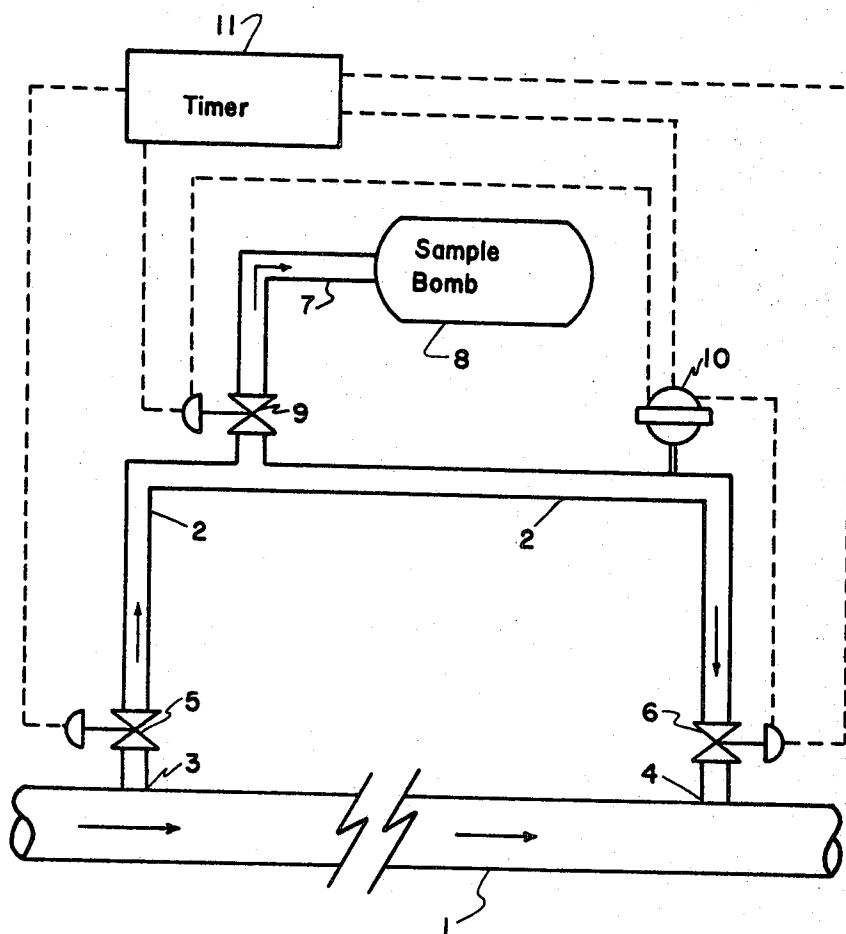


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GAS SAMPLE COMPOSITOR

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GAS SAMPLE COMPOSITOR

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ABSTRACT OF THE DISCLOSURE

An apparatus for sampling a gas flowing through a line comprising a valved chamber for isolating a portion of said gas, a pressure sensitive means within said chamber for adjusting the pressure of the gas therein to a first predetermined level, a sample container for receiving the gas in said chamber, said container being maintained at a pressure lower than a second predetermined pressure in said chamber and means for transferring said gas from said chamber to said container.

The present invention relates to a method and an apparatus for collecting samples of gas. More particularly, the present invention relates to a method and apparatus for collecting several samples of a gas in the same sample container so as to provide a composite sample.

In the sampling of a gas stream having varying compositions it often becomes necessary to have a composite sample which is representative of that gas stream over a given period. Various devices have been devised for this purpose such as one will allows a very small constant stream of the gas to be sampled to exit for the desired period into a sample container maintained at a pressure lower than the gas stream to be sampled. This method has not proved satisfactory in providing a representative sample since the pressure build up in the sample container causes the flow of gas into the sample container to be smaller and smaller as the pressure increases within the container. A gas sample thus taken contains a greater proportion of the gas stream present during the early part of the sample period.

It is, therefore, an object of the present invention to provide a method and apparatus for sampling the gas in a gas stream. An additional object of the present invention is to provide a method and an apparatus for providing a representative sample of a gas stream over a given period. Another object of the present invention is to provide a method and an apparatus for providing a composite sample of a gas stream over a period of time wherein the amount of each increment of the composite sample is not dependent on the time at which it was taken. Additional objects will become apparent from the following description of the present invention.

The accompanying drawing is a diagram showing a preferred embodiment of the present invention.

The present invention in one of its embodiments is an apparatus for sampling gas flowing through a gas line comprising a first conduit having a first end to be placed in open communication with a point in said gas line and a second end to be placed in open communication with a gas disposal means, a first valve and a second valve located in said first conduit and being spaced apart from each other, said first valve being located between said second valve and said first end of said conduit, a second conduit in open communication at one end with a container for holding gas samples and at the other end with said first conduit at a point between said first valve and said second valve, a third valve located in said second conduit at the end of said second conduit which is connected to said first conduit, said second and said third

valves being responsive to pressure sensitive means located so as to detect the pressure in the system defined by said first conduit and the aforementioned valves.

In another embodiment the present invention is a method of collecting a plurality of samples of a gas in a sample container comprising cyclically repeating the steps of isolating a portion of said gas in a closed system, lowering the pressure of said closed system to a first predetermined pressure, and allowing the gas in said closed system to escape into a said sample container until the pressure in said closed system is lowered to a second predetermined pressure, said sample container being maintained at a pressure which is less than said second predetermined pressure at all times during the collection of said samples.

Referring now to the drawing which shows a preferred embodiment of the present invention, a gas which is to be sampled passes through line 1 in the direction indicated by the arrows. A first gas conduit 2 is attached to and in open communication with line 1 at an upstream point 3 and a downstream point 4, the pressure at upstream point 3 being higher than that at downstream point 4. The first conduit 2 has a first valve 5 and a second valve 6 located therein with first valve 5 being located between upstream point 3 and valve 6. A second conduit 7 is in open communication at one end with sample bomb 8 and at the other end with first conduit 2 at a point between valve 5 and valve 6. Located at the end of second conduit 7 is a third valve 9. Pressure switch 10 is located so as to detect the pressure in the system defined by conduit 2, valve 5, valve 6 and valve 9 as hereinafter explained. As indicated by the various dotted lines, timer 11 is capable of operating valves 5, 6, and 9 as well as pressure switch 10 while valves 6 and 9 are also responsive to pressure switch 10.

In operation of the illustrated apparatus, valves 5, 6, and 9 are closed when sample collecting operations begin. The timer then opens valves 5 and 6 and, due to the pressure differential between upstream point 3 and downstream point 4, allows a side stream of gas to flow through conduit 2 in the direction indicated by the arrows. After a time sufficient to purge conduit 2 of any undesirable gases, timer 11 closes valve 6 leaving valve 5 open and valve 9 closed. Timer 11 then allows sufficient time for the pressure in conduit 2 to reach the pressure existing in line 1 at upstream point 3 at which time timer 11 closes valve 5. As a result of the foregoing operations, it may be seen that a portion of the gas to be sampled has been isolated in a closed system defined by valves 5, 6, and 9 and conduit 2 with the pressure in the closed system being approximately that existing in line 1 at upstream point 3. Continuing the operation, timer 11 then opens valve 6 and due to the pressure differential the gas in the foregoing described closed system begins to flow into line 1 at downstream point 4 and continues to do so until a first predetermined pressure is reached at which time pressure switch 10 closes valve 6. The gas in the closed system defined by conduit 2, and valve 5, 6, and 9 is now at the first predetermined pressure. Timer 11 then opens valve 9 and due to the relatively low pressure which is maintained in sample bomb 8 in operation of the present invention, gas flows into the sample bomb until a second predetermined pressure is detected by pressure switch 10 at which time pressure switch 10 closes valve 9 isolating a sample of gas in sample bomb 8. The foregoing steps are then cyclically repeated at desired time intervals in order to place the desired number of samples in the sample container. It is obvious, however, that samples may be taken in the described manner only as long as the pressure in the sample bomb remains below the second predetermined pressure as defined above and it is for this reason that it is prefer-

able to have the pressure in the sample container substantially below the second predetermined pressure at the start of taking samples. In actual practice, the sample bomb will almost always be evacuated as at the start of taking samples in order to eliminate components from the sample bomb which would contaminate the composite sample.

The foregoing has been a description of a preferred embodiment of the present invention. In other embodiments where the nature and the pressure of the gas to be sampled permits, the end of conduit 2 attached to line 1 at downstream point 4 might instead be vented to some other gas disposal means such as to the atmosphere or to some closed system provided that it is vented to a pressure lower than the above-described first predetermined pressure. Also the apparatus illustrated in the drawing might be operated by manually performing the sequence of steps required in collecting a sample so that the timer could be eliminated.

The pressure sensitive means of the present invention, shown as pressure switch 10 in the drawing, does not have to be a pressure switch or switches but can be any device capable of sensing a predetermined pressure and operating a valve in response thereto. If a pressure switch is used a "double" pressure switch capable of detecting two different pressures might be used or separate switches might be used to detect the first predetermined pressure and the second predetermined pressure. Pressure switches are the preferred pressure sensitive means as they are available for wide pressure ranges and are easily adjusted. Referring to the drawing, conduit 2 may be of various shapes and sizes depending on the size sample needed. For example, the conduit may include an enlarged chamber between valves 5 and 6 so as to increase the size of the closed system as defined by valves 5, 6, and 9 and conduit 2. The only requirement for the valves of the present invention are that they be capable of completely stopping the flow of gas in the conduits. For example, gate valves, butterfly valves, globe valves, needle valves, etc., may be used.

The type of timing devices useful in the present invention may vary widely provided the devices are capable of performing a sequential series of events as described above when taking a sample. A particularly preferred type of timing device is one wherein cams are used to actuate the various valves and switches of the present invention. The timing used in collecting a sample according to the present invention can be readily ascertained and depends mainly on the frequency of sampling desired. For example, one sample per hour might be taken for 24 hours in order to accumulate a composite sample or a sample could be taken every 15 minutes over a 4-hour period in order to accumulate a sample.

The present invention is capable of sampling practically any gas. Some examples of the gas which may be sampled according to the present invention are acetylene, nitrogen, ethane, methane, oxygen, carbon dioxide, ethylene, air, propylene, propane and natural gas.

As an illustration of a specific embodiment of the present invention, an apparatus was constructed as in the drawing in order to collect a composite sample of acetylene gas over a 24-hour period. Referring to the drawing, sample bomb 8 had a volume of about eight liters and the closed system as defined by valve 5, valve

6, valve 9 and conduit 2 had a volume of about one liter. Pressure switch 10 consisted of a double pressure switch set to detect a first predetermined pressure of 14 p.s.i.g. and a second predetermined pressure of 12 p.s.i.g., while valves 5, 6, and 9 were all solenoid valves. The timer 11, through the use of several cams, supplied voltage so as to actuate the solenoid valves and the pressure switch. The pressure of the acetylene gas in line 1 was 15 p.s.i.g. at upstream point 3 and 5 p.s.i.g. at downstream point 4. When sample collecting operations began the sample bomb 8 was substantially evacuated and samples were taken every twenty minutes so that the final pressure in the sample bomb was 10 p.s.i.g.

What is claimed is:

1. An apparatus for sampling gas flowing through a gas line comprising a first conduit having a first end to be placed in open communication with a point in said gas line and a second end to be placed in open communication with a gas disposal means, a first valve and a second valve located in said first conduit and being spaced apart from each other, said first valve being located between said second valve and said first end of said conduit, a second conduit in open communication at one end with a container for holding gas samples and at the other end with said first conduit at a point between said first valve and said second valve, a third valve located in said second conduit at the end of said second conduit which is connected to said first conduit, said second and said third valves being responsive to pressure sensitive means located so as to detect the pressure in the system defined by said first conduit and the aforementioned valves.

2. The apparatus of claim 1 wherein said second end of said first conduit is connected to a point in said gas line downstream of the point where said first end of said first conduit is to be placed in open communication with said gas line.

3. The apparatus of claim 1 wherein said pressure sensitive means is a pressure switch.

4. The apparatus of claim 1 wherein said pressure sensitive means, said first valve, said second valve, and third valve are responsive to a central timing device.

5. A method of collecting a plurality of samples of a gas in a sample container comprising cyclically repeating the steps of isolating a portion of said gas in a closed system, lowering the pressure of said closed system to a first predetermined pressure, and allowing the gas in said closed system to escape into a said sample container until the pressure in said closed system is lowered to a second predetermined pressure, said sample container being maintained at a pressure which is less than said second predetermined pressure at all times during the collection of samples.

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