

Nov. 24, 1953

A. W. UHL

2,660,052

APPARATUS FOR DETECTING SUSPENDED MATTER IN FLUIDS

Filed May 18, 1950

2 Sheets-Sheet 1

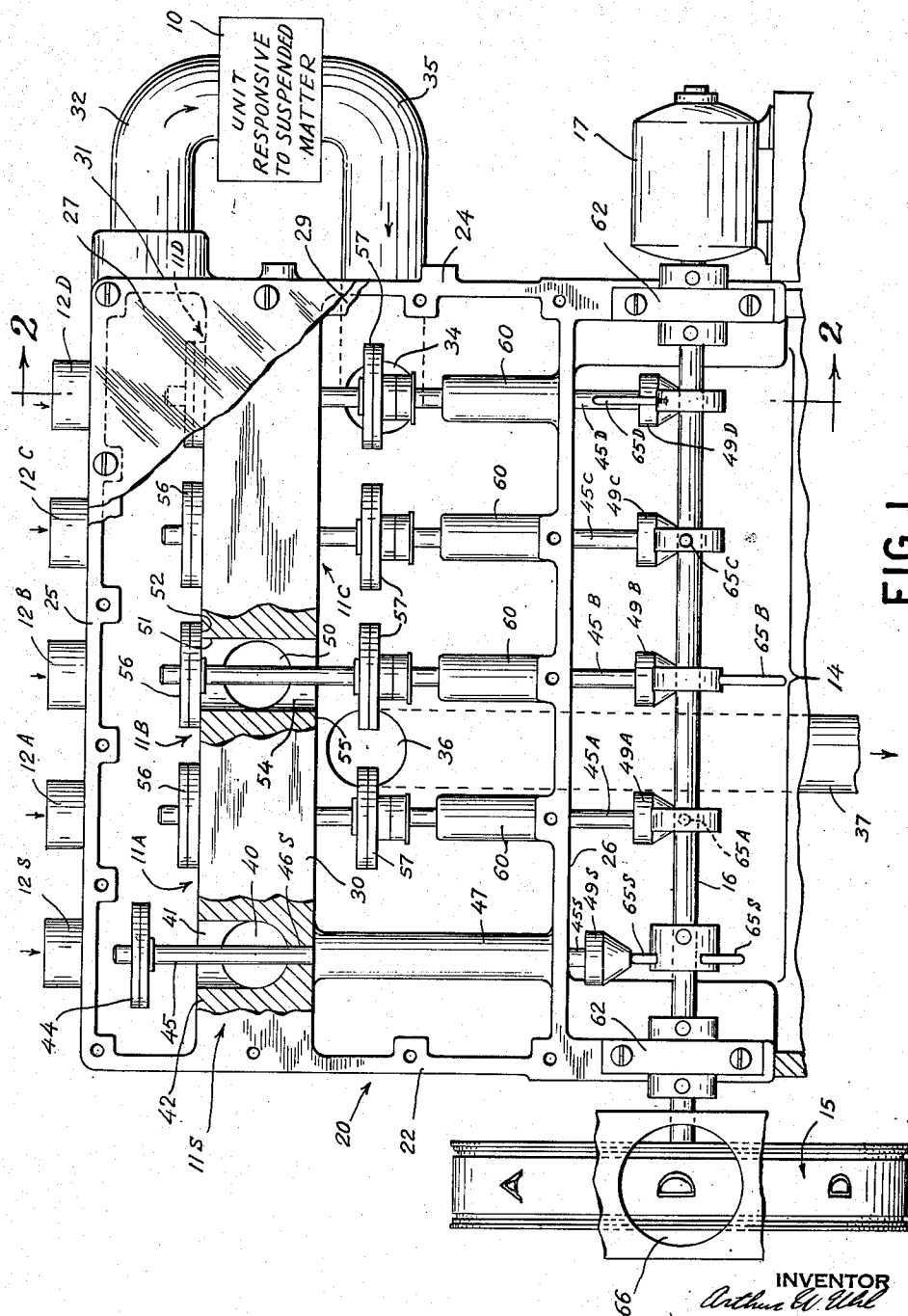


FIG. 1

INVENTOR
Arthur W. Uhl
BY
Ernest A. Berren
ATTORNEY

Nov. 24, 1953

A. W. UHL

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2 Sheets-Sheet 2

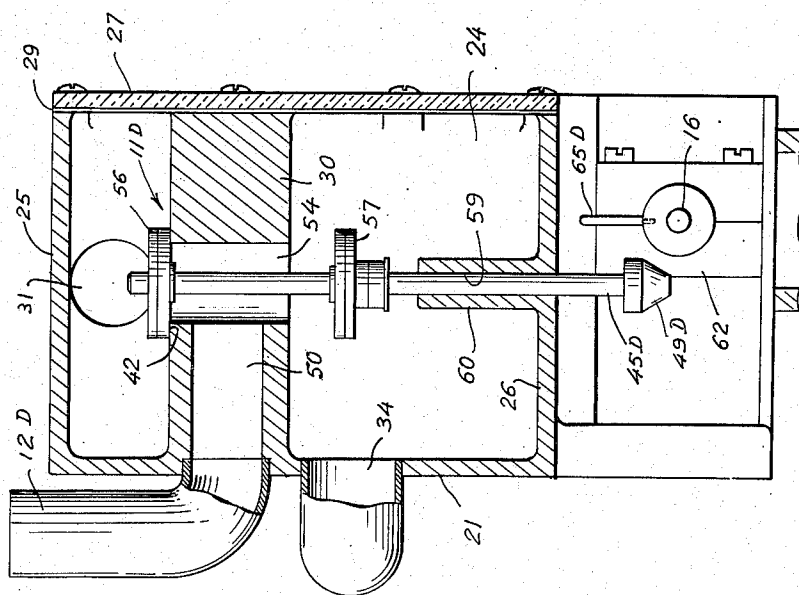


FIG. 2

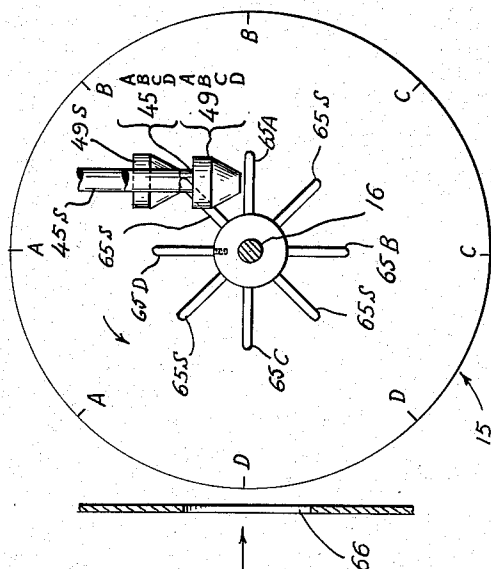


FIG. 3

INVENTOR
Arthur W. Uhl
 BY
Ernest A. Jensen
 ATTORNEY

UNITED STATES PATENT OFFICE

2,660,052

APPARATUS FOR DETECTING SUSPENDED
MATTER IN FLUIDS

Arthur W. Uhl, Inwood, N. Y., assignor to Specialties Development Corporation, Belleville, N. J., a corporation of New Jersey

Application May 18, 1950, Serial No. 162,643

8 Claims. (Cl. 73—28)

1

The present invention relates to apparatus for detecting the presence and origin of suspended matter in fluids, such as smoke in air; and, more particularly, relates to improvements over apparatus of the type disclosed in Letters Patent of the United States No. 2,034,281.

As disclosed in the aforementioned patent, it has been found desirable to successively sample the atmosphere of a plurality of spaces, such as cargo holds, storage vaults or the like in which fire may occur, to detect the presence of smoke and to give an indication of the origin of the smoke in response to the detection thereof. One of the difficulties heretofore encountered with such apparatus has been that the sampling means, the smoke responsive means and the indicating means have failed to cooperate to properly indicate in which space the smoke originated. This difficulty has been due primarily to the fact that, by the time a sample from a given space was directed to the responsive means and an indication could be given in response to smoke therein, the sampling and indicating means of the apparatus were advanced to a succeeding position associated with another space, whereby, if smoke was detected in the sample from the given space, it was falsely indicated that the smoke originated in the other space.

Such false indication has caused confusion and often has resulted in discharging fire extinguishing medium into a space other than that in which the smoke had originated. In order to avert such confusion, it has been customary to recheck the spaces to definitely ascertain in which space the smoke originated before discharging the fire extinguishing medium. Consequently, when smoke was detected which indicated the commencement of a fire, valuable time was lost in effecting the extinguishment of such fire.

Accordingly, an object of the present invention is to overcome the foregoing difficulties and disadvantages.

Another object is to provide apparatus of the foregoing character which gives a true indication as to the origin of the smoke in every instance.

Another object is to provide such apparatus which is relatively simple and economical in construction and is reliable in operation.

A further object is to provide apparatus wherein the operation of the sampling, responsive and indicating means is coordinated to accomplish the foregoing.

Other and further objects of the invention will be obvious upon an understanding of the illustrative embodiment about to be described, or will be indicated in the appended claims, and various

2

advantages not referred to herein will occur to one skilled in the art upon employment of the invention in practice.

In accordance with the invention, the foregoing objects are accomplished by successively sampling fluid withdrawn from a plurality of sources and directing the same to a zone wherein the samples are tested for detecting suspended matter therein, and passing clean air through the path through which samples have been directed at intervals between successive samples. This method may be carried out manually or automatically by suitable apparatus; for example, such apparatus may comprise a plurality of means for supplying samples of fluid in which suspended matter is to be detected, means for supplying a purging or scavenging medium such as clean air, means responsive to the presence of suspended matter in the sample fluid, and valve means for effecting connection of the responsive means with each of the supplying means successively, preferably, in such sequence, whereby, after each connection of the sample supplying means, the purging fluid supplying means is connected with the responsive means.

As illustrated in the embodiment of the present invention about to be described in detail, indicating means are associated with the valve means for controlling the supply of sample fluid and purging medium. The indicating means are so constructed and arranged, and operated in relation to the valve means, that an indication is given which identifies the space or source from which a sample is being withdrawn, and that such same or similar indication is given while purging medium follows the path of the sample. In this manner, any suspended matter in the sample is passed through the responsive means to detect the same before the valve means and indicating means are positioned to supply a sample from another space. Consequently, when the responsive means give out an alarm or preferably stop the operation of the indicating means, the indicating means are still positioned to identify the space in which suspended matter was detected.

A preferred embodiment of the invention has been chosen for purposes of illustration and description, and is shown in the accompanying drawings, forming a part of the specification, wherein:

Figure 1 is a front elevational view of apparatus in accordance with the present invention, certain parts being broken away and shown in section for clearness.

Figure 2 is a sectional view taken along the line 2—2 on Figure 1.

Figure 3 is a schematic view illustrating the cooperation of the valve actuating means and the indicating means.

Referring to the drawings in detail and more particularly to Figures 1 and 2 thereof, there is shown apparatus which generally comprises a unit 10 responsive to suspended matter, a plurality of valves 11A, 11B, 11C and 11D for connecting the unit 10 with spaces (not shown) from which samples of fluid to be tested are withdrawn by conduits 12A, 12B, 12C and 12D, respectively, a valve 11S for connecting the unit 10 with a source of clean air or the like supplied by a conduit 12S, valve actuating means 14, and indicator or annunciator 15, a shaft 16 for operating the valve actuating means and the indicator, and drive means including a motor 17 for effecting intermittent rotation of the shaft.

The suffixes A, B, C and D will be used to facilitate understanding that the reference numerals followed by these suffixes designate elements which are operatively associated with the respective spaces (which, while not shown, are identified as A, B, C and D), and, similarly, the suffix S will be used in connection with elements associated with the supply of scavenging fluid.

The unit 10 may be a smoke detecting device of any conventional design, for example, of the type disclosed in Letters Patent of the United States No. 2,032,746. Since such devices are well known in the art, detailed description and illustration thereof are unnecessary.

In order to operatively associate the unit 10, the valves, the valve actuating means 14 and the indicator, a generally rectangular casing or box-like structure 20 is provided which comprises a rear wall 21, side walls 22 and 24, a top wall 25, a bottom wall 26 and a front opening. A cover 27, preferably formed of transparent material, is removably secured to the casing by screws or the like to close the front opening, and a gasket 28 is disposed between the cover and the surface of the casing defining the opening to provide a fluid-tight seal.

The valves 11S, 11A, 11B, 11C and 11D are positioned in the casing in side by side relation and in lengthwise alignment, and preferably are provided in a valve block or housing 30 formed integral with the casing or positioned therein to serve as a partition, which divides the interior of the casing into an upper zone and a lower zone. The upper zone is connected in fluid flow communication with the unit 10 by an opening 31 in the side wall 24 and a tube 32 leading to the inlet of the unit 10, and the lower zone is similarly connected to the outlet of the unit 10 by an opening 34 in the rear wall 21 and a tube 35. An opening 36 is formed in the rear wall for connecting the lower zone to exhaust means, such as a suction fan (not shown), by a conduit 37.

The valve 11S comprises an inlet port 40 in connection with the conduit 12S, an outlet port 41 surrounded by a seat 42 and in communication with the upper zone, a valve member 44 for the seat, and a stem or rod 45S supporting the valve member which is slidably mounted in a vertical bore 46S extending through the valve block, a fixed sleeve 47 and the bottom wall 26. The lower end of the stem 45S extends outwardly of the casing and has secured thereon a frusto-conical head 49S adapted to be engaged by the valve actuating means, as will be described hereinafter. The stem preferably is fitted in its

bore to reduce sliding friction therebetween to a minimum, so that the valve member is adapted to normally engage its seat and close the port under the influence of gravity.

The valves 11A, 11B, 11C and 11D each comprise an inlet port 50 in connection with one of the conduits 12A, 12B, 12C and 12D, respectively, an outlet port 51 surrounded by a seat 52 and in communication with the upper zone, a second outlet port 54 surrounded by a seat 55 and in communication with the lower zone, a valve member 56 for the seat 52, a valve member 57 for the seat 54, and a stem or rod (45A, 45B, 45C or 45D) supporting the valve members 56 and 57 in positions for alternately opening and closing the ports 51 and 54, respectively. The stems each extend through the ports 51 and 54, a bore 59 in a fixed sleeve 60, and the bottom wall. The lower ends of the stems extend outwardly of the casing and have secured thereon a frusto-conical head 49A, 49B, 49C or 49D, respectively, adapted to be engaged by the valve actuating means. The stems are fitted in their bores 59 to reduce sliding friction therebetween to a minimum, so that the valve members 56 are normally on their seats 52 to close the ports 51 and the valve members 57 are normally spaced from their seats 55 to open the ports 54 under the influence of gravity.

The shaft 16 is rotatably mounted in and extends through bearings 62 below the casing and adjacent the sides thereof. One end of the shaft is connected to the motor 17 for rotation at a relatively low speed, and the other end of the shaft carries the indicator 15. As shown in Figure 2, the shaft is positioned to the side of the valve stems.

The valve actuating means 14 are operatively associated with the shaft and comprise pins, cams or the like for raising the valve stems in a predetermined succession to connect the conduits 12A, 12B, 12C, 12D and 12S with the responsive means unit 10 in a desired sequence. As illustrated herein, radially extending pins 65A, 65B, 65C and 65D are provided for engaging the heads 49A, 49B, 49C and 49D, respectively. These pins are evenly spaced circumferentially about the shaft at an angle of 90° apart (Figure 3), and are positioned in relation to each other to successively effect operation of the valves 11A, 11B, 11C and 11D in the order named.

Four radially extending pins 65S are provided on the shaft for engaging the head 49S. These pins are evenly spaced circumferentially at an angle of 90° apart (Figure 3) with each pin being spaced 45° with respect to a pair of adjacent pins 65A, 65B, 65C or 65D, whereby the valve 11S will be operated at intervals between the operation of successive valves 11A, 11B, 11C or 11D.

The indicator 15, as shown herein, is in the form of a wheel having indicia thereon for identifying the space from which fluid is being withdrawn or has just been withdrawn. In the illustrative embodiment, the wheel has eight stations which are evenly spaced circumferentially about the wheel at 45° apart and are identified by suitable indicia, such as the letters A, B, C and D, designating the four spaces associated with the elements so suffixed. These letters are duplicated in succession so that the same space is identified twice at an indexing point such as a sight opening 66, once while its sampling valve is opened and once while the scavenging valve is opened. For example, the indicia may be arranged about the

5

wheel and related to the valve operation as follows:

Position Number	Angle of Rotation, degrees	Indicia Sequence	Valving Sequence
1	0	A	11A
2	45	A	11S
3	90	B	11B
4	135	B	11S
5	180	C	11C
6	225	C	11S
7	270	D	11D
8	315	D	11S
1	360 (0)	A	11A

The apparatus is illustrated herein with the valve actuating means and the indicator wheel in position 8, with the valve 11S in open position.

In operation, with the apparatus in the condition as shown, the pins are positioned (Figure 3) so that the valve member 44 of the valve 11S is off its seat 42 to cause scavenging or purging medium to be directed to the detector unit 10 and be eventually withdrawn through the conduit 37; the valve members 56 of the valves 11A, 11B, 11C and 11D are on their seats 52 to close their ports 51; and the valve members 57 are off their seats 55 to cause fluid withdrawn from the spaces to be exhausted through the conduit 37. As the shaft is rotated not quite 45° in a counterclockwise direction (as viewed), the pin 65S releases the head 49S, allowing the valve 11S to close, and the pin 65A engages the head 49A to raise the stem 45A and operate the valve 11A, whereby its port 51 is open and its port 54 is closed. A sample of the fluid in which suspended matter is to be detected is then directed to the unit 10. In the next operative position which follows, the valve 11S is again opened as just described, and the valving continues in the sequence hereinbefore described, with the cycle being continuously repeated.

If, for example, a sample withdrawn from the space connected with conduit 12D should contain suspended matter, the suspended matter may be detected instantly by the responsive means unit 10 while the first letter D of the indicia is visible through the sight opening. However, if the unit 10 does not respond instantly because the suspended matter has not yet reached the unit, the opening of the valve 11S, which immediately follows, causes scavenging medium to be directed through the path through which the fluid containing suspended matter has passed, whereby any suspended matter in the sample will pass through the unit and will be detected before the next sample is taken from another space. An indication of suspended matter will be given at a time while the second letter D is still visible through the sight opening, whereby the origin of the suspended matter can be accurately determined by either an instantaneous response or a delayed response.

When suspended matter is detected, rotation of the shaft 16 is stopped, whereby the indicia on the wheel designates the space from which the sample was taken, an alarm may be sounded to attract the attention of an attendant, and switch means may be operated to actuate other mechanism or devices, for example, an indicator or annunciator at a remote location, a fire extinguishing system or the like. Since such means which may be associated with the unit 10, the motor and/or the shaft are generally known, illustration and detailed description thereof are believed to be unnecessary.

6

While the present invention has been described with reference to smoke detection, it will be understood that the apparatus may be readily adapted for other uses. The responsive means unit may be a gas analyzer for detecting the lack of or a surplus of certain gases suspended in air, whereby conditions may be detected to indicate the presence of explosive mixtures, poisonous gases, or the presence of gases in insufficient quantities. It will also be apparent that the purging or scavenging medium need not be air, but could be any other gas which is suitable for the particular purpose of the apparatus.

It will be further appreciated that, while the embodiment herein illustrates four sampling valves and one scavenging valve, any number of such valves may be utilized depending upon the number of spaces to be supervised, and that the valving sequence may be modified to fulfill the requirements of other conditions. For example, more than one scavenging valve may be desirable in cases where a large number of spaces are sampled, to facilitate arrangement of the valve actuating means.

From the foregoing description, it will be seen that the present invention provides an improved method of and apparatus for detecting suspended matter in fluids for many purposes. The apparatus is simple, compact, light in weight and inexpensive, is practical and reliable in operation, and is capable of being operated continuously without necessitating shut down or repair.

As various changes may be made in the form, construction and arrangement of the parts herein, without departing from the spirit and scope of the invention and without sacrificing any of its advantages, it is to be understood that all matter herein is to be interpreted as illustrative and not in any limiting sense.

I claim:

1. In apparatus for detecting suspended matter in fluids, the combination of a casing providing a chamber, a valve block in said chamber partitioning the same into first and second chamber sections; exhaust means including an opening in fluid flow communicating with said second chamber section; means responsive to the presence of suspended matter in fluid having an inlet in fluid flow communication with said first chamber section and having an outlet in fluid flow communication with said exhaust means opening through said second chamber section; a plurality of means for supplying sample fluid in which suspended matter is to be detected; a plurality of sample fluid flow controlling valves each including an inlet in fluid flow communication with one of said sample fluid supplying means respectively, a first outlet in fluid flow communication with the inlet of said responsive means through said first chamber section, a second outlet in fluid flow communication with said exhaust means opening through said second chamber section, a valve member normally closing said first outlet, a valve member normally unclosing said second outlet, and means for operating said valve members to effect unclosing of said first outlet and simultaneous closing of said second outlet; means for supplying purging fluid; a purging fluid flow controlling valve including an inlet in fluid flow communication with said purging fluid supplying means, an outlet in fluid flow communication with the inlet of said responsive means through said first chamber section, a valve member normally closing said last mentioned outlet, and means for operating said last mentioned

valve member to uncloset said last mentioned outlet; and mechanism for controlling all of said valve member operating means to effect selective and successive unclosing of said first outlet of said sample fluid flow controlling valves and to effect unclosing of said outlet of said purging fluid flow controlling valve after each unclosing of one of said first outlets of said sample fluid flow controlling valves.

2. An apparatus according to claim 1, including annunciator means operated by said mechanism having means for respectively indicating the unclosing of said first outlet of said sample fluid flow controlling valves and having means for giving a similar indicating upon unclosing of said outlet of said purging fluid flow controlling valve after a given unclosing of one of said first outlets of said sample fluid flow controlling valves.

3. A unit for detecting suspended matter in fluids, comprising a casing providing a chamber; a valve block in said chamber partitioning the same into an upper and a lower chamber section, said valve block having an inlet for introducing a purging fluid from the exterior of said casing, an outlet for establishing fluid flow communication between said inlet and said upper chamber section including an upwardly facing valve port, a plurality of inlets for introducing sample fluid from the exterior of said casing in which suspended matter is to be detected, an upper outlet for each of said sample fluid inlets for establishing fluid flow communication therebetween and said upper chamber section including an upwardly facing valve seat, and a lower outlet opposite said upper outlet for each of said sample fluid inlets for establishing fluid flow communication therebetween and said lower chamber section including a downwardly facing valve seat, said casing having an opening providing exhaust outlet means for said lower chamber section; means responsive to the presence of suspended matter in fluid having an inlet in fluid flow communication with said upper chamber section and having an outlet in fluid flow communication with said lower chamber section; a valve member above said valve port arranged for normally closing the same; a rod connected to said valve member extending downwardly through said valve block and exteriorly of the lower end of said casing; a set of valve members for each pair of opposed upper and lower outlets each set including an upper valve member for said upwardly facing valve seat and a lower valve member for said downwardly facing valve seat of each pair; a stem connected to each set of said upper and lower valve members extending downwardly through said valve block and exteriorly of the lower end of said casing, each said set of valve members being arranged to normally close its said upper outlet and uncloset its said lower outlet controlled thereby simultaneously with its stem in lowermost position and being operable to uncloset said upper outlet and close said lower outlet simultaneously when its stem is in uppermost position, said rod and said stems being aligned in a substantially vertical plane; and mechanism for effecting movement of said valve members including a rotatable shaft beneath said casing having means thereon for raising said stems selectively and successively from their lowermost to their uppermost positions and having means thereon to raise said rod from its lowermost to its uppermost position each time after one of said stems has returned from its uppermost position.

4. Apparatus according to claim 3, wherein said first mentioned valve member and its rod and said sets of upper and lower valve members and their stems are constructed and arranged to assume their lowermost positions under the influence of gravity.

5. Apparatus according to claim 3, wherein an indicator wheel is mounted on said shaft and index means are provided adjacent said wheel, said wheel having indicia thereon in duplicate cooperating with said index means for respectively indicating the successive unclosing of said plurality of upper outlets and for giving the same indication upon an immediately following unclosing of said port.

6. Apparatus according to claim 3, wherein the front wall of said casing is transparent.

7. In apparatus for detecting suspended matter in fluids, the combination of means responsive to the presence of suspended matter having an inlet and an outlet; exhaust means, a plurality of means for supplying sample fluid in which suspended matter is to be detected; a plurality of sample fluid flow controlling valves each including an inlet, means connecting said inlet in fluid flow communication with one of said sample fluid supplying means respectively, a first outlet, a second outlet, valve means normally closing said first outlet, valve means normally unclosing said second outlet, and means for operating said valve means to effect unclosing of said first outlet and simultaneous closing of said second outlet; means for supplying purging fluid; a purging fluid flow controlling valve including an inlet, means connecting said inlet in fluid flow communication with said purging fluid supplying means, an outlet, valve means normally closing said last mentioned outlet and means for operating said last mentioned valve means to uncloset said last mentioned outlet; means connecting said first outlet of said sample fluid controlling valves and said outlet of said purging fluid flow controlling valve in fluid flow communication with said inlet of said responsive means; means connecting said second outlet of said sample fluid controlling valves and said outlet of said responsive means in fluid flow communication with said exhaust means; and mechanism for controlling all of said valve means operating means to effect selective and successive unclosing of said first outlet of said sample fluid controlling valves and to effect unclosing of said outlet of said purging fluid flow controlling valve after each unclosing of one of said first outlets of said sample fluid flow controlling valves.

8. Apparatus according to claim 7, including annunciator means operated by said mechanism having means for respectively indicating the unclosing of said first outlet of said sample fluid flow controlling valves and having means for giving a similar indication upon unclosing of said outlet of said purging fluid flow controlling valve after a given unclosing of one of said first outlets of said sample fluid flow controlling valves.

ARTHUR W. UHL.

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