

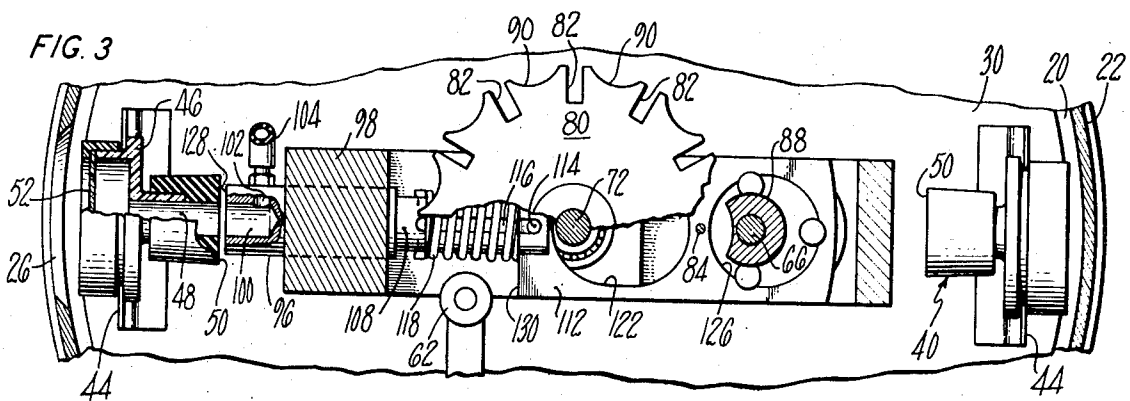
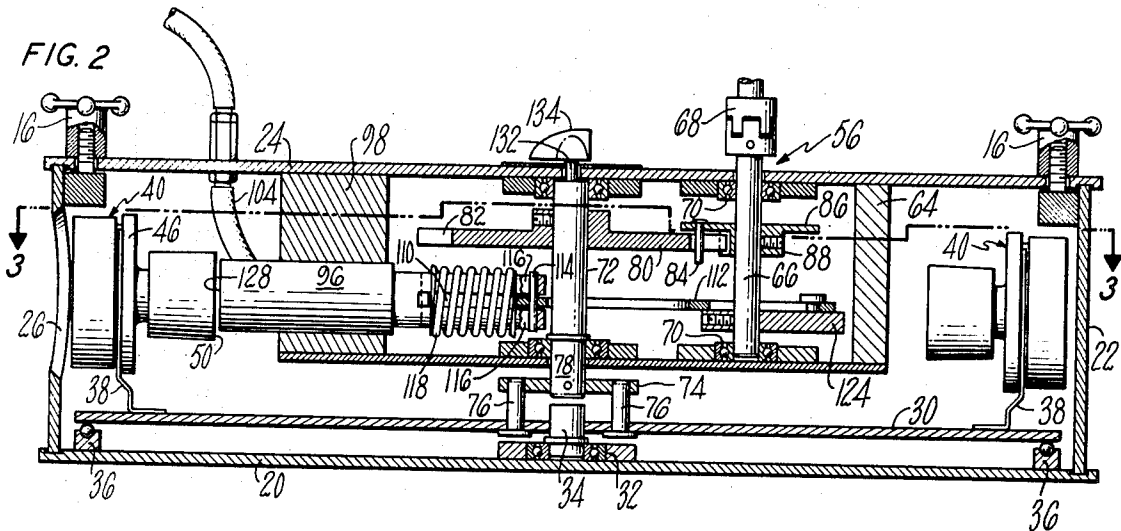
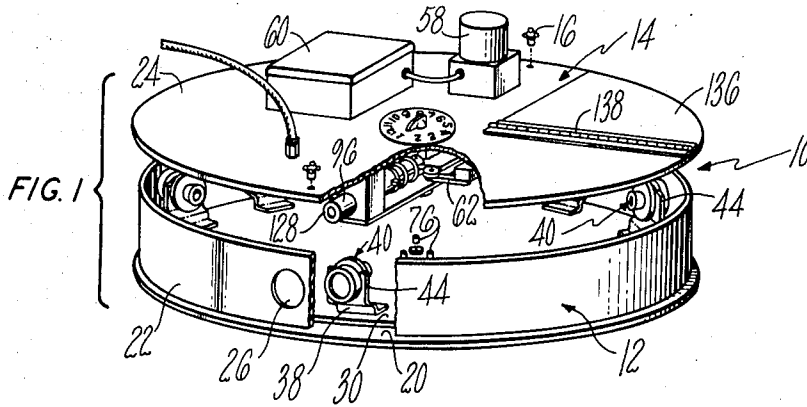
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ATMOSPHERE SAMPLING DEVICE

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ATMOSPHERE SAMPLING DEVICE

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ABSTRACT OF THE DISCLOSURE

An atmosphere sampling device having a single atmosphere monitoring station communicating with the interior of a shallow, drum-like housing for a plurality of uniformly spaced, individually removable samplers provides for the programmed advancement of a sampler-mounting magazine. The samplers are indexed into registry with the monitoring station and are sequentially connected with a source of vacuum for drawing the ambient atmosphere toward and through the sampler. The device is provided with a single, time controlled drive system which both makes and breaks the vacuum seal with the sampler and advances the succeeding samplers into and out of an exposed atmosphere monitoring station.

BRIEF SUMMARY OF THE INVENTION

The present invention relates to an atmosphere sampling device and is particularly directed to a new and improved device for the efficient collection of air-borne particles and other pollutants in a controlled time sequence.

Recently a great deal of effort has been expended in the field of air pollution and many attempts have been made to develop new techniques which will permit accurate, statistical measurement of the quantity and quality of various types of solid and gaseous pollutants to be found in the atmosphere, particularly in municipal areas where the degree of pollution can rise to deleterious levels. In this connection it is frequently necessary to be able to repeat sampling procedures at predetermined time intervals and locations for the purpose of monitoring the atmosphere pollutants as well as the changing characteristics thereof. This is particularly true where it is desirable to fix the time of arrival or departure of a specific concentration of material in the atmosphere. Accordingly, it is an object of the present invention to provide a sequential air sampling device which can be automatically controlled for preset programmed operation to provide an efficient and rapid monitoring of the ambient atmosphere in accordance with a predetermined time resolution.

Another object of the present invention is to provide a new and improved sampling device of the type described which will automatically expose in succession each of a series of individual samplers for a definite and controlled period of uniform or variable length, and provide not only the rapid, automatic and successive exposure of other samples but also the enclosed storage of those samplers which have been or are about to be exposed.

Still another object of the present invention is to provide a sampling device of the type described which is

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adapted for use in conjunction with a source of vacuum and is programmed to advance sampler to an atmosphere monitoring station and effect a vacuum seal therewith for drawing the pollutant laden atmosphere toward and through the sampler and subsequently release the sampler from the source of vacuum and store the exposed sampler during the remaining portion of the programmed sampling period, thus protecting the samplers from accidental contamination at all times other than the collection period for that particular sampler.

A further object of the present invention is to provide a new and improved atmosphere sampling device which exhibits improved accuracy, speed, reliability and trouble-free operation coupled with a simplified, lightweight and compact yet sturdy design permitting its ready portability for use in heretofore inaccessible or isolated areas and under adverse environmental conditions.

A still further object of the present invention is to provide a sampling device of the type described which prevents exposure of more than one sampler at a time while facilitating the individual mounting and removal of the samplers, even during a sample collecting operation and without interference with that operation.

Other objects will be in part obvious and in part pointed out more in detail hereinafter.

These and related objects of the present invention are achieved by the utilization of a low profile sampling device having a single atmosphere monitoring station communicating with the interior of the sampling device wherein is housed a plurality of indexable, individually removable samplers adapted to move into registry with the monitoring station and to be connected with a source of vacuum for drawing the ambient atmosphere toward and through the sampler in order to entrap the pollutants therein. The sampling device is provided with a single time controlled drive system which both makes and breaks a vacuum seal with the sampler and advances the succeeding samplers into and out of an exposed atmosphere monitoring station.

The invention accordingly consists in the features of construction, combination of elements and arrangement of parts which will be exemplified in the construction hereafter set forth and the scope of the application which will be indicated in the appended claims.

BRIEF DESCRIPTION OF THE DRAWING

In the drawing:

FIG. 1 is a perspective view of the sampling device of the present invention with the top cover section raised slightly away from the lower section of the device and with portions thereof broken away;

FIG. 2 is a sectional view of the sampling device of FIG. 1 illustrating the internal mechanism thereof during the indexing of an individual sampler into registry with an atmosphere monitoring station; and

FIG. 3 is a fragmented top view of the device, partially broken away, the view being taken along the line 3-3 of FIG. 2.

DESCRIPTION OF PREFERRED EMBODIMENT

Referring now to the drawing in greater detail, wherein like reference numerals indicate like parts throughout the several figures, the sampling device of the present

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invention takes the form of a portable, low profile, drum-like structure of durable lightweight construction which can be easily and readily moved to different locations in order to provide comparative monitoring of atmospheric pollutants at different locations. The sampling device, generally designated by the numeral 10, consists of a shallow lower section 12 to which an upper section 14 is secured as by the bolt connections 16 best seen in FIG. 2. The lower section 12 includes a flat circular base 20 and an arcuate, upstanding side wall 22 supported by the base adjacent its periphery and adapted to receive the substantially flat cover 24 of the upper section which is similar in size and shape to the base 20. The side wall 22 of the lower section is provided with a single aperture or port 26 communicating with the interior of the drum-like sampling device and forming the atmosphere monitoring station thereof.

Rotatably mounted on the flat base 20 within the lower section and spaced slightly therefrom is a sampler mounting magazine which takes the form of a flat disk 30 having a diameter only slightly smaller than the diameter defined by the arcuate side wall 22. The disk 30, which is rotatably mounted on the bearing 32 through the depending axial hub 34, may be stabilized against tilting or other undesirable displacement during operation by providing suitable stabilizing supports 36 intermediate the base and the disk, as shown in FIG. 2. Fixedly secured to the disk 30 adjacent its periphery are a plurality of uniformly spaced mounting brackets 38 adapted to receive individual atmosphere monitoring samplers 40 which may be of the membrane filter or impinger type. The number of mounting brackets carried by the disk may vary substantially depending upon such factors as the size and type of sampler employed, the desired programmed operation of the sampling device or the overall size of the device itself. In the embodiment illustrated in FIG. 1, provision is made on a 15" diameter disk for twelve uniformly spaced samplers which can be programmed for individual collection periods ranging from five minutes to twenty-four hours.

In the embodiment of the present invention illustrated in the drawing, the thin, resilient mounting brackets 38 are provided with bifurcated or U-shaped sampler receiving portions 44 upstanding from the disk 30 and adapted to slidably receive the grooved filter housing 46 of the individual samplers 40. In this manner the brackets 38 mount the samplers a short distance from and facing the side wall 22 facilitating smooth radially outward movement thereof into the atmosphere monitoring station. In FIG. 3 the sampler 40 is depicted as including a central vacuum conduit or passage 48 extending through the filter housing 46 and terminating rearwardly at a flat cushioned face 50 which provides a firm yet resilient surface suitable for effecting a satisfactory vacuum seal and facilitating the drawing of the atmosphere through the sampling medium 52 securely held within the housing 46. Thus, it will be appreciated that the individual samplers 40 carried by the rotatable magazine can be readily rotated into registry with the sole atmosphere monitoring station of the device and resiliently moved outwardly to provide full and complete exposure to the atmosphere while enabling the atmosphere to be drawn therethrough by a suitable vacuum source.

The flat cover 24 which encloses the samplers 40 within the device fixedly supports a depending drive mechanism 56 operable by a single motor 58 resting on the top of the cover. Operation of the motor 58 is controlled by both a timing and switching mechanism 60, also supported on the exterior of the device by the cover, and an interior microswitch 62 within the interior of the device. The drive mechanism 56 is supported by the fixed support frame 64 depending from the flat cover 24 and includes a rotatable drive shaft 66 connected to the motor through a coupling 68. The drive shaft 66 extends through cover 24 into the interior of the drum-

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like sampling device and is rotatably supported therein by the fixed bearings 70. The drive mechanism 56 is additionally provided with a center shaft 72 mounted coaxially of the magazine hub 34 and extending downwardly from the top cover 24 through the support frame 64 and toward the base 20 to a position spaced from the hub 34. Affixed to the free end 78 of the center shaft closest to the hub is an apertured drive transmission plate 74 adapted to cooperatively receive the upstanding pins 76 fixedly carried by the magazine disk 30 thereby providing a driving connection between the center shaft 72 and the magazine for coaxial rotation of the magazine corresponding to rotation of the center shaft 72.

As best seen in FIGS. 2 and 3 the center shaft 72 is driven by the motor 58 through a locked intermittent drive mechanism of the Geneva type which includes a segmented driven plate 80 affixed to the center shaft 72. The plate 80 has a plurality of inwardly extending radial notches 82 adapted to cooperate with a single pin 84 carried by drive gear 86 fixedly secured to drive shaft 66. The drive gear 86 additionally is provided with a convex locking sector 88 which cooperates with the concave peripheral segments 90 of the driven plate 80 to lock the center shaft 72 against movement during a portion of the drive shaft's rotational movement. In the embodiment best illustrated in FIG. 3 the driven plate 80 is provided with twelve radial notches 82 so that each revolution of the drive shaft 66 will cause the center shaft 72 to rotate one-twelfth of a revolution, that is, through an arc of about 30°. Accordingly, where a full complement of samplers are mounted on the magazine an individual sampler will be indexed into registry with the atmosphere monitoring station 26 upon each complete revolution of the drive shaft 66. As will be appreciated, if fewer samplers are utilized either the timing mechanism can be altered to suitably program the indexing and registering of the samplers or the segmented driven plate 80 can be replaced by a plate which corresponds to the number of samplers being utilized.

It is an advantageous feature of the present invention that the drive mechanism 56 utilized to advance the individual samplers into registry with the monitoring station may also include provisions for moving the samplers toward the side wall 22 and positioning them in the monitoring station, thereby fully exposing the sample collecting medium 52 to the atmosphere being monitored. To accomplish this the drive mechanism 56 includes a reciprocating plunger head 96 slidably housed within an enlarged depending wall 98 of the drive mechanism frame 64. The cylindrical plunger head 96 is provided with a cavity 100 in an end wall thereof and a side port 102 communicating with the cavity 100, the side port 102 being connected through a suitable flexible conduit 104 to a separate vacuum source (not shown) which will continually operate to draw the ambient atmosphere toward the sampling device. The plunger cavity 100 constantly faces the aperture 26 in the side wall 22 and, as shown in FIG. 3, is in alignment with the central channel or passage 48 of each sampler 40 when the sampler is in registry with the aperture. A bifurcated plunger extension 108 projects from the head 96 inwardly away from the cavity 100 and receives within the bifurcating slot 110 a flat plunger drive arm 112 which is slidably held within the plunger extension through the cooperative interengagement of the extension with a locking pin 114 carried by the arm 112. The pin 114 is slidably positioned within the longitudinally extending top and bottom apertures 116 of the extension 108 and compressively held adjacent the free end of the extension by means of the overtravel cushioning spring 118 circumscribing the extension. The drive arm 112 which is provided with a suitable central aperture 122 for avoiding contact with the center shaft 72 is driven by the eccentric drive cam 124 fixedly secured to the drive shaft 66. In the embodiment illustrated, the cam takes the form of a tri-pin cam which cooperates

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with a cam follower aperture 126 in the drive arm 112 for reciprocally moving the arm and therefore the plunger head 96 toward and away from the monitoring station in the side wall of the sampling device. Thus, during one complete revolution of the drive shaft 66, the plunger drive arm 112 is cammed toward the side aperture 26 thereby causing the plunger head 96 to move toward the sampler 40 in registry with the aperture. As the plunger contacts the sampler a vacuum seal is created between the front face 128 of the plunger and the resilient rear wall 50 of the sampler. The plunger continues its outward travel to drive the sampler into the side wall aperture 26 for exposure to the atmosphere while a separate source of vacuum draws the ambient atmosphere toward and through the sampler in order to collect the pollutants therein. As can be appreciated, the spring 118 provides an additional cushioning effect between the drive arm 112 and the plunger extension, the compressive resistance of the spring 118 being balanced with the resiliency of the mounting bracket 38 in order to provide proper positioning of the sampler 40 in the monitoring station.

As mentioned hereinbefore, the timing and switching mechanism 60 carried by the cover may be programmed to provide individual collection periods ranging from five minutes to twenty-four hours. For example, an individual collection period of approximately two hours may be desired so that a full twenty-four hour period is monitored. The timer which can be set for the appropriate collection interval will actuate a single-pole double-throw micro-switch (not shown) of the mechanism 60 to activate the motor. The motor will rotatably drive the drive shaft 66 and its fixed eccentric cam 124 causing retraction of the plunger, withdrawal of the sampler by the resilient bracket 38 and release of the sampler from the vacuum line. As the plunger is retracted the locking sector 88 of the single pin drive gear 86 momentarily prevents rotation of the center shaft 72 until the plunger head 96 is free of the sampler. Thereupon, the pin 84 of the drive gear 86 comes into cooperative driving engagement with the radial notch 82 of the driven plate 80 to rotate the magazine and advance the next sampler into registry with the monitoring station. Upon completion of the sampler advance, the locking sector 88 again holds the center shaft against movement as the eccentric cam 124 completes its rotation and advances the plunger into contact with the newly registered sampler, pushing the sampler into the side aperture 26 and exposing it to the atmosphere. At the same time, the front edge 130 of the drive arm 112 contacts the interior micro-switch 62 carried by the top cover 24 to turn off the motor. The entire sampler changing operation can be accomplished in about six seconds. It will be appreciated that the vacuum source may be programmed to be turned on as soon as the timer and switch are initially activated and to remain on during the entire twelve sampler collection period. At the end of each individual sampling period the operating cycle is repeated, that is, the timer activates the motor to retract the plunger head thereby withdrawing and releasing the sampler and permitting advance of the immediately adjacent sampler into registry with the monitoring station. The newly registered sampler is then connected to the source of vacuum by means of the plunger head and advanced into the monitoring station for the desired collection period. When all the samplers have been collected the timer will automatically terminate the operation and, if desired, simultaneously shut down the source of vacuum.

As illustrated in FIG. 1 an extension 132 of the center shaft 72 may protrude through the top cover 24 and be provided with an interior knob 134 which will move with the center shaft and provide an immediate visual indication of which sampler is located at the monitoring station. Additionally, a portion 136 of the cover may be hingedly secured at 138 to provide ready access to individual samplers within the device prior to completion of the entire sampler collecting operation.

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As will be apparent to persons skilled in the art, various modifications and adaptations of the structure above-described will become readily apparent without departure from the spirit and scope of the invention, the scope of which is defined in the appended claims.

I claim:

1. In a sampling device for monitoring atmospheric pollutants comprising a monitoring station; a movable magazine including a plurality of atmosphere samplers mounted thereon, the magazine being operable for the sequential indexing of individual samplers into registry with the monitoring station; a vacuum line and a drive mechanism for indexing the magazine; the combination including a connector movable between retracted and extended positions and being operable in its extended position to connect a registered sampler with the vacuum line, the connector being movable toward its retracted position to facilitate disconnection from the sampler; said drive mechanism being operative for driving the connector between its retracted and extended position, said drive mechanism further being operative to sequentially advance an individual sampler into registry with the monitoring station while the connector is in its retracted position and to drive the connector between its retracted and extended positions upon registry of a sampler with the monitoring station.

2. The sampling device of claim 1 wherein the drive mechanism for indexing the magazine includes a locked intermittent feed mechanism holding the magazine against movement during operative connection between the vacuum line and to the sampler and driving the magazine upon disconnection therebetween.

3. The sampling device of claim 1 wherein the connector drive includes a lost motion drive connection to the magazine permitting movement of the connector for both connecting and disconnecting the vacuum line prior to driving engagement with the magazine for indexing a subsequent sampler into registry with the monitoring station.

4. The sampling device of claim 1 wherein the drive mechanism for the magazine and the connector includes a rotatable drive shaft, a gear train intermediate the drive shaft and the magazine for intermittently driving the magazine upon rotation of the drive shaft and a cam drive intermediate the drive shaft and the connector for imparting reciprocable motion to the connector upon rotation of the drive shaft.

5. The sampling device of claim 4 wherein the gear train includes a Geneva plate connected to the magazine for rotation therewith and a pin and locking gear driven by the drive shaft for intermittently driving the plate and holding it against movement upon continued rotation of the drive shaft.

6. The sampling device of claim 1 wherein the samplers are resiliently mounted in spaced relationship adjacent the periphery of the magazine for individual movement into and out of an exposed position within the monitoring station.

7. The sampling device of claim 1 wherein the individual samplers are provided with a cushioned, plunger contacting surface to provide a vacuum seal therewith and are separately removable from the magazine when disconnected from the vacuum line.

8. The sampling device of claim 1 including a shallow, drum-like housing having a lower section provided with a side aperture forming the monitoring station and an upper cover section removably enclosing the lower section and stably confining the atmosphere samplers therein, the magazine being positioned in the lower section and including a plate rotatable relative to the monitoring station, said plate having a plurality of uniformly spaced mounting brackets upstanding therefrom adjacent the periphery thereof and operative for biasing the samplers into a rest position within the lower housing section, the connector including a plunger driving the registered sampler against said bias upon movement to its extended position.

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9. The sampling device of claim 1 including programming means for sequentially activating and deactivating the drive mechanism.

10. The sampling device of claim 9 wherein the programming means includes a timer operable for activating the drive mechanism for advance of a sampler into the monitoring station and a switch for deactivating the drive mechanism upon positioning of a sampler therein.

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