Aug. 19, 1958 F. RAIBLE ET AL 2,848,635

IONIZATION GAUGES

Filed Nov. 16, 1954

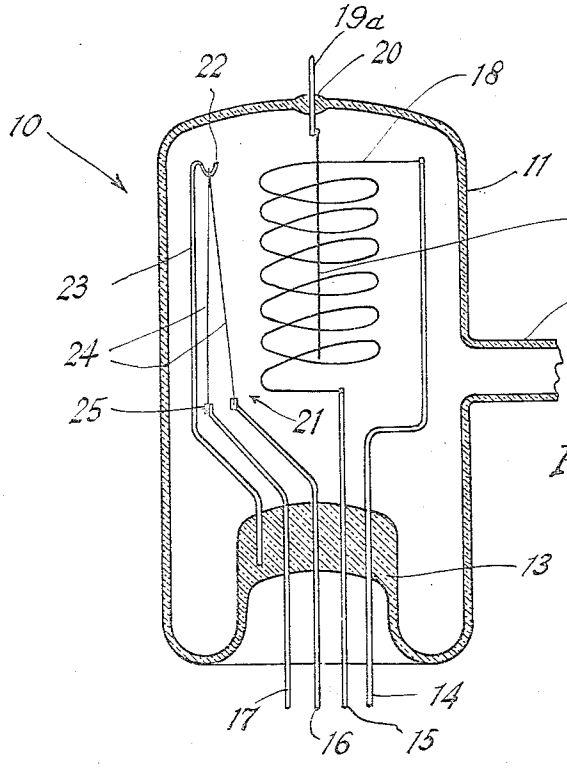



Fig. 1

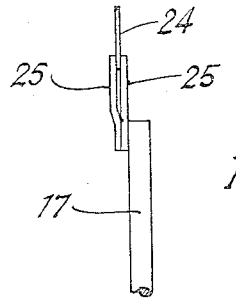



Fig. 2

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2,848,635

Patented Aug. 19, 1958



2,848,635

# IONIZATION GAUGES

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Application November 16, 1954, Serial No. 469,147

7 Claims. (Cl. 313—7)

This invention relates to gauges for measuring gas pressures and more specifically, concerns gauges of the ionization type.

A number of ionization gauges have been recently developed which are quite sensitive to very low gas pressures. However, despite the sensitivity of such gauges, they present several problems which adversely affect the optimum operation thereof.

Thus, some of the gauges known in the art include a negative collector electrode of substantial area. Such an electrode holds a substantial amount of gas and considerable equipment is required to outgas the electrode. Furthermore, it is not always certain with such gauge in use, whether the pressure indicated is the true pressure or the pressure of the gas evolved by the electrode.

Also, all of these gauges utilize a tungsten filament as the means for emitting electrons. Such filaments are adversely affected by atmospheric pressures and if the interior of the gauge should be accidentally exposed to atmospheric pressure, while operating, the filament will burn out, thereby destroying the gauge.

Accordingly, an object of this invention is to provide improved ionization gauges having such electrodes and electron emissive filaments as to overcome the disadvantages set forth and thus provide devices capable of withstanding accidental exposure to air and removing the possibilities of errors in the readings.

Another object of this invention is to provide an improved ionization gauge including a filament formed of a material such as iridium, rhodium or platinum-iridium alloy, together with a coating thereon of electron emissive material such as thorium oxide, cerium oxide, zirconium carbide and the like, such composite filament being undamaged by exposure to atmospheric pressure while in operation.

A further object of this invention is to provide an improved ionization gauge including a positive electrode in helical form, thereby permitting the application thereto of a low voltage, such as that applied to the filament, for heating and outgassing the electrode.

Still another object of this invention is to provide for use in ionization gauges, an improved filament of ductile iridium which is adapted to be connected to the heavy input conductor leads in a manner to substantially eliminate any cooling effect due to such heavy conductor leads and thereby increase the effective electron emissive length of the filament while in operation.

Other objects of this invention will in part be obvious and in part hereinafter pointed out.

In the drawing, Fig. 1 is a vertical sectional view of an ionization gauge embodying the invention;

Fig. 2 is an enlarged elevational view showing the welded connections between the terminal ends of the filament and the incoming conductor leads therefor.

Essentially, the invention is embodied in the form of an envelope containing the electron emissive filament and a plurality of electrodes; the filament taking the form of a ductile iridium member or the like, bent into proper



shape and having a coating thereon of an electron emissive material such as thorium oxide or the like; such filament being proof against burning out at atmospheric pressure; the positive electrode taking the form of a helical wire grid to facilitate outgassing when heated by the application thereto of a low voltage; and a negative collector electrode of minimum area in the form of a wire axially related to the helical grid.

Referring in detail to the drawing and particularly to Fig. 1, 10 designates an ionization gauge embodying the invention. The same comprises an enclosing envelope 11 of glass which is provided with a tubulation 12 extending from a side wall portion thereof for connection to a system whose gas pressure is to be measured. The envelope 11 is formed at its lower end with a stem 13 through which extend conductor leads 14, 15, 16 and 17, the leads being sealed therein in a manner known in the art.

A positive electrode 18 is provided in the form of a helical grid and is mounted centrally within envelope 11 on the inner ends of conductor leads 14, 15. A negative collector electrode 19, in the form of a rectilinear wire is located axially in electrode 18, with the upper end thereof welded to a lead 19*a* which passes through the top wall of envelope 11 and is sealed therein as at 20.

A filamentary electron emissive means generally indicated at 21, is mounted within envelope 11 adjacent to electrode 18. The filament means 21 comprises an iridium element in ductile form which has been bent into an inverted V shape and is supported at its apex portion by spring or guide means 22 extending from the upper end of a stiff wire support 23 which is vertically positioned and secured at its lower end in stem 13.

It has been found that iridium, which is normally extremely brittle, may be made ductile by heating the iridium in its elongated form in a vacuum to a temperature just below the melting point thereof. Under these conditions, the member can be bent to its V shape. The thus formed filament is then coated with electron emissive material such as thorium oxide, cerium oxide, zirconium carbide or the like.

The conductor leads 16, 17 which are connected to the terminal ends of legs 24 of filament means 21, are usually formed of nickel and are of substantial diameter in order to provide a proper welded joint which will not melt away. However, such heavy leads, if directly connected to the filament which is of relatively small sectional dimensions, would cool the terminal portions of the filament while at operating temperature and thereby substantially reduce the length of the effective electron emitting portions of filament legs 24.

Accordingly, there is provided a pair of tabs 25 of platinum or platinum alloy, which are used to interconnect the filament legs 24 and leads 16, 17, as shown in Fig. 2. Thus, for the purpose of illustration, with filament legs having a section of .0015" by .027", there are used tabs having a section of .002" by .040", while the leads 16, 17 may have a diameter of about .060".

The terminal ends of filament legs 24 are welded between the upper ends of the pair of tabs 25 while the lower ends of said tabs are welded to the sides of said leads 16, 17. The length of the platinum tabs 25 between the terminal ends of filament legs 24 and the leads 16, 17, may be about .25", thereby allowing the tabs 25 to attain a high temperature and thus avoid the cooling effect of the nickel conductor leads 16, 17 on the iridium filament means 21.

It will be apparent that with the positive electrode 18 in the form of a helix, it may be heated by the application of a relativey small voltage applied to leads 14, 15. The filament voltage is of a magnitude sufficient to heat

and thereby outgas the electrode 18. In this way, it may be certain that with the gauge in operation, the readings thereon do not reflect gas from the electrode, but are true pressure readings.

Furthermore, if by accident, the interior of the gauge is exposed to atmospheric pressure while in normal operation, the filament means will not burn out and will continue to give good service when high vacuum conditions are restored. With the filament means in inverted V shape, rather than in rectilinear form, the heating current passes directly through the filament without the necessity of passing through a supporting spring and necessarily heating the same which affects its springiness and requires a bulky construction.

It will thus be seen that there has been provided an improved ionization gauge in which the several objects of the invention are achieved and which is well adapted to meet the conditions of use.

As various possible embodiments might be made of the invention herein described, and as various changes might be made in the embodiment set forth, it is to be understood that all matter herein set forth or shown in the accompanying drawing is to be interpreted as illustrative and not by way of limitation.

Having thus described our invention, we claim as new and desire to protect by Letters Patent:

1. An ionization gauge for measuring gas pressures comprising an envelope, a helical positive grid electrode positioned within said envelope, a negative rectilinear wire collector electrode located axially within said positive electrode, and electron emissive means positioned adjacent said positive electrode, said means comprising a filament base selected from the group consisting of iridium, rhodium and platinum-iridium alloy and being unaffected by exposure to atmospheric pressure and elevated temperature and a coating of electron emissive material selected from the group consisting of thorium oxide, cerium oxide, zirconium carbide and mixtures thereof on said base.

2. A gauge as in claim 1 and further including conductor leads passing through said envelope and metal means having a melting point higher than that of said conductor leads connecting the terminal ends of said electron emissive means and said conductor leads.

3. A gauge as in claim 2 wherein said metal means is selected from the group consisting of platinum, the platinum metal group and alloys thereof.

4. A gauge as in claim 1 wherein said electron emissive means comprises a V shaped member of ductile iridium and said electron emissive coating comprises thorium oxide.



5. An ionization gauge comprising an envelope, a positive helical grid electrode located within said envelope, a small area rectilinear wire negative collector electrode disposed axially in said positive electrode, and electron emissive filament means adjacent said positive electrode, said means comprising a ductile iridium base undamaged by exposure to substantially increased pressures at operating temperatures and a coating of electron emissive thorium oxide material on said base, said positive electrode being outgassed upon the application thereto of a low voltage of the order of that applicable to said filament means.

6. In an ionization gauge comprising an envelope, a collector electrode within said envelope, a grid electrode in cylindrical form enclosing said collector electrode, and a filament within said envelope and disposed exteriorly of said grid electrode, said filament comprising a base selected from the group consisting of iridium, rhodium, and platinum-iridium alloy, and a coating of electron emissive material on said base selected from the group consisting of thorium oxide, cerium oxide, zirconium carbide and mixtures thereof, and conductor leads passing through said envelope and connected to said filament and electrodes.

7. An ionization gauge as in claim 6 and further including metal means having a melting point higher than that of said conductor leads connecting the terminal ends of said filament and said conductor leads associated therewith.

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