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Garnier

[11] **3,802,250**

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[54] **DEVICE FOR SAMPLING RADIOACTIVE AEROSOLS**

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[52] **U.S. Cl.** **73/28**

[51] **Int. Cl.** **G01d 46/00**

[58] **Field of Search** ..... 73/28, 421.5 R; 55/270

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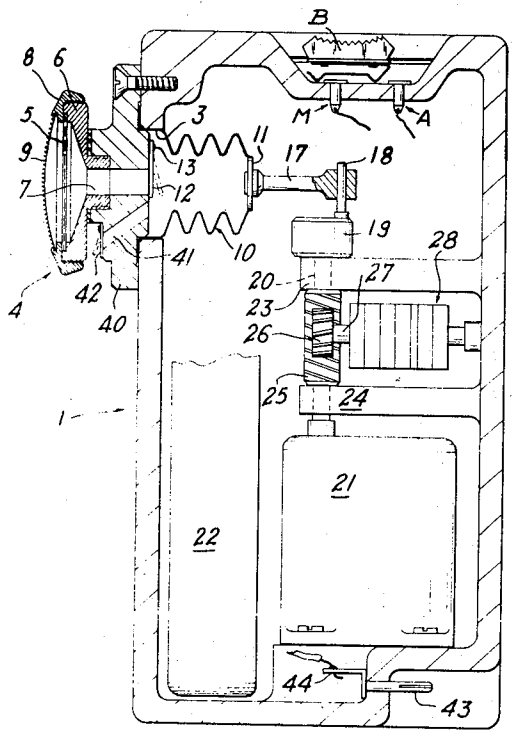
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Primary Examiner—S. Clement Swisher
Attorney—Cameron, Kerkam & Sutton

[57] **ABSTRACT**

The device comprises a chasing in which is formed an opening for the leak-tight assembly of a filter support by means of a bearing collar and which contains a compact storage battery for driving a constant-speed motor. The motor is associated with an eccentric which converts the movement of rotation of the motor shaft to a reciprocating movement of translation for an actuating link-rod which is connected to a bellows element having a generally cylindrical shape. One end of the bellows element is secured to the casing in the filter-support opening and the other end is secured to a closure plate. A check-valve is provided for suction through the filter and placed within the bellows element in front of a communication bore which is formed in the filter support and in the collar. A second check-valve is provided for delivery to the exterior of the casing and mounted on the bearing collar of the filter support in front of a duct which extends through the collar and opens into the interior of the bellows element.

1 Claim, 3 Drawing Figures



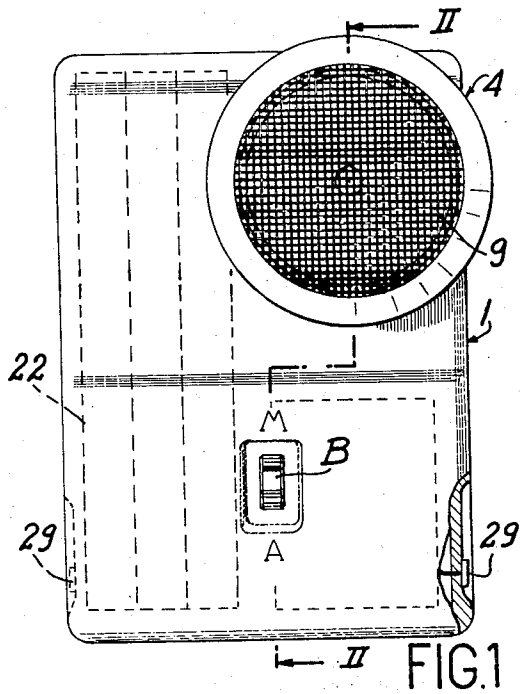

II
4
9
1
22
M
B
A
29
29
II

FIG.1

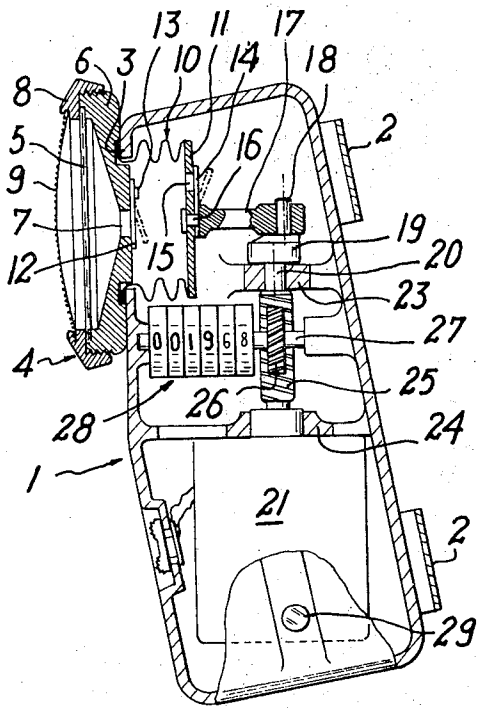

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FIG.2

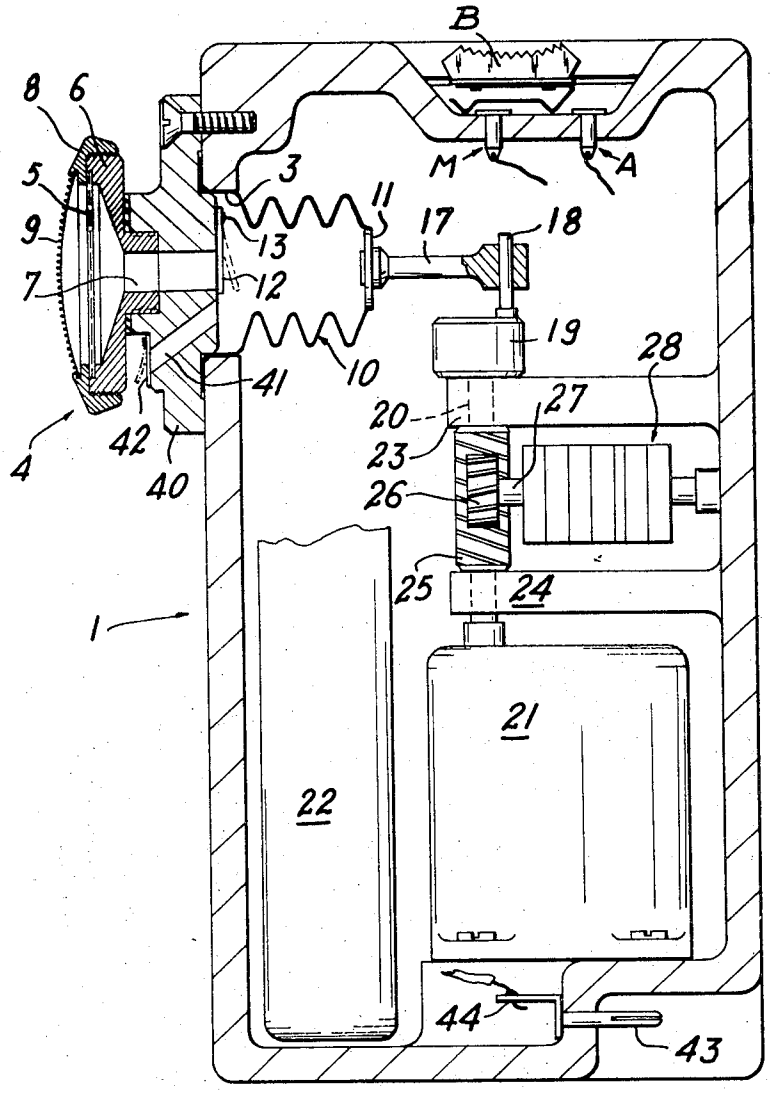

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FIG.3

DEVICE FOR SAMPLING RADIOACTIVE AEROSOLS

This invention relates to a portable device for continuous sampling in an atmosphere which is contaminated by radioactive aerosols in order to determine by inspection and analysis of products collected on a filter which is mounted on the apparatus the contamination to which an operator has been subjected after working in this atmosphere during a predetermined period of time.

One device which has already been proposed for this purpose consists of a casing provided with an opening for the leak-tight assembly of a filter support and containing a compact storage battery which serves to supply the necessary electric power for driving a constant-speed motor, said motor being associated with an eccentric which converts the movement of rotation of the motor shaft to a reciprocating movement of translation for an actuating link-rod. The device also comprises a bellows element having a generally cylindrical shape, one end of said bellows element being stationarily fixed with respect to the casing in the opening provided for the assembly of the filter support whilst the other end of said bellows element is secured to a closure plate. The filter support is provided with a bore which communicates with the bellows element and is fitted with a suction valve placed within the interior of said bellows element. The closure plate which is rigidly fixed to the actuating link-rod is fitted with a delivery valve which is mounted outside the bellows element and towards the interior of the casing.

The apparatus as thus constructed offers many advantages which arise in particular from its simplicity of operation and low cost price. However, under certain special conditions of use, the apparatus is subject to a slight disadvantage in the design of the filter which is placed within a support, said support being mounted against the casing of the apparatus and a part of the surrounding atmosphere being sucked through the filter as a result of the reciprocating movements of displacement of the bellows element. In point of fact, a so-called "absolute" filter, namely of the same type as a membrane, is not usually employed for this purpose by reason of the consequent need for an electric motor having a power rating which would be incompatible with the size and weight of the apparatus. In practice, the filters employed are mainly of the paper or fiber type and do not offer every guarantee of absolute leak-tightness since s small but nevertheless appreciable fraction of the surrounding atmosphere is liable in some instances to pass through the filter towards the interior of the bellows element. Thus, by reason of the position of the delivery valve in the closure plate, this fraction of the atmosphere is permitted to reach the internal region of the casing and the mechanisms which are contained within this latter (motor, storage battery, meter and the like). Particularly in the case in which the surrounding atmosphere is highly radioactive, the particles which may pass through the filter then contaminate the avbove-mentioned mechanisms, thereby putting them out of service.

The aim of this invention is to provide improvements in the prior arrangements which have been recalled, especially in order to make the sampling device wholly leak-tight and thus to prevent contamination and/or pollution of the internal region of the casing.

The following complementary description provides a detailed explanatory illustration of the improvements which are contemplated with a view to achieving the aim which is thus proposed, reference being made to the accompanying drawings, in which:

FIG. 1 illustrates the front face of a sampling device comprising a filter support which is fixed directly on the casing of the apparatus;

FIG. 2 is a sectional view taken along line II—II of FIG. 1;

FIG. 3 illustrates an alternative form of construction of the device according to FIG. 1 which embodies the necessary improvements for making the apparatus completely leak-tight.

As shown in FIGS. 1 and 2, the sampling device which is illustrated comprises mainly a casing 1 having a general shape which is substantially parallelepipedal and formed of any suitable material, preferably a light-weight plastic material of ordinary type. Lugs 2 are provided on the rear face of said casing in order to mount this latter on the user's clothing with the aid of any suitable fastening or attachment means (sliding clip, clamp or the like). The casing 1 is provided in its opposite face with a circular opening 3 which is intended to receive a supporting element 4 for a filter 5 on which radioactive aerosols are collected, said aerosols being sampled by the apparatus by means of the pumping unit which forms part of this latter and the constructional detail of which is described hereinafter. Subsequent analysis of said filter after a given period of operation serves to determine as a function on the one hand of the volume of air or more generally of the atmosphere sampled by the device and on the other hand of the ratio of said volume to the real volume breathed by the user both the quantity and the nature of the aerosols which have been breathed and consequently the degree of contamination received. The supporting element 4 preferably comprises a base 6 which is fitted externally within the opening 3 and provided internally with the shape of a cup through which is pierced an axial bore 7. The filter 5 is stationarily mounted against the base 6 in parallel relation to the corresponding face of the casing 1 by means of a circular ring 8 which is screwed on the edge of the base 6 and fitted with an external protective grid 9.

The sampling device comprises a pumping unit which is mounted within the interior of the casing 1 and mainly constituted by an elastic bellows element 10 formed especially of flexible rubber and cylindrical in shape, one end of which is secured to the casing 1 within the opening 3 in which the base 6 of the filter support 4 is mounted, leak-tightness being provided directly by the outer edge of said bellows element. The other end of said element is closed by a transverse plate 11 which is substantially parallel to the base 6 and capable of undergoing a reciprocating movement of displacement in a direction at right angles to said base in order to form in conjunction with the bellows element 10 and judiciously disposed valves a unitary pump which sucks air through the filter 5, then discharges the air to the exterior of the casing 1. To this end, a suction valve 12 is mounted within the interior of the bellows element 10 and is constituted by a resilient tongue, one edge of which is secured with respect to the base 6 by means of a rivet 13 or the like and the other edge of which is disposed in front of the bore 7 which provides a communication between the bellows element and the

exterior of the casing beneath the filter **5**. Similarly, provision is made on the closure plate **11** but externally of the bellows element **10** for a delivery valve **14** which closes off a communication orifice **15**, said valve **14** being secured to the closure plate by means of a fastening member **16** which also couples said plate with one extremity of an actuating link-rod **17**. Said link-rod extends substantially along the axis of the bellows element and cooperates at its other extremity with a stud **18** carried in an eccentric position on a crank-plate **19** which is rigidly fixed to the shaft **20** of an electric motor **21**. Said shaft is guided in its movement of rotation about its own axis by means of two transverse rings **23** and **24**, the function of the second ring being also to support and maintain the motor within the casing. Said motor is supplied from a storage battery **22** especially of the nickel-cadmium type which has a small volume and is placed within the casing **1** next to the motor (as shown in FIG. **1**). Starting or stopping of the movement of rotation is controlled by means of a button B which has two positions, namely "on" M and "off" A, and is readily accessible to the user of the device. Provision is made on the shaft **20** of the motor **21** and between the rings **23** and **24** for a threaded portion **25** which is adapted to cooperate with a pinion **26** and this latter is fixed on the shaft **27** of a meter **28**. Said meter is graduated so as to represent either the time during which the motor actuates the pumping bellows or the quantity which is sampled. The numerals of the meter pass in front of a window (not shown) which enables the user of the device to read them without difficulty. Finally, the equipment of the apparatus is completed by means of contact-studs **29** formed in relief on the outer wall of the casing **1**, said contact-studs being connected electrically within the interior of said casing to the storage battery **22** so that this latter may be recharged during periods when the apparatus is not in use, especially by automatic positioning of the device in a special rack which is connected to a suitable voltage source. By way of alternative, provision is made for a simple flexible connector of the male and female type.

The operation of the aerosol sampling device can immediately be deduced from the foregoing. The user who is wearing the box unit or casing after having attached this latter to his clothing in a suitable manner sets the operating button B from the "off" position A to the "on" position M as soon as he enters a radioactive zone. The motor **21** drives the time meter **28**, initiates the reciprocating movements of displacement of the bellows element **10** by means of the actuating link-rod **17** and carries out continuous pumping from the outer air through the filter **5**. During the suction stage, the check-valve **12** opens under the action of the negative pressure produced within the bellows element, thereby freeing the bore **7**; on the other hand, the inertial effect arising from the displacement of the link-rod is added to the check-valve **14** which is naturally applied against the closure plate **11**. On the other hand, in the following stage corresponding to the return movement of the link-rod in the opposite direction, the check-valves are automatically reversed. It will be noted at this juncture that the motion of the bellows element is added to the effect of the pressure variation which is produced and assists the opening or closing action of the valves in the two successive stages, this result being achieved in particular without any attendant danger of backlash or reversals which would be detrimental to the operation and mechanical strength of said valves.

FIG. **3** again shows most of the arrangements which have been described above with reference to FIGS. **1** and **2**.

The casing **1** as illustrated and preferably formed of molded plastic material is provided with a circular opening **3** in which is placed a support **4** for a filter **5**. Said support has a base **6** which is provided with a central bore **7** and fitted with a ring **8** for retaining the filter **5** against the base **6**. There is mounted within the interior of the casing **1** a pumping unit which is essentially constituted by an elastic bellows element **10** of cylindrical shape, one extremity of which is engaged between the support **4** and the wall of the casing **1** within the opening **3** and ensures leak-tightness of these two components at the time of assembly. The base of the bellows element **10** is fitted with a closure plate **11** and this latter is connected externally of the bellows element to an actuation link-rod **17**. Said link-rod is displaced in axial translational motion by means of an eccentric system **19** which is driven by an electric motor **21**, said motor being in turn supplied from a storage battery **22**. The support **4** of the filter **5** comprises a wide circular collar **40** which is intended to fit within the opening **3** and on which the base **6** is intended to be mounted in leak-tight manner. There is formed in said collar **40** a transverse duct **41** which is associated externally of the casing **1** with a resilient check-valve **42** having the intended function of delivery valve for the pumping unit formed by the bellows element **10** and its driving motor **21**, the suction valve **12** being disposed in front of the bore **7** on the collar **40**.

By virtue of the foregoing arrangement and without in any way modifying the general principle of operation of the apparatus, the outer atmosphere which is sucked into the apparatus through the filter **5** is discharged through the duct **41** and the check-valve **42** to the exterior of the casing and no longer to the interior of this latter. The motor **21**, the storage battery **22** as well as the volumetric meter **28** are no longer liable under these conditions to be contaminated by the atmosphere which is drawn into the apparatus since said atmosphere never comes into contact with these mechanisms.

Total leak-tightness of the apparatus is in any case maintained while avoiding any free penetration through the casing wall. In particular, the operating button B for starting-up the motor is adapted to cooperate outside the casing with two contact-studs which are embedded in the material of the casing and mounted level with the external wall of this latter. Similarly, the contact-studs which serve to recharge the storage battery while the apparatus is not in use are advantageously constituted by a pin **43** which is connected within the interior of the casing by means of connections **44** to the battery terminals.

It will readily be understood that the invention is not limited to the examples which have been more especially described with reference to the accompanying drawings but extends to all alternative forms. In particular, it would be an advantage to dispose outside the casing and in front of the delivery valve a shield or cover which has the function of protecting said valve.

What is claimed is:

1. A device for sampling radioactive aerosols comprising a molded plastic unitary casing provided with a single opening for the leak-tight assembly of a filter support by means of a bearing collar and containing a compact storage battery which serves to supply the necessary electric power for driving a constant-speed motor, said motor being associated with an eccentric which converts the movement of rotation of the motor shaft to a reciprocating movement of translation for an actuating link-rod and further comprising a bellows element having a generally cylindrical shape, one end of said bellows element being stationarily fixed in leak-tight manner with respect to the casing in the opening provided for the assembly of the filter support beneath said collar whilst the other end of said bellows element is secured to a closure plate, a check-valve for suction through the filter and placed within the interior of the bellows element in front of a communication bore which is formed in the filter support and in the collar, a check-valve for delivery to the exterior of the casing and mounted on the bearing collar of the filter support in front of a duct which extends through said collar and opens into the interior of said bellows element and a connector-pin passing in leak-tight manner through the casing wall and connected to the terminals of the storage battery so that said battery can be charged when the device is not in use.

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