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Y. MATUNAGA

1,768,415

VACUUM GAUGE

Filed April 7, 1927

Fig.1.

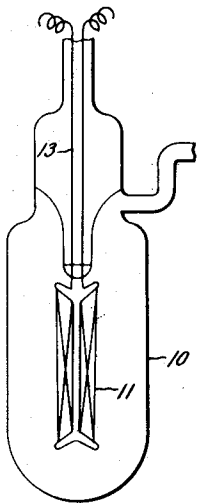


Fig.2.

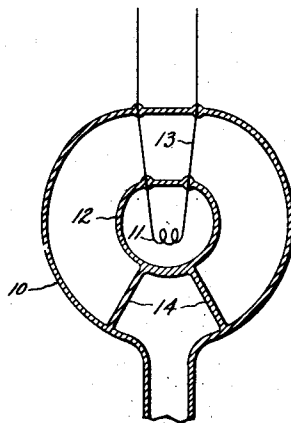


Fig.3.

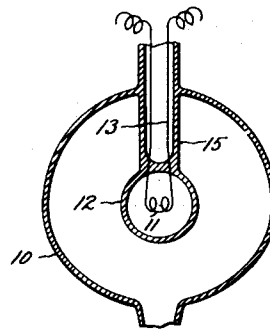


Fig.4.

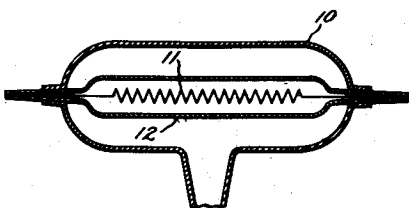


Fig.5.

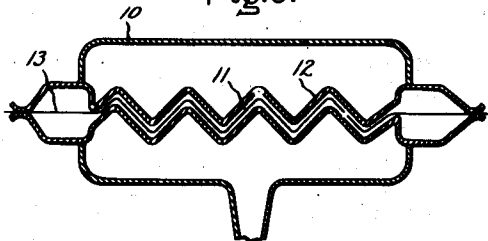
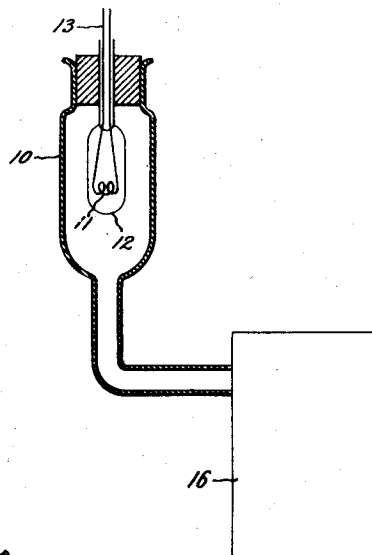


Fig.6.



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UNITED STATES PATENT OFFICE

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VACUUM GAUGE

Application filed April 7, 1927, Serial No. 181,859, and in Japan September 7, 1926.

My invention relates to electric vapor pressure measuring apparatus and its object is to eliminate a troublesome source of error and deterioration previously existing in such devices.

Many vacuum measuring schemes employ an electric conductor which is exposed directly to the vacuum; for example, resistance wires are employed which are heated by a given electric current or at a constant voltage and the degree of vacuum determined by the variation in resistance of the wire due to the variation in the heat conducting capacity of the surrounding gas residue as the vacuum changes. Where the conductor is exposed directly to the vacuum, I have discovered that the properties of the conductor undergo a change with variations in the vacuum; for example, at very low absolute pressures occluded gas escapes from the conductor and changes its resistance. As soon as the conductor is again exposed to a higher pressure, it absorbs gases. Not only does the resistance of the conductor vary under these changing conditions, but it also deteriorates. The heat intensity of such a conductor must be reduced to a safe value when exposed to a perfect vacuum which makes its action sluggish for higher pressures.

I have overcome these difficulties by mounting the electric conductor or conductors in a chamber sealed from the vacuum. This sealed conductor chamber is then mounted in the vacuum chamber. I prefer to fill the sealed conductor chamber with an inert gas at a suitable pressure so that the conductor may be safely heated to a much higher temperature than was heretofore possible. The pressure in the heater chamber remains substantially constant and deterioration and resistance errors due to variations in pressure are thus avoided.

The features of my invention which are believed to be novel and patentable will be pointed out in the claims appended hereto. For a better understanding of my invention reference is made in the following description to the accompanying drawing which

illustrates in Fig. 1 a vacuum gauge of the prior art showing how the heater wire was exposed directly to the vacuum to be measured; Figs. 2 to 6 inclusive show different forms of my invention where the heater wire is contained in an inner chamber sealed from the vacuum chamber.

In the drawing, 10 designates the vacuum chamber, 11 the heater wire or conductor, and 12 the inner sealed conductor chamber of my invention.

In Fig. 1 representative of the prior art, the heater wire which has a high temperature coefficient of resistance is exposed directly to the vacuum in chamber 10 without any protective covering. A constant electric current is conveyed through conductor 11 through the leading-in wires 13 or a constant voltage is impressed across the conductor and variations of its resistance are measured in any suitable manner. The heat of the wire is conveyed away at a rate which varies directly with the absolute pressure, thus varying the temperature and resistance of the conductor. It is at once apparent to those skilled in the art that the amount of gas occluded in the conductor wire will vary depending upon the absolute pressure. The escape and absorption of the occluded gas of the conductor is a fairly slow process so that this condition changes for a considerable period of time and at a varying rate even after the surrounding pressure becomes constant. This changes the resistances of the conductor and causes its deterioration so that accurate calibration and measurements of vacuum are practically impossible. The conductor being exposed directly to a partial vacuum containing oxygen and other elements tends to oxidize if operated at high temperatures, thus limiting the efficiency of the device.

These disadvantages are overcome by mounting the conductor 11 in the separate sealed chamber 12 represented in the remaining figures of the drawing. This chamber preferably contains an inert gas such as argon, nitrogen, helium, or the like, in order that the conductor may be operated at a high temperature without oxidizing or deteriorating.

rating. Variations in resistance due to variations in the occluded gas condition of the conductor are eliminated or reduced to a negligible factor. The heat of the conductor 11 is conveyed rapidly to the outer wall of the chamber 12 which thus exposes a much larger heating area to the vacuum chamber than is possible in Fig. 1. The efficiency, life, and accuracy of the device is thus very much improved.

In Fig. 2 the inner chamber 12 is supported by integral legs 14 extending to the outer chamber. Both chambers are spherical.

In Fig. 3 the chamber is supported by a tube 15 which encloses the leading-in wires 13.

In Fig. 4 the outer and inner chambers are tubular in shape.

In Fig. 5 I have shown how the heating chamber and wire may be arranged to have a large surface area with the heater wire 11 in close proximity to the wall of chamber 12. The inner chamber of this modification is preferably made of refractory material such as pyrex glass. This makes a very sensitive device.

Fig. 6 shows a further modification and also illustrates how the vacuum chamber 10 is connected to the vacuum pump or other vacuum chamber 16 of which the vacuum is to be measured. The improvement permits a larger heating current to be used. The external measuring instruments, relays, or the like, operated or controlled in response to the vacuum measuring device may, therefore, be more rugged and less expensive than those heretofore used with this class of apparatus.

In accordance with the provisions of the patent statutes, I have described the principle of operation of my invention, together with the apparatus which I now consider to represent the best embodiment thereof; but I desire to have it understood that the apparatus shown and described is only illustrative and that the invention may be carried out by other means.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. In a vapor pressure measuring system, an electric pressure measuring unit adapted to be exposed to a vapor the pressure of which is to be measured, comprising an electric heating element having an appreciable temperature coefficient of resistance and a vapor tight container within which said heating element is sealed for protecting such element from direct contact with the vapor.

2. In a vapor pressure measuring system, an electric pressure measuring unit adapted to be exposed to a vapor the pressure of which is to be measured, comprising a vapor tight sealed chamber containing an inert gas and an electric heater in said chamber

having an appreciable temperature coefficient of resistance, said gas-filled container serving to protect the heater from direct contact with the vapor, the pressure of which is to be measured, and serving also as a heat conducting medium between the vapor and the heater.

In witness whereof, I have hereunto set my hand this tenth day of March, 1927.

YOSINOBU MATUNAGA.