April 10, 1956 R. FUTTERKNECHT 2,741,706

IONIZATION-MEASURING INSTRUMENT

Filed July 26, 1954 2 Sheets-Sheet 1

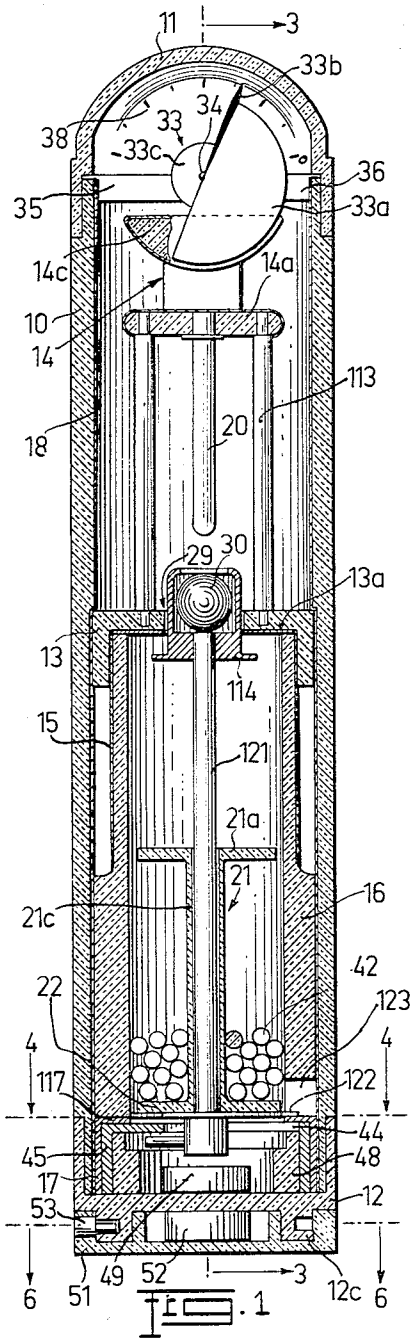


FIG. 1

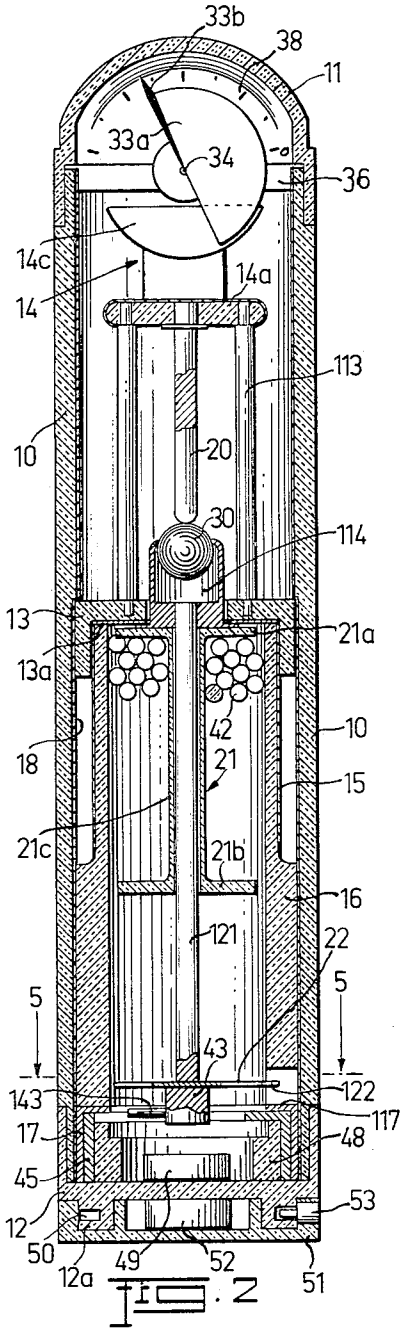


FIG. 2

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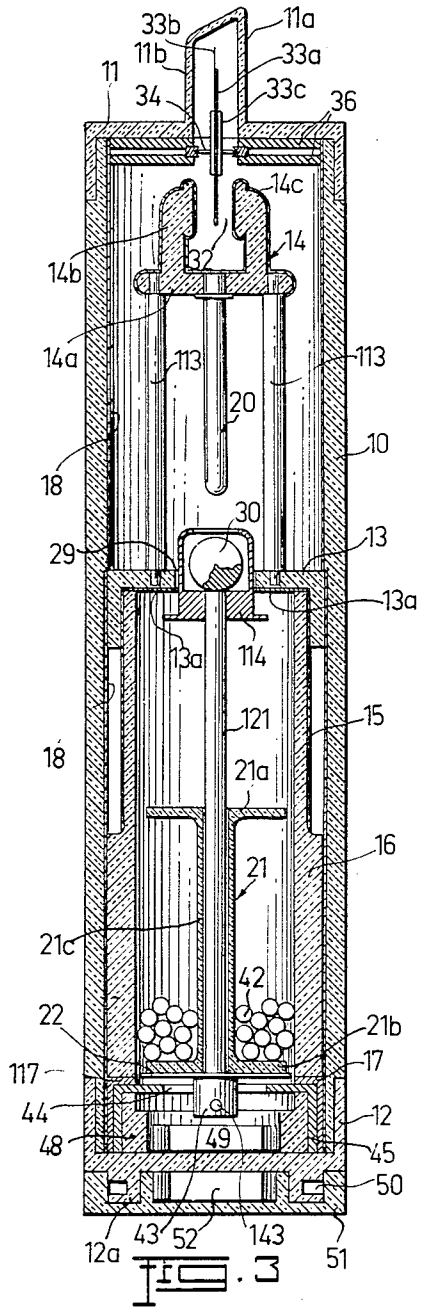


FIG. 3

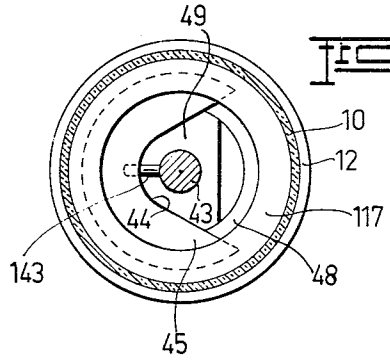


FIG. 4

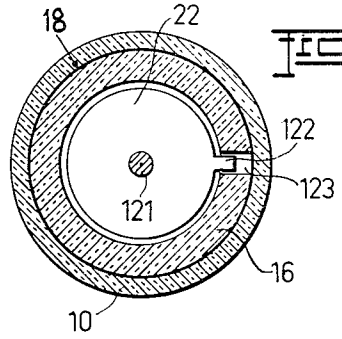


FIG. 5

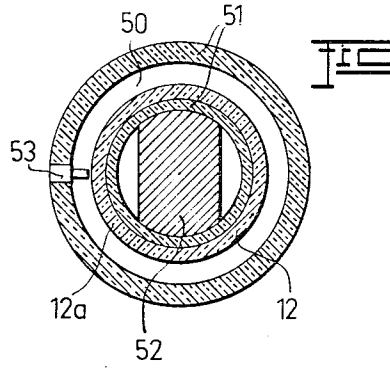


FIG. 6

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United States Patent Office 2,741,706 Patented Apr. 10, 1956

2,741,706

IONIZATION-MEASURING INSTRUMENT

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Application July 26, 1954, Serial No. 445,796

15 Claims. (Cl. 250—83.6)

My present invention relates to an ionization-measuring instrument of the general type disclosed in my U. S. Patent No. 2,646,516, issued July 21, 1953.

Instruments of the type referred to include a sealed charge generator comprising a set of dielectric pellets movable within a housing and adapted to produce, by their movement, a charge across a pair of condenser plates which can be read by a suitable indicating device, such as as electrometer. The two condenser plates define an ionization chamber whose atmosphere, when ionized by impinging radiation, will cause a gradual dissipation of the charge at a rate determinable by means of the indicator.

In my co-pending application Ser. No. 356,278, filed May 20, 1953, I have disclosed an improved version of such instrument wherein the charge generator is adapted to be locked, preferably by magnetic means, in a reading position in which a first condenser, representing a charging capacitance associated with the generator, is effectively disconnected from a second condenser, representing a storage capacitance associated with the indicating device. The presence of this charging capacitance, however small, introduces an element of uncertainty in that it affects the magnitude of the charge stored after a finite number of charging operations (shakings or inversions).

An important object of my present invention is to provide an improved instrument of the general character referred to in which the aforementioned charging capacitance is substantially eliminated by short-circuiting after each charging step and in which stray capacitances of a similar character are practically eliminated.

Another important object of this invention is to introduce substantial simplifications in the construction of such instrument.

In accordance with the instant invention I provide a charge generator in the form of a preferably cylindrical housing, of dielectric material, within which the aforementioned pellets are movable by gravity or inertia between two extreme positions and which is provided with means for establishing a conductive path between the generator and one or the other condenser plate in one or the other extreme position, respectively. As in the system of my above-identified co-pending application, the generator is preferably provided with magnetic locking means for immobilizing it in a reading position in which the circuit to at least one of the condenser electrodes is permanently broken.

The invention will be more fully described with reference to the accompanying drawing in which:

Fig. 1 is a view, in axial section, of an ionization-measuring instrument according to the invention, shown in partially discharged condition;

Fig. 2 is a view similar to Fig. 1 but showing the instrument in the process of charging by shaking or inversion, the same being illustrated, however, in upright position for easier comparison with Fig. 1;

Fig. 3 is a sectional view taken on the line 3—3 of Fig. 1;

Fig. 4 is a cross-sectional view taken on the line 4—4 of Fig. 1;

Fig. 5 is a cross-sectional view taken on the line 5—5 of Fig. 2; and

Fig. 6 is a cross-sectional view taken on the line 6—6 of Fig. 1.

Throughout the several views of the drawing I have used, so far as applicable, the same reference numerals as in my co-pending application Ser. No. 356,278 to designate similar parts.

The instrument shown in the drawing comprises a housing composed of a tubular central body **10** of insulating material, a cap **11** of similar but highly transparent material, and a base **12** of insulating material. The body **10** is internally lined, over substantially its entire length, with a metallic coating **18** constituting one of the plates of a charge-storing condenser, the other condenser plate being represented by a similar coating **15** on a dielectric insert **16** which is press-fitted inside body **10**. A plastic piston **21**, comprising an upper disk **21***a*, a lower disk **21***b* and a connecting tube **21***c*, is slidably mounted within insert **16** by means of an axially extending metal rod **121** traversing the tube **21***c*. Dielectric pellets **42**, preferably of quartz glass, occupy part of the space between disks **21***a* and **21***b*.

The rod **121** terminates at its bottom in a cylindrical boss **43** having a pin **143** projecting laterally therefrom. This boss is rigid with a metal plate **22** having a radially extending lug **122** which plays in a slot **123** of insert **16**, whereby the unit **121**, **43**, **22** is held against rotation within this insert but is axially slidable over a short distance limited by the length of slot **123**. The upper end of rod **121** is fixed to a short metallic thimble **114** within which a metal ball **30** is held for limited axial movement. Thimble **114** is slidably received in an aperture **29** of a flanged spacer member **13** inserted between the housing body **10** and the upper end of insert **16**; member **13**, which consists of dielectric material, is provided at its underside with a metal plate **13***a* making contact with the outer conductive coating **15** of insert **16** and with the sliding thimble **114**.

A plurality of insulating rods **113**, rising from the spacer member **13**, support a central electrode **14** consisting of a conductively coated, molded plate **14***a* and a pair of similarly coated, spaced segments **14***b*, **14***c* integral with and carried by plate **14***a*. The segments **14***b*, **14***c* define a gap **32** for the movement of an indicating member **33** which comprises a segmental body **33***a*, a pointer **33***b* and a reinforced hub portion **33***c*. Member **33** is supported by a pin **34** which spans the gap **32** and is journaled in bearings **35**, **36** extending inwardly from the top of housing portion **10**, whereby a metallic connection is formed between this indicator member and the inner conductive coating **18** of the housing. A metal rod **20** depends from central electrode **14** and terminates just short of ball **30** in the normal position of the instrument (Figs. 1 and 3).

The transparent cap **11** of the instrument housing is formed integral with a pair of parallel, upstanding walls **11***a*, **11***b* substantially aligned with electrode segments **14***b*, **14***c* respectively; wall **11***b* carries a scale **38** cooperating with the pointer **33***b*.

Press-fitted inside housing portion **10** immediately below insert **16** is a metal ring **17** having a horizontal flange portion **117** which makes contact with lug **122** when the latter is in its bottom position, as shown in Fig. 1. Freely rotatable within ring **17** is a metallic retaining member **45**, of inverted cup shape, formed with a roughly segmental cut-out **44** as best seen in Fig. 4. A plastic insert **48** within member **45** is partly molded around a bar magnet **49** which is thus fixed in position with respect to this member. The base **12** has a depend-

ing flange 12*a* provided externally with an annular groove 50; a control knob 51 is molded around a bar magnet 52 and has a peripheral portion surrounding the flange 12*a*, this portion having imbedded therein at least one pin 53 projecting into groove 50 to hold the knob 51 in place.

The operation of the instrument shown in the drawing is as follows:

Knob 51 at the bottom of housing base 12 is manually rotatable between a reading position (Fig. 1) and a diametrically opposite charging position (Fig. 2) which may be marked on the instrument by suitable legends and/or indexing means (not shown). In the reading position the magnet 52 holds the magnet 49 and, thereby, the retaining member 45 in a position in which a solid portion of this retaining member overlies the pin 143 and the assembly 43, 22, 121, 114 is substantially immobilized near the lower end of its short axial travel. In this position, and with the instrument held upright, the charging capacitance 15, 18 is short-circuited over a conductive path extending from metallic layer 18 to ring 17 and lug 122 of plate 22, rod 121, thimble 114 and thence via plate 13*a* to coating 15. The position of the pointer 33*b* on scale 38 is determined by the charge on a storage condenser represented by coating 18 and member 33 on the one hand and central electrode 14 on the other.

When the knob 51 is rotated by 180° and the instrument inverted or shaken horizontally into a position as illustrated in Fig. 2, pin 143 passes through the cut-out 44 and rod 121 is unlocked. Lug 122 now disengages the ring 117 and breaks the connection between plates 15 and 18 of the charging condenser; also, ball 30 conductively connects thimble 114 to rod 20, thereby establishing a path from coating 15 to central electrode 14. At the same time the presence of frictionally charged pellets 42 near plate 13*a* attracts electrons toward the coating 15 and positively charges the central electrode 14. When the instrument is now again righted, or shaken in the opposite direction, electrode 14 is again insulated from coating 15 and the aforementioned short circuit across the capacitance 15, 18 is reestablished, the negative charge on coating 15 being thereby communicated to coating 18.

When, by repetition of the above operations, the instrument has been fully charged, the pointer 33*b* will register with the 0-point of the scale 38 and the knob 51 may now be returned to reading position. If radiation is present, ionization will occur in the space between the plates of the aforementioned storage condenser 14, 18, 33 and this condenser will gradually discharge; the rate of the pointer's return to no-charge position, or the position reached by the pointer at the end of a predetermined time interval (as read on the suitably calibrated scale 38), will give an accurate indication of the radiation intensity.

It will be noted that the capacitance of charging condenser 15, 18 is considerably greater than that of the storage condenser at the top of the instrument, and that the two condensers are effectively in parallel when the instrument is inverted and unlocked, whereby discharges due to ionization will occur at a much more rapid rate than in normal reading position. It is, accordingly, possible to correct overcharges or to produce limited discharges in this manner even where no appreciable radiation is present. More rapid discharges are possible by unlocking the instrument (as in Fig. 2) and shaking it several times in inverted position, whereby pellets 42 and ball 30 will move out of step (owing to differences in weight and mobility) and electrons will be returned to the central electrode 14.

My invention is, of course, not limited to the specific embodiment described and illustrated but may be realized in numerous modifications and adaptations without departing from the spirit and scope of the appended claims.

I claim:

1. In an ionization-measuring instrument, in combination, a pair of conductive elements insulated from each other, a charge generator comprising charge-carrying means displaceable between two positions relatively close to and relatively remote from one of said elements, respectively, electrostatic indicator means comprising a first and a second electrode relatively remote from said charge-carrying means in both of said positions, first bridge means for conductively connecting said one of said elements to said first electrode in said relatively close position of said charge-carrying means, thereby inducing a charge of predetermined polarity in said one of said elements and a charge of opposite polarity in said first electrode, second bridge means for conductively interconnecting said elements in said relatively remote position of said charge-carrying means, and means conductively interconnecting the other of said elements and said second electrode at least in said relatively remote position of said charge-carrying means.

2. The combination according to claim 1, further including manually operable means for selectively blocking the operation of said first bridge means.

3. In an ionization-measuring instrument, in combination, a pair of conductive elements insulated from each other, a charge generator comprising charge-carrying means displaceable between two positions relatively close to and relatively remote from one of said elements, respectively, electrostatic indicator means comprising a first and a second electrode relatively remote from said charge-carrying means in both of said positions, first bridge means on said charge generator for conductively connecting said one of said elements to said first electrode in said relatively close position of said charge-carrying means, thereby inducing a charge of predetermined polarity in said one of said elements and a charge of opposite polarity in said first electrode, second bridge means on said charge generator for conductively interconnecting said elements in said relatively remote position of said charge-carrying means, and means conductively interconnecting the other of said elements and said second electrode at least in said relatively remote position of said charge-carrying means.

4. The combination according to claim 3, wherein said charge generator comprises a tubular container of dielectric material, said charge-carrying means being held in said container for axial displacement relative thereto, and an elongated member traversing said container in axial direction and adapted to move axially with respect thereto, said first and second bridge means being operative connected with said member.

5. The combination according to claim 4, further including locking means for substantially immobilizing said member in a position of inoperativeness of said first bridge means.

6. An apparatus for charging a pair of electrodes, comprising a first and a second conductive element insulated from each other, a dielectric container of tubular configuration, charge-carrying means within said container movable between a first and a second axial position and adapted to become frictionally charged by such movement, said charge-carrying means being relatively close to said first element in said first position and relatively remote therefrom in said second position, bridge means coupled with said container for conductively connecting said first element to one of said electrodes in said first axial position and for conductively interconnecting said elements in said second axial position of said charge-carrying means, and means conductively interconnecting said second element and the other of said electrodes at least in said second position of said charge-carrying means.

7. An apparatus according to claim 6, wherein said elements are a pair of condenser plates.

8. An apparatus according to claim 6, wherein said container is provided with a member mounted thereon for limited relative axial displacement, said bridge means being operatively coupled with said member.

9. An apparatus according to claim 8, wherein said member is a rod axially traversing said container.

10. An ionization-measuring instrument comprising a charge indicator including a pair of electrodes together defining an ionization chamber, a pair of condenser plates remote from said electrodes, means conductively connecting one of said condenser plates to one of said electrodes, a tubular container of dielectric material, a conductive element adjacent one end of said container forming electrically a part of the other of said condenser plates, dielectric charge-carrying means movable inside said container between two extreme axial positions close to and remote from said conductive element, respectively, and adapted to become frictionally charged by such movement, first bridge means coupled with said container for conductively interconnecting said element and the other of said electrodes in said close axial position of said charge-carrying means, and second bridge means coupled with said container for conductively connecting said element to said one of said condenser plates in said remote axial position of said charge-carrying means.

11. An instrument according to claim 10, further comprising a housing forming an air-tight enclosure around said indicator, said condenser plates and said container, magnetic control means outside of said housing and magnetic follower means inside said housing, said follower means being adapted to inactivate said first bridge means upon movement of said control means from a charging position to a reading position.

12. An instrument according to claim 10, further comprising an elongated member traversing said container in axial direction and mounted thereon for limited relative axial displacement, said first and second bridge means being operatively coupled to said member.

13. An instrument according to claim 12, wherein said first bridge means comprises a metallic retainer mounted on an extremity of said member, adjacent said one end of said container, and a metallic connector telescoped within said retainer and adapted to engage part of said other of said electrodes only in an extreme position of said connector and of said member.

14. An instrument according to claim 13, wherein said member is a metallic rod, said second bridge means comprising a metallic part extending from the other extremity of said rod.

15. An instrument according to claim 13, further comprising locking means for substantially immobilizing said member in a position in which said connector is held out of engagement with said other of said electrodes, a housing forming an air-tight enclosure around said indicator, said condenser plates and said container, said locking means comprising a magnetic control member outside of said housing and a magnetic follower member inside said housing, said housing comprising a substantially cylindrical, dielectric wall, said one of said condenser plates being constituted by a conductive coating on the inside of said wall.

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