

July 6, 1965

A. M. KLOPPER
IONIZATION MANOMETER
Filed March 28, 1962

3,193,724

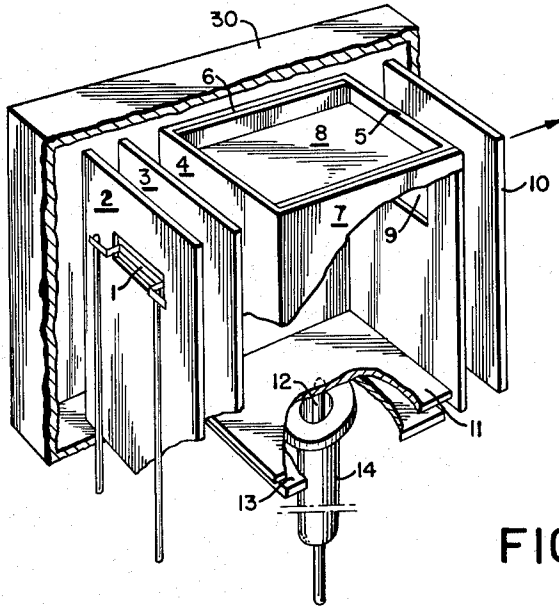


FIG. 1

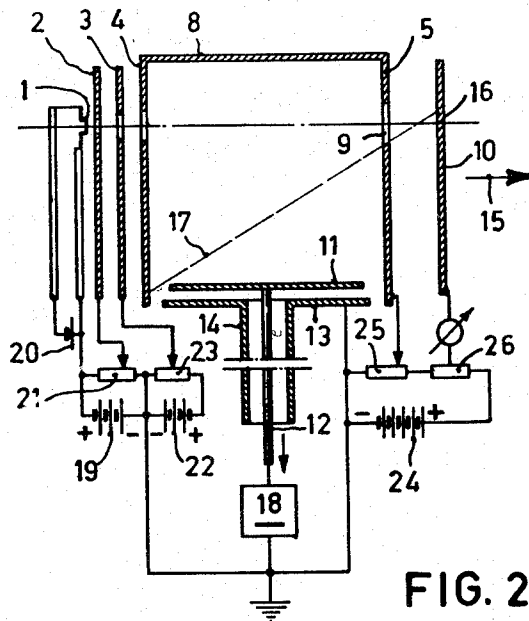


FIG. 2

INVENTOR
ANTON M. KLOPPER

BY *Frank R. Diefen*
AGENT

1

3,193,724

IONIZATION MANOMETER

Anton Martin Klopfer, Aachen, Germany, assignor to North American Philips Company, Inc., New York, N.Y., a corporation of Delaware

Filed Mar. 28, 1962, Ser. No. 183,079

Claims priority, application Germany, Apr. 17, 1961, N 19,897

2 Claims. (Cl. 315-111)

The invention relates to an ionization manometer in which the gas to be measured is ionized between the two apertured diaphragms, the ionizing electron beam being concentrated by a magnetic field so that no electrons impinge upon the edges of the diaphragm apertures for the passage of the electron beam, while precautions are taken to prevent ions liberated from the anode from striking the collector electrode which is arranged laterally of the electron beam between the diaphragms.

Ionization manometers of the above described kind are known. Their collector electrode is either cylindrical and surrounds the electron beam or is a flat plate arranged opposite other flat electrodes, a potential difference being set up between these electrodes. In the known ionization manometer the anode is hollow so that the liberated ions enter a field-free space and hence are hardly capable of leaving the hollow anode. Furthermore, the anode is at a slightly negative voltage with a respect to the diaphragms through which the electrodes enter the anode.

In other known manometers the anode is a grid cage within which a thin wire is arranged as an ion collector. A thermionic cathode is disposed outside the anode cage. The lower measuring limit is determined by the X-ray effect, which is defined hereinafter. The electrons striking the anode by their impact produce very soft X-rays which strike the ion collector also. The incident X-rays liberate electrons from the ion collector electrode and thus simulate an ion current which falsifies the measurements. Since the electron current produced at the collector depends upon the surface properties, which vary with the gas covering, no constant correction can be applied.

It is the object of the present invention to provide an ionization manometer which has certain advantages over the known manometer.

In an ionization manometer, in which the gas to be measured is ionized between two apertured diaphragms, the ionizing electron beam is concentrated by a magnetic field so that no electrons impinge upon the edges of the diaphragm apertures for the passage of the electron beam, while precautions are taken to prevent ions liberated from the anode from striking the collector electrode arranged laterally of the electron beam between the diaphragm. According to the invention there is set up between the anode and the last diaphragm through which the electron beam passes a voltage of such value that the ions liberated from the anode are given a velocity sufficient to drive them under the influence of the magnetic field towards the cathode, while the ion collector electrode is so disposed with respect to the aperture in the final diaphragm that no straight lines can be drawn between the area of the anode struck by electrons and the collector electrode. By the arrangement in accordance with the invention two causes are eliminated which in other cases raise the lower limit of the pressure to be measured in ionization manom-

2

eters. The first cause consists of the ions liberated from the anode, which now are given a velocity such as to prevent them from being drawn towards the collector, even if this collector is negative with respect to the diaphragm. The second cause, the so-called X-ray limit, is eliminated by the fact that the anode struck by electrons is prevented from "seeing" the ion collector so that the X-rays produced are now prevented from liberating electrons from the collector.

The chamber in which ionization is effected preferably is completely enclosed by electrodes joined to one another with the exception of the collector electrode, so that interference fields are reduced to a minimum.

The invention will now be described with reference to the accompanying drawing, in which:

FIG. 1 shows the electrode of an ionization manometer partly broken away, and

FIG. 2 shows a simple circuit arrangement comprising such an electrode system.

In FIG. 1 a thermionic cathode 1, which is in the form of a flat ribbon, is separated by two apertured diaphragms 2 and 3 from a metal case having a front wall 4, a rear wall 5, lateral walls 6 and 7 and an upper wall 8. The electron beam emitted by the cathode 1 leaves the case-shaped chamber through an aperture 9 in the rear wall 5 (the wall 4 is also apertured) and impinges upon the anode 10. A flat collector electrode 11 is supported by a rod 12, screening being effected by a flat plate 13 and a cylinder 14. The entire assembly is housed in an evacuated chamber 30.

FIG. 2 is a sectional view of the electrode system taken parallel to the direction of the electron beam and the magnetic field (indicated by an arrow 15). The electron beam impinges upon a part 16 of the anode 10 and, as is shown by a broken line 17, no straight lines can be drawn from this part 16 through the aperture 9 to the collector electrode 11. The collector electrode is connected to earth by way of a direct-current amplifier 18, which may be provided with the measuring and registering instruments required. The thermionic cathode 1 is given a positive voltage of about 30 volts to ground by a battery 19. A filament current battery is designated 20. With the aid of a potentiometer 21 a positive voltage of about 30 volts with respect to ground is applied to the diaphragm. A positive voltage of at most 200 volts is set up by a battery 22 and a potentiometer 23 at the diaphragm 3. The case comprising the electrodes 4 to 8 has a positive voltage of 150 volts applied to it by a battery 24 and a potentiometer 25, a positive voltage of 250 volts being set up with the anode 10 by a potentiometer 26.

Ions liberated from the cathode surface 16 when passing through the aperture 9 have a velocity corresponding to an energy of about 100 e.v. so that the ions travel towards the cathode under the influence of the magnetic field which is from about 600 Gauss to about 1000 Gauss. The upper limit of the pressure which can be measured is about 10^{-2} Torr when the dimensions of the ionizing chamber correspond to a cube the edges which are of about 25 mm. long. The lower measuring limit lies at 10^{-14} Torr.

What is claimed is:

1. An ionization manometer comprising a pair of parallel plates with aligned apertures, means to generate and project an electron beam through the apertures in said plates whereby gas between the plates is ionized, an anode electrode on the side of said plates remote from

the electron beam generating means and aligned with said apertures, a magnetic field for concentrating the electron beam so that electrons in said beam pass through said apertures and strike a given area of said anode without striking the edges of said plates bounding said apertures, a collector electrode disposed between said plates and positioned so that a straight line drawn between the collector and said given area of said anode intersects one of said plates adjacent said anode, and means to apply a potential between the anode and the plate adjacent thereto at which ions liberated by the anode have a velocity sufficient to drive them towards the cathode under the influence of the said magnetic field.

2. An ionization manometer as claimed in claim 1 in which said apertured plates are connected by side and upper plates to define a chamber whose bottom is open and the collector electrode is disposed in the lower portion of said chamber.

References Cited by the Examiner

UNITED STATES PATENTS

2,937,295 5/60 Redhead.
3,051,868 8/62 Redhead.

GEORGE N. WESTBY, *Primary Examiner.*