SEPTUM VALVES

This invention relates to apparatus for containing fluids, i.e., liquids and gases, or both, within a confined space. In all combinations, the apparatus includes valves, with seal features, adapted especially for use in confining fluids until such time as it is desired to withdraw fluid from or inject other fluid into the confined space, e.g., a container or sample inlet system such as is widely used in modern analytical instruments.

Among the objects of this invention are:

To provide a valve which makes the confinement of even highly volatile fluids feasible, without adverse effect or change caused by the external environment.

To provide a valve not only effective for preventing such adverse effect or change, or loss of fluid from a confined space when closed, but yet effective even when the valve is opened, or used repeatedly, to permit withdrawal or injection of fluid into the space within which it is confined.

To provide unique valve container combinations by virtue of which even highly volatile fluids can be contained without adverse effect, change or loss of contents from the container, even after repeated usage, and wherein the fluid withdrawn therefrom is truly representative of that originally supplied to the container.

To provide unique valve sample inlet system combinations by virtue of which fluid specimens can be injected therein conveniently, easily and without loss of fluid.

To provide such valve container, and valve sample inlet combinations which are readily adapted for reuse by virtue of easily changeable septum portions.

To provide valves and valve combinations, the valve portions of which contain stems readily freely rotatable or movable without side thrust within the tubular portion of the valve, or body, and a valve which is compact and readily operated, without lubrication.

These and other objects will be apparent in view of the present invention which, in all embodiments, includes a valve structure comprising a body, or tubular member, which leads into a space wherein fluids can be confined, and which contains a septum and stem integrally mounted, or mounted in series. The stem, provided with a lateral opening therethrough, is rotatably mounted within the wall of the tubular member to provide a means for exposure of the septum to permit injection or withdrawal of fluid from the confined space. The valve, but for the presence of the septum, is thus opened and closed by alignment and misalignment of the lateral opening of the stem with the axial opening through the tubular member to expose the septum located adjacent the stem, or preferably within the stem itself. In either instance, the septum acts as a fluid impervious seal to maximize closure of the tubular member, even when the valve is open for fluid withdrawal or injection.

These and other features and advantages will be better understood by reference to the following detailed description and to the accompanying drawings to which reference is made in the description.

Referring to the drawings:

FIG. 1 is a side elevation view, in section, showing a preferred valve, and valve-container combination. The valve, shown in open position, is provided within a stem within which an easily changed septum is integrally mounted;

FIG. 2, a fragmentary view, is also a sectional side elevation view identical to the preceding figure except that the valve is shown in closed position; and

FIG. 3, also a fragmentary sectional side elevation view, is the same as FIG. 1 except that the septum has been punctured by the needle of a syringe for withdrawal of liquid contents from the container;

FIG. 4 depicts a valve generally similar, at least in part, to that described by reference to the preceding figures except that, in this instance, the valve is employed as a portion of a sample inlet system, e.g., as used on a G.C. column or mass spectrometer;

FIGS. 5 and 6 depict the sequence of simple steps involved in changing a septum as employed in the several apparatus combinations described in the foregoing figures;

FIGS. 7 and 8 depict valve portions wherein the septum is located adjacent, separate from, and in series with the stem.

Referring to the sequence represented by FIGS. 1–3, there is shown generally a preferred type of flanged valve **10** in combination with a container or bottle **26**, filled to a level **25** with a volatile liquid composition.

The valve **10** is constructed of a body or tubular member formed by the enclosing wall **11**, providing an axial opening **12** which leads into the vapor space above the liquid level **25**. A stem **14**, provided with a handle **17** and a lateral opening **15**, is rotatably mounted within the transverse opening **13** of wall **11**. The stem **14**, in this embodiment, is also provided with an axial opening **18** within which is contained a plug septum **16** which lies across, seals off, blocks, or closes the transverse opening **15**.

For use in valve-container combinations, the lower portion of the tubular member **11** is also provided with a flanged end portion containing a peripheral groove **23** within which rests a packing or O-ring **21**. The O-ring **21** is pressed between the upper side **19** and the lower thin member **22**, and pressure is maintained on the O-ring **21** by tightening down on the open centered cap or cover **24** which is threadably engaged to the top of the bottle **26**. Thus, it is to be observed that the upper side **19** of the flanged member is pressed downward by the cap **24**, and the O-ring **21** is compressed between member **19** and member **22**, shown as an integral construction in this instance, which rests atop the upper rim **27** of bottle **26**. In this fashion, the O-ring **21** is extruded or thrust outwardly and downwardly against the inside of the cap **24** and thin member **22**, so that the latter presses against the rim **27** of bottle **26** to form an effective leakproof seal.

In the closed position of the valve **10** as shown by reference to the first figure, the fluid contents of the bottle **26** are maintained completely isolated from the external environment. Highly volatile fluids, and mixtures of such fluid components, will retain their original composition and condition without significant change as would be expected even when such fluids are loaded and contained in ordinary bottles or containers. Such high degree of isolation can even be maintained in accordance with the present invention, however, even after the bottles have been once opened, or repeatedly opened.

The structure which permits removal of contents from the bottle **26** without exposure to the atmosphere is further described by reference to FIGS. 2 and 3. Stem **14** is first rotated through a 90° angle, by action on handle **17** as shown by specific reference to FIG. 1. The contents of the bottle **26** nonetheless remain protected from exposure to the atmosphere because of the presence of the septum **16**. In this position of the valve stem, however, a needle syringe **20** can be passed through the septum **16** and into the liquid for withdrawal of a fluid specimen as shown in the third figure. The needle **20** can be withdrawn back through the septum which in itself tends to return to its original unstretched, unruptured position to minimize or prevent leakage of fluid from the bottle **26**. Immediately after the withdrawal of fluid, the valve is again closed as again shown by reference to FIG. 2 to protect the fluid contents. This process can be repeated ad infinitum until the bottle **26** has been emptied. The elimination of changes brought about by entry of air into such containers, escape of highly volatile components as by diffusion and pressure increases, particularly as occurs after such bottles or containers are once opened, is striking. This is particularly important with regard to standard fluids used in highly accurate modern analytical instruments.

Valves of generally the same type can also be directly used in sample inlet systems of modern analytical instruments. This is shown by reference to FIG. 4 wherein a valve **30** is mounted upon a sample inlet system, represented by the enclosing wall **28**. The sample inlet system is, in turn, provided with an optional carrier gas inlet formed by the enclosing wall **29**. Rotation of the stem **34**, to the position shown, via action upon