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E. F. BLONDFIELD
FLUID SAMPLING DEVICE

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FIG. 1.

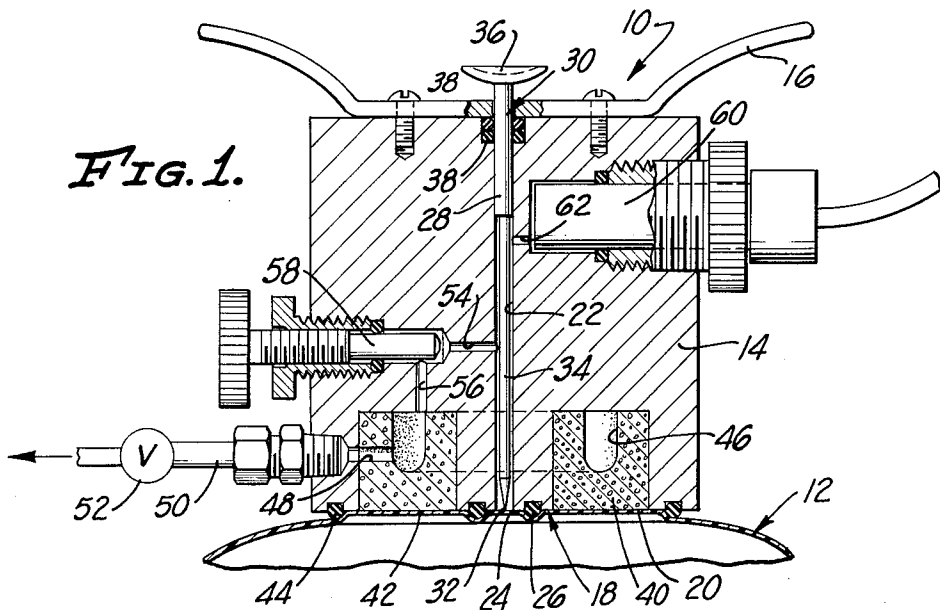
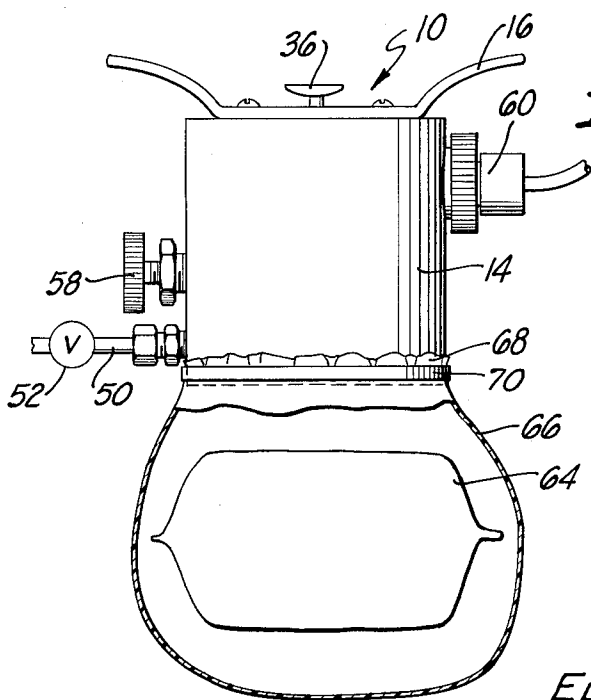


FIG. 2.



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FLUID SAMPLING DEVICE

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The present invention relates in general to obtaining substantially uncontaminated fluid samples, e.g., gas samples, from closed containers, and particularly from flexible, puncturable bags of plastic or other materials.

Considering an illustration of the utility of the invention, flexible bags are widely used as containers for gases which are to be analyzed, samples being withdrawn from the bags for delivery to suitable analyzing equipment. The problem is to establish communication between the interior of such a plastic bag and a sampling device in a manner to reduce to an insignificant minimum contamination of a sample withdrawn for analysis purposes. The primary object of the present invention is to provide a simple and effective way of obtaining such a substantially uncontaminated sample from a flexible bag.

More particularly, an important object of the invention is to provide a sampling device having vacuum means for attaching a flexible bag thereto and for purging an isolated space externally of the bag so that a substantially uncontaminated sample can be admitted into such space through a wall of the bag, preferably by puncturing such wall.

Still more particularly, it is an important object of the invention to provide a method of and apparatus for obtaining a substantially uncontaminated gas sample from a flexible, puncturable bag, which involve: isolating a region externally of the flexible bag and bounded on one side of a wall thereof; evacuating this region so as to purge a space occupying at least a part thereof, and so as to secure the flexible bag to the sampling device; and puncturing the wall of the flexible bag within the confines of the purged space so as to establish communication between the interior of the bag and the purged space, thereby enabling a substantially uncontaminated sample of the gas in the bag to flow into the purged space. This sample may be analyzed by a sensor, or other analyzing means, incorporated in the sampling device, or it may be delivered to remote gas analyzing equipment, such as a gas chromatograph.

Another object is to provide a sampling device of the foregoing nature wherein the evacuable region is divided into an evacuable sampling space and an evacuable annular zone encircling the sampling space, the function of such evacuable annular zone being to secure a flexible bag to the sampling device.

Another and more specific object of the invention is to provide a sampling device which includes: a housing having a surface engageable with a wall of a flexible bag, the housing being provided therein with a sample chamber having an open side in the bag-engaging surface and closable by the wall of the bag; annular evacuable means in the housing and encircling the open side of the sample chamber, the annular evacuable means forming part of the bag-engaging surface of the housing and being engageable by the wall of the bag; means for evacuating the annular evacuable means to hold the wall of the bag against the bag-engaging surface of the housing; means for evacuating the sample chamber to purge it of atmospheric gases; and means carried by the housing for puncturing the wall of the bag through the open side of the sample chamber to establish communication between the interior of the bag and the sample chamber so as to enable a sample of the gas in the bag to flow into the sample chamber. Such sample may be analyzed by analyzing means incorporated in the sampling device, or may, as herein-

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before outlined, be delivered to external analyzing equipment.

An important object of the invention is to provide a sampling device of the foregoing character wherein the annular evacuable means includes a porous ring, such as a sintered metal ring, having an annular face which forms part of the bag-engaging surface of the housing and which is engageable by the wall of the flexible bag. A related object is to provide an evacuable annular manifold communicating with the porous ring and preferably formed therein.

Another object is to provide the sampling device with concentric annular seals carried by the bag-engaging surface of the housing and respectively encircling the open side of the sample chamber and the evacuable porous ring, these annular seals being engageable by a wall of a flexible bag to respectively isolate the sample chamber from the evacuable porous ring and the evacuable porous ring from the atmosphere.

Another object of the invention is to provide a sampling device having means for securing to the housing thereof a flexible outer bag within which the gas-containing flexible bag is disposed. With this construction, the entire sample-containing bag may be completely isolated, as for reasons of safety.

The foregoing objects, advantages, features and results of the present invention, together with various other objects, advantages, features and results thereof which will be evident to those skilled in the sampling art in the light of this disclosure, may be achieved with the exemplary embodiments of the invention described in detail hereinafter and illustrated in the accompanying drawing, in which:

FIG. 1 is a sectional view of a gas sampling device of the invention in use to obtain a sample from a gas-filled flexible bag; and

FIG. 2 is a view showing the gas sampling device of FIG. 1 in use to obtain a sample from a gas-filled flexible bag disposed within an enclosing outer bag.

Referring first to FIG. 1 of the drawing, the gas sampling device of the invention is designated generally by the numeral 10 and is shown in use to obtain a sample from a flexible, puncturable bag 12. This bag may be formed of a suitable plastic material, or any other suitable material.

The sampler or sampling device 10 includes a housing 14 having on one side thereof a handle 16 of any suitable construction. The housing 14 is provided on the opposite side thereof with a bag-engaging surface 18 engageable with a wall 20 of the bag 12.

The housing 14 is provided therein with an evacuable sampling space or sample chamber 22 having in the housing surface 18 an open side or end 24 closable by the bag wall 20. An O-ring 26, or other suitable seal, is carried by the housing 14 in the housing surface 18 and in encircling relation to the open end 24 of the sample chamber 22. The O-ring 26 is engageable with the bag wall 20 to provide a fluid tight seal around the open end 24 of the sample chamber 22.

In the particular construction illustrated, the sample chamber 22 has the form of a bore which extends entirely through the housing 14 and which slidably receives a shank 28 of a needle 30 for puncturing the bag wall 20. The point 32 of the needle is formed on a reduced-diameter stem 34 which renders the sample-receiving space annular. The shank 28 of the needle 30 projects outwardly from the housing 14 adjacent the handle 16, and is provided at its outer end with a button 36 for depressing the needle to puncture the bag wall 20. A fluid tight seal around the needle shank 28 is provided by O-rings 38 carried by the housing 14 and engaging the shank.

Surrounding the sample chamber 22 adjacent its open end 24 is an annular evacuable means shown as comprising a porous ring 40, which may be a sintered metal ring, having an annular face 42 located outwardly of the O-ring 26 and forming part of the housing surface 18. It will be noted that the O-ring 26, when engaged by the bag wall 20, provides a fluid-tight seal between the sample chamber 22 and the annular evacuable zone formed by the porous ring 40. Carried by the housing 14 in the housing surface 18 outwardly of the porous ring 40 is an outer O-ring 44, or similar annular seal, which is engageable by the bag wall 20 to isolate the porous ring 40 from the atmosphere. Preferably, the O-rings 26 and 44 are concentric.

Communicating with the pores of the ring 40 is an annular manifold 46, preferably formed by an annular groove in the annular face of the ring opposite the annular face 42. The annular manifold 46 communicates, through a passage 48 in the porous ring 40 and the housing 14, with a vacuum line 50 controlled by a valve 52. The vacuum line 50 may be connected to a suitable vacuum pump, or the like. As will be apparent, when the housing surface 18 is placed against the bag wall 20 and the porous ring 40 is evacuated, the bag wall will be held firmly against the annular face 42 of the porous ring between the O-rings 26 and 44. Preferably, the area of the annular face 42 is relatively large to provide large-area vacuum engagement between the housing surface 18 and the bag wall 20 so as to securely attach the bag wall to the sampling device 10.

In order to permit purging the sample chamber 22 by evacuation, the housing 14 is provided with a passage 54 which communicates with the sample chamber and which is adapted to be placed in communication with a passage 56 leading to the annular manifold 46 by opening a needle-type valve 58 carried by the housing. After purging of the sample chamber 22 in this manner, the valve 58 is closed and the bag wall 20 is then punctured by means of the needle 30 to admit a gas sample from the bag 12 into the sample chamber.

The sample thus introduced into the sample chamber 22 may be analyzed in any suitable manner by any suitable analyzing means which preferably includes an element 60 carried by the housing 14 in communication with the sample chamber 22 through a passage 62. The element 60 may be a gas sensor, or it may be a septum inlet assembly from which the sample may be transferred to a gas chromatograph, or other analyzer, not shown.

Operation of sampler 10

In operation, the surface 18 of the sampling device 10 is placed against the bag wall 20 and the valve 52 is opened, the valve 58 being closed at this stage. The foregoing has the effect of evacuating the porous ring 40 so as to press the bag wall 20 tightly against the annular face 42 of the porous ring between the O-rings 26 and 44.

Once the sampling device 10 has been attached to the bag wall 20 in this manner, the valve 58 is opened to evacuate the sample chamber 22 and all spaces, passages, and the like, communicating therewith. Once the sample chamber 22 has been purged by evacuating it in this fashion, the valve 58 is closed and the needle 30 is actuated to puncture the bag wall 20 so as to admit a sample into the sample chamber. This sample is then analyzed, either by the element 60 directly, or by equipment connected to such element.

Apparatus of FIG. 2

Turning to FIG. 2 of the drawing, the sampler 10 is shown therein in use to obtain a gas sample from an inner bag 64 which is enveloped by an outer bag 66. In the particular construction illustrated, the outer bag 66 has a mouth 68 into which the portion of the housing 14 adjacent the surface 18 thereof is inserted. The mouth of the outer bag 66 is clamped against the housing 14 in a

fluid tight manner by means of an encircling clamping band 70.

The foregoing arrangement is used wherever it is desirable, for reasons of safety, or otherwise, to enclose the sample bag 64 within the outer bag 66.

When using the double bag arrangement described, the space between the inner and outer bags 64 and 66 is evacuated (through the porous ring 40 and through the sample chamber 22 if the valve 58 is open) until the outer bag has collapsed sufficiently to bring the inner bag into engagement with the surface 18 of the sampler. When this occurs, communication between the vacuum source and the space between the inner and outer bags 64 and 66 is cut off, and the inner bag is held firmly against the surface 18 in the manner hereinbefore described. After the sample chamber 22 has been completely purged by evacuation, the valve 58 is closed and the inner bag is punctured, by means of the needle 30, in the manner hereinbefore set forth.

Although exemplary embodiments of the invention have been disclosed herein for purposes of illustration, it will be understood that various changes, modifications and substitutions may be incorporated in such embodiments without departing from the spirit of the invention as defined by the claims which follow.

I claim:

1. In a sampling device for obtaining a substantially uncontaminated sample from a flexible, puncturable container of fluid, the combination of:

- (a) a housing providing a surface engageable with a wall of the container;
- (b) a sample chamber in said housing and having an open side in said surface and closable by said wall;
- (c) means for holding said wall against said surface in sealing relationship;
- (d) means for evacuating said sample chamber;
- (e) means carried by said housing for puncturing said wall of the container through said open side of said sample chamber so as to establish communication between the interior of the container and said sample chamber through said wall, whereby to enable a sample of the fluid in the container to flow into said sample chamber; and
- (f) said means for evacuating said sample chamber being operable after the holding of said wall against said surface by said holding means but prior to the puncturing of said wall of the container by said puncturing means whereby said sample, after entering said sample chamber, is not contaminated by residual gases in said sample chamber.

2. A sampling device as set forth in claim 1 including means for analyzing said sample, said means including an element carried by said housing in communication with said sample chambers.

3. In a sampling device for obtaining a substantially uncontaminated sample from a flexible, puncturable container of fluid, the combination of:

- (a) a housing having a surface engageable with a wall of the container;
- (b) said housing being provided therein with a sample chamber having an open side in said surface and closable by said wall;
- (c) annular evacuable means in said housing and encircling said open side of said sample chamber;
- (d) said annular evacuable means forming part of said surface of said housing and being engageable by said wall of the container;
- (e) means for evacuating said annular evacuable means to hold said wall of the container against said surface of said housing;
- (f) means for evacuating said sample chamber; and
- (g) means carried by said housing for puncturing said wall of the container through said open side of said sample chamber to establish communication between the interior of the container and said sample cham-

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ber through said wall, whereby to enable a sample of the fluid in the container to flow into said sample chamber.

4. In a sampling device for obtaining a substantially uncontaminated sample from a flexible, puncturable container of fluid, the combination of:

- (a) a housing having a surface engageable with a wall of the container;
- (b) said housing being provided therein with a sample chamber having an open side in said surface and closable by said wall;
- (c) annular evacuable means in said housing and encircling said open side of said sample chamber;
- (d) said annular evacuable means including a porous ring having an annular face which forms part of said surface of said housing and which is engageable by said wall of the container;
- (e) means for evacuating said porous ring to hold said wall of the container against said annular face of said porous ring and thus against said surface of said housing;
- (f) means for evacuating said sample chamber; and
- (g) means carried by said housing for puncturing said wall of the container through said open side of said sample chamber to establish communication between the interior of the container and said sample chamber through said wall, whereby to enable a sample of the fluid in the container to flow into said sample chamber.

5. In a sampling device for obtaining a substantially uncontaminated sample from a flexible, puncturable container of fluid, the combination of:

- (a) a housing having a surface engageable with a wall of the container;
- (b) said housing being provided therein with a sample chamber having an open side in said surface and closable by said wall;
- (c) annular evacuable means in said housing and encircling said open side of said sample chamber;
- (d) said annular evacuable means including a porous ring having an annular face which forms part of said surface of said housing and which is engageable by said wall of the container, and including an annular manifold in communication with said porous ring;
- (e) means communicating with said annular manifold for evacuating said porous ring to hold said wall of the container against said annular face of said porous ring and thus against said surface of said housing;
- (f) means for evacuating said sample chamber; and
- (g) means carried by said housing for puncturing said wall of the container through said open side of said sample chamber to establish communication between the interior of the container and said sample chamber through said wall, whereby to enable a sample of the fluid in the container to flow into said sample chamber.

6. In a sampling device for obtaining a substantially uncontaminated sample from a flexible, puncturable container of fluid, the combination of:

- (a) a housing having a surface engageable with a wall of the container;
- (b) said housing being provided therein with a sample chamber having an open side in said surface and closable by said wall;
- (c) annular evacuable means in said housing and encircling said open side of said sample chamber;
- (d) said annular evacuable means forming part of said surface of said housing and being engageable by said wall of the container;
- (e) means for evacuating said annular evacuable means to hold said wall of the container against said surface of said housing;
- (f) means carried by said housing and communicat-

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ing with said annular evacuable means for evacuating said sample chamber; and

- (g) means carried by said housing for puncturing said wall of the container through said open side of said sample chamber to establish communication between the interior of the container and said sample chamber through said wall, whereby to enable a sample of the fluid in the container to flow into said sample chamber.

7. In a sampling device for obtaining a substantially uncontaminated sample from a flexible, puncturable container of fluid, the combination of:

- (a) a housing having a surface engageable with a wall of the container;
- (b) said housing being provided therein with a sample chamber having an open side in said surface and closable by said wall;
- (c) annular evacuable means in said housing and encircling said open side of said sample chamber;
- (d) said annular evacuable means forming part of said surface of said housing and being engageable by said wall of the container;
- (e) means for evacuating said annular evacuable means to hold said wall of the container against said surface of said housing;
- (f) means for evacuating said sample chamber; and
- (g) needle means carried by said housing and extending through said sample chamber for puncturing said wall of the container through said open side of said sample chamber to establish communication between the interior of the container and said sample chamber through said wall, whereby to enable a sample of the fluid in the container to flow into said sample chamber.

8. In a sampling device for obtaining a substantially uncontaminated sample from a flexible, puncturable container of fluid, the combination of:

- (a) a housing having a surface engageable with a wall of the container;
- (b) said housing being provided therein with a sample chamber having an open side in said surface and closable by said wall;
- (c) annular evacuable means in said housing and encircling said open side of said sample chamber;
- (d) said annular evacuable means forming part of said surface of said housing and being engageable by said wall of the container;
- (e) means for evacuating said annular evacuable means to hold said wall of the container against said surface of said housing;
- (f) means for evacuating said sample chamber;
- (g) concentric annular seals carried by said housing on said surface thereof and respectively encircling said open side of said sample chamber and said annular evacuable means;
- (h) said annular seals being engageable by said wall of the container to respectively isolate said sample chamber from said annular evacuable means and said annular evacuable means from the atmosphere; and
- (i) means carried by said housing for puncturing said wall of the container through said open side of said sample chamber to establish communication between the interior of the container and said sample chamber through said wall, whereby to enable a sample of the fluid in the container to flow into said sample chamber.

9. In a sampling and analyzing device for obtaining a substantially uncontaminated sample from a flexible, puncturable container of fluid and for analyzing such sample, the combination of:

- (a) a housing having a surface engageable with a wall of the container;
- (b) said housing being provided therein with a sam-

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- ple chamber having an open side in said surface and closable by said wall;
- (c) annular evacuable means in said housing and encircling said open side of said sample chamber;
- (d) said annular evacuable means forming part of said surface of said housing and being engageable by said wall of the container;
- (e) means for evacuating said annular evacuable means to hold said wall of the container against said surface of said housing;
- (f) means for evacuating said sample chamber;
- (g) means carried by said housing for puncturing said wall of the container through said open side of said sample chamber to establish communication between the interior of the container and said sample chamber through said wall, whereby to enable a sample of the fluid in the container to flow into said sample chamber; and
- (h) means for analyzing said sample, including an element carried by said housing in communication with said sample chamber.
10. In a sampling device for obtaining a substantially uncontaminated sample from a flexible, puncturable inner container of fluid disposed in a flexible outer container, the combination of:
- (a) a housing having a surface engageable with a wall of the inner container;
- (b) said housing being provided therein with a sample chamber having an open side in said surface and closable by said wall;
- (c) annular evacuable means in said housing and encircling said open side of said sample chamber;
- (d) said annular evacuable means forming part of said surface of said housing and being engageable by said wall of the inner container;
- (e) means for evacuating said annular evacuable means to hold said wall of the inner container against said surface of said housing;
- (f) means for evacuating said sample chamber;

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- (g) means carried by said housing for puncturing said wall of the inner container through said open side of said sample chamber to establish communication between the interior of the inner container and said sample chamber through said wall, whereby to enable a sample of the fluid in the inner container to flow into said sample chamber; and
- (h) means for securing the outer container, with the inner container therein, to said housing around said surface of said housing.
11. A sampling device for obtaining a substantially uncontaminated sample from a flexible, puncturable container of fluid, the combination of:
- (a) a housing providing a surface engageable with a wall of the container;
- (b) a sample chamber in said housing and having an open side in said surface and closable by said wall;
- (c) evacuable means for holding said wall against said surface;
- (d) means for evacuating said sample chamber and said evacuable means; and
- (e) means carried by said housing for puncturing said wall of the container through said open side of said sample chamber so as to establish communication between the interior of the container and said sample chamber through said wall, whereby to enable a sample of the fluid in the container to flow into said sample chamber.

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