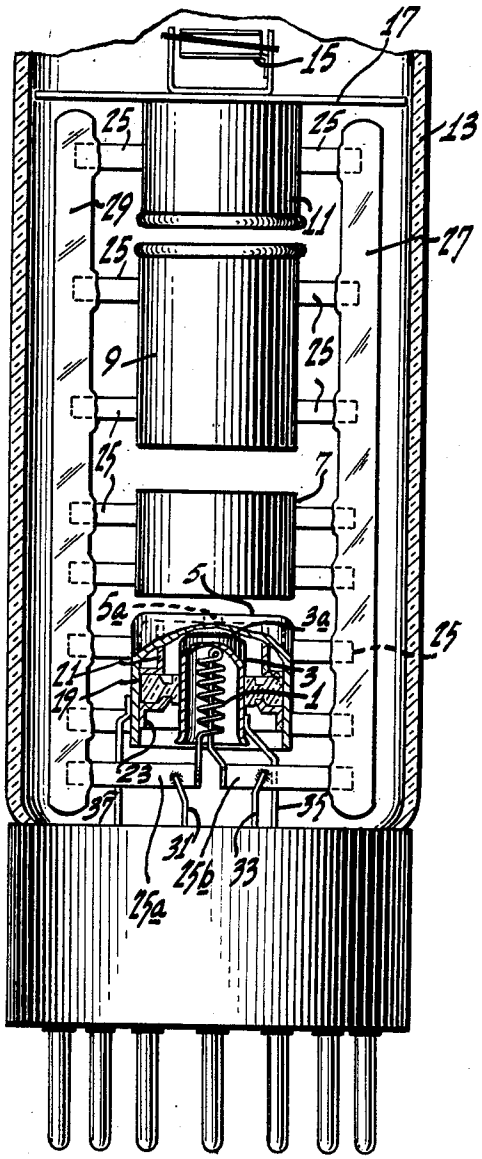
May 26, 1964 M. K. BROWN 3,134,923

PLURAL PARALLEL ELECTRON-GUNS

Filed Aug. 22, 1960

Fig. 1.



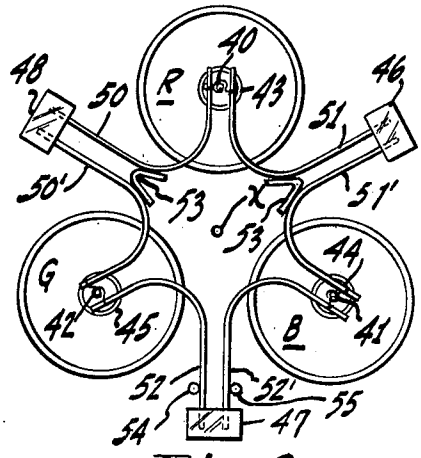


Fig. 2.

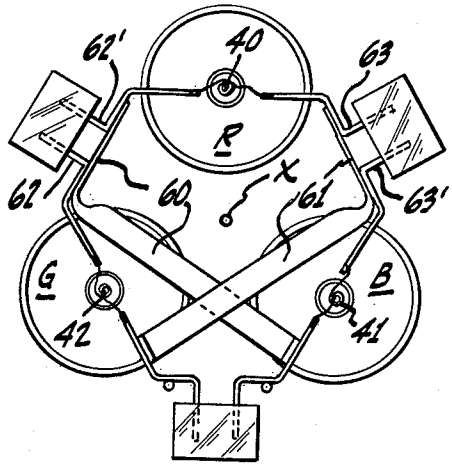


Fig. 3.

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PLURAL PARALLEL ELECTRON-GUNS

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This invention relates to electron-guns and has special reference to improvements in the art of mounting the filamentary heaters for the indirectly heated cathodes of such devices.

The invention is predicated upon an appreciation of the fact that the now standard practice of employing separate mounting arrangements for the heater and cathode elements of an electron-gun causes short-circuits and other hazards that inhibit the achievement of a long useful life for the tube in which the gun is employed.

In accordance with the now standard practice, the coiled filamentary heater is mounted directly on the stem-leads, or extensions of such leads, and the cathode and other cylindrical elements of the gun are separately supported, as a unit, by glass rods or "beads" secured indirectly to the stem. Thus, there may be relative movement and resulting friction between the cathode-cylinder and the heater therein, e.g., during the sealing of the separate mounts, during thermal cycling, or when the tube is subject to microphonic vibrations. As a consequence, the heater wire may become distorted or the insulating coating thereon may wear off, causing a short-circuit.

The foregoing objections to present day bi-part gun-mounting arrangements are substantially obviated, in accordance with the invention, by the provision of a mount wherein the heater as well as the cathode and other elements of the gun are supported as a single rigid unit as by straps or mounting lugs secured to inflexible side-rods.

The invention is described in greater detail in connection with the accompanying single sheet of drawings, wherein:

FIG. 1 is an elevational view, partly in section, of the neck portion of a cathode-ray tube containing a unitary gun-structure including heater and cathode elements mounted in accordance with the principle of the invention;

FIG. 2 is an end elevational view showing cathode heaters of a battery of three electron guns, with the heaters connected electrically in series and supported in accordance with the invention; and

FIG. 3 is a view similar to FIG. 2 but showing the heater elements connected in electrically parallel relationship.

Referring to FIG. 1: The electron gun that has been selected for illustration comprises a filamentary heater **1**, a thimble-like cathode **3**, an inverted cup-shape control grid **5**, and three cylindraceous beam-controlling electrodes **7**, **9**, and **11** disposed in the order named in spaced apart relationship along the central axis of the neck portion **13** of a cathode-ray tube. A single getter structure **15**, which forms no part of the present invention, is shown mounted on the apertured end plate **17** of the uppermost cylinder **11**.

As is conventional, the thimble-like cathode **3** is coated on the outer surface of its closed end with a thermionic electron-emissive material *3a* which is presented across an intervening space to an aperture *5a* in the control-grid cylinder **5**. An insulating grommet or washer **19** fitted tightly in the grid cylinder **5** about the cathode "thimble" **3**, and two bent metal cylinders **21** and **23**, disposed on opposite sides of said washer and welded to the inner surface of the grid cylinder **5** serve to establish and to maintain the desired spacing between the emissive coating *3a* and the grid aperture *5a*. As is also conventional, the several cylindrical electrodes **5**, **7**, **9**, and **11** are rigidly

supported in spaced apart axial alignment by means of mounting lugs or straps **25** whose outer terminals are embedded in two or more inflexible glass support rods or "beads" **27** and **29**.

In accordance with the present invention the filamentary heater **1**, for the indirectly heated electron-emissive layer *3a*, instead of being independently mounted upon the stem leads **31** and **33** (which supply heating current to the filament) is supported, as by means of rigid lugs or straps *25a* and *25b*, upon the same inflexible glass side-rods **27** and **29** as the other gun-elements. Thus, there is substantially no possibility that the filament **1** will be subjected to abrasion or collapse resulting from undesired movement with respect to the inner surface of the thimble-like cathode **3** either during assembly or when in use.

The entire gun assembly, including its inflexible side-rods, may be mounted and supported, for example, by leads **35** and **37** for the cathode and grid cylinders **3** and **5**, respectively, or by other support leads sealed through the stem.

FIG. 2 shows the invention as applied to supporting the heating elements **40**, **41**, and **42** for the indirectly heated cathodes **43**, **44**, and **45**, respectively, of a battery of three electron-guns R, G, and B which are arranged delta (Δ) fashion in equally spaced array about a common axis X, as in a conventional color-kinescope. Here, three glass support rods **46**, **47**, and **48** are disposed in parallel relationship adjacent to the corners of an equilateral triangle, and the supports for the filamentary cathodes **40**, **41**, and **42** comprise three pairs of L-shape rigid metal straps **50—50′**, **51—51′**, and **52—52′**, respectively. Corresponding terminals of the paired L-shape straps are embedded in respective ones of the rigid glass rods **46**, **47**, and **48**. The free end of each L extends beneath one of the cathode thimbles, so that there are two such strap end-portions, spaced from each other adjacent to the open end of each of said thimbles. The terminals of each filamentary heater are welded, respectively, to one of these strap-ends and the coiled body of that heater is presented to the interior of the cathode cylinder which will be understood to be supported thereabove, for example, in the manner shown in FIG. 1. Where, as here, the filaments **40**, **41**, and **42** are to be connected in series, the connectors may take the form of small metal angle pieces **53** bridging the embedded arms of two (of the three) pairs of straps; in which case the current supply leads **54** and **55** are connected, respectively, to the arms of the other pair.

When, as shown in FIG. 3, the filamentary heating elements **40**, **41**, and **42** of a battery of three electron-guns R, B, and G are to be connected in electrically parallel (instead of series) relationship, the auxiliary connectors that provide such relationship are designed, positioned and arranged, in accordance with the invention, to enhance the rigidity of the assembly without increasing its overall dimensions. Here, it will be observed, the auxiliary connectors take the form of rigid bent metal strips **60** and **61** of L-shape construction. A major surface of the short arm of each L lies in a plane parallel to the central axis X of the assembly and bridges the paired support straps **62—62′**, **63—63′**, respectively. The other or long arms of the L's **60** and **61** are connected respectively to the other filament supporting straps **64—64′** so that they cross each other in spaced apart horizontal planes without increasing the overall dimensions of the assembly.

What is claimed is:

1. A battery of three electron-guns comprising three glass support rods disposed in parallel relationship adjacent to the corners of an equilateral triangle, three pairs of rigid metal straps having corresponding ends of each pair embedded in the glass of a respective one of said

support rods and the free-end of each strap extending in the direction of a strap of another pair, three filamentary heaters each having two ends, each heater being supported at one of its ends upon the strap of one pair and, at its other end, upon an adjacent strap of another pair, and means including said straps for connecting said filamentary heaters in electrically parallel relationship.

2. The invention as set forth in claim 1 and wherein said last-mentioned means comprises a pair of rigid bent metal straps of L-shape construction having the major faces of the short arm of each L lying in planes parallel to the direction of extension of said support rods and welded to each of the filament-support straps of respective adjacent pairs of such straps and the long arms of said L's lying in spaced apart crossed planes normal to said first-mentioned planes and welded to respective ones of the filament supporting straps of the other pair.

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