United States Patent

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[72] Inventors **Stanislav Matousek**
Prague;
Zdenek Typlt, Prague; Josef Kovar,
Klecany, all of, Czechoslovakia

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[73] Assignee **Chemoprojekt, Projektova, Inzenyrska A**
Konzultacni Organisace
Praha, Czechoslovakia

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[33] **Czechoslovakia**
[31] **PV 6043**
Continuation-in-part of application Ser. No. 501,842, Oct. 22, 1965.

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[54] **DEVICE FOR HIGH-SPEED CHROMATOGRAPHIC ANALYSIS OF GASES**
10 Claims, 9 Drawing Figs.

[52] **U.S. Cl.** **250/83.6,** 250/43.5, 250/83.3, 324/33, 73/23.1
[51] **Int. Cl.** **H01j 39/34**
[50] **Field of Search** ..... G01t/1/15; 250/83.6 IT, 43.5 FC, 83.3; 324/33; 73/23.1

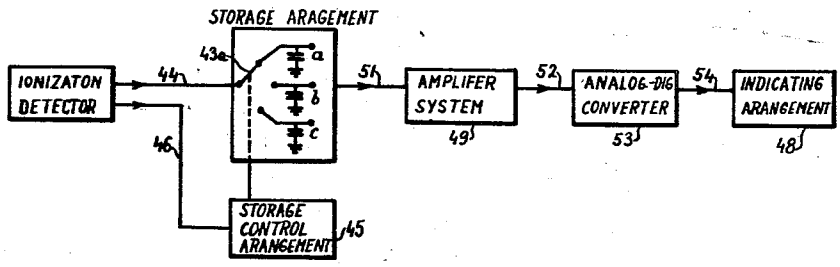
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Primary Examiner—Ralph G. Nilson
Assistant Examiner—Morton J. Frome
Attorney—Michael S. Striker

ABSTRACT: A high-speed chromatographic gas analysis apparatus with an evaluating system and an ionization detector. The substance to be analized becomes ionized within the detector, and the resulting ions are attracted to electrodes of the detector. The ions generate an ionic current in the electrodes, and this current is used to indicate the weight of the substance being analized. The electrode arrangement is such that two separate and independent ionic current circuits are formed. One current circuit is connected to a capacitor which becomes charged by the current flow. The other ionic current circuit is transmitted to a controlling arrangement which establishes the interval during which the capacitor is charged. Although the two current circuits are independent and separate from each other, the current flow through both circuits is substantially identical.



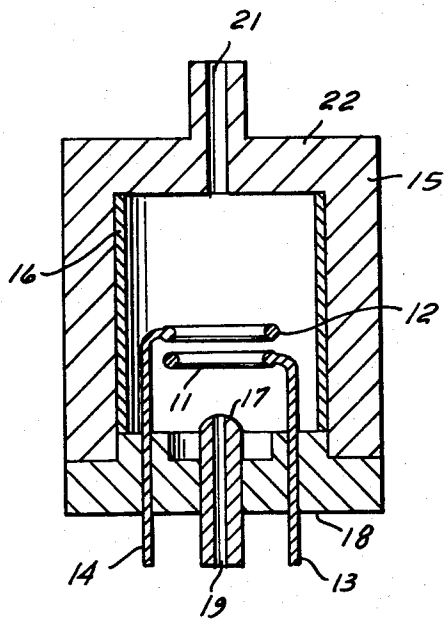


FIG. 1

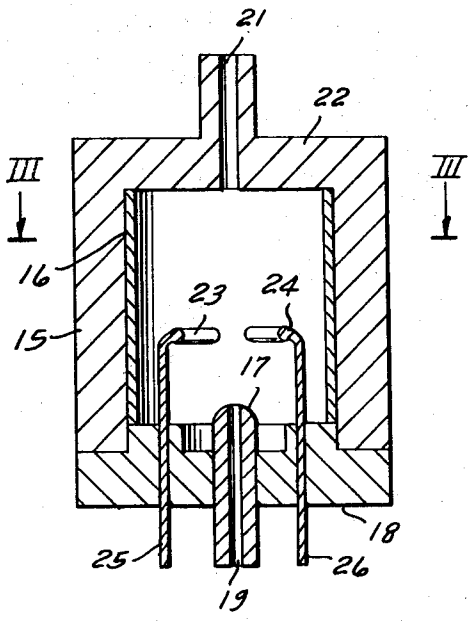


FIG. 2

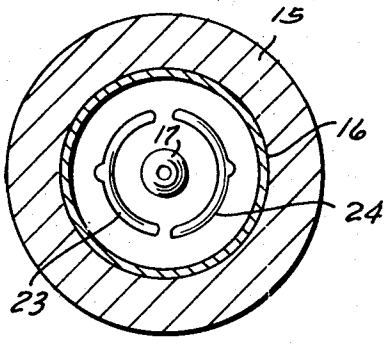


FIG. 3

INVENTORS
Stanislaw Jan Jaroszek
Edward Tyl Cat, Jerzy Kwiat
BY
Richard S. Sciascia
Attorney

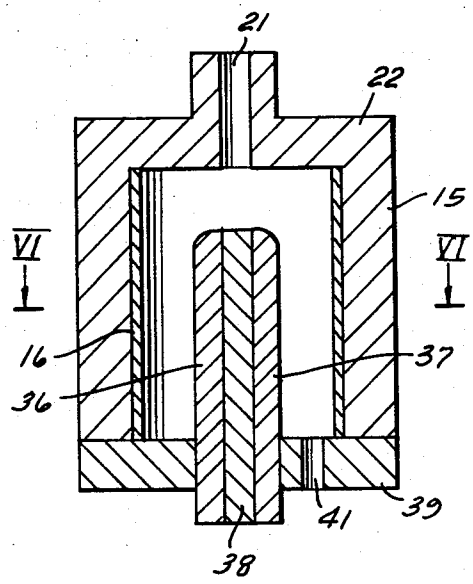


FIG. 5

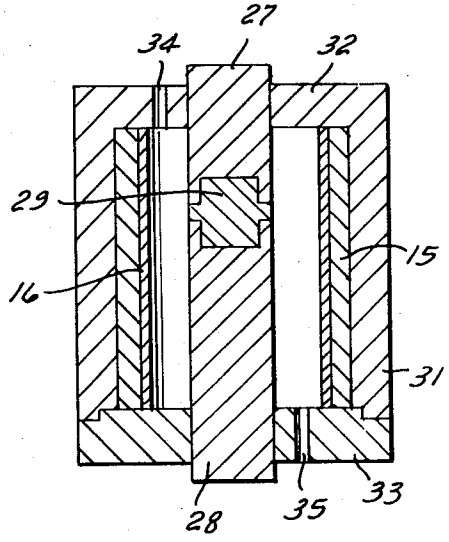


FIG. 4

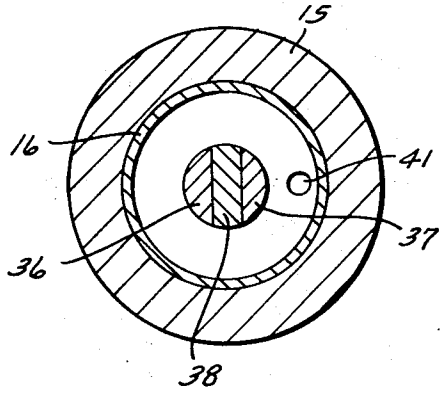


FIG. 6

INVENTORS
BY
Attorney

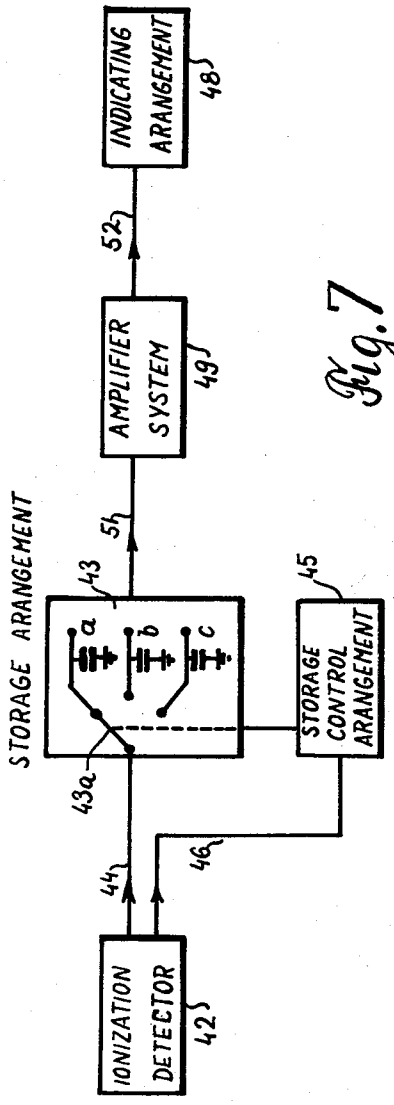


Fig. 7

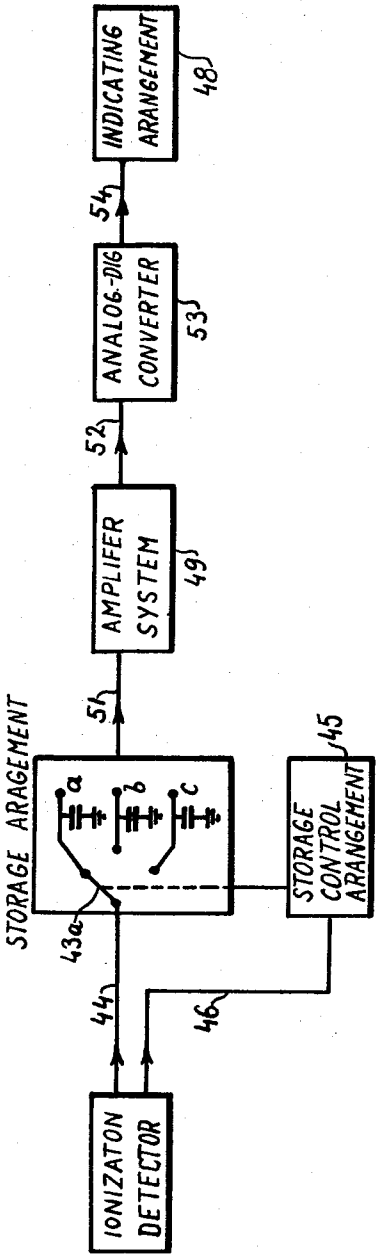
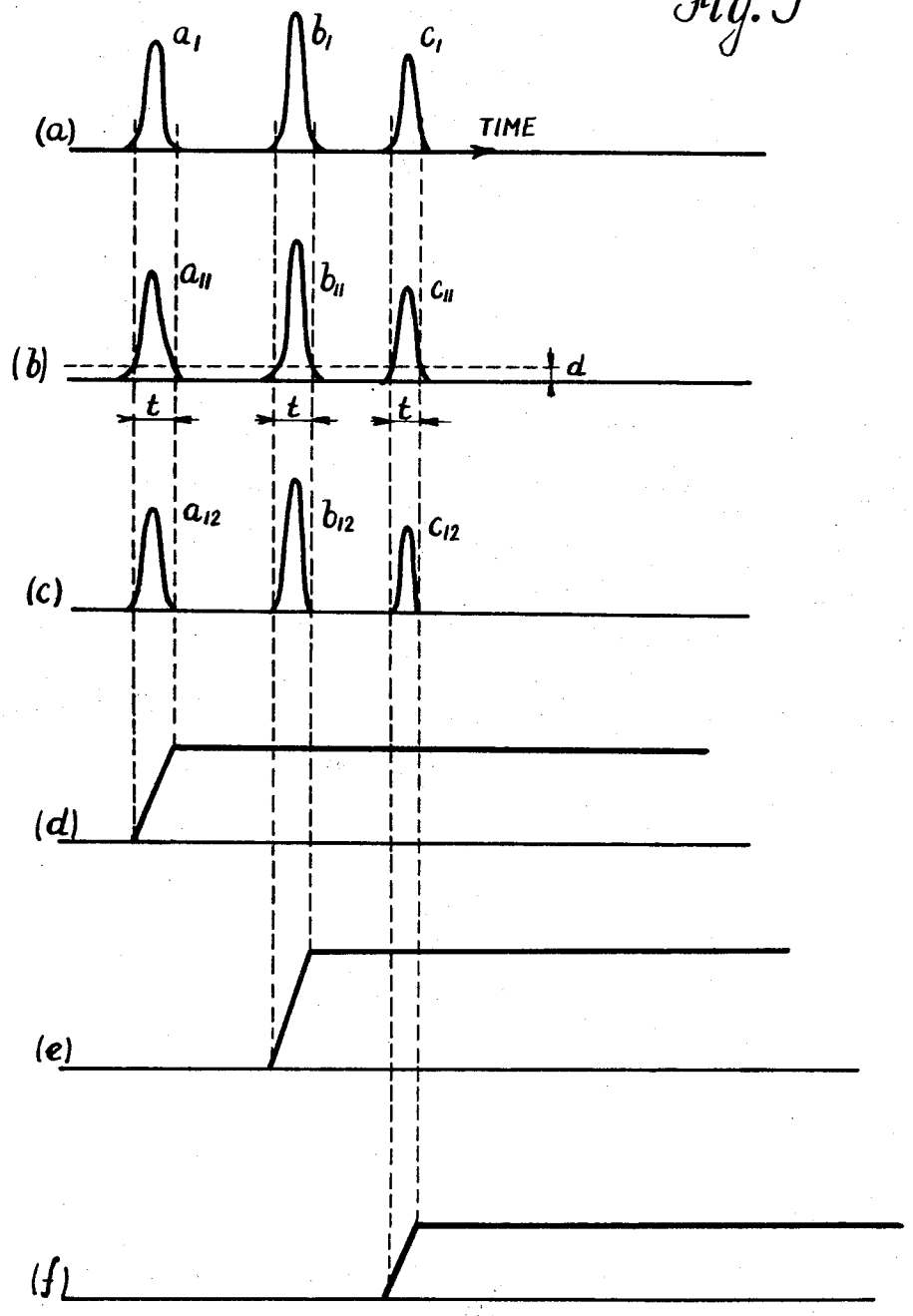


Fig. 8

INVENTORS:
STANISLAV MATOUSEK
ZDENEK TYBLT
JOSEF KOMR
By: Michael S. Striker
ATTORNEY

Fig. 9



INVENTORS:
STANISLAV HATOUSEK
ZDENEK TYPKI
JOSEF KOVAR
By: Miller & Stockli
ATTORNEY

DEVICE FOR HIGH-SPEED CHROMATOGRAPHIC ANALYSIS OF GASES

The present application is a continuation-in-part of our copending application Ser. No. 501,842, filed Oct. 22, 1965.

BACKGROUND OF THE INVENTION

High-speed chromatographic gas analysis apparatus comprises an evaluator and an ionization detector. High-speed chromatographic gas analysis apparatus is utilized for the chromatographic gas analysis of a multicomponent mixture of gas and known apparatus utilizes oscilloscopes or galvanometers and high-speed recorders to provide an analysis in less than 100 seconds. Analysis columns are utilized for partition of the substances which under determined conditions permit partition of a complex mixture in a very short time. Very sensitive devices having very short time response are required for partition of substances flowing from the column.

A suitable known ionization detector is the triode argon detector, which comprises a cylindrical cathode having a radioactive radiator on its inner surface functioning as the ionization source. The carrier gas flows continuously through the cathode. A needle-type anode having a high positive voltage is coaxially positioned with the cathode and extends partly into said cathode. The carrier gas and the substance to be detected flow from the analysis column out through the detector. A high intensity electric field is formed at the anode due to the small surface of such anode. A concentration of excited argon atoms thus forms close to the anode and produces a considerable current at the instant that the detected component starts flowing from the anode. The produced current is measured by a third or measuring electrode, which is of annular configuration and is coaxially positioned with the anode and cathode in proximity with the anode. The third or measuring electrode is at the same potential as the cathode. The measuring electrode does not conduct the ionization current and therefore produces very little noise, so that said electrode conducts the produced current at the instant that the detected component starts flowing from the anode. The triode argon detector is very efficient, for example, 1 to 10 c./g., so that an amplifier having a low input resistance and a low time constant may be utilized with it.

A diode ionization detector utilizes a rod-shaped anode which also functions as the measuring electrode and is coaxially positioned in a cathode of cylindrical configuration having a radioactive radiator on its inner surface. If the effective volume of this type of detector is sufficiently small, for example, 50 to 300 m1., it may be utilized with a capillary column. Both the triode and diode ionization detectors are suitable for high-speed chromatographic analysis which is accomplished in less than 100 seconds.

The operational and speed chromatographs are especially suitable for industrial regulation and automatic control. However, complex electronic equipment is required for automatic evaluation of chromatograms. This is due to the fact that quantitative evaluation is difficult, because the flow of the single components from the column is chronological and the starting instant of the flow from the anode of any single component is dependent upon the temperature of the partition column and the pressure and rate of flow of the carrier gas. It is difficult to adhere to the parameters upon which the flow time depends, and furthermore such adherence precludes the application of programmed transflux and programmed temperature to the column. To permit the partition of complex mixtures, two columns with a backflushing system must be provided. The entire analysis is performed under the control of a program unit. Chromatographic gas analysis apparatus of the aforedescribed type is very complex and is unreliable in operation and highly susceptible to failure.

The principal object of the present invention is to provide new and improved chromatographic gas analysis apparatus.

An object of the present invention is to provide a new and improved measuring electrode for the ionization detector of high-speed chromatographic gas analysis apparatus.

Another object of the present invention is to provide chromatographic gas analysis apparatus of simple structure which is efficient, effective and reliable in operation.

Another object of the present invention is to provide a necessary electrode for the ionization detector of high-speed chromatographic gas analysis apparatus which is of simple structure and is efficient, effective and reliable in operation.

In accordance with the present invention, an ionization detector for high-speed chromatographic gas analysis apparatus includes a cathode and a measuring electrode at least partially coaxially positioned in the cathode and comprising two members electrically insulated from each other and each producing an electrical output signal independent from that of the other. The cathode comprises a member of substantially cylindrical configuration having an inner surface with a radioactive radiator on such inner surface.

Further in accordance with the present invention, an evaluation system for high-speed chromatographic gas analysis includes an ionization detector comprising a cathode of substantially cylindrical configuration having an inner surface with a radioactive radiator on such inner surface and a measuring electrode at least partially coaxially positioned in the cathode and comprising two electrode parts electrically insulated from each other and each producing an electrical output signal independent from that of the other. A storage arrangement for storing an electrical signal is supplied with the output signal from one of the electrode parts of the measuring electrode. A storage control arrangement is connected to the storage arrangement for controlling the storage of electrical signals from one electrode part by the storage arrangement, and is supplied with and actuated by the output signal from the other electrode part of the measuring electrode.

SUMMARY OF THE INVENTION

An arrangement for high-speed chromatographic gas analysis. The substance to be analyzed is passed through an ionization detector which ionizes the substance and the carrier gas circulated through the detector. A radioactive member ionizes the substance to be analyzed, and the resulting ions are attracted to electrodes maintained at a potential for attracting these ions. Two separate electrodes having separate and electrically isolated circuits are provided for the ionization detector. The magnitude of the current flow through each electrode is identical to the other. The ionic current through one electrode is transmitted to a capacitor which becomes charged by the ionic current. The second electrode is connected to an electronic switching circuit which also receives an ionic current similar to that in the first electrode connected to the capacitor. When the ionic current within the second electrode attains a predetermined level, the electronic switching circuit connects the first electrode to the capacitor and permits the capacitor to become charged with the ionic current from the first electrode. The capacitor continues to charge through the first electrode until the ionic current in the second electrode drops to a predetermined level. Although the current circuits of the two electrodes are separate, the rise and fall of the currents in the two electrodes are identical and occur simultaneously. For the purpose of analyzing a number of substances or components carried by the carrier gas, a plurality of capacitors are provided. After the electronic switching circuit controlled by the second electrode disconnects the charging of the capacitor by the first electrode as a result of the ionic current having dropped below a predetermined level, the first electrode becomes connected to a second capacitor which then becomes charged with a new ionic current flow derived from the ionization of a new substance circulated through the ionization detector.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a sectional view of an embodiment of an ionization detector of the present invention;

FIG. 2 is a sectional view of another embodiment of an ionization detector of the present invention;

FIG. 3 is a view taken along the lines III—III of FIGS. 2;

FIG. 4 is a sectional view of another embodiment of an ionization detector of the present invention;

FIG. 5 is a sectional view of another embodiment of an ionization detector of the present invention;

FIG. 6 is a view taken along the lines VI—VI of FIG. 5;

FIG. 7 is a functional schematic diagram of an embodiment of an evaluation system utilizing the ionization detector of the present invention;

FIG. 8 is a functional schematic diagram of a modification of the embodiment of FIG. 7; and

FIG. 9 is a graphical representation of the ionic currents in the electrodes and the charges on the capacitors, when analyzing a plurality of substances or components carried through the ionization detector by the carrier gas, in accordance with the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In the embodiment of FIG. 1, the ionization detector comprises a measuring electrode having two spaced coaxially positioned annular or ring-shaped electrodes 11 and 12. Each ring of the measuring electrode 11, 12 has an independent electrical conductor connected to and supporting it. Thus, the ring 11 of the measuring electrode has an electrical conductor 13 connected to it and supporting it and the ring 12 of the measuring electrode has an electrical conductor 14 connected to it and supporting it. The cathode 15 is of cylindrical configuration and has a radioactive radiator 16 on its inner surface. A needle-type anode 17 is coaxially position in an insulator member 18. A duct 19 is formed through the anode 17 and a duct 21 is formed through the base end 22 of the cathode 15.

In operation, carrier gas is continuously circulated through the ionization detector by passage through the ducts 19 and 21. The substance to be analyzed is injected or inserted into the carrier gas and permitted to enter the ionization detector through, for example, the duct 19. Once the substance is within the chamber enclosed by the cathode 15, the substance becomes ionized as a result of the radioactive member 16 lining the walls of the cathode. The released ions resulting from the ionization process through the radioactive member 16, are attracted to the anode and cathode, depending upon their valence. At the same time, however, these ions are also attracted to the electrodes 11 and 12, during their flow between the anode and cathode. The electrodes are maintained at a constant potential within the range of 600 to 1,800 volts. The conductors 13 and 14 are electrically isolated from each other so that the current flow through the conductor 13, resulting from the ionic current in the electrode 11, is entirely independent of the current flow through the conductor 14. This current flow through the conductor 14, however, is identical, substantially, to the current flow through the conductor 13, because the ion attraction to the electrodes 11 and 12 is substantially equivalent. This results from the condition that both electrodes are maintained at the same potential and have a tendency to attract the ions with equal intensity. The current flow from the conductor 13 and electrode 11, may be transmitted to a capacitor for subsequent analysis and evaluation. The current through the conductor 14 may be employed to switch the conductor 13 between a number or plurality of capacitors, for the purpose of evaluating the multicomponent substance or a number of substances injected into the carrier gas. The circuitry connecting to the conductors 13 and 14 is described below in relation to FIG. 7 to FIG. 9.

In the embodiment of FIGS. 2 and 3, the ionization detector has measuring electrodes with two spaced symmetrically positioned half or semiannular or annular section shaped members 23 and 24 opening toward each other. The annular sections 23 and 24 are substantially coplanarly positioned. The section 23 of the measuring electrode has an electrical conductor 25 connected to it and supporting it and the section 24 of the measuring electrode has an electrical conductor 26 connected to it and supporting it. The cathode 15 is of cylindrical configuration and has a radioactive radiator 16 on its inner surface. The needle-type anode 17 is coaxially positioned in an insulator member 18. A duct 19 is formed through the anode 17 and a duct 21 is formed through the base end 22 of the cathode 15.

In the embodiment of FIG. 4, the ionization detector has measuring electrodes with two coaxially positioned rod-shaped members 27 and 28 extending end to end in rodlike configuration and separated by an insulating member 29 positioned therebetween. The rod-shaped members 27 and 28 are coaxially positioned in the cathode 15 of cylindrical configuration. A radioactive radiator 16 is on the inner surface of the cathode 15. The cathode 15 is coaxially positioned inside a cylindrical housing 31 of insulation material having a base end 32. The open base end of the cylindrical housing 31 is closed by an insulator member 33. The member 27 of the measuring electrode extends through and is supported by the base end 32 of the housing 31. The member 38 of the measuring electrode extends through and is supported by the insulator member 33. A duct 34 is formed through the base end 32 of the housing 31 and a duct 35 is formed through the insulator member 33.

In the embodiment of FIGS. 5 and 6, the ionization detector has measuring electrodes with two symmetrically positioned rodlike members 36 and 37 of circular zonelike cross section separated along their length by an insulating member 38 of approximately rectangular cross section positioned therebetween so that the three members 36, 37 and 38 together have a circular cross section. The three members 36, 37 and 38 together are coaxially positioned in the cathode 15 of cylindrical configuration. A radioactive radiator 16 is on the inner surface of the cathode 15. The cathode 15 functions as the housing and has a base end 22. The open base end of the cathode 15 is closed by an insulator member 39. The members 36, 37 and 38 extend through and are supported by the insulator member 39. A duct 21 is formed through the base end 22 of the cathode 15 and a duct 41 is formed through the insulator member 39.

FIGS. 7 and 8 represent the evaluation systems which operate in conjunction with the ionization detector of the present invention. In FIGS. 7 and 8, the ionization detector 42, of the present invention, provides two output signals representing the ionic current flow in the two electrodes which are part of the ionization detector. The ionic current flow 1 of these electrodes is transmitted via the conductor or current path 44 to a multiplexing or switching device 43*a* within the storage arrangement 43. This storage arrangement 43 includes a number of capacitors which may be connected to the conductor or circuit path 44, at will, depending upon the position of the switching device 43*a*. The position of this switching device 43*a* is determined by the storage control arrangement 45. Thus, in the position of the switch 43*a*, shown in the drawing, the capacitor *a* is being charged. The storage control arrangement 45 may then multiplex the switch 43*a* so that the capacitor *b* is connected to the conductor or circuit path 44 so that this capacitor *b* may become charged with the ionic current flowing through the circuit path 44. The purpose of providing a number or plurality of such capacitors in the storage arrangement 43, is to permit the evaluation of several substances or components passed through the ionization detector. Thus, when the first substance is passed through the ionization detector 42, the capacitor *a* in the storage arrangement 43 is connected to the circuit path 44. As a result, the capacitor *a* becomes charged with the ionic current derived from ionization of this first substance passed through the ionization detector by means of the appropriate carrier gas. The carrier gas is an inert gas and serves the purpose of conveying the substance through the ionization detector.

By being connected to the circuit path 44, the capacitor *a* becomes charged with the ionic current from this first substance being evaluated. As the substance passes through the

ionization detector, the ionic current rises and falls as shown graphically by the curve a_1 in FIG. 9*a*. Thus, this curve a_1 represents the ionic current through the circuit path 44, corresponding to the first substance passing through the ionization detector Since this ionic current charges the capacitor *a* in the storage arrangement 43, the charge of the capacitor represents the magnitude of the ionic current integrated over time. This time interval corresponds to the interval *t* shown in FIG. 9 A total charge from the capacitor *a* resulting from being charged by ionic current represents the weight of the substance to be analyzed and evaluated.

After the current represented by a_1 in FIG. 9*a*, has dropped to a predetermined level, a second substance may be passed through the ionization detector for evaluation purposes. To record the ionic current of this new substance, the switch 43*a* becomes connected to the capacitor *b* within the storage arrangement 43 As a result, the capacitor *b* now becomes charged with the ionic current b_1, shown in FIG. 9*a*, corresponding to the second substance. The resulting charge upon the capacitor *b*, therefore, represents the weight of the second substance being analyzed and evaluated. In a similar manner, a third substance may be evaluated through the ionic current c_1 in FIG. 9*a*, by connecting the switch 43*a* to the capacitor *c* within the storage arrangement 43.

The multiplexing or switching of the switch 43*a* between the capacitors *a*, *b* and *c* is accomplished by the storage control arrangement 45. The input to this storage control arrangement is derived from the second electrode of the ionization detector 42, and the ionic current on this second electrode is transmitted by way of the conductor or circuit path 46 to the unit 45 The storage control arrangement comprises essentially of an amplifier operating in conjunction with a Schmitt trigger circuit. The amplifier amplifies the ionic current transmitted through the circuit path 46, and applies an amplified signal to the Schmitt trigger. The latter changes state whenever the ionic current, after amplification, exceeds or drops below the predetermined level. The Schmitt trigger, in turn, actuates the multiplexing device or electronic switching arrangement 43*a* so that it advances progressively from one capacitor to the other Thus, when the ionic current in circuit path 44 exceeds a predetermined level, the ionic current in conducting path 46 also exceeds the same level simultaneously. As a result, the storage control arrangement as determined by the state of the Schmitt trigger therein, connects the capacitor *a* to the circuit path 44 for charging The ionic current in the conducting path 46 is shown in FIG 9*b*, and may be seen to be similar to the ionic currents shown in FIG 9*a* After the ionic current in either circuit path 44 or 46 has dropped below a predetermined level, denoting that the substance is passing out of the ionization detector, the Schmitt trigger again changes state and connects the circuit path 44 to the capacitor *b*, through the multiplexing or switching arrangement 43*a*. This predetermined level at which the Schmitt trigger changes states in shown by the ordinate marked *d* in FIG. 9*b*.

When the ionization current passing to the capacitors become clipped or limited through the threshold level *d*, the resulting waveforms of the currents are shown in FIG. 9*c*. Thus, the current a_{12} is the result of clipping the ionization current a_{11} with the threshold level *d*. The ionization current in FIG 9*b* is the current passing through the conducting path 46. FIG. 9*a* shows the corresponding ionization current passing through the conductor 44 and charging the capacitors. Accordingly, FIG 9*c* represents the ionization currents used to control the sequence of charging the capacitors. The control current a_{12} controls the charging current a_1 to the capacitor *a* in the storage arrangement 43. Similar conditions prevail for the control currents b_{12} and c_{12} in relation to capacitors *b* and *c* in the storage arrangement 43.

Thus, the control currents in FIG. 9*c* establish the time interval *t* for charging the capacitors. FIG. 9*d* is the graphical representation of the charging of the capacitor *a* in the storage arrangement 43. Thus from the instant that the ionization current exceeds the predetermined level *d*, the capacitor commences to charge and continues to charge until the end of the time interval *t* when the ionization current has dropped back to the threshold level *d*. At that point, the capacitor *a* ceases to be charged because the storage control arrangement 45 switches the conducting path 44 to capacitor *b*. The charging of this capacitor *b* is illustrated in FIG. 9*e*. The capacitor *a*, in the meantime, retains the charge that it acquired during the previous cycle of operation, because of its inherent nature to store such charge. As a result, a continuous line parallel to the time abscissa is shown in FIG. 9*d* to represent a constant charge upon the capacitor *a* after its charging time interval *t*. This same relationship prevails with respect to the capacitor *b*, the charging function of which, is shown in FIG 9*e*. Accordingly, the capacitor *b* retains a zero charge until the instant that switch 43*a* connects the conducting path 44 to the capacitor *b*, and the ionization current has exceeded the predetermined threshold level *d*. At that point the capacitor *b* commences to charge similar to recharging of the capacitor *a*, until the end of the time interval *t* when the current has dropped back to the threshold level *d*. The same analysis applies to the capacitor *c* which has the charging function illustrated in FIG. 9*f*.

Although the capacitors are charged through the switching or multiplexing arrangement 43*a*, in a similar manner with respect to each other, the charging current representing the ionization current may or may not be the same for each one of the capacitors, depending upon the substance being analyzed. In general, different substances will be analyzed and, accordingly, different magnitudes of ionization current will be encountered. This is illustrated in FIG. 9*a*, in which the ionization currents peak at different magnitudes, corresponding to different substances being analyzed. As a result of such different magnitudes of ionization current, the charge left upon the capacitors must necessarily differ also. This is again illustrated in FIG. 9*d* to FIGS. 9*f*. In these charging graphical representations, the constant value line denoting the final charge upon the capacitor, is different for each one of the capacitors and corresponds in value to the peak of the ionization current shown in FIG. 9*a*. Thus, the levels of a constant value line parallel to the abscissa differ and will be smaller or larger from each other depending upon the variation of their peaks in the ionization current.

The capacitors within the storage arrangement 43 are connected to an amplifier system 49, by way of the conducting path 51. When a plurality of such capacitors are used as illustrated in the embodiments of FIGS. 7 and 8, the amplifier system 49 has a plurality of corresponding amplifier channels, with one channel connected to each capacitor Thus, the potential across each capacitor, representing the charge acquired by the capacitor, is amplified by the amplifier system 49 and transmitted as an amplified signal by way of the signal path 52 to an indicating arrangement 48. This indicating arrangement 48 indicates the magnitudes of all of the potentials across the capacitors after suitable amplification by the amplifier system 49. Since, each capacitor has its own individual amplifier channel within the amplifier system 49, such an indication can be made simultaneous for all of the capacitors. Since the voltage across the capacitor is proportional to the charge of the capacitor, the voltage or potential indication by the indicating arrangement 48 provides an indication of the weight of the substance being analyzed.

The embodiment of FIG. 8 differs from that of FIG. 7 in the respect that an analog to digital converter 53 is inserted between the amplifier system 49 and the indicating arrangement 48. The purpose of this analog-digital converter 53 is to convert the analog information provided by the amplifier system 49 into its digital equivalent so that the indicating arrangement 48, which is a digital type in FIG. 8, may indicate the data in digital form. In FIG. 7, the indicating arrangement is of analog design, and indicates the data as supplied by the amplifier system 49, in analog form. Thus, in FIG. 8, the circuit paths 52 transmit analog data from the amplifier system 49 to analog-digital converter 53. This data is then converted

into its digital equivalent and the resulting digital data is transmitted via the circuit paths **54** to the indicating arrangement **48** which is of digital design in FIG. **8**.

The charge of each capacitor is evaluated during the course of the analysis by the apparatus, if the evaluation time is less than the shortest time interval between successive chromatographic peaks. The embodiment of FIG. **7** almost always satisfies this condition. If the evaluation time is longer than the shortest time interval between successive chromatographic peaks, the evaluation is accomplished successively in accordance with the operation of the storage control arrangement **45**.

Evaluation apparatus utilizing the two output signal ionization detector of the present invention is suitable for performing and evaluating high-speed laboratory and industrial analyses. A principal advantage of the evaluation system of the present invention is that the evaluation process is not subject to a fixed time program, but is controlled by the storage control arrangement **45** in accordance with the analysis. This permits evaluation of components of the gas mixture analyzed having flow times which change due to changing conditions in the analysis column during the analysis. This may occur, for example, when the temperature or other variable such as flow in the analysis column is varied in accordance with a program. When the temperature of the analysis column is controlled in accordance with a program, a high-speed analysis of a complex mixture may be reliably performed by simple chromatographic apparatus. Another principal advantage of the evaluation system of the present invention is that the storage arrangement **43** produces analog outputs. This is especially advantageous in industrial evaluations or analyses, particularly in regulation and automatic control of manufacturing processes

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of constructions differing from the types described above.

While the invention has been illustrated and described as embodied in high-speed chromatographic gas analysis apparatus. it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims.

1. An arrangement for the chromotographic analysis of gases, comprising an ionization detector including a source of ionization and a measuring electrode having a first electrode part and a second electrode part for simultaneously generating two mutually independent sets of first and second output signals which are similar in shape and are generated for each component of analyzed gas so that successive components produce successive pairs of said first and second output signals; storage means including a plurality of storage elements for storing data on the quantity of each of said components present in said analyzed gas, each component being associated with a different storage element so that each of said storage elements defines uniquely the quantity of the component associated with the respective storage element, said storage elements being isolated from each other so that the data stored within each of said storage elements is variable and independent of the data stored in the remaining elements; switch means connected with said first electrode part and having a plurality of positions for connecting said first electrode part with said storage elements, respectively so that in each connecting position of said switch means a different storage element is charged by said first output signal generated by said first electrode part; storage control means for moving said switch means between said positions, said storage control means being connected with said second electrode part and being controlled by said second output signals generated by the same to move said switch means from any of said positions thereof to another position when said second output signal generated by a component reaches a predetermined level so that each first output signal representing a different component is stored in a different storage element whereby each storage element stores a final charge representing the quantity of the respective stored component when the respective storage element is disconnected by said switch means from said first electrode part; and means for evaluating the charges of said storage elements for determining the quantity of each component.

2. The arrangement as defined in claim **1** including amplifying means connected between said storage elements and said means for evaluating the charges of said storage elements, said amplifying means amplifying the signals stored in said storage elements.

3. The arrangement as defined in claim **1** wherein said means for evaluating the charges of said storage elements comprises indicating means whereby the data stored by said storage elements may be displaced to an observer.

4. The arrangement as defined in claim **1** including analog to digital converting means for converting the data stored in analog form by said storage elements into corresponding digital form for applying to said means for evaluating the charges of said storage element, said evaluating means being a digital evaluator adapted to receiving digital signals.

5. An arrangement for the chromatographic analysis of gases, as claimed in claim **1** wherein said ionization detector includes a cylindrical cathode, a radioactive radiator on the inner surface of said cathode, and wherein said measuring electrode is at least partially positioned in the axis of said cylindrical cathode.

6. An arrangement as claimed in claim **1** wherein said electrode parts are a pair of spaced coaxial annular members.

7. An arrangement as claimed in claim **1** wherein said electrode parts are symmetrically positioned semiannular members located in the same plane and opening toward each other.

8. An arrangement as claimed in claim **1** wherein said electrode parts are a pair of coaxially positioned rod-shaped members extending end to end, said measuring electrode including an insulating member positioned between said rod-shaped members.

9. An arrangement as claimed in claim **1** wherein said electrode parts are a pair of spaced symmetrically positioned rodlike members of circular cross section extending coaxially, said measuring electrode including an insulating member of substantially rectangular cross section positioned between said rodlike members.

10. An arrangement as claimed in claim **9** wherein said rodlike members and said insulating member together have a circular cross section.