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Gunther et al.

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[54] **MULTIPORT SAMPLING VALVE**

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[52] **U.S. Cl.** .....**73/422 GC**

[51] **Int. Cl.** **G01n 1/10**, G01n 1/22

[58] **Field of Search** .....73/422, 422 GC, 23.1

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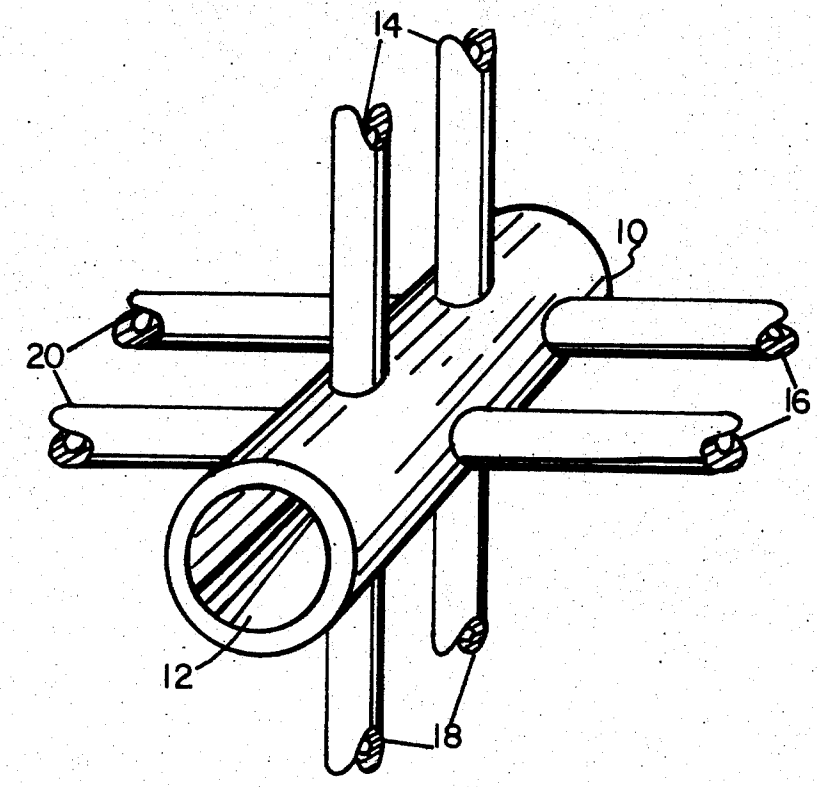
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[57] **ABSTRACT**

A multiport sampling valve for corrosive gases and liquids. The multiport sampling valve has a hollow barrel, a series of pairs of arms projecting radially therefrom, and a plug inserted into and adapted for rotation in the barrel, the plug having a series of pairs of holes which are each alignable with each of said pairs of arms to allow the passage of a gas from one arm of a pair through the plug and out the other arm of a second pair extending from the barrel to an analyzer.

12 Claims, 5 Drawing Figures



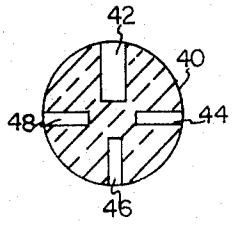


FIG. 4

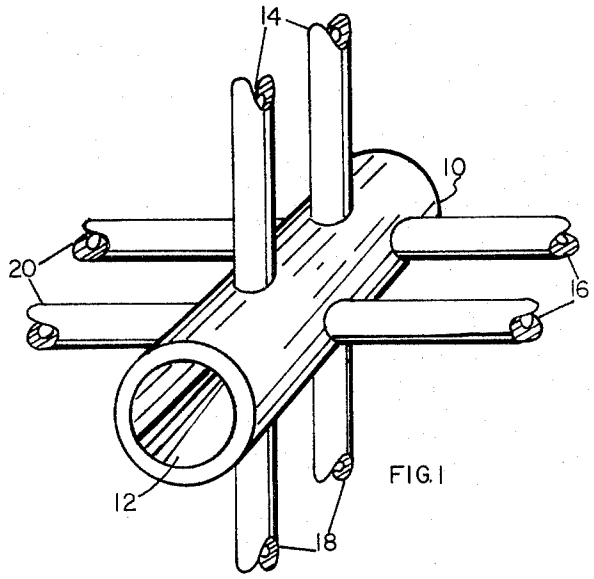


FIG. 1

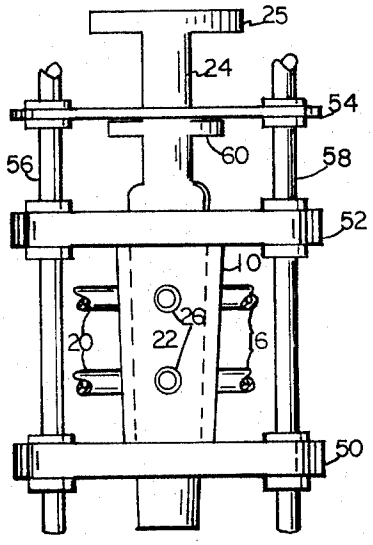


FIG. 5

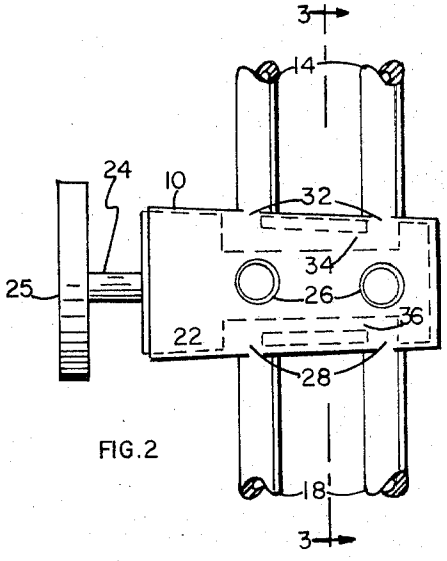


FIG. 2

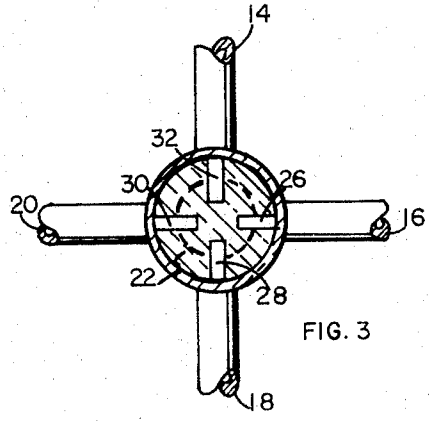


FIG. 3

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MULTIPORT SAMPLING VALVE

BACKGROUND OF THE INVENTION

This invention relates to a multiport sampling valve for corrosive gases and liquids to be analyzed. In the analysis of a gas or liquid such as in a chromatograph, it is often necessary to produce several samples of the gas or liquid at the same instant in time, whether they be of the same or of different materials of gas or liquid being analyzed, in order to have a consistent analysis. Accordingly, there is a need for a sampling valve which will provide several similar samples of a stream of gas or liquid to be analyzed in an analyzer such as a chromatograph. Such a valve may also be used for simultaneously providing samples of several different gases or liquids.

There are valves for providing a gas sample for a gas chromatograph, however, these valves are not made to withstand the corrosiveness of the gas or liquid analyzed nor the pressure at which the gas or liquid is passed from its source through the valve to the analyzer, e.g., a chromatograph. Moreover, the valves may be made of materials such as metals which are reactive with the material being sampled or a plastic which is not able to withstand excessively low or high temperatures.

Accordingly, it is the primary purpose of the present invention to provide a multiport sampling valve for simultaneously providing several samples of a corrosive gas or liquid, or different corrosive gases or liquids to be analyzed.

Another object of the present invention is to provide a sampling valve of a material which is chemically inert and operative over a wide temperature range.

The present invention provides such a multiport sampling valve with a two-piece valve, in the form of a stopcock. The valve comprises a hollow barrel having pairs of arms projecting radially therefrom and spaced circumferentially around the barrel, and a plug which is inserted into the barrel and having pairs of holes which are alignable with each pair of arms extending from the barrel. Thus, by turning or rotating the plug within the barrel, each of the pairs of holes can be aligned with each of the pairs of arms to allow the entrance and passage at a high pressure therethrough of a corrosive gas or liquid.

These and other objects of the present invention will become apparent from the following description and the accompanying drawing, in which:

FIG. **1** is a schematic view of the exterior of the barrel of the present sampling valve with pairs of arms extending therefrom;

FIG. **2** is a detailed interior side view of a plug inserted into the barrel shown in FIG. **1**;

FIG. **3** is a cross-sectional view of the sampling valve, taken along line **3—3** of FIG. **2**;

FIG. **4** is a cross-sectional view of a plug having different size holes; and

FIG. **5** is an elevational view of a sampling valve mounted for high pressure operation.

Referring to FIG. **1**, there is shown a hollow barrel **10** of the multiport valve of the present invention. The barrel **10** has an opening **12**, and pairs of arms **14**, **16**, **18**, and **20**, projecting radially from it in opposite directions. The pairs of arms are circumferentially spaced at **90°** around the barrel. The valve barrel **10** may be of any length desired, e.g. between **2** and **8** inches, and its diameter may range anywhere from about one-half inch to about 4 inches or more as may be desired. The pairs of arms **14**, **16**, **18**, and **20** will have a diameter less than that of the barrel, ranging from about one-sixteenth inch to about 1 inch or more. The pairs of arms may vary in diameter and size from one pair to another. The barrel **10**, as well as the pairs of arms **14**, **16**, **18**, and **20**, may be made of Pyrex glass or a thermal material which is resistant to temperatures as low as −100° C. and as high as about 500° C. and tempered to withstand pressures ranging from about 10^{-6} mm Hg to about 5 atmospheres.

A side interior view of the multiport valve is shown in FIG. **2**. A plug **22** having a stem **24** and a handle **25** is inserted in the barrel **10**. The plug has pairs of ports or holes **26**, **28**, **30**, and **32**. By means of the handle **25**, the plug may be rotated so that each of the pairs of holes **26**, **28**, **30**, and **32** may be aligned with each of the pairs of arms **14**, **16**, **18**, and **20** of the barrel **10**. As shown, the pairs of holes **26** and **30**, etc., are respectively joined by passages **34** and **36**. Thus, a gas or liquid sample is admitted into the plug **22** through one arm of a pair, e.g. an arm of pair **14**, contained within the passage joining the pair of holes, e.g. passage **34** of holes **32**, and after the plug **22** has been rotated one-quarter of a turn, the gas or liquid sample will pass through an arm of a second pair, e.g. pair **16**, into an analyzer, i.e. a chromatograph. In order to prevent the flow of gas through the valve, the plug **22** may be turned in a clock or counterclockwise manner, to seal off the holes to the arms.

In FIG. **3**, there is a cross-sectional view of the multiport valve of the present invention. In this view there is shown the plug **22** inserted in the barrel **10**. The pairs of holes **26**, **28**, **30**, and **32** of the plug **22**, are circumferentially spaced around the plug **22** at 90° intervals and each pair is alignable with each of the pairs of arms **14**, **16**, **18**, and **20** projected radially from the barrel **10**. The plug **22** is of a diameter less than the interior diameter of the barrel **10** and should be properly lubricated to be easily rotated clockwise or counterclockwise within the barrel, and to prevent any leakage of the sample from between the plug and barrel of the valve.

The lubricant used according to this invention, may be any lubricant which is highly viscose and is thermally and chemically inert so as to be stable at the low or high temperatures at which the valve is to be operated and not reactive with any material being sampled by the present valve.

In FIG. **4**, there is shown an end cross-sectional view, of a plug **40** having ports or holes **42**, **44**, **46**, and **48**, of different sizes so as to allow the sampling of small and large volumes of gases or liquids. This arrangement is necessary when an analysis of a gas or liquid must be made with samples of different volumes.

As indicated above, the multi-sampling valve can be operated with materials under pressures ranging from as low as about 10^{-6} mm Hg. to about 5 atmospheres. At these higher pressures, i.e. between 1 and 5 atmospheres, the valve has to be properly mounted as shown in FIG. **5**. This is necessary in order to maintain the component plug **22** snugly inserted in the barrel **10**. Obviously, if this were not done, the plug **22** would

become dislodged upon exertion of pressure and the material being sampled would also leak or run out of the valve.

As illustrated in FIG. 5, the plug 22 is securely placed in the barrel 10 by a mounting generally indicated by M. The mounting consists of a base plate 50, a stabilizing horizontal plate 52, and a top pressure plate 54, joined together by four rods (only rods 56 and 58 are shown) and held in place at spaced distances by nuts placed on both sides or surfaces of each of the plates.

The valve as mounted, can be mounted to an analyzer, i.e. a chromatograph, by means of the base plate 50. The valve is maintained in a stable vertical position by the horizontal plate 52 and the plug 22 is maintained in a secured inserted position by the top pressure plate 54 pressed against a shoulder ridge 60 on the stem 24 of the plug.

The components of the mounting may be made of several suitable materials, e.g., the base plate 50 may be made of aluminum with the horizontal plate 52 being made of a plastic or a plexiglass and the pressure top plate 54 may be made of a stainless steel, as well as the rods and nuts may be made of a stainless steel or iron. With this arrangement, the mounting M is strong enough to hold the component parts of the valve in place so as not to release or lose any of the material being sampled at high pressures.

The multiport sampling valve as illustrated in the drawing, i.e. FIGS. 1 thru 5, is designed and adapted to be connected to an instrument analyzer, such as a chromatograph and to a gas or liquid stream which is to be analyzed. As shown in FIG. 1, one arm of a pair (e.g., pair of arms 14) would be connected to the gas or a liquid stream from which a sample is to be taken and the other arm of the pair 14 would be the exhaust arm through which any excess of the material being sampled will be exited from the valve. The material being sampled after having passed through one of the arms is passed to the passage in the plug 22 which connects the two holes aligned with the pair of arms 14, and when the sample is to be admitted to the chromatograph, the the plug 22 is rotated one-quarter of a turn such as in a clockwise manner so that the passage which contains the sample, is aligned with the second pair of arms 16. Then by means of a gas such as helium or nitrogen passing through one arm of the pair 16 the sample material is forced or flushed out of the passage to the other arm of the pair 16 to the chromatograph to be analyzed. The remaining pairs of arms 18 and 20 will be connected to the gas or liquid stream and the analyzer in a like manner.

The valve is arranged so that a sample may be held within the plug 22 until it is to be analyzed. This is done simply by rotating or turning the plug so that the holes or openings are closed. Therefore, as shown in the drawing, one sample may be taken through the valve and then a second sample be analyzed in a chromatograph according to the present invention.

It is noted that in the proper and efficient operation of the valve, a suitable lubricant is needed in order to properly seal the plug 22 within the barrel 10. For example, where a gas is being sampled, the lubricant should be viscous and stable at high temperatures such as between 200° and 500° C. However, a different lubricant is needed where a sample is being taken at low temperatures such as at sub zero temperatures as low as minus 100° C. Therefore, depending upon what material is being analyzed and the temperature at which the sample is to be taken, a proper and suitable lubricant is chosen as known by those skilled in the art to be used.

This lubricant should be stable at the temperatures at which the sample will be taken. This is important or else some of the samples will be lost through seepage or leakage from the plug 22 and out the barrel 10.

The valve as indicated above is preferably made of Pyrex glass but may be made of any suitable material which is resistant to high pressures ranging from about 10^{-6} mm Hg. to about 5 atmospheres, and which is thermally inert to temperatures ranging from about minus 100° C. to about 500° C., and chemically inert to any material that may be sampled by the valve.

In sampling gases, the valve is heated to temperatures higher than the boiling point (B.P.) of the material being sampled. This is necessary since if the valve is cooled below the boiling point of a gas being sampled, the gas will condense on the walls of the barrel and arms of the valve and interfere with the proper function of the valve. In order to prevent this condensation of the material, the valve is heated by any suitable means to a temperature about 50° C. above the boiling point (B.P.) of the sampled material, or the highest B.P. of the gases or liquids being sampled.

The description of the present multiport sampling valve is not to be limited to the preferred embodiments disclosed herein but there may be many modifications and variations of the present valve shown in the drawings and described herein; and the present valve is not to be limited to the disclosure but to extend to the scope of the appended claims.

What is claimed is:

1. A multiport sampling valve for corrosive gases and liquids which pass through said valve at a pressure ranging between 10^{-6} mm Hg. and 5 atmospheres, said sampling valve comprising a hollow barrel, a series of pairs of arms spaced circumferentially around and projecting radially from said barrel, a plug inserted into and adapted for rotation in said barrel, said plug having a series of pairs of holes spaced circumferentially around said plug with each pair joined by a passage extending longitudinally in said plug, each of said pairs of holes being alignable with each pair of said arms.

2. A sampling valve according to claim 1, wherein said pairs of arms projecting radially from said barrel are circumferentially spaced at 90° apart around said barrel, and said holes in said plug are circumferentially spaced at 90° apart around said plug.

3. A sampling valve according to claim 1, wherein said pairs of holes in said plug are alignable with said pairs of arms projected radially from the barrel to allow the simultaneous multisampling of a single stream of a gas or liquid, or the simultaneous multisampling of different gases or liquids.

4. A sampling valve according to claim 1, wherein said barrel, arms, and plug are made of Pyrex glass.

5. A multiport sampling valve according to claim 1, wherein the valve is adopted to sample gases and liquids at temperatures ranging from about −100° to about 500° C.

6. A multiport sampling valve according to claim 1, wherein the valve is adapted to take samples of gases and liquids of different volumes.

7. A multiport sampling valve according to claim 1 wherein said plug is fitted with a shoulder ridge and is secured in said barrel by a mounting means, said mounting means being adapted to provide a pressure against said shoulder ridge in order to secure said plug in said barrel.

8. A sampling valve according to claim 7 wherein said mounting means is comprised of a base plate, a stabilizing plate and a top pressure plate joined together by four rods said stabilizing plate being positioned between said base plate and said top pressure plate being positioned so as to provide pressure against said shoulder ridge in order to secure said plug in said barrel.

9. A multiport sampling valve for corrosive gases and liquids which pass through said valve at a pressure ranging between 10^{-6} mm Hg. and 5 atmospheres, and at a temperature ranging from about −100° to about 500° C., said sampling valve comprising a hollow barrel, a series of pairs of arms spaced circumferentially around and projecting radially from said barrel, a plug inserted into and adapted for rotation in said barrel, said plug having a series of pairs of holes with each pair joined by a passage extending longitudinally in said plug, each of said pairs of holes being alignable with each pair of said arms.

10. A sampling valve according to claim 9 wherein said pairs of arms projecting radially from said barrel are circumferentially spaced at 90° apart around said barrel, and said holes in said plug are circumferentially spaced at 90° apart around said plug.

11. A sampling valve according to claim 9 wherein said pairs of holes in said plug are alignable with said pairs of arms projected radially from the barrel to allow the simultaneous multisampling of a single stream of a gas or liquid, or the simultaneous multisampling of different gases or liquids.

12. A multiport sampling valve according to claim 7, wherein the valve is adapted to take samples of gases and liquids of different volumes.

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