

[54] **LIQUID-SAMPLING STRUCTURE**

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[58] Field of Search **73/425.4 R, 422 R, 73/421 R, 423 R; 137/238, 240; 222/148**

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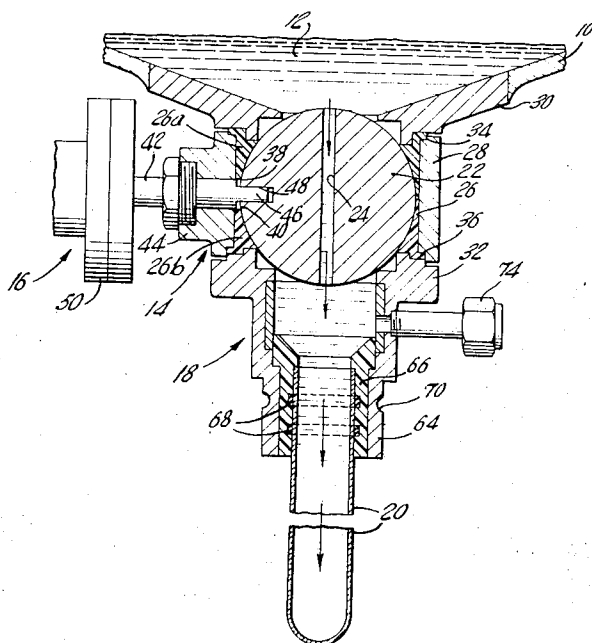
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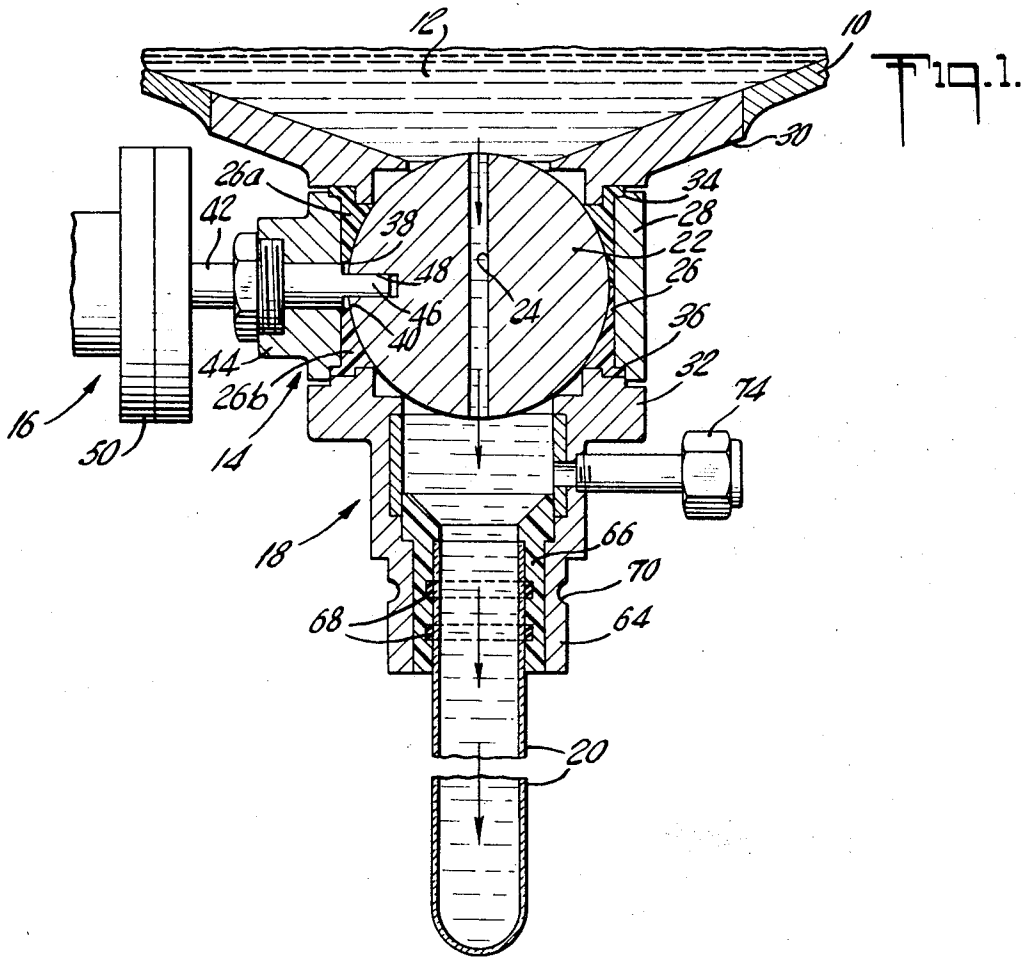
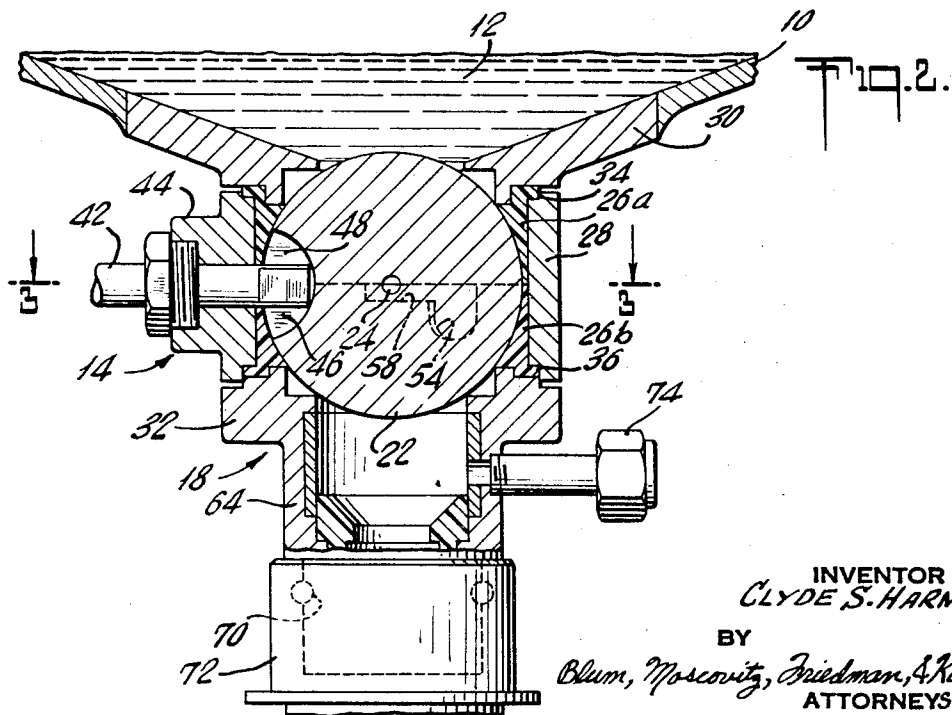
ABSTRACT

A liquid-sampling structure located at the bottom of a vessel which contains the liquid from which samples are to be taken. A valve is located at the bottom end of the vessel and has a closed position closing the vessel and an open position providing a passage through which a sample of the liquid in the vessel can flow, a suitable supporting structure being located beneath the valve for supporting a test tube which receives the sample. A valve actuator is operatively connected with the valve to displace between its closed and open positions. A structure is operatively connected with the valve to form a fluid passage through which a cleaning fluid can be directed through the valve when it is in its closed position so as to clean the valve with a cleaning fluid while the valve is in its closed position. An additional fluid passage is provided for providing a path for a cleaning fluid in order to clean the interior of the structure which supports a test tube beneath the valve.

7 Claims, 6 Drawing Figures



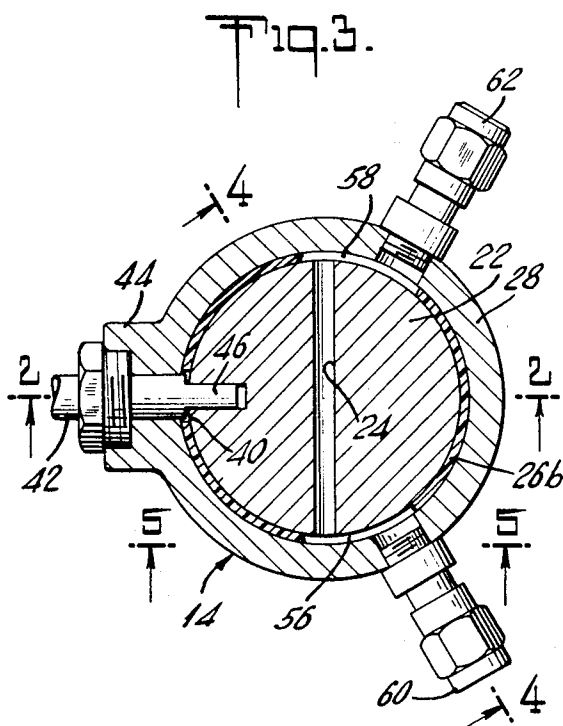
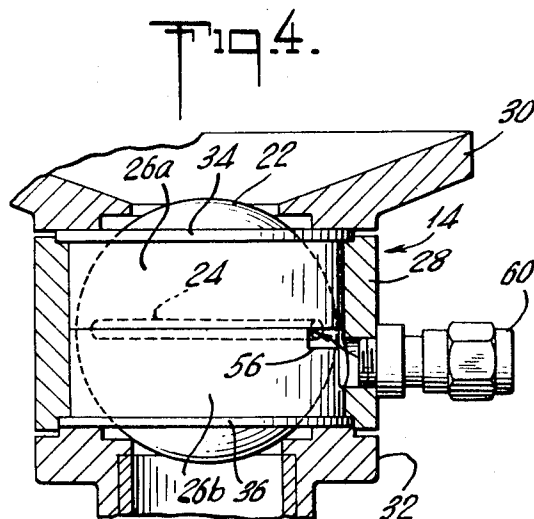
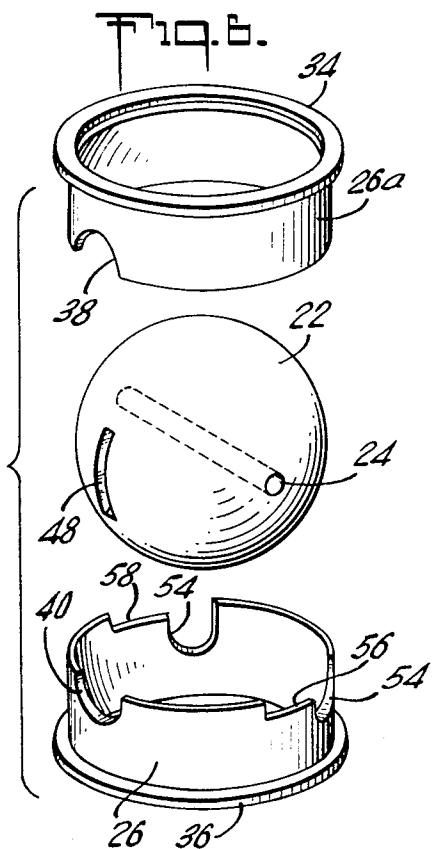
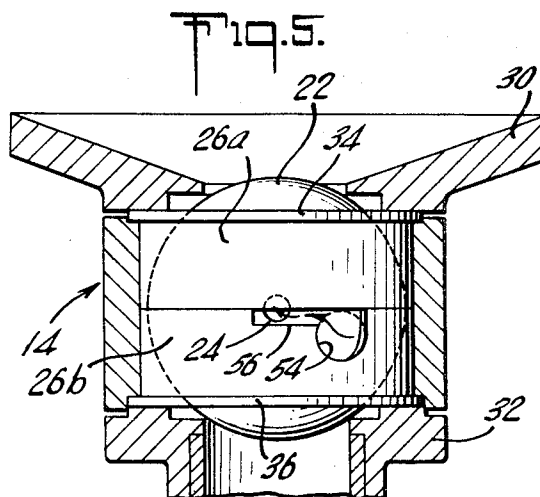
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LIQUID-SAMPLING STRUCTURE

BACKGROUND OF THE INVENTION

The present invention relates to liquid-sampling structure.

In particular, the present invention relates to a structure for deriving liquid samples from a vessel such as a fermentation vessel in which a liquid is treated in such a way that samples thereof are required to be tested from time to time.

One of the most serious drawbacks encountered with conventional structures of the above type is that it is extremely difficult to maintain the surfaces contacted by the sampling liquid perfectly clean. As the liquid flows out of the vessel into a test tube or the like for receiving a sample, the liquid unavoidably contacts surfaces which contaminate the liquid and prevent a true sample from being obtained.

Furthermore, with conventional structures a considerable amount of inconvenience is involved in taking a sample from a vessel, with the result that it is not possible to obtain samples with as much rapidity as is desired and as is in fact required under certain conditions.

SUMMARY OF THE INVENTION

It is accordingly a primary object of the present invention to provide a liquid-sampling structure which will avoid the above drawbacks.

In particular, it is an object of the present invention to provide a liquid sampling structure which is capable of being thoroughly cleaned in a highly reliable manner so that contamination of a sample can be avoided.

Furthermore it is an object of the present invention to provide a structure of this type which will enable a sample to be taken with extreme rapidity, so that samples will not change their characteristics because of the duration of time required for taking a sample while at the same time a true sample, uncontaminated by unclean surfaces, will be achieved.

In particular it is an object of the present invention to provide a structure of the above type which lends itself to automatic regulation according to which an operating cycle is provided for placing the liquid-contacting surfaces in a hygienically clean condition between the intervals when the samples are taken, with each cycle having one part during which the liquid-contacting surfaces are hygienically cleaned and another part during which the samples actually taken.

Yet another object of the present invention is to provide a structure which can accomplish the above objects while at the same time being characterized by great simplicity and reliability in operation.

According to the invention the vessel which contains the liquid which is to be sampled has a bottom end where a valve means of the invention is located. This valve means has a closed position closing the bottom end of the vessel and an open position providing an opening through which liquid will flow out of the vessel into a test tube, for example. Beneath the valve means is located a support means for supporting a test tube in a position to receive a sample. A valve-actuating means is operatively connected with the valve means to displace the latter between its open and closed positions. In accordance with the present invention a first fluid-passage means communicates with the valve means for directing a cleaning fluid therethrough when the valve means is in its closed position, while a second fluid-

passage means communicates with the support means for cleaning the interior surface areas thereof so that the entire path of flow of a sampling liquid from the vessel into a test tube can be maintained in a hygienically clean condition.

BRIEF DESCRIPTION OF DRAWINGS

The invention is illustrated by way of examining the accompanying drawings which form part of this application and in which:

FIG. 1 is a fragmentary sectional elevation of an embodiment of the present invention, the valve of FIG. 1 being shown in its open position;

FIG. 2 shows the structure of FIG. 1 with the valve in its closed position;

FIG. 3 is a sectional plan view taken along line 3—3 of FIG. 2 in the direction of the arrows;

FIG. 4 is a sectional elevation of the structure of FIG. 3 taken along line 4—4 of FIG. 3 in the direction of the arrows;

FIG. 5 is a sectional elevation of the structure of FIG. 3 taken along line 5—5 of FIG. 3 in the direction of the arrows; and

FIG. 6 is an exploded perspective illustration of a ball valve and ring means which form part of the valve means of the invention.

DESCRIPTION OF A PREFERRED EMBODIMENT

Referring now to the drawings, there is shown in FIG. 1 a lower part of a vessel 10 which contains a liquid 12 such as a liquid is undergoing fermentation. In order to check on the condition of the liquid 12 samples are regularly taken therefrom in order to be tested.

For this purpose the bottom end of the vessel 10 is operatively connected with a valve means 14 which is a type of flush-bottom ball valve. The valve means 14 is capable of being moved between the open position shown in FIG. 1 and closed position shown in FIG. 2 by a valve-actuating means 16, and beneath the valve means 14 is a support means 18 for supporting a test tube 20 which receives a sample of the liquid 12 when the valve means 14 is placed by the actuating means 16 in the open position shown in FIG. 1.

The valve means 14 includes a ball valve member 22 which is in the form of a sphere made of a suitable metal, for example. The ball valve member 22 is formed with a bore 24 passing diametrically therethrough so that when the bore 24 is in the vertical position shown in FIG. 1 the valve means is in its open position permitting a sample of the liquid 12 to be received in the test tube 20.

The valve means 14 includes a ring means 26 surrounding the ball valve 22 and having an inner surface forming part of a sphere identical with the sphere formed by the exterior surface of the ball valve 22. The ring means 26 is surrounded by an exterior housing part 28 of the valve means 14 so as to be retained around the ball valve 22 in the assembled condition shown in FIGS. 1 and 2. This ring means 26 is made, for example, of Teflon and the ring means 26 has a slidable but fluid-tight engagement with the exterior surface of the ball valve 22.

Above the circular housing part 28 of the valve means 14, this valve means includes an upper circular member 30 of frustoconical configuration welded to the vessel 10 so as to form the open bottom thereof, this circular component 30 of the valve housing having

an open central portion through which the ball valve 22 extends. The frustoconical member 30 of the valve means is fixed in any suitable way to the circular cylindrical housing part 28.

Beneath this housing part 28 the housing of the valve means includes a lower circular tubular component 32 which is fixed in any suitable way to the lower end of the housing part 28, and the elongated tubular portion of the housing component 32 where it extends downwardly from the ball valve 22 forms the support means 18 for the test tube 20.

As is shown that particularly in FIG. 6, the ring means 26 includes a pair of Teflon rings 26a and 26b. The ring 26a has an upper flange 34 clamped between the housing parts 28 and 30, while the ring element 26b has a lower outer flange 36 clamped between the cylindrical housing component 28 and the lower housing component 32.

The pair of rings 26a and 26b are respectively formed with registering semi-circular notches 38 and 40 forming an opening through which the actuating means 16 extends. This actuating means includes a rotary shaft 42 extending fluid-tightly through a fitting 44 carried by the valve housing and having a flat tip 46 received in an arcuate groove 48 which is formed in the ball valve. Through a coupling 50 the rotary shaft 42 of the actuating means 16 is operatively connected with any suitable device such as a double-acting air cylinder and piston which may be automatically actuated in any suitable way for periodically oscillating the ball valve 90° between the open position of FIG. 1 and the closed position of FIG. 2.

As may be seen from FIG. 6, except for the notch 38 the lower circular edge of the ring 26a is uninterrupted. However, the upper circular edge of the lower ring 26b is interrupted by a pair of stepped notch configurations 54 which are of identical shape and which are displaced by 120° with respect to each other about the central vertical axis of the ring 26b. The semi-circular notch 40 is displaced by 120° about this axis from the pair of notches 54 so that the notches 54 and the notch 40 are all equidistantly spaced from each other about the central vertical axis of the ring 26b. When the pair of rings 26 and 26b are assembled so that their adjoining edges butt against each other, the lower circular edge of the ring 26a forms with the notches 54 a pair of openings 56 and 58. The opening 56 is shown most clearly in FIG. 5, and part of the opening 58 is apparent from FIG. 3.

As is apparent from FIG. 3, the circular housing part 28 is formed with threaded openings passing there-through for fluid-tightly receiving tubular fittings 60 and 62 which thus communicate respectively with the openings 56 and 58. These fittings 60 and 62 together with the openings 56 and 58 form a fluid-passage means for directing a cleaning fluid through the bore 24 of the ball valve 22 when the ball valve is in its closed position shown in FIGS. 2 and 3. Thus a fluid such as steam can be introduced through the tubular fitting 60 to pass through the opening 56 and along the interior of the bore 24 so as to be received at the opening 58 with the condensate discharging through the tube 62. Because of the arrangement of the notches 54 and the notches 38 and 40 equidistantly with respect to each other about the central vertical axis of the ring means 26, the fittings 60 and 62 can be equidistantly

located from each other and from the actuating means 16, as is particularly apparent from FIG. 3.

Because of the tightness of the slidable engagement between the ball valve 22 and the ring means 26, none of the steam introduced through the fitting 60 can reach the liquid 12. However whenever the valve is returned to its closed position it is possible to purge the passage through which the sampling liquid flows by directing the hot steam through the bore 24 in the manner described above and shown most clearly in FIG. 3. If desired, an air blast can also be used as part of the cleaning process.

The elongated tubular extension of the lower housing part 32 forms the support means for the test tube 20, as pointed out above. For this purpose the lower tubular portion 64 of the lower housing component 32 carries in its interior a sleeve 66 which may also be made of Teflon, for example. This sleeve 66 is formed with a pair of interior grooves provided with O-rings 68 so that the test tube 20 can very quickly and easily be slipped into the sleeve 66 engaging the downwardly directed shoulder thereof situated above the upper O-ring 68, and these rings not only provide a fluid-tight mounting for the test tube in the support means but in addition serve to hold the test tube 20 in the position shown in FIG. 1 while a sample is delivered into the interior of the test tube. This test tube may initially be provided with known materials which will keep the sample in the condition required for testing purposes. Such materials are well known.

The tubular extension 64 is also formed at its exterior with an annular groove 70. Through this annular groove it is possible to snap onto the tubular extension 64 a coupling 72 shown at the lower part of FIG. 2 and connected to a suitable hose. This structure together with a lower tubular fitting 74 form a fluid-passage means for directing through the interior of the support means 18 a cleaning fluid such as steam. Thus, when the ball valve is turned to its closed position shown in FIG. 2 the coupling 72 is quickly snapped onto the exterior of the support means and steam or another suitable cleaning fluid is introduced through the fitting 74 in order to clean the interior of the support means.

In this way all of the surfaces engaged by the liquid sample to be tested are completely sterilized and the structure may be automatically actuated through cycles each which includes a first part during which a liquid sample is taken and a second part during which the sterilization procedures are carried out so that subsequent thereto the cycle can be repeated without any possibility of contaminating the sample with foreign matter deposited or dried onto the surface defining the bore 24 or the surface at the interior of the support means 18.

Thus, with the structure described above, which may form part of a fermentation apparatus, it is possible to derive periodically samples which may be reliably tested without any danger of improper results resulting from contamination of the liquid which is used for the sample. The simple turning of the valve means 14 to its open position shown in FIG. 1 will enable the liquid 12 to flow by gravity through the bore 24 into the test tube 20, and then the actuating means 16 is automatically actuated in any suitable way so as to return the valve means to the closed position shown in FIG. 2, whereupon a suitable valve is actuated for automatically admitting steam through a steam input line connected to

the fitting 60 of the fluid-passage means. This steam will flow through the bore 24 after passing through the opening 56, and the discharge fitting 62 is connected to a condensate exit line so that the purging steam can be quickly discharged, flowing through the ball valve to effectively sterilize the latter. The same operations can go forth simultaneously through the lower fitting 74 also connected to the steam input line with the discharge hose connected to the support means by way of the coupling 72 serving as the condensate exit line for the steam used to sterilize the interior of the support means.

It will be noted furthermore that with the structure of the invention a sample can be very quickly taken from the vessel 10, this operation requiring only the slipping of the test tube 20 into the support means to be engaged by the O-rings 68, whereupon the valve means 18 is opened to provide a rapid delivery of a required sample, followed by immediate closing of the valve so that the test tube 20 can be removed with said sample and then the purging procedures can go forth as described above.

What is claimed is:

1. In a liquid-sampling structure, a vessel for containing the liquid, said vessel having a bottom end through which liquid is adapted to be discharged from the vessel, valve means having a sample receiving bore therethrough and located at the bottom end of said vessel and sealed by seal means, said valve means having a closed position for closing the bottom end of said vessel and an open position for discharging liquid out through the bottom end of said vessel, valve-actuating means operatively connected with said valve means for displacing the latter between said open and closed positions thereof, support means situated beneath said valve means for supporting a test tube beneath said valve means to receive the sample of the liquid discharging through said valve means when the latter is in its open position, first fluid-passage means operatively connected to said valve means for directing a cleaning fluid therethrough when said valve means is in its closed position, and second fluid-passage means selectively connected to said support means when the valve means is in its closed position for directing a cleaning fluid through the interior thereof for cleaning the surfaces contacted by the liquid sample as it flows into a test tube.

2. The combination of claim 1 and wherein said valve means includes a ball-valve member formed with said bore passing diametrically therethrough and having a vertical position when said valve means is in its open position for directing liquid from the vessel through said bore into a test tube carried by said support means, said bore having a horizontal position when said valve means is in its closed position.

3. The combination of claim 2 and wherein said first fluid passage means has an inlet and an outlet operatively connected to said valve means for introducing and discharging cleaning fluid, respectively, and said valve-actuating means together with said inlet and said outlet being connected to said valve means in a plane which contains the axis of said bore when said valve means is in its closed position, and said inlet and said outlet and valve-actuating means being equidistantly spaced with respect to each other circumferentially about a vertical axis passing perpendicularly through said bore centrally thereof when said valve means is in its closed position.

4. The combination of claim 2 and wherein said seal means includes a ring means surrounding and slidably engaging said ball valve in a fluid-tight manner, said ring means being formed with openings forming part of said first fluid passage means and communicating only with said bore when the latter is in its horizontal closed position, and said first fluid-passage means including fittings communicating with said openings of said ring means for directing cleaning fluid through one of said fittings and one of said openings of said ring means into said bore while the latter is in its horizontal position, the other of said fittings and the other of said openings receiving the cleaning fluid after it has passed through said bore and directing the cleaning fluid away from said bore.

5. The combination of claim 4 and wherein said ring means includes a pair of rings respectively having inner surfaces forming part of the sphere matching that formed by the exterior surface of said ball valve, said rings respectively having circular edges butting against each other, and only one of said rings being formed with notches at its circular edge, said notches being closed by the circular edge of the other of said rings for forming said openings communicating with said bore.

6. The combination of claim 5 and wherein both of said rings are formed with registering notches for receiving said valve-actuating means, said ball valve being formed with a cutout which receives said valve-actuating means.

7. The combination of claim 1 and wherein said second fluid-passage means is detachably connected to said support means beneath the first fluid-passage means and includes a fitting communicating with the interior of said support means beneath said valve means, said support means including a tubular structure having an inner surface for engaging and supporting a test tube, and said support means having at its outer surface a coupling means for receiving a discharge pipe for receiving the cleaning fluid introduced into the said fitting on said second fluid passage means.

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