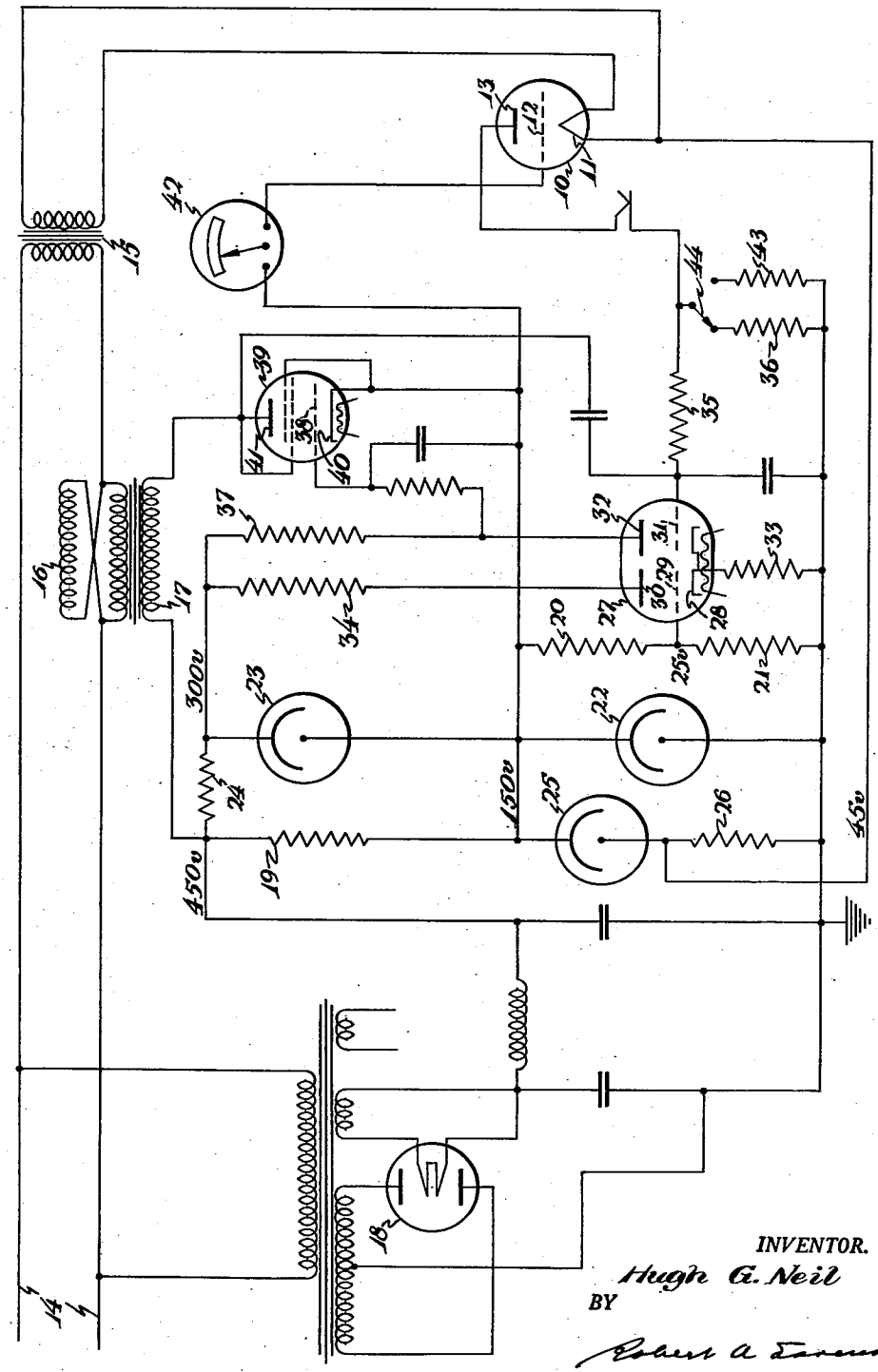
July 22, 1952 H. G. NEIL 2,604,514

IONIZATION GAUGE REGULATION

Filed Aug. 16, 1944



INVENTOR.

Hugh G. Neil

BY

Robert A. Sanders

Patented July 22, 1952 2,604,514

UNITED STATES PATENT OFFICE

2,604,514

IONIZATION GAUGE REGULATION

Hugh G. Neil, Oak Ridge, Tenn., assignor, by mesne assignments, to the United States of America as represented by the United States Atomic Energy Commission

Application August 16, 1944, Serial No. 549,773

5 Claims. (Cl. 175—183)

1

This invention relates to ion vacuum gauges and more particularly to an improved cricuit arrangement for regulating the ion current to hold it constant while measuring the electron current as a pressure indication.

The primary object of the present invention is the provision of a circuit which furnishes improved regulation which is very stable and which does not require adjustment.

Other objects and advantages of the invention will become apparent from the following description when read in connection with the accompanying drawing, the single figure of which illustrates schematically the preferred embodiment of the invention.

The operation of an ion vacuum gauge so that the electron current required to produce a predetermined ionization is an indication of the pressure of the gas being ionized is disclosed and broadly claimed in an application Ser. No. 546,902, filed July 27, 1944, by Stephen M. MacNeille, now Patent No. 2,537,775.

Referring to the drawing, a gas discharge tube 10 having a filament 11, a grid 12 and a plate 13 is connected and operated so that an electronic discharge from the filament 11 ionizes the gas within the tube 10 to produce a predetermined ion current to the plate 13. This ion current is maintained constant under varying pressure by varying the electronic discharge which is collected by the grid 12 and measured as an indication of pressure. For this purpose the filament 11 is connected to be adjustably energized from a suitable power source 14 through a transformer 15 and a saturable reactor 16 having a D. C. winding 17. Also connected to the power source 14 is a conventional power supply including a full wave rectifier 18 the output of which is filtered and impressed across a voltage divider comprising resistances 19, 20, and 21 in series, this voltage divider having associated therewith in shunt relation two voltage regulating tubes 22 and 23 and a resistance 24. The filament 11 of the ion tube 10 is given a potential of 45 volts above ground by connecting it between a voltage regulating tube 25 and a resistance 26 forming a series shunt across the regulating tube 22. The grid 12 of the tube 10 is maintained positive with respect to the filament 11 by being connected between resistances 19 and 20 in the

2

voltage divider. The plate 13 of the tube 10 is maintained negative with respect to the filament 11 as will later be described. Thus the filament 11 is negative with respect to the grid 12 and positive with respect to the plate 13 so that the grid 12 functions as an anode to collect electrons and the plate 13 collects positive ions.

The circuit for regulating ion current collected by the plate 13 comprises a duotriode tube 27, preferably type 6SC7, having a cathode 28 common to two grid-plate combinations 29, 30 and 31, 32, respectively, connected so that the plate current through the plate 30 and the cathode 28 flows to ground through a resistance 33 in the common lead to the cathode 28 to hold the cathode 28 at approximately 26 volts. The plate 30 is connected to the positive side of the voltage regulating tube 23 through a resistance 34 and the grid 29 is connected to a regulated 25 volts between resistances 20 and 21. The other triode in the tube 27 has its grid 31 connected to the plate 13 of the tube 10 through a resistance 35 and senses variations in the ion current collected by the plate 13 as a voltage drop across a resistance 36 provided in the ion current path, and has its plate 32 connected through a resistance 37 to the 300 volt side of the voltage regulator tube 23. It is to be understood that the numerical values and various circuit constants mentioned are illustrative of a circuit adapted to regulate at a potential of 24.6 volts on the grid 31 and the plate 13 but are not limiting.

With no ionization in the tube 10 there will be no voltage drop across the resistance 36, the grid 31 will be at zero voltage which is 26 volts negative with respect to its cathode 28 and its plate 32 will be at 300 volts since no current is flowing through the plate 37.

The voltage of the plate 32 is applied to a control grid 38 of an amplifier tube 39 having a cathode 40 connected to 150 volts supply and having a plate 41 connected to the 450 volt supply through the D. C. winding 17 of the saturable reactor 16. The tube 39 which may be type 6SH7, is conducting, and the flow of its plate current through the winding 17 brings about an increased voltage on the transformer 15 so that the filament 11 of the tube 10 is heated; electrons are emitted and ionization occurs. The ions collected by the plate 13 furnish a current through

the resistance 36 which increases until the voltage drop becomes 24.6 volts at which time the current through the resistance 37 has lowered the potential of the plate 32, and hence the grid 33, so that less plate current flows through the tube 39 and the winding 17. This increases the impedance of the reactor 16 which brings about a reduction in the temperature of the tube filament 11 to the point where just enough electrons are emitted to produce ionization sufficient to provide a voltage drop of 24.6 volts across the resistance 36. The electron emission required for this purpose will differ for different pressures in the tube 10, and therefore, a meter 42 included in the circuit of the grid (anode) 12 will give a reading indicative of the pressure in the tube 10.

Another range of plate current in the tube 10 may be provided by using a different value for the resistance 36. This may conveniently be done by providing an additional resistance 43 and a selector switch 44.

It will be noted that the potential difference between the filament 11 and the grid 12 of the tube 10 is held constant by the voltage regulator tube 25 and the potential difference between the filament 11 and the plate 13 is held constant by the drop across the resistance 26 when the ion current through the gauge tube 10 is constant at its regulated value.

The circuit of the present invention functions to regulate the supply of energy to the filament of a vacuum gauge so that a constant space current is maintained therein under varying conditions of pressure. By means of the invention stable regulation is obtained without the need for adjustment.

While a specific circuit arrangement has been described to illustrate the invention, it will be evident that modifications may be made without departing from the scope of the invention as set forth in the appended claims.

I claim:

1. In an ion vacuum gauge circuit in which the ion current is held constant and the electron current indicates pressure; a pair of triodes having electrically connected cathodes connected through a common resistance to a common fixed potential, means for supplying one of the triodes with fixed voltages on its plate and grid, a connection from the grid of the other triode to the ion collecting plate of the ion vacuum gauge, a filament current control circuit for said ion gauge for varying the filament current in response to a voltage signal applied to the input of said control circuit, and a connection between the plate of said other triode and the input to said control circuit.

2. A circuit for regulating the electron emission of a filament in a vacuum gauge to maintain constant the rate of ionization of a gas under varying conditions of pressure comprising a duotriode discharge device having two sets of control and output electrodes and a common cathode, means for applying across one of the control electrodes and the cathode a voltage which is the algebraic sum of a fixed voltage and a voltage directly proportional to the current flowing between the cathode and both of the output electrodes, means for applying across the other of the control electrodes and the cathode a voltage which is the algebraic sum of said directly proportional voltage and a voltage corresponding to the rate of ionization, a connection from the output electrode associated with said other of the control electrodes to a fixed plate voltage supply through a resistance, a current control device in the filament circuit of said vacuum gauge for controlling the filament current of said gauge in accordance with the voltage applied to the input of said control device, and a connection between the output electrode associated with said other of the control electrodes to the input of said control device.

3. In an ion vacuum gauge wherein the gauge tube has an electrode maintained at a positive potential relative to a cathode and an electrode maintained at a negative potential relative to the cathode and the current through one of the electrodes is maintained constant by controlling the cathode emission, the current through the other electrode being representative of the pressure in the tube, in combination, amplifier means for amplifying a signal from the electrode through which the current is to be held constant, said amplifier means including a pair of triodes having a common cathode connection through a common resistance to a regulated potential, means for impressing regulated potentials on the plate and grid of one of said triodes so that both cathodes are held at a fixed potential, means for impressing a potential on the grid of the other of said triodes proportional to the current through the electrode of the gauge tube through which the current is to be held constant, a cathode emission control for said gauge tube for regulating the cathode emission of said gauge tube in accordance with a voltage signal applied to the input of said emission control, and a connection between the plate of said other triode and the input of said emission control.

4. In an ion vacuum gauge wherein the gauge tube has an electrode maintained at a positive potential relative to a cathode and an electrode maintained at a negative potential relative to the cathode and the current through one of the electrodes is maintained constant by controlling the cathode emission, the current through the other electrode being representative of the pressure in the tube, in combination, an automatic control device in the filament circuit of said gauge tube for regulating the filament current in accordance with a signal voltage applied to the input of said device, a pair of triodes having interconnected cathodes and a common cathode resistance, a connection from said common resistance to a fixed potential, respective connections through respective resistances from the respective plates of said triodes to a common regulated plate voltage, a connection from the grid of one of said triodes to a regulated grid voltage, a connection from the grid of the other of said triodes to the electrode of said gauge tube through which the current is to be kept constant, and a connection from the plate of said other of said triodes to the input of said control device.

5. In an ion vacuum gauge wherein the gauge tube has an electrode maintained at a positive potential relative to a cathode and an electrode maintained at a negative potential relative to the cathode and the current through one of the electrodes is maintained constant by controlling the cathode emission, the current through the other electrode being representative of the pressure in the tube, in combination, an automatic control device in the filament circuit of said gauge tube for regulating the filament current in accordance with a signal voltage applied to the input of said device, a pair of triodes having interconnected cathodes connected to ground

through a common resistance, respective connections through respective resistances from the respective plates of said triode to a common regulated plate voltage, a connection from the grid of one of said triodes to a regulated grid voltage, a connection from the grid of the other of said triodes to the electrode of said gauge tube through which the current is to be kept constant, a connection from the grid of said other of said triodes through a resistance to ground, and a connection from the plate of said other of said triodes to the input of said control device.

HUGH G. NEIL.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,334,143	Dushman	Mar. 16, 1920
1,592,364	Houskeeper	July 13, 1926
1,649,016	Buckley	Nov. 15, 1927
2,310,286	Hansell	Feb. 9, 1943