Sept. 2, 1958 M. W. ECHO 2,850,633

THERMIONIC EMISSION SOURCE

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FIG. 1

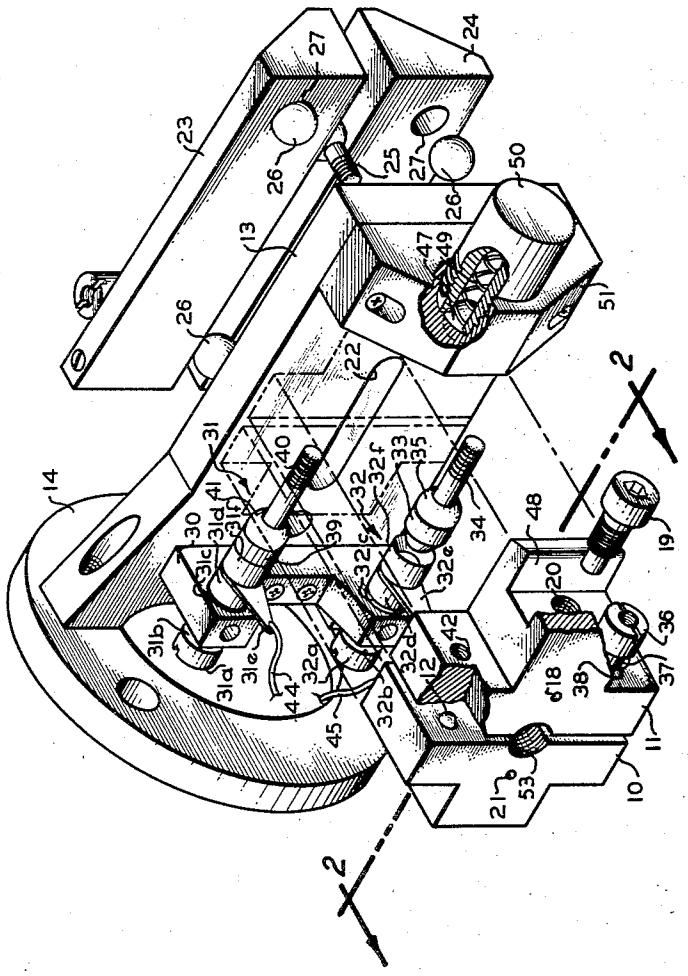
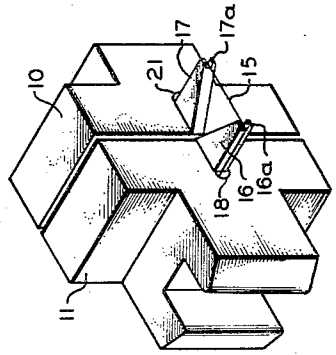



FIG. 2

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# THERMIONIC EMISSION SOURCE

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6 Claims. (Cl. 250—41.9)

This invention relates to a thermionic emission source. In another aspect, it relates to a readily replaceable filament for a mass spectrometer.

Heretofore, in making analyses with mass spectrometers, the filament has been secured, as by spot welding, to suitable glass-to-metal seals. Inasmuch as it is desired to deposit samples to be analyzed on the filament in many instances, it is desirable that the filament be readily removable and replaceable. Where the previous constructions have been utilized, quite marked variations in filament position have been noted, and jig setting of the filament is required before each use.

In accordance with this invention, the filament or emission source is carried by a pair of slotted members protruding from a metal block having two sections insulated from each other. This block can be readily snapped into place on an electrode assembly and cooperates with a spring pressed spacer ball assembly so that it is readily removable. In its assembled position, the source is accurately positioned in an immovable manner, and electrical connections are made to the two filament terminals by independent socket connections extending to the respective metal block sections.

In this manner, filament or source can be readily dismounted and a new source substituted with a considerable saving in the down time required for filament changing in a mass spectrometer. It will be evident that the structure of the invention permits glass-to-metal seals to be eliminated, and permits the filament assembly to be put together without requiring a jig operation.

Also, as will be evident from the foregoing discussion, although the thermionic source of the invention is of principal application in mass spectrometers, it is useful generally in many varied types of thermionic emission devices.

Accordingly, it is an object to provide an improved thermionic emission source which can be readily assembled and disassembled.

It is a further object to provide such a source which accurately positions the filament without requiring a jig operation.

It is a still further object to provide an improved mass spectrometer emission source.

It is a still further object to provide a filament assembly which is reliable in operation, rugged and economical.

Various other objects, advantages and features of the invention will become apparent from the following detailed description taken in conjunction with the accompanying drawings, in which:

Figure 1 is a perspective view of an emission source constructed in accordance with the invention with the parts in disassembled relation; and

Figure 2 is a perspective view of the filament holder.

Referring now to the drawings in detail, I have shown a filament holder having two metal sections 10 and 11 which are held apart by a plurality of sapphire ball



spacers, one of which is shown at 12. This filament holder is detachably secured to an electrode, for example, an anode block 13 in the manner hereinafter explained in detail, the block 13 being suitably secured to a base ring 14 which is connected to the end of a metal tube, not shown, which is a part of the spectrometer vacuum lock and contains the electrical leads for the tube.

A filament 15 is carried by slotted end portions 16*a*, 17*a* of a pair of triangular filament supports 16 and 17 which are secured to the respective filament holder sections 10 and 11. The filament can be a strip of tantalum ribbon 0.001" by 0.030". One end of this ribbon extends through an opening 18 in the holder section 11 and is secured in position within this opening by a bolt 19 extending through a tapped opening 20 in the section 11. The other end of the ribbon extends through an opening 21 in the filament holder section 10 and is held in position by a bolt, not shown, similar to the bolt 19, which extends through a tapped opening in the section 10. Thus, to install or remove the filament, it is only necessary to loosen the bolts and withdraw or insert the ends of the ribbons from or in the openings 18 and 21. The bolts, in their clamped position, securely hold the filament in position as determined by the edges of the slotted end portions 16*a* and 17*a*.

When the filament holder is clamped into position, as hereinafter described, the filament protrudes into a slot 22 formed in the anode block 13 and is positioned adjacent a pair of focus plates 23 and 24 which are secured to the anode block by a bolt 25 and spaced therefrom by sapphire ball spacers 26 fitting into suitable openings 27 in the focus plates.

The filament holder assembly can be readily clamped into position upon the anode block 13 or removed therefrom by virtue of the supporting structure now to be described. A supporting block 30, preferably formed from stainless steel, is secured to the anode block 13 and carries a pair of combined support and terminal assemblies 31 and 32. These assemblies include a pair of threaded rods carrying, respectively, nuts 31*a* and 32*a*; sapphire bead insulators 31*b*, 32*b*, 31*c*, and 32*c*; spacers 31*d*, 32*d*; connection lugs 31*e*, 32*e*; and gold plated conical sockets 31*f*, 32*f*. It will be evident that both sockets are insulated from the anode block by the insulator sets 31*b*, 32*b*, and 31*c*, 32*c* while electrical connection thereto can be made by the lugs 31*e*, 32*e*.

Fitting within the lower socket 32*f* is a spherical contact member 33 secured to a threaded rod 34 carrying a sapphire bead insulator 35. The rod 34 is received within a threaded opening in block 10 so as to make electrical connection therewith and, thence, passes through a larger opening in filament section 11, the protruding end having a nut 36 secured thereto which abuts a sapphire bead insulator 37 fitting within an opening 38 in the filament holder section 11.

In similar fashion, the upper socket 31*f* receives a spherical contact member 39 which is secured to a threaded rod 40 carrying a sapphire ball insulator 41. The rod 40 passes through a relatively large opening in filament support section 10 and is screwed within a tapped opening 42 formed within the filament holder section 11.

The filament circuit can, therefore, be traced from a filament lead 44 through the lug 31*e*, socket 31*f*, socket 39, rod 40, filament holder section 11, filament 15, filament holder section 10, rod 34, socket 33, socket 32*f*, and lug 32*e* to a lead 45.

When the filament holder is inserted into position with the contacts 33 and 39 positioned within the respective sockets 32*f* and 31*f*, a sapphire spacer ball 47 is snapped into position within a slot 48 formed in the filament

holder section 11. It will be noted that the sapphire ball 47 is urged into the slot by a spring 49 secured within a cup 50. This cup is threaded within a block 51 protruding from the anode support block 13. Thus, the filament holder can be readily snapped into desired position with relation to the anode block 13.

In one typical operation, a number of filament holders are utilized in a succession of analyses, each holder having a filament secured thereto in the manner previously described. The samples to be analyzed are deposited on the respective filament ribbons in liquid form, and dried by passing current through the filament for a short time. A threaded rod, which can be inserted into a tapped opening 53, is attached to the filament holder to serve as a guide or handle, and the filament holder is brought up to its position next to the anode block 13. The contacts 33 and 39 are placed into the sockets 32*f* and 31 *f*, the filament holder being rotated about the ball and socket contacts 33, 32*f* and 39, 31*f* toward the anode block 13 until the sapphire ball 47 seats in the slot 48. In this position, the ball clears the head of screw 15 and maintains the filament holder in desired fixed position relative to the anode block. The filament thereupon protrudes into the slot 22 exposing the sample to the electrostatic fields of the source region, and power is supplied to the filament by the previous filament circuit to cause it to heat up so that the analysis can be carried out.

When the analysis is completed, the current is turned off and the filament holder is removed simply by rotating or "prying" the assembly out from the anode block 13 until ball 47 snaps out of slot 48, releasing the filament holder. Ball 47 does not fit so far into slot 48 that the spring must be released in order to remove the holder. The sequence of removing the filament holder is exactly opposite of the installation sequence. Thus, the filament holder is readily removed and replaced by a new unit.

It will be evident that I have achieved the obects of the invention by providing a filament holder which can be rapidly inserted into position and removed therefrom. When snapped into position, as described, the filament is supported in precisely the desired position by the triangular support members 16, 17 and successive filaments are accurately positioned in the location when new filament holders are inserted into the apparatus. It has been found that there is substantially no variation in filament position when the present source structure is utilized, and that the time required to assemble the filament holder on the source unit is substantially decreased with resultant substantial decrease in pump down time.

While the invention has been described in connection with a present, preferred embodiment thereof, it is to be understood that this description is illustrative only and is not intended to limit the invention.

I claim:

1. A thermionic emission source forming a part of a thermionic emission device comprising, in combination, an elongated block forming a part of said device, and a filament holder detachably secured to said block, said filament holder being formed from a pair of spaced insulated metal sections, a pair of elongated filament support members protruding from the respective sections and having guides at the outer ends thereof, a pair of passages extending into the respective sections, a filament carried by said protruding members and received within the guides thereon, the ends of the filament extending into said passages, and means for detachably securing the respective ends of the filament within said passages, said block having terminals thereon, and detachable connection means connecting the respective terminals with the ends of the filament extending into said passages.

2. A thermionic emission source which comprises, in combination, a filament holder having a pair of spaced metal block sections insulated from each other, a triangular member protruding from each block, a slot formed at the apex of each triangular member, a pair of passages formed in said sections adjacent the edges of the respective triangular members, a filament carried by said members and received within said slots, the ends extending into the respective openings, means for detachably securing the respective ends of said filament within said openings, an elongated block, and means for detachably supporting said filament holder on said block and making electrical connections to the filament including, in combination, a pair of sockets secured to and insulated from said block, a rod secured to one section of said filament holder and having a contact fixed thereto which seats in one of said sockets, said rod being insulated from the other section, a second rod secured to said other section and insulated from said one section, the last-mentioned rod having a contact member secured thereto fitting within the other socket, one of said sections having a slot formed therein, a snap element, and means urging said snap element into said last-mentioned slot to secure the filament holder in fixed position in respect to said block.

3. The structure of claim 2 wherein the sockets are of conical configuration and the contact numbers are of spherical configuration.

4. A thermionic emission source which comprises, in combination, a filament holder having a pair of spaced metal block sections insulated from each other, a triangular member protruding from each block, a slot formed at the apex of each triangular member, a pair of passages formed in said sections adjacent the edges of the respective triangular members, a filament carried by said members and received within said slots, the end of said filament extending into the respective openings, means for detachably securing the respective ends of said filament within said openings, an elongated block, and means for detachably supporting said filament holder on said elongated block and making electrical connections to the filament including, in combination, a pair of sockets secured to and insulated from said block, a rod secured to one section of said filament holder and having a contact fixed thereto which seats in one of said sockets, said rod being insulated from the other section, a second rod secured to said other section and insulated from said one section, the last-mentioned rod having a contact member secured thereto fitting within the other socket, one of said sections having a slot formed therein, a snap element, and means urging said snap element into said last-mentioned slot to secure the filament holder in fixed position in respect to said block, said block having an elongated passage formed therein and said filament extending into said passage when the filament holder is assembled to the block, a pair of focus plates secured to the side of said block opposite said filament holder, and a plurality of sapphire balls spacing said focus plates from the anode block.

5. A thermionic emission source which comprises, in combination, a filament holder having a pair of complementary metal sections spaced and insulated from each other, a filament detachably secured to the two sections, an elongated block, and means for detachably supporting said filament holder on said block and making electrical connections to the filament including, in combination, a pair of sockets secured to and insulated from said block, a rod secured to one section of said filament holder and having a contact fixed thereto which seats in one of said sockets, said rod being insulated from the other section, a second rod secured to said other section and insulated from said one section, the last-mentioned rod having a contact member secured thereto fitting within the other socket, one of said sections having a slot formed therein, a snap element, and means urging said snap element into said slot to secure the filament holder in fixed position with respect to said block.

6. A thermionic emission source which comprises, in combination, a filament holder having a pair of spaced

metal block sections insulated from each other, a support member protruding from each block, a guide formed at the protruding end of each support member, a pair of passages formed in said sections adjacent the edges of the respective support members, a filament carried by said members and received within said guides, the ends of said filament extending into the respective openings, means for detachably securing the respective ends of said filament within said openings, an elongated block, and means for detachably supporting said filament holder on said elongated block and making electrical connections to the filament including, in combination, a pair of sockets secured to and insulated from said block, a rod secured to one section of said filament holder and having a contact fixed thereto which seats in one of said sockets,



said rod being insulated from the other section, a second rod secured to said other section and insulated from said one section, the last-mentioned rod having a contact member secured thereto fitting within the other socket, one of said sections having a slot formed therein, a snap element, and means urging said snap element into said slot to secure the filament holder in fixed position with respect to said block.

**References Cited** in the file of this patent

UNITED STATES PATENTS

| | | |
|---|---|---|
| 2,583,121 | Raynolds | Jan. 22, 1952 |
| 2,587,647 | Pallette | Mar. 4, 1952 |
| 2,703,843 | Cameron | Mar. 8, 1955 |
| 2,733,346 | Oppenheimer | Jan. 31, 1956 |