

[54] AUTOMATED SEQUENTIAL AIR SAMPLER
[75] Inventor: George A. Griffith, Pasadena, Calif.
[73] Assignee: California Institute of Technology,
Pasadena, Calif.
[22] Filed: June 24, 1974
[21] Appl. No.: 482,140

[52] U.S. Cl. 73/421.5 R
[51] Int. Cl. G01n 1/24
[58] Field of Search 73/421.5 R, 425.6, 28;
23/254 R

[56] References Cited
UNITED STATES PATENTS

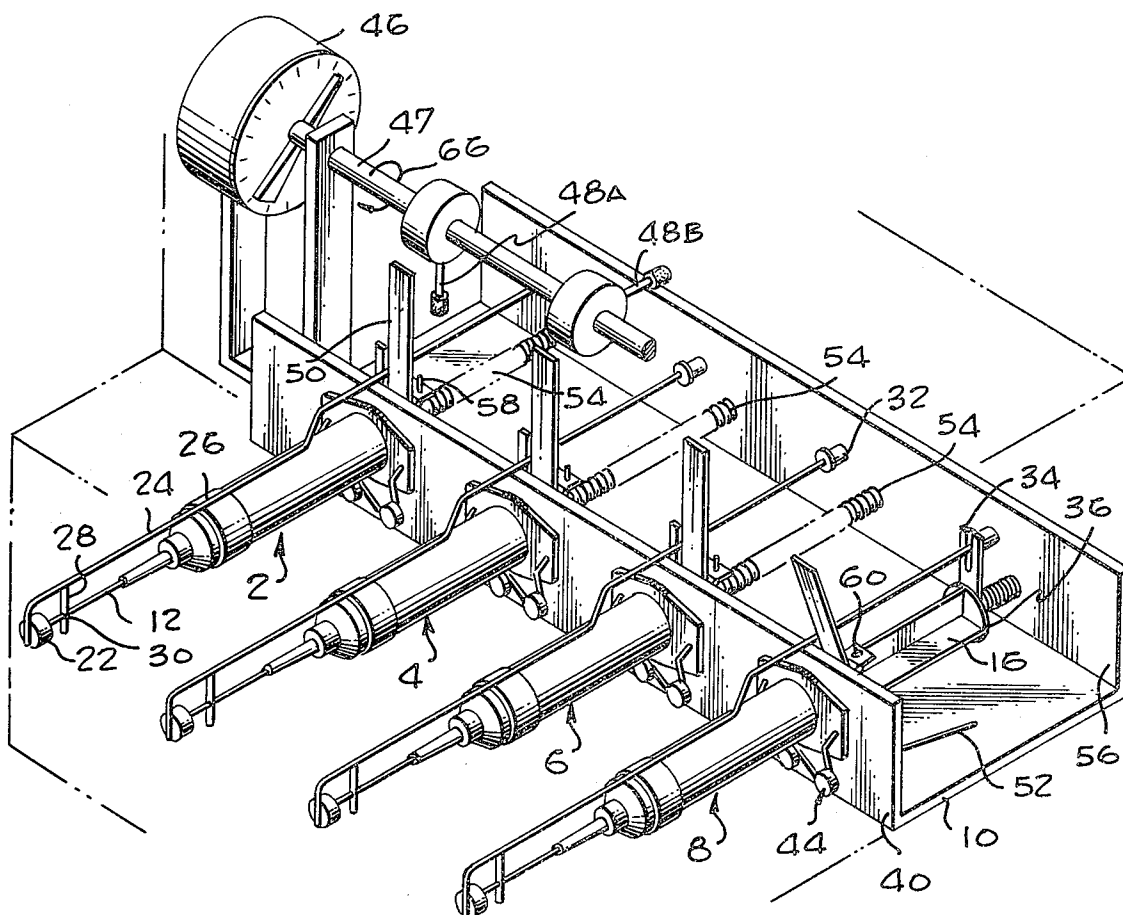
2,411,157	11/1946	Fene et al.	73/421.5 R
3,044,300	7/1962	Eden	73/421 B
3,166,938	1/1965	Weyrauch	73/425.6
3,334,788	8/1967	Hamilton	73/425.6
3,765,402	10/1973	Grabhorn	128/DIG. 5

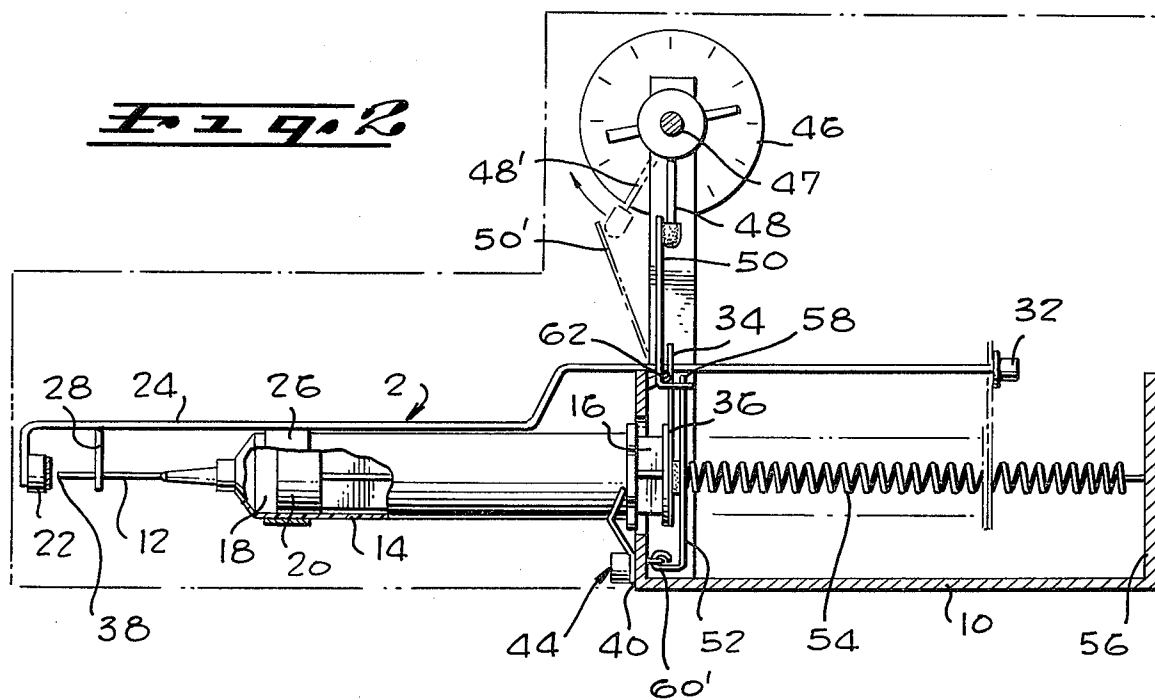
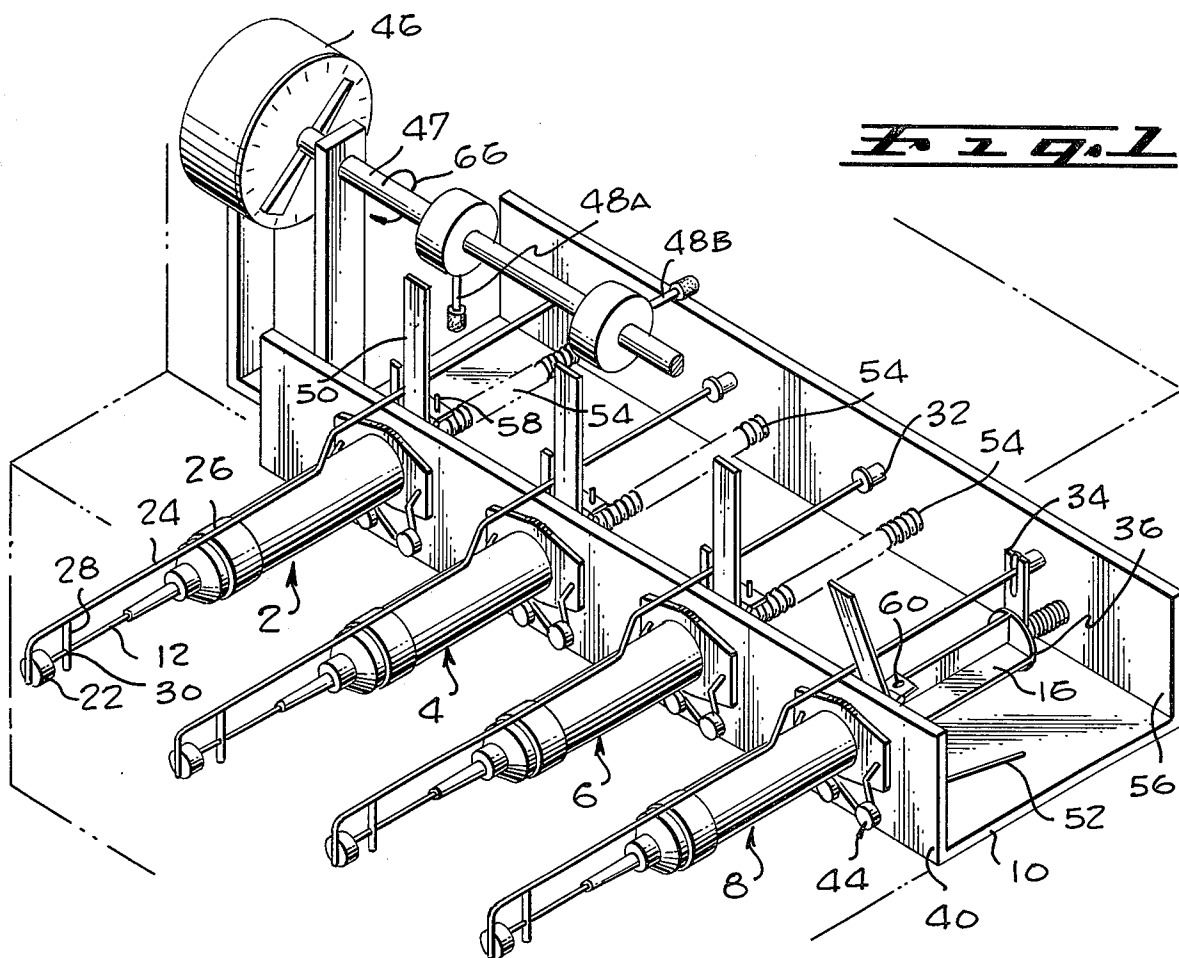
Primary Examiner—S. Clement Swisher
Attorney, Agent, or Firm—Eric T. S. Chung

[57] ABSTRACT

An automated sequential air sampler that is highly suitable for being remotely situated to obtain a plurality of air samples at predetermined intervals of time over an extended time period, is disclosed. The air sampler includes a plurality of piston pumps that may be in the form of hypodermic syringes. Each pump operates to obtain an air sample whenever a plunger thereof is retracted to have air drawn through an inlet needle into an interior chamber thereof. The inlet to each pump is automatically sealed by having the inlet needle thereof covered by a septum that is drawn against said inlet with a guide rod on which it is mounted and in response to the plunger reaching the end of its stroke. Sequential retraction of the several syringe plungers is accomplished by operation of a timed retractor assembly which functions to retract individual plungers at predetermined intervals of time.

37 Claims, 11 Drawing Figures





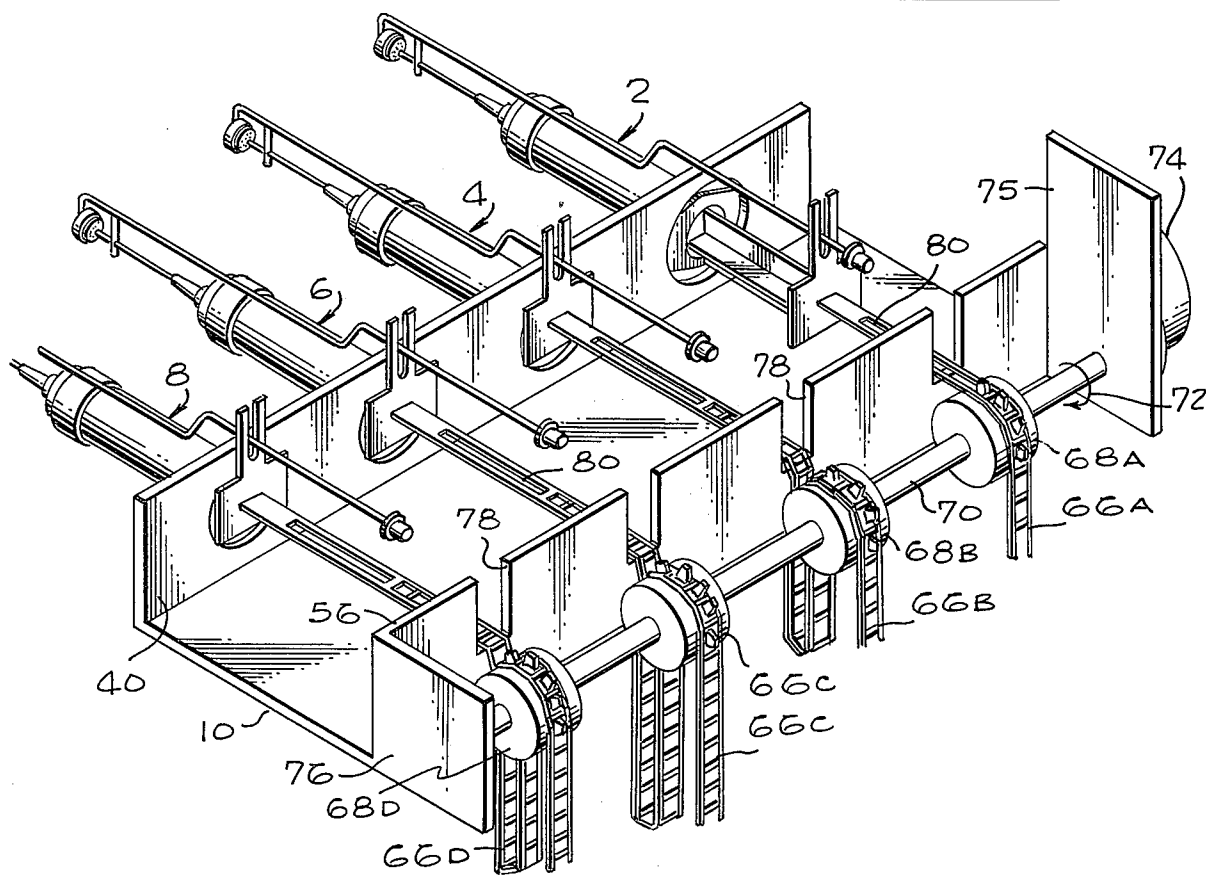
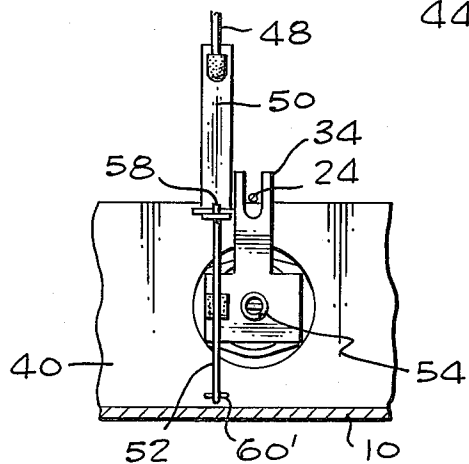
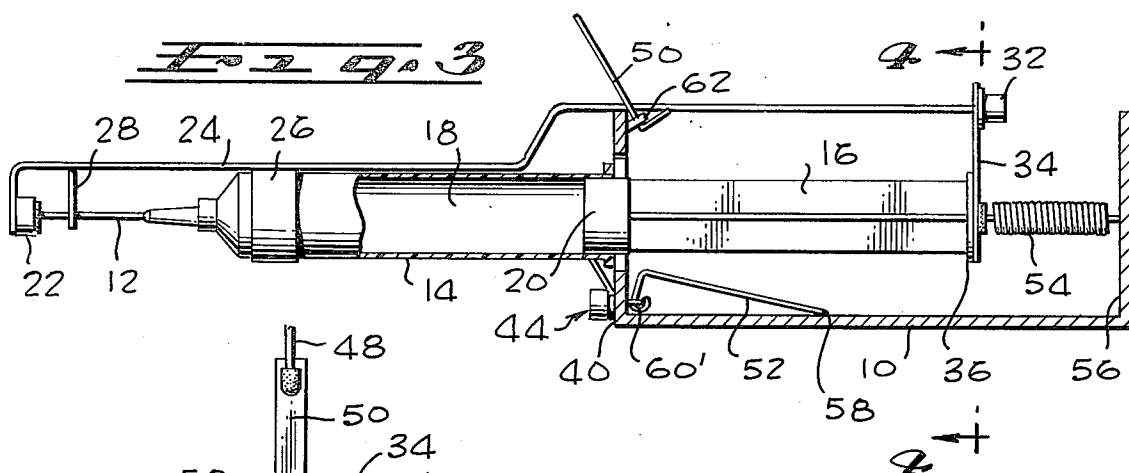


Fig. 6

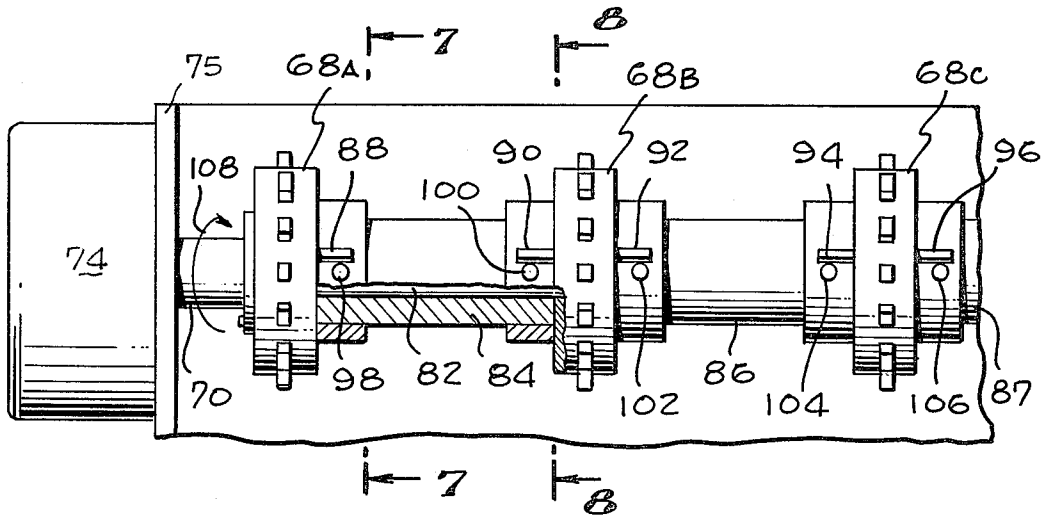


Fig. 7

Fig. 8

Fig. 10

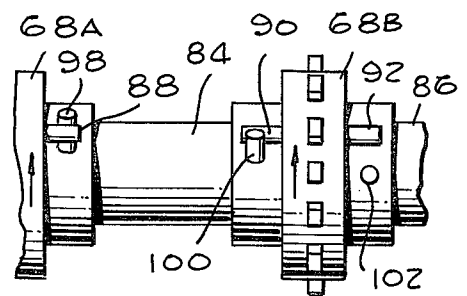
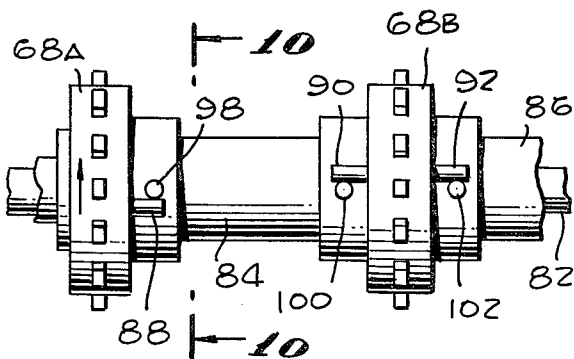
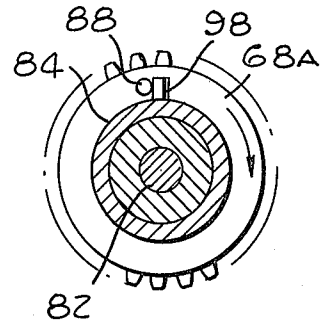
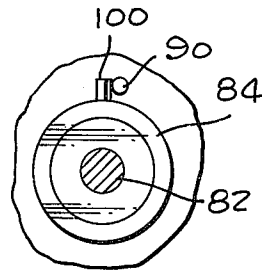
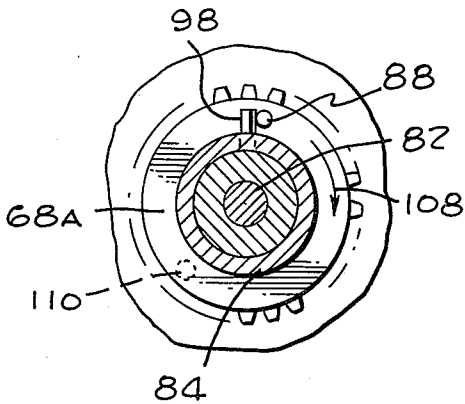


Fig. 11

Fig. 9

AUTOMATED SEQUENTIAL AIR SAMPLER

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention generally relates to air sampling devices. More specifically, the present invention concerns an automated sequential air sampler that is particularly suitable for remotely obtaining a plurality of air samples at spaced predetermined intervals of time.

2. Description of the Prior Art

Atmospheric studies such as may be attendant to air pollutant monitoring requires that ambient air samples be obtained for analysis. Typically, such samples may be obtained manually and returned to a laboratory for analysis. Obtaining samples at different time intervals in the course of a day or other time period may typically involve a person being required to make several trips to and from the site at which the air samples are to be taken, i.e., the vicinity of a factory, a downtown area, a mountain top, etc. In the alternative, the person taking the air sample may choose to remain at the site at which samples are being taken for the entire time period during which samples are desired. Economic considerations, such as the cost of manpower, obviously make highly desirable the availability of an automated sequential air sampler that can be readily implaced and later retrieved after several air samples have been automatically obtained.

There are currently available sequentially operated instruments that are designed to collect particulate matter in the air. Also available are instruments that operate to continuously collect certain gaseous compounds by absorption in a liquid solution. Most of such units are either not portable or difficult to transport. Such prior art devices are also fairly expensive.

Numerous air sampling devices designed for manual operation have been heretofore used. As an example, evacuated stainless steel containers, plastic bags, and plastic squeeze bottles have been used. Piston pumps in the form of hypodermic syringes have also been employed. However, such prior art devices have in the past been primarily employed as single units and have not been used in combination to provide an automated sequential air sampler capable of obtaining several air samples at predetermined time intervals and without the requirement that an operator or other attendant be present.

One of the prime difficulties that has thwarted successful design of a portable sequential air sampler is the need for an effective means for sealing the container in which the air sample is contained once it is obtained. An acceptable solution must be effective, simple, easy to manufacture, and capable of being reliably activated after each sample is obtained.

Accordingly, it is the intention of the subject invention to provide an automated sequential air sampler that is simple, capable of being economically manufactured, and effective to obtain plural air samples at predetermined time intervals without requiring the continuous presence of an operator or other attendant.

SUMMARY OF THE INVENTION

Briefly described, the present invention involves an air sampling device that is capable of being remotely situated for the purpose of obtaining air samples at predetermined time intervals over a selected period of

time without the need for manual operation of individual sampling units forming a part thereof.

More particularly, the subject automated air sampler includes a plurality of piston pumps each adapted to have the plunger thereof retracted at scheduled time intervals to have air samples drawn into the interior cavity of each said pump. The input through which air is drawn into said cavity is automatically sealed by automatic placement of a septum over said inlet in response to a guide rod on which said septum is mounted interacting with said plunger at the end of its stroke. Retraction of the individual plungers is accomplished with a retractor assembly that is attached to each of said plungers and which is designed to retract individual plungers only at scheduled time intervals.

The objects and many attendant advantages of the invention will be more readily appreciated as the same becomes better understood by reference to the following detailed description which is to be considered in connection with the accompanying drawings wherein like reference symbols designate like parts throughout the figures thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic diagram illustrating a perspective view of a first embodiment of an automated sequential air sampler in accordance with the present invention.

FIG. 2 is a schematic diagram illustrating an end view of the air sampler device shown in FIG. 1.

FIG. 3 is a schematic diagram illustrating a piston pump that is useable for forming individual air sampling units in accordance with the present invention.

FIG. 4 is a schematic diagram illustrating an end view of the piston pump shown in FIG. 3.

FIG. 5 is a schematic diagram illustrating a perspective view of a second embodiment of an automated air sampler in accordance with the present invention.

FIG. 6 is a top view of an alternative timed retractor assembly that is useable with an automated air sampler in accordance with the present invention.

FIGS. 7 and 8 are schematic diagrams illustrating crosssectional views of the retractor assembly shown in FIG. 6.

FIG. 9 is a schematic diagram illustrating a partial top view of the retractor assembly illustrated by FIG. 6 after a first section thereof has nearly completed a rotation to be in position to activate a second section thereof.

FIG. 10 is a schematic diagram illustrating a cross-sectional view of the retractor assembly shown in FIG. 9.

FIG. 11 is a schematic diagram illustrating a further view of the retractor assembly shown in FIG. 9 after a second section thereof has commenced operation.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawings, FIGS. 1 through 4 illustrates a first embodiment of an automated sequential air sampler in accordance with the present invention. As shown, an air sampler includes a plurality of piston pumps 2, 4, 6, and 8 which are removably mounted on a supporting channel plate 10. Each piston pump 2, 4, 6 and 8 essentially includes an inlet needle 12, a cylindrical housing 14, and a piston-like plunger 16 which functions to draw air through the inlet needle 12 into

the interior cavity 18 of the housing 14 when the plunger 16 is retracted. Conversely, full insertion of the plunger 16 into the interior cavity 18 of the housing 14 will evacuate said cavity 18 by forcing air therein to be ejected through the inlet needle 12. The plunger 16 may be suitably equipped to have a disk seal 20 at the interior tip thereof which seal 20 is preferably sized to snugly fit within, and abut, the interior walls of the cylindrical housing 14 to thereby form an airtight seal in a manner well known in the prior art. A somewhat resilient material such as rubber may be used as the seal 20.

Sealing of the individual piston pumps 2, 4, 6 and 8 after an air sample has been drawn into the interior cavity 18 thereof, is required to maintain the sample until such time as it can be transported to a laboratory or like facility for analysis. Sealing of individual piston pumps is accomplished with a septum 22 that may be mounted at one end of a guide rod 24. As shown, the guide rod 24 is slidably maintained on the piston pump to which it corresponds by a guide ring 26 and a positioning arm 28.

The guide ring 26 should be appropriately sized to have the interior diameter thereof be slightly larger than the exterior diameter of the housing 14 to permit the guide ring 26 and the guide rod 24 to be easily moved or slid along the axis of the housing 14.

Similarly, the positioning arm 28 may be provided with an aperture 30 through which the input needle 12 is extended. The size or diameter of the aperture 30 should be sufficiently large to accommodate the outer diameter of the needle 12 and thereby permit sliding of the positioning arm 28 along the length of the needle 12.

The opposite end of the guide rod 24 is provided with an enlarged stop disc 32. The stop disc 32 is situated to engage a pair of upstanding arms formed on a U-plate 34 which is attached to the exterior end 36 of the plunger 16. As shown, the guide rod 24 extends between said upstanding arms such that upon near full retraction of the plunger 16, the upstanding arms of the U-plate 34 will contact the stop disc 32 and move or pull the guide rod 24 laterally rearward with respect to the piston pump as the plunger 16 continues to full retraction. Upon such full retraction of the plunger 16, the septum 22 will abut the tip 38 of the input needle 12. The tip 38 is preferably squared to promote an air tight seal when covered by the septum 22.

Clearly, the guide rod should have a length that would permit the septum 22 to abut the tip 38 of the input needle 12 when the plunger 16 is fully retracted in accordance with the invention. To this end, fine adjustments of the distance between the face of the septum 22 and the stop disc 32 may be provided for by having either, or both, the septum 22 and the stop disc 32 movably mounted on the guide rod 24 to allow forward or rearward adjustments. For example, the stop disc 32 may be threaded on the end of the guide rod 24 to allow turning and thereby permit adjustment of its distance from the septum 22. Similarly, the septum 22 may be attached to the end of the guide rod 24 with a mount that is threaded therethrough to allow forward and rearward adjustment.

The septum 22 may be made of any resilient material such as rubber or the like. The entire septum 22 need not be made of resilient material; however, the fact thereof contacting the needle 12 should be made of such resilient material. In such case, for example, a disc

of rubber material may be appropriately maintained in a cup-like receptacle which is in turn mounted on the forward end of the guide rod 24.

Referring to FIG. 1, each of the piston pumps 2, 4, 6 and 8 are mounted on the channel plate 10 by being extended through an appropriately sized hole in a front wall 40 thereof. The rearward end of the housing 14 of each pump is provided with a flange 12, or the like, which is somewhat larger than the holes provided in the forward wall 40 of the channel plate 10. Any appropriate means, such as a thumb screw and mounting wire combination 44, may be used to removably secure the individual pumps to the forward wall 40. The plunger 16 of each of the pumps 2, 4, 6 and 8 hence would be drawn across the channel plate 10 as it is retracted.

The U-plates 34 are attached to be removably clipped onto the exterior end 36 of the respective plungers 16 so as not to impede or hinder the mounting and/or removal of piston pumps on the forward wall 40 of the channel plate 10. Accordingly, assembling the subject sequential air sampler in preparation for the obtaining of air samples would initially simply involve fastening each of the piston pumps to the channel plate by manipulation of the thumb screw assembly 44, positioning a guide rod 24 on each pump, and attaching a U-plate 34 to the exterior end 36 of the piston 16 to each pump. Conversely, removal of the pumps for air analysis would simply require manipulation of the thumb screw assembly 44 and removal of the U-plate 34 to allow the individual pumps to be removed.

Although four piston pumps have been illustrated, it is to be understood that a greater or lesser number of pumps may be employed.

Operation of the individual piston pumps at predetermined time intervals may be accomplished by the use of a timed retractor assembly that would be necessarily connected to the individual plungers 16 of the respective pumps to produce retraction thereof. FIGS. 1 through 4 illustrate a first embodiment of a suitable timed retractor assembly that would be useable in accordance with the subject invention. FIG. 5 illustrates a second embodiment of a retractor assembly while FIGS. 6 through 11 illustrate a third embodiment of a retractor assembly that would be suitable.

Referring to FIGS. 1 through 4, a said first embodiment of a suitable timed retractor assembly includes a rotary mechanical timer 46 that rotates an armature 47 on which a plurality of trigger arms 48 are mounted to contact and move corresponding L-shaped lever arms 50. Forward movement of said L-shaped lever arms 50 cause release of the retention pins 52 respectively associated therewith. Coil springs 54 are used to provide a spring tension on each of the individual plungers 16. As shown, a coil spring 54 is attached between the exterior end 36 of each plunger 16, through the U-plate 34 as is necessary, and the rearward wall 56 of the channel plate 10.

When the individual plungers 16 are fully inserted into the interior chambers 18 of the housing 14 of the respective pumps, the associated spring 54 attached thereto is expanded or stretched as shown in FIG. 2 and in FIG. 1 with respect to the pumps 2, 4, and 6. The individual plungers 16 are retained in such an inserted position by having the tip 58 of a corresponding pin 52 inserted through an aperture 60 on the L-shaped lever arm 50 as shown by FIGS. 2 and 4. The opposite end 60' of the retention pin 52 may be suitably anchored or

fastened to a face of the forward wall 40 of the channel plate 10 by being looped through an anchor provided on the wall 40 for this purpose. As shown in FIG. 2, continued rotation of a trigger arm 48 first results in contact with an associated L-shaped lever arm 50 and finally forward movement of such lever arm 50, as shown by the phantom lines 48' and 50' of FIG. 2. Such forward movement of the L-shaped lever arm 50 causes a pivoting movement with respect to a retainer 62 and thereby permits the tip 58 of the retention pin 52 to be extracted from the aperture 60 and thereby become disengaged from its associated L-shaped lever arm 50. The resulting contraction of the associated spring 54 causes retraction of the plunger 16 as is shown by FIG. 3. An air sample is thereby drawn into the interior cavity 18 of the housing 14 through the input needle 12. As earlier explained, the septum 22 is pulled rearwardly by lateral movement of the guide rod 24 in response to interaction of the stop disc 32 and the U-plate 32 as the plunger 16 reaches full retraction.

The time at which the individual L-shaped lever arm 50 are contacted by corresponding trigger arms 48 may be readily predetermined and adjusted for by rearrangement of the relative radial positioning of the trigger arms 48 with respect to each other about the armature 47. Referring to FIG. 1, let it be assumed that the rotary mechanical timer causes the armature 47 to be rotated in the direction of the arrow 66. The trigger arm 48A would then contact its corresponding L-shaped lever arm 50 before trigger arm 48B reaches its corresponding L-shaped lever arm 50. As shown, if the displacement between the trigger arms 48A and 48B is approximately 90° and the mechanical timer 46 is designed to rotate the armature 47 at a rate of one revolution per hour, all pumps would be actuated within one hour and the piston pumps 2 and 4 would be successively actuated in an interval of 15 minutes. Clearly, by employing rotary mechanical timers or any other movers that are designed to rotate the armature 47 at a different rate, the time period over which all piston pumps would be actuated can be made longer or shorter as is desired. Correspondingly, the time intervals between the actuation of successive piston pumps can be varied.

Referring now to FIG. 5, an alternative timed retractor assembly may include the use of a plurality of chains 66A through 66D, such as ladder chains, each having a different length. One end of each of the chains 66A through 66D is connected to the end 36 of the piston 16 to be retracted thereby via its U-plate 34 as may be necessary. As shown, the other end of each chain 66A through 66D is situated to be engaged by a corresponding one of the drive sprockets 68A through 68D which have the conventional plurality of radially extending teeth. The sprocket wheels 68A through 68D are mounted on an armature 70 which is connected to be rotated, i.e., in the direction indicated by an arrow 72, by an appropriate motor 74 of conventional design. The armature 70 may be supported at its ends by being appropriately mounted on and/or through a pair of support panels 75 and 76 which may be a part of or attached to the rearward wall 56 of the channel plate 10. A plurality of notches or cut-out portions 78, as shown, may be fashioned in said rearward wall 56 to allow the respective chains 66A through 66D to be generally drawn along the longitudinal axis of the pistons 16 to which the chains are attached.

In operation, as the armature 70 and hence the respective sprocket wheels 68A through 68D are rotated by operation of the motor 74, each of the chains 66A through 66D are drawn over associated sprockets with which each is engaged. The specific times at which the individual piston pumps are actuated by having the plungers 61 thereof retracted, is determined by the length of the chain attached thereto. The longer the length of a chain, the more delayed will be the actuation of the pump attached thereto due to the requirement that extra or slack portions of the chain must first be drawn across a sprocket before a plunger to which the chain is attached will commence to be retracted. Clearly, to have successive actuation of pumps, the chains 68A through 68D would be successively longer. The actual length of chain that must be used to provide any desired time of actuation would be calibrated for, or tailored to, a specific rate of rotation of the armature 70 and/or the motor 74. Any conventional motor may be used. Preferably, a motor that can be adapted to be operated with a portable power pack, i.e., battery, electrical, etc. would be advantageous for operation at remote sites.

In the embodiment of FIG. 5 the rate at which a plunger 16 is retracted may also be varied by simply altering the diameter of the sprocket wheels 68A through 68D. The rate of retraction would be increased as the diameter of a sprocket is decreased. It is noted that in the embodiment illustrated by FIGS. 1 through 4, the plungers 16 are quickly retracted to effectively obtain what may be considered in a practical sense as an instantaneous air sample. By comparison, slow withdrawal of the plungers 16, as may be accomplished by the embodiment of FIG. 5, would permit the collection of an air sample over a somewhat extended time period to provide what is sometimes referred to as an "integrated" air sample.

Each of the chains 66A through 66D are provided with an extended channel 80 such that upon the plunger 16 to which the chain is attached being fully retracted, such channel 80 eliminates engagement of a chain with the teeth of its associated sprocket and permits the chain to simply slip with respect to the sprocket wheel so as to prevent complete withdrawal of the plunger 16 from its cylindrical housing 14. Clearly, the rate at which the chains 66A through 66D are drawn by the respective sprockets 68A through 68D depends on the rate of rotation thereof and can be as fast or as slow as is desired. It is to be understood that the respective chains may be attached in any convenient manner to the plungers 16 and/or the U-plates 34 such as by simply having a hook and eye arrangement (not illustrated).

A further embodiment of a timed retractor assembly suitable for use with the subject invention is illustrated by FIGS. 6 through 11. The individual chains 66A through 66D have been omitted for the purpose of brevity and simplification of the drawings. Referring to FIG. 6, it may be observed that the drive motor 74 is positioned to have the armature 70, or an extension thereof, extended through the support panel 75. The armature is shortened in this embodiment and is attached to the closest sprocket 68A. The next positioned sprockets 68B and 68C are freely rotatable about an axle 82. Similarly, drive spacers or spools 84 and 86 which are situated between successive sprockets, i.e., drive spacer 84 is positioned between sprock-

ets 68A and 68B while drive spacer 86 is situated between sprockets 68B and 68C, are mounted to be freely rotatable about the axle 82.

As shown by FIG. 6, the sprockets 68A, 68B and 68C are equipped with pins which laterally extend out of the side walls of the respective sprockets. For example, the sprocket 68A is provided with a pin 88, sprocket 68B is provided with pins 90 and 92, and sprocket 68C is provided with pins 94 and 96. Additional sprockets would be similarly constructed. Spacers 84 and 86 are provided with pins which extend radially from enlarged portions at either end thereof. Specifically, spacer 84 is provided with pins 98 and 100 while spacer 86 is provided with pins 102 and 104. The next successive spacer 87 between spacer 68C and 68D (not shown) would have a similar pair of pins including the pin 106.

Assuming that the respective pins 88, 90, 92, 94, 96, 98, 100, 102, 104 and 106 are initially situated as shown in FIG. 6, rotation of the armature 70 in the direction indicated by the arrow 108 will cause rotation of the first sprocket 68A connected thereto without any rotational effect on the remaining spacers and sprockets freely supported on the axle 82. FIGS. 7 and 8 illustrate side cross-sectional views of the sprocket 68A and the spacer 84, respectively, in their initial positions as shown by FIG. 6. As a near complete rotation of the sprocket 68A is completed, the pin 88 will be positioned behind the pin 98, as shown by FIGS. 9 and 10, such that continued rotation of the sprocket 68A will produce rotation of the spacer 84 and also the sprocket 68B by reason of the interaction of pins 90 and 100, as shown by FIG. 11. Rotation of the sprockets 68A and 68B and the intervening spacer 84 will leave the next successive spacer 86 unaffected. Upon near completion of a rotation of the sprocket 68B, the pin 92 will become positioned behind the pin 102 of the spacer 86. Continued rotation of the sprocket 68B will produce rotation of the spacer 87 and a sprocket associated therewith in unison with the already rotating sprockets 68A and 68B and spacers 84 and 86.

It is clear that by altering the initial positions of the pins on the sprockets with respect to the pins on the spacers, the time at which the next successive adjacent sprocket would be driven can be prescheduled. For example, were the pin 88 repositioned to be 180° away from its position shown in FIGS. 7 and 8, i.e., as shown by the dotted circle 110 in FIG. 7, the interval between the start of sprocket 68A and the start of sprocket 68B would be cut in half assuming that the pins 90 and 100 are initially positioned as shown in FIGS. 6 and 8. Similarly, as a further example, if the pins 88 and 98 are initially positioned as shown in FIGS. 6 and 7, but the positions of the pins 90 and 100 are reversed to have the pin 100 be in front of rather than in back of the pin 90, the spacer 84 would complete on full rotation before the pin 100 would be positioned behind the pin 90 and thereby commence driving the sprocket 68B by continued rotation. The interval of time between the start of sprocket 68A and the start of sprocket 68B would thereby be effectively near doubled in that sprocket 68A would be required to make a complete rotation before causing rotation of the spacer 84 which in turn would be required to complete a near full rotation before engaging the sprocket 68B.

The sprockets 68A, 68B, etc. may readily be provided with a circular grouping of holes along the periphery, and in the sides, thereof to accommodate

movement of the pins 88, 90, 92, etc. to different positions thereon and thereby permit adjustment, in smaller increments, of the time intervals between rotation of successive sprockets. Similarly, the spacers 84, 86, etc. may be provided with a series of holes to accommodate movement of the pins 98, 100, 102 etc. thereon to also allow finer time adjustments.

Although operation of the embodiment of FIGS. 6 through 11 has been described without reference to drive chains, it is clear that chains similar to the chains 66A through 66D would be used to retract that respective plunger 16 by being connected thereto.

It is further clear that in addition to using the drive mechanism of FIGS. 6 through 11 to alter the time intervals between the start of successive sprockets and hence the retracting of corresponding pistons 16, the length of the chains 66A through 66D may also be varied as was described in conjunction with FIG. 5, to further increase or decrease the intervals of time between actuation of successive pistons. Further, the diameter of the individual sprockets 68A, 68B, 68C etc. can be increased or decreased to thereby alter the speed at which the individual pistons are retracted as was earlier explained.

It is to be understood that although a single motor for operating a plurality of piston pumps has been discussed in the foregoing description, the subject invention may be constructed to have separate motors for each of the piston pumps wherein the individual motors are timely energized to have pumps operated in accordance with a desired time schedule.

From the foregoing it is now clear that the subject invention provides an automated sequential air sampler that is simple in construction and readily portable, and which would be highly effective in obtaining air samples without the need for manual operation of the individual air sampling units or for continuous attention of an attendant.

While a preferred embodiment of the present invention has been described hereinabove, it is intended that all matter contained in the above description and shown in the accompanying drawings be interpreted as illustrative and not in a limiting sense and that all modifications, constructions and arrangements which fall within the scope and spirit of the invention may be made.

What is claimed is:

1. An air sampling device for obtaining a plurality of air samples at scheduled time intervals, said air sampling device comprising:

a plurality of piston pumps each having a housing forming an interior chamber, an inlet port member communicating with said chamber, and a plunger which is partially retracted from within said chamber of said housing to draw air into said chamber through said inlet port member when a said piston pump is actuated;

a plurality of sealer means respectively connected to a different one of said pumps for sealing off said inlet port member thereof in response to the plunger thereof being partially retracted from within the chamber thereof by a predetermined distance; and

actuator means for actuating each of said plurality of pumps at scheduled time intervals.

2. The device defined by claim 1, said piston pumps being elongate and further including a stopper arm attached to said plunger, said sealer means including:
 an elongated member positioned to extend along the length of a pump associated therewith; and
 cover means attached at an end of said elongate member for preventing the passage of air through an inlet port member when positioned to cover said inlet port by being drawn thereagainst in response to being engaged by said stopper arm when said plunger is retracted by said predetermined distance.
3. The device defined by claim 2, said elongate member further including a nub attached on said elongate member to be engaged by said stopper arm, said stopper arm having a central groove for receiving said elongate member therein, said stopper arm engaging said nub on said elongate member to draw said cover means against said inlet port.
4. The device defined by claim 3, said cover means and said nub being movably on said elongate member to allow adjustment of the distance therebetween.
5. The device defined by claim 4, wherein the distance between said cover means and said nub is equal to the distance between the tip of said inlet port member and the outermost end of a plunger when retracted by said predetermined distance.
6. The device defined by claim 2, said sealer means further including:
 a positioning arm attached to and extending from said elongate member, said positioning arm having an aperture for receiving said inlet port member which is extended therethrough; and
 a guide member attached to said elongate member for slideably moving with respect to said housing of an associated pump for guiding said elongate member when moved with respect to said housing.
7. The device defined by claim 1, said air sampler device further including a mount on which said plurality of piston pumps are removably mounted, said mount configured to have first and second walls connected to a base panel to form a channel therebetween, said plurality of piston pumps being attached to said first wall.
8. The device defined by claim 7, said actuator means including:
 a plurality of retention means respectively associated with each of said pumps for maintaining said plunger thereof within said interior chamber of the housing thereof;
 a plurality of retracting means respectively connected to a plunger of one of said pumps for retracting a plunger connected thereto by said predetermined distance in response to an associated retention means being released; and
 trigger means for releasing each of said retention means at scheduled time intervals.
9. The device defined by claim 8, said retracting means including a spring which is attached between the outermost end of a plunger to be retracted and said second wall of said channel mount.
10. The device defined by claim 8, said retention means including a latching pin and a latching arm having means for receiving said latching pin and thereby maintaining said latching pin in a position preventing retraction of a plunger retained thereby, said latching arm being mounted to be pivoted by said trigger means, whereby said latching pin is released by said latching

arm when pivoted by said trigger means to allow retraction of said plunger.

11. The device defined by claim 10, said trigger means including:

- an armature;
- a plurality of trigger arms mounted on said armature; and

means for rotating said armature about the longitudinal axis thereof whereby said trigger arms are moved to contact and thereby cause pivoting of said latching arms to produce release of corresponding latching pins and consequent retraction of plungers retained thereby.

12. The device defined by claim 11, wherein the trigger arms are mounted on said armature at radial angles with respect to the longitudinal axis thereof that are determinative of the time interval at which individual ones of said plurality of pumps are actuated.

13. The device defined by claim 1, said actuator means including:

- a plurality of retracting means respectively connected to a plunger of a different one of said plurality of pumps for retracting the plunger connected thereto at predetermined times; and

timing means for initiating the retraction of the respective plungers of said plurality of pumps in accordance with a predetermined time schedule.

14. The device defined by claim 13, said plurality of retracting means each including a chain and having a predetermined different length, a first end portion of each chain connected to the outermost end of a different one of said plungers, a second end portion of each chain connected to said timing means, said chains being drawn away from said plungers by said timing means.

15. The device defined in claim 14, the lengths of said chains determining the succession in which the plungers connected thereto are retracted, the plunger connected to the shortest chain being retracted first and the plunger attached to the longest chain being retracted last.

16. The device defined by claim 13, said timing means including:

- a plurality of sprockets each positioned to be engageable with a different one of said retracting means; and

mover means for driving said sprockets to have said retracting means engaged therewith retract plungers connected thereto at said predetermined times.

17. The device defined by claim 16, said mover means including an armature that is adapted to be rotated about the longitudinal axis thereof, said armature being connected to at least one of said sprockets to cause rotation thereof.

18. The device defined by claim 14, said timing means including:

- a plurality of sprockets each positioned to engage a different one of said chains; and

mover means for causing said sprockets to be rotated to have chains engaged therewith drawn in a direction away from the plungers connected thereto to produce retraction of said plungers connected thereto.

19. The device defined by claim 18, said sprockets each having a diameter corresponding to a desired rate at which an associated plunger is to be retracted.

20. The device defined by claim 19, wherein said mover means is connected to rotate said sprockets in unison.

21. The device defined by claim 19, wherein said mover means is connected to rotate said sprockets successively.

22. The device defined by claim 5, said air sampler device further including a mount on which said plurality of piston pumps are removably mounted, said mount configured to have first and second walls connected to a base panel to form a channel therebetween, said plurality of piston pumps being attached to said first wall.

23. The device defined by claim 22, said actuator means including:

a plurality of retention means respectively associated with each of said pumps for maintaining said plunger thereof within said interior chamber of the housing thereof;

a plurality of retracting means respectively connected to a plunger of one of said pumps for retracting a plunger connected thereto by said predetermined distance in response to an associated retention means being released; and

trigger means for releasing each of said retention means at scheduled time intervals.

24. The device defined by claim 23, said retracting means including a spring which is attached between the outermost end of a plunger to be retracted and said second wall of said channel mount.

25. The device defined by claim 14, said retention means including a latching pin and a latching arm having means for receiving said latching pin and thereby maintaining said latching pin in a position preventing retraction of a plunger retained thereby, said latching arm being mounted to be pivoted by said trigger means, whereby said latching pin is released by said latching arm when pivoted by said trigger means to allow retraction of said plunger.

26. The device defined by claim 25, said trigger means including:

an armature;

a plurality of trigger arms mounted on said armature; and

means for rotating said armature about the longitudinal axis thereof whereby said trigger arms are moved to contact and thereby cause pivoting of said latching arms to produce release of corresponding latching pins and consequent retraction of plungers retained thereby.

27. The device defined by claim 26, wherein the trigger arms are mounted on said armature at radial angles with respect to the longitudinal axis thereof that are determinative of the time intervals at which individual ones of said plurality of pumps are actuated.

28. The device defined by claim 5, said actuator means including:

a plurality of retracting means respectively connected to a plunger of a different one of said plurality of pumps for retracting the plunger connected thereto at predetermined times; and

timing means for initiating the retraction of the respective plungers of said plurality of pumps in accordance with a predetermined time schedule.

29. The device defined by claim 28, said plurality of retracting means each including a chain and having a predetermined different length, a first end portion of

each chain connected to the outermost end of a different one of said plungers, a second end portion of each chain connected to said timing means, said chains being drawn away from said plungers by said timing means.

30. The device defined by claim 29, the lengths of said chains determining the succession in which the plungers connected thereto are retracted, the plunger connected to the shorter chain being retracted first and the plunger attached to the longest chain being retracted last.

31. The device defined by claim 29, said timing means including:

a plurality of sprockets each positioned to be engageable with a different one of said retracting means; and

mover means for driving said sprockets to have said retracting means engaged therewith retract plungers connected thereto at said predetermined times.

32. The device defined by claim 29, said sprockets each having a diameter corresponding to a desired rate at which as associated plunger is to be retracted.

33. The device defined by claim 32, wherein said mover means is connected to rotate said sprockets in unison.

34. The device defined by claim 32, wherein said mover means is connected to rotate said sprockets successively.

35. The device defined by claim 33, said mover means including an armature that is adapted to be rotated about the longitudinal axis thereof, said armature being connected to at least one of said sprockets to cause rotation thereof.

36. An air sampling device for successively obtaining a plurality of air samples, said device comprising:

a plurality of air sampler units each including a cylindrical housing defining an interior cavity, an inlet needle connected to said cavity, and a piston-like plunger housed in said cavity for drawing an air sample through said inlet needle into said cavity as said plunger is partially withdrawn from said cavity;

a plurality of stopper means respectively connected with a different one of said sampler units for covering the inlet needle thereof in response to the plunger thereof being withdrawn from the cavity thereof by a predetermined distance, said stopper means serving to prevent the escape of an air sample through the inlet needle covered thereby;

retractor means connected to the plungers of said sampler units for partially withdrawing each plunger for said predetermined distance in accordance with a selected time schedule.

37. An air sampling device for automatically obtaining an air sample, said device comprising:

an air sampler unit including a housing defining an interior cavity, an inlet needle connected to said cavity, and a piston-like plunger housed in said cavity for drawing an air sample through said inlet needle into said cavity as said plunger is partially withdrawn from said cavity;

stopper means connected with said sampler unit for covering said inlet needle in response to the plunger thereof being withdrawn from said cavity by a predetermined distance, said stopper means serving to prevent the escape of an air sample through said inlet needle covered thereby;

retractor means connected to said plunger for partially withdrawing said plunger for said predetermined distance.

* * * * *