacent turns of each of said springs, said discs having apertures for guiding said hook members.

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