Nov. 2, 1948. Z. J. ATLEE 2,452,626

ELECTRON EMITTER

Filed March 3, 1945

Fig. 1

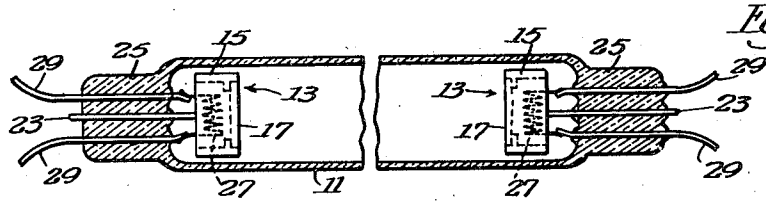


Fig. 2

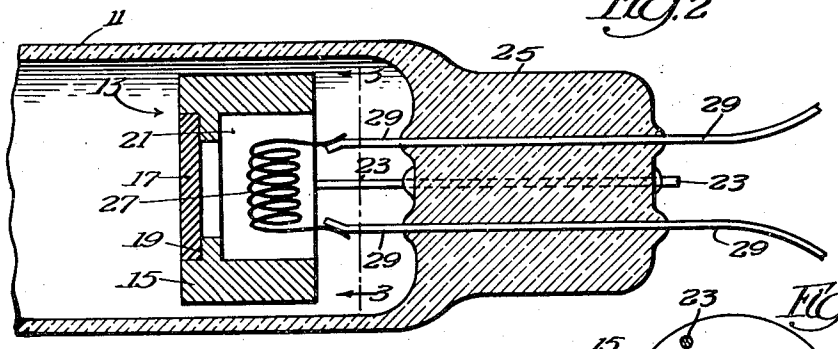


Fig. 3

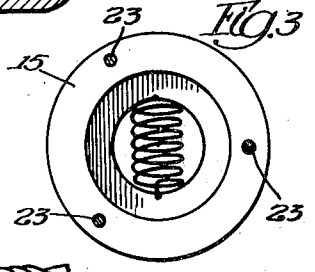


Fig. 4

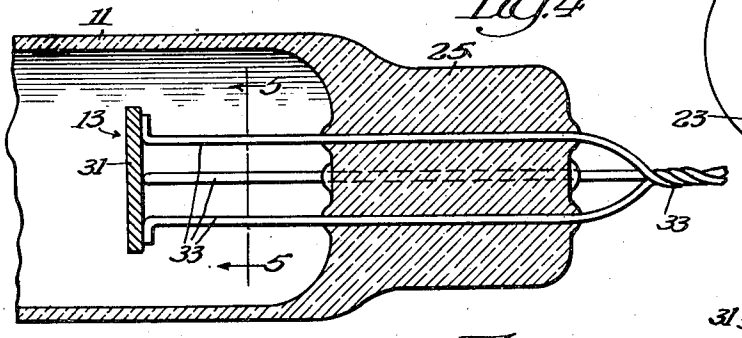


Fig. 5

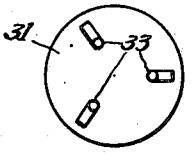


Fig. 6

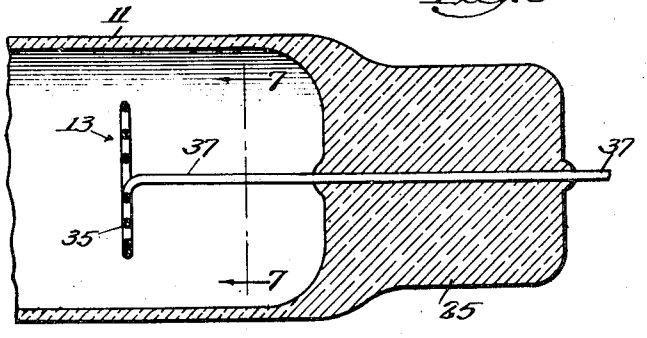
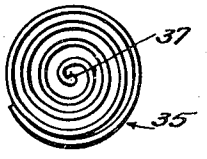


Fig. 7



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ELECTRON EMITTER

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Application March 3, 1945, Serial No. 580,818

1 Claim. (Cl. 176—126)

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The present invention relates in general to electron emission, and has more particular reference to the provision of an improved electron emitter, particularly well adapted for use in gaseous conduction electron flow devices, the invention being concerned specifically with the use of metallic columbium for electron emission purposes.

An important object of the invention is to use columbium as an electron emitter; a further object being to provide an electrode comprising columbium for operation as an electron emitter in an electron flow device; a still further object being to provide an improved electron flow device having an electron emitting cathode comprising columbium.

Another important object is to provide an emission device including an emission element comprising columbium carried on a suitable mounting comprising material having a low sputter factor, high melting point and low electron emissivity; a further object being to utilize beryllium as a mounting for the columbium emitter.

Another important object is to provide an improved gaseous conduction glow lamp having a cathode comprising metallic columbium.

Another object is to provide a gaseous conduction lamp having an electrode embodying a columbium metal electron emitting element supported on a mounting of substantially non-sputtering high melting point material, such as beryllium.

Another important object is to provide a cathode comprising a plate or sheet of pure columbium metal.

Another object is to provide a cathode comprising a looped wire having electron emitting surfaces of columbium.

Another object is to utilise columbium metal as an electron emitting electrode having a low sputter factor in an electron flow device.

The foregoing and numerous other important objects, advantages, and inherent functions of the invention will become apparent as the invention is more fully understood from the following description, which, taken in conjunction with the accompanying drawings, discloses selected embodiments of the invention for the purpose of demonstrating the same.

Referring to the drawings:

Fig. 1 is a sectional view taken through a glow discharge lamp device fitted with electrodes in accordance with the present invention;

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Fig. 2 is an enlarged sectional view of a portion of the device shown in Fig. 1;

Fig. 3 is a sectional view taken substantially along the line 3—3 in Fig. 2;

Fig. 4 is a sectional view showing a modified electrode arrangement;

Fig. 5 is a sectional view taken substantially along the line 5—5 in Fig. 4;

Fig. 6 is a sectional view showing another electrode form; and

Fig. 7 is a sectional view taken substantially along the line 7—7 in Fig. 6.

To illustrate the invention, the drawings show electron flow devices comprising glow discharge lamps, although the invention, of course, is not necessarily limited to glow lamps, but may have wider application wherever electron emission is needed. The discharge devices each comprise a sealed envelope 11, preferably of glass and conveniently fabricated in elongated tubular form, although other envelope forms may, of course, be employed, if desired. The envelope 11 may contain a suitable gas adapted to be electrically excited to glow, and to this end, as shown more particularly in Fig. 1, the envelope is provided with spaced apart electrodes 13, which may be disposed in the opposite ends of the tubular envelope. By ionizing the gaseous glow medium within the envelope, the medium may be rendered electrically conductive and may be caused to glow by passing current through the conductive medium between the electrodes.

Any suitable gaseous conduction medium, such as neon, argon, crypton, mercury vapor and other gaseous media, may be employed in the envelope 11. An important difficulty, however, that is encountered in the operation of gas conduction devices of the character mentioned is apparent consumption, evaporation or disappearance of the gaseous medium during the operating life of the lamp. It is thought that such disappearance is in reality a deterioration or disintegration or some sort of conversion of the gas by the action of the electrodes thereon in the presence of the high heat and electronic activity which prevails in the device during operation, for the material of the electrodes employed appears to have an effect upon the rate at which the gas is used up or its conducting qualities impaired.

It is the purpose of the present invention to provide improved electrodes 13, the use of which in gaseous conduction electron flow devices will greatly extend the life and improve the performance thereof.

In gaseous conduction devices, the conducting medium may be ionized and thus rendered conducting either as a result of the application of

relatively high potential between electrodes, or by constituting the electrodes as electron emitting devices.

Where ionization of the gaseous medium is accomplished by electron emission from electrodes separately excited for that purpose, emission is accomplished, usually, by heating the electrode, and the electrode so heated may conveniently be referred to as a "hot" cathode. Such a "hot" cathode may be employed in combination with a spaced electrode comprising an anode, which need not necessarily be an electron emitting element, to provide means for delivering electrical current, unidirectionally, through the gaseous medium from the anode to the cathode in order to cause the medium to glow and constitute the device as a lamp. A pair of "hot" cathodes, however, may be employed in order to allow the lamp to be operated by the application of alternating potential between the electrodes, in which case the electrodes alternately function as anode and cathode to permit current flow in alternating directions therebetween.

Where the electrodes are not separately excited, as by heating the same for electron emission, they may be designated as "cold" cathodes. In devices embodying "cold" cathodes, it is necessary, in order to start the device in operation, to apply potential, between the electrodes, of sufficient intensity to cause current flow therebetween, such potential being substantially in excess of that required to initiate current flow between "hot" cathodes. It is, however, advantageous, in a device embodying "cold" cathodes, to fabricate the electrodes of electron emitting material, since the flow of current therebetween, itself heats the electrodes and if the same comprise electron emitting material, such heating will result in electron emission and facilitate the flow of current through the gaseous medium after the device has gone into operation. Where the electrodes comprise electron emitting material, operation of the device can be accomplished more efficiently and at less cost than where ordinary non-emitting electrodes are employed.

For the purpose of operating gaseous conduction devices, I propose the use of pure columbium metal as an electron emitting element in electrodes, whether the same be constituted as "hot" or "cold" cathodes.

In Figs. 1, 2 and 3 of the drawings I have shown electrodes 13 constituting "hot" cathodes, the same comprising a mounting 15 carrying a disc 17 of pure columbium metal. The disc when heated comprises an electron emitting element. The mounting 15 provides an annular seat 19 in which the emitter disc 17 is soldered, brazed or otherwise suitably secured. The mounting 15 also provides a cavity 21 behind the emission disc 17, the rearward surface of which is exposed in the cavity.

The support 15 is mounted within the envelope in any suitable or convenient fashion, the same being preferably secured on, and electrically connected with, metal support rods 23 which are sealingly secured in and extend outwardly of the envelope. As shown in Figs. 1 and 2, these mounting rods 23 extend through pinch seals 25 formed at the opposite ends of the tubular envelope 11. Electrical potential for the operation of the gas conduction device may be applied between the electrodes 13 by connecting the exposed ends of the support rods 23, at the opposite ends of the device, to a suitable source of electrical power.

In order to heat and thus activate the electron emitting elements 17 for electron emission, I provide, within the cavity 21, a suitable heating filament 27, said filament being electrically connected at its opposite ends with lead conductors 29 mounted in and extending through the pinch seal 25. Heating current may be supplied to the filament by connecting the outwardly extending ends of the conductors 29 with a suitable source of electrical potential.

The mounting 15 preferably comprises material having a high melting point and low sputter factor. The material of the mounting 15 also preferably has low electronic emissivity and I have found beryllium to be exceedingly well suited for use as a non-sputtering, non-emitting mounting for the electron emission element 17.

In Figs. 4, 5, 6 and 7 I have shown electrodes of the "cold" cathode type, which are not separately excited for electron emission, but from which electrons are emitted as a result of the application of electrical potential directly between the electrodes. The electrodes may be of any preferred shape. As shown in Fig. 4, however, the electrode comprises a disc 31 of pure columbium metal mounted on support means comprising, preferably beryllium, wires 33 formed at their inner ends to receive and support the disc 31, which is attached to the wires by soldering, brazing, welding, or other suitable fastening expedient. The wires 33 extend outwardly of the envelope through the pinch seal 25 and serve as means for applying electrical potential to the electrode disc 31 from a suitable power source, outwardly of the envelope.

As shown in Figs. 6 and 7 of the drawings, the electrode 13 comprises a spiral coil or filament 35 of columbium. The filament is preferably arranged as a pancake coil, secured, at its center, on a suitable support 37. This support 37 may comprise a conductor extending outwardly of the envelope through the pinch seal 25 and may comprise a rod or stem of beryllium to which the coil may be connected in any suitable fashion, as by soldering, brazing, or welding. The support 37, however, may comprise an integral extension of the material of the coil 35. The conductor 37, of course, provides means for connecting the electrode with a suitable external source of lamp energizing power.

By thus employing electrodes of pure columbium metal having substantially non-sputtering characteristics, I am able to appreciably improve the operation of gaseous conduction devices. This improvement is not only in the efficiency of operation of the device, but also includes an improvement in the rate of deterioration of the gaseous conduction medium to the end that the operating life of devices embodying my new electrode is substantially extended.

It is thought that the invention and its attendant advantages will be understood from the foregoing description and it is obvious that numerous changes may be made in the form, construction and arrangement of the several parts without departing from the spirit or scope of the invention, or sacrificing any of the attendant advantages, the forms herein disclosed being the selected embodiments for the purpose of demonstrating the invention.

Having thus described the invention, what I claim as new and desire to secure by United States Letters Patent is:

A gaseous conduction device comprising a sealed envelope of glass containing a gas, an electron

emitting member comprising columbium, and means for supporting said member on and in said envelope comprising a length of beryllium wire electrically and mechanically secured to said member within said envelope, said wire extending outwardly of the envelope and being sealed to the envelope and thereby supported thereon.

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