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Rosenwald

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[54] **CELL FOR COLLECTING AND MIXING FLUIDS**

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[52] **U.S. Cl.** ..... **73/421 R,** 73/421.5 R, 73/422 R, 259/72

[51] **Int. Cl.** **G01n 1/14**

[58] **Field of Search** ..... 73/422 R, 422 GC; 259/72; 222/226, 243

[56] **References Cited**

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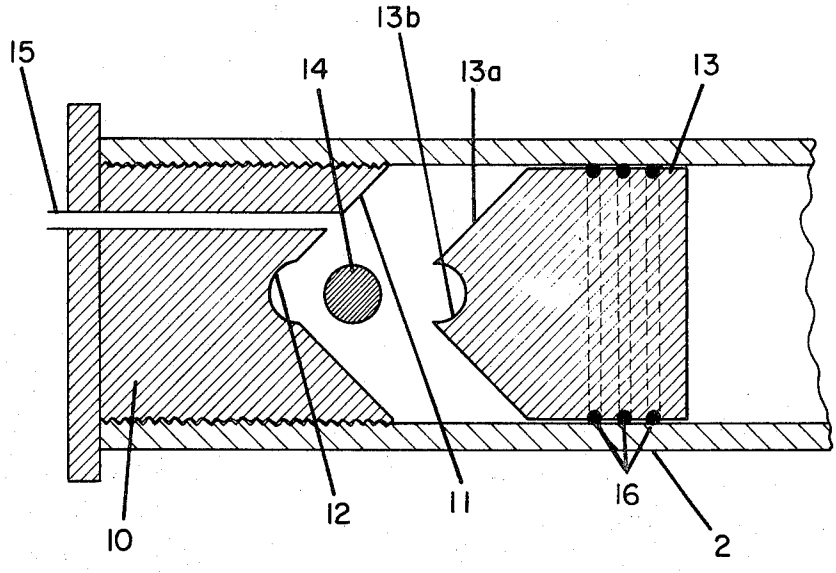
[57] **ABSTRACT**

Apparatus for collecting a sample of fluids which includes a piston slidable in a cylinder displacable by the sample. A mixing element is provided within the cylinder. The piston and end wall of the cylinder are of such configuration that when the piston and end wall are in contact a small space of the proper size and shape is left to just enclose the mixing element leaving substantially no dead space within the sampling chamber.

7 Claims, 3 Drawing Figures



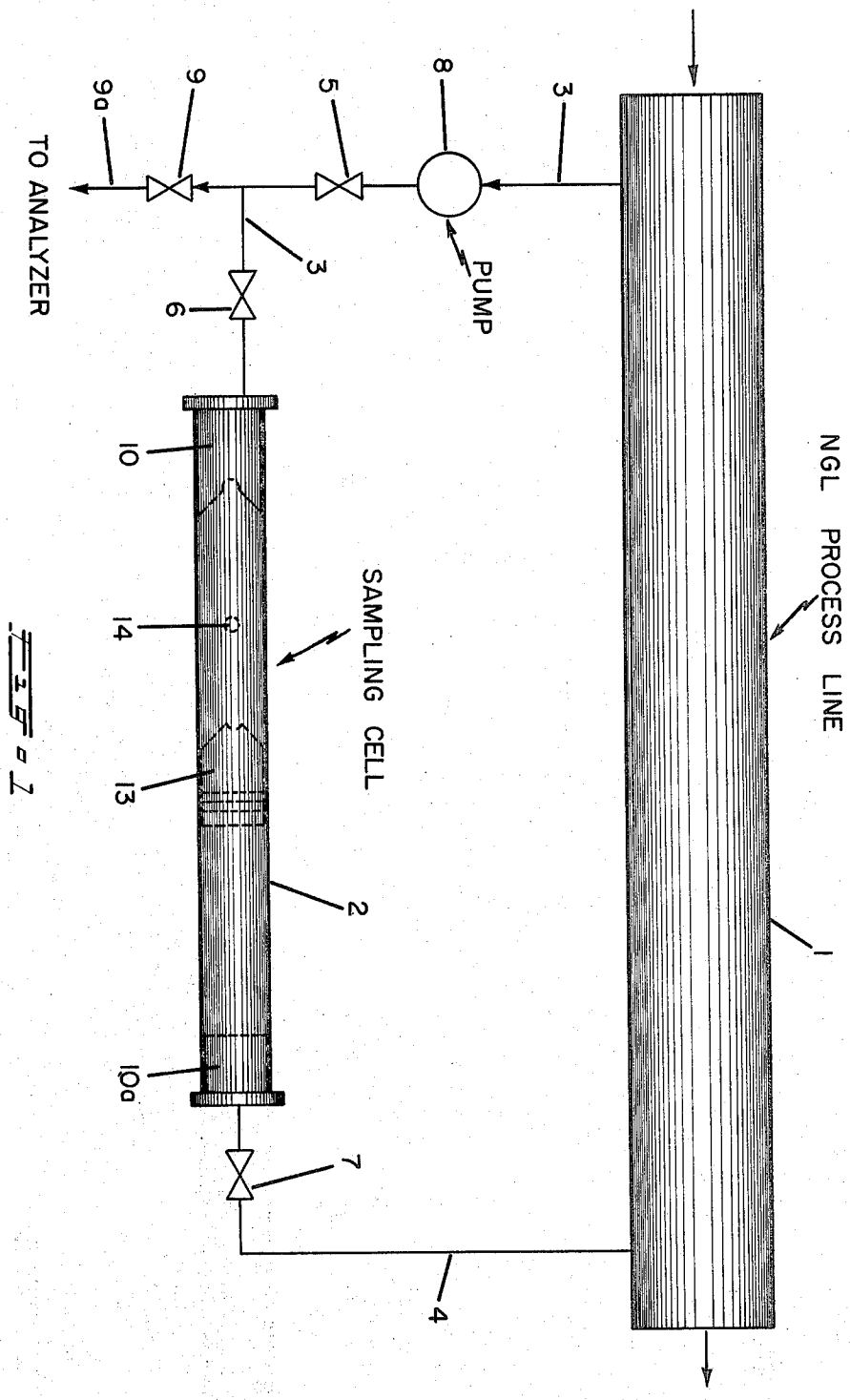

TO ANALYZER
9a
9
5
8
3
PUMP
3
6
10
14
13
SAMPLING CELL
2
10a
7
4
NGL PROCESS LINE
1

FIG. 1

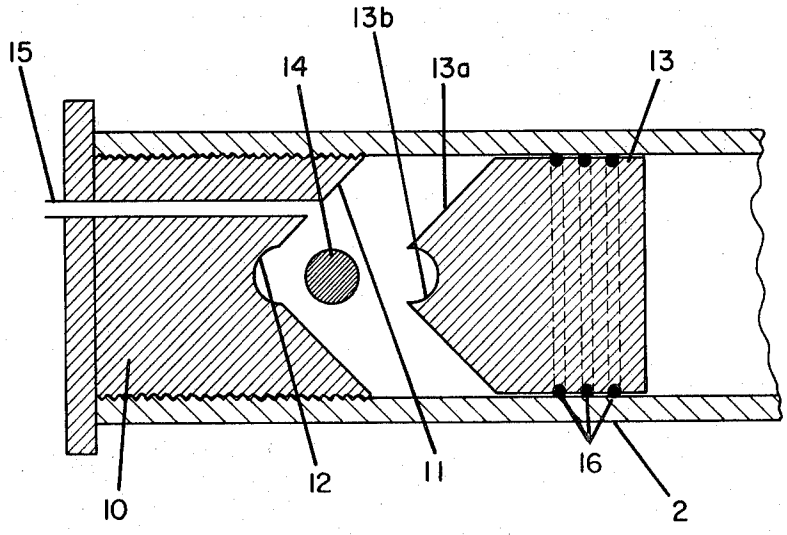


Fig. 2

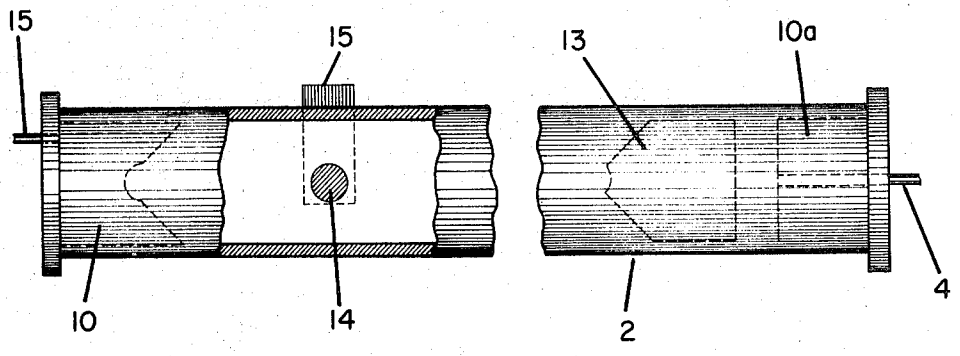


Fig. 3

CELL FOR COLLECTING AND MIXING FLUIDS

BACKGROUND OF THE INVENTION

In the production of natural gas liquids such as ethane, propane, and butane, a stream of the mixed liquids is sampled to determine the quantity of each component contained in the stream. In accordance with prior practice, small samples are taken from the stream periodically. Multiple samples have been required for buyer, seller, transporter and a referee. Attempts to collect separate yet identical samples for analysis by the different parties has required many pieces of hardware and electronic devices which need frequent maintenance, and also has resulted in disagreement between the parties regarding analytical results of the supposedly identical samples.

By taking numerous small samples into a collecting cell incrimentally over a long period of time, a large component sample can thus be accumulated and later subdivided into numerous smaller portions. Many problems could thus be eliminated provided the large composite sample is homogeneously mixed and is thus representative of the composition of the stream over the entire sampling period.

It was learned prior to the present invention that homogeneous blending of the fluid components in such large composite samples does not occur readily by diffusion alone; complete blending cannot be assured in the absence of mechanical agitation within the collecting cell. This problem is further complicated by the fact that a cell which contains internal means for agitating the fluids must nonetheless be designed so that the fluid sample can be completely displaced therefrom mechanically.

It is therefore an object of this invention to provide a cell for collecting samples of mixed fluids, and which also includes means whereby the fluids can be quickly and easily blended once they have been drawn into the cell, and also completely displaced from cell after the mixing has been completed. Other objects and advantages of the of the invention will become apparent from the following description and the appended claims.

SUMMARY OF THE INVENTION

The present invention is a collecting cell for mixed fluids which includes means whereby crudely mixed fluids are homogeneously blended within the cell prior to quantitative analysis of a collected sample.

The present collecting-mixing cell comprises a cylinder having plugs fitted at each end, one of the plugs having an inward frusto-conical recess which communicates with the interior of the cylinder and is aligned coaxially therewith, an inward hemispherical recess which leads from the small end of the frusto-conical recess of the plug, and a passageway for fluids which extends through the body of the plug from the cylinder interior to the outside. A free piston is coaxially aligned within the cylinder and is located between the cylinder plugs. The end of the piston toward the frusto-conically recessed plug has an outward frusto-conical taper at an included angle which matches that of the inward frusto-conical recess of the plug, and the small end of the piston taper has an inward hemispherical recess with the same diameter as the hemispherical recess in the cylinder plug. A ball resides within the cylinder between the plug and the piston, and the ball floatingly fits into the hemispherical recesses of each of these members. The term "floatingly fits" pertains to as close a fit as possible of the ball within the recesses without siezure therein. Such a close fit is necessary in assuring complete emptying of fluid from the cell when the piston is driven toward the recessed plug and this is also the reason why the taper angle of the plug and the piston must be matched.

Fluids enter the cylinder of the collecting cell through the fluids passageway in the recessed plug, thus displacing the piston from the plug and allowing the ball to move freely within the space between the two. Moving of the ball within the space effects mixing of the fluids therein. After mixing, during emptying of the cell, the piston is moved back into the recess of the plug, and the ball is engaged by the hemispherical recess, thus effecting substantially complete emptying of fluids from the cell through the passageway in the plug.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 illustrates the manner in which a sample of fluids is drawn into the collecting cell of this invention.

FIG. 2 is a partial sectional view of one end of the collecting cell showing the recessed plug, the ball and the tapered piston.

FIG. 3 is a sectional view of the claimed apparatus wherein the mixing ball is magnetically attracted and magnetic means are employed for moving the ball back and forth within the interior of the cylinder.

DETAILED DESCRIPTION OF THE INVENTION

In FIG. 1 a pipe line for natural gas liquids in shown at **1**. The sampling cylinder is shown at **2**. Fluid from the pipe line is fed into the sampling cylinder through tap lines **3** and **4**, which are provided with stopcock valves **5, 6,** and **7**. To draw a sample into the cylinder **2**, stopcock valves **5, 6,** and **7** are opened and pump **8** is activated. By means of the intensified pressure provided by the pump, fluid from line **1** is driven into the sample cylinder **2**, displacing the free piston **13** from its seated position in the recessed plug **10** and toward the other plug **10***a* at the opposite end of the cylinder. To accomplish filling of the cylinder in this fashion, valves **5, 6,** and **7** must be open. Once the desired quantity of fluids has been injected into the cylinder, valves **5** and **6** are closed to seal the fluid within the cylinder and the pump is then stopped. Subsequent incremental injection of samples into the cylinder is accomplished by restarting the pump and opening valves **5, 6,** and **7**, followed by sealing off of the cylinder, as previously explained.

The fluid sample is removed from the cell and passed to an analyzer by closing valve **5** and opening valves **6** and **9** so that the sample can be discharged from the cell into an analyzer through line **9***a*. (Valve **9** remains closed during the filling sequences.) Complete discharge of fluid from the cylinder is accomplished by driving the piston against the plug **10** with pressure supplied from the line **1** through line **4** and valve **7**.

Referring to FIGS. **2** and **3**, the cylinder of the cell is shown at **2**. Plug **10** is threadably inserted into one end of the cylinder and has an inward frusto-conical recess **11** which leads at its small end into a hemispherical recess **12**. Both plug recesses are coaxially aligned with the elongated interior of the cylinder. A free piston **13**

is fitted within the cylinder **2** and is located between the cylinder plugs **10** and **10***a*. The end of the piston towards the recessed cylinder plug **10** has an outward frusto-conical taper **13***a* which matches that of the inward recess **11** of the plug. The small end of the piston taper has an inward hemispherical recess **13***b* with the same diameter as the hemispherical recess in the cylinder plug. Between the hemispherical recesses of the plug and the piston there is a ball **14** which floatingly fits into each of the hemispherical recesses.

Before pumping a fluid sample into the collecting cell, the piston **13** is advanced into the recessed plug **10** as far as is possible by fluid pressure supplied from line **4**. The piston mates with the plug, the ball **14** being located between the two, in the hemispherical spaces **12** and **13***b*. Practically no space exists between the recessed plug and the piston when they are in contact with each other, thus assuring that the sample-containing space of the cell is totally empty upon starting the filling sequence and upon completing discharge of the sample from the cell.

Once a large composite sample has been gathered by repeated injection of small samples into the cell, the piston **13** and plug **10** are thus separated and ball **14** is is free to move within the cylinder. Movement of the ball within the cylinder creates turbulence within the contained fluids and hence mixing thereof. One method of moving the ball is to employ one which is magnetically attractive, e. g. made of steel, then move a magnet **16** back and forth over the exterior of the cylinder to accomplish movement of the ball. In such a case the cylinder should be constructed from a substance which is either non-magnetic or only slightly magnetic. Alternatively the cylinder can be shaken up and down while vertically oriented, or mounted horizontally and the ends thereof rocked up and down since either will cause the ball to move back and forth within the cylinder and thus agitate the contained fluids.

Best sealing between the piston **13** and cylinder **2** can be accomplished by means of piston rings. Rubber O-rings are preferred and at least two rings can be used to assure stabilization of the piston with respect to maintaining coaxial alignment within the cylinder **2**.

Although a ball of any size can be used for homogeneous mixing of gases within the sampling cell, it will be appreciated that faster mixing is accomplished by means of a larger ball. It is therefore preferred that the ball should have a diameter which is almost as large as the inside diameter of the cylinder of the sampling cell and no smaller than about one-fourth the inside diameter of the cylinder.

While the present invention has been described with reference to particular materials, apparatus and arrangements thereof, it will nonetheless be understood that still other embodiments will become apparent which are within the spirit and scope of the invention defined in the following claims.

What is claimed is:

1. Sample collecting cell comprising:

a. a cylinder leaving plugs fitted in each end,

b. one of the plugs having an inward frusto-conical recess which communicates with the interior of the cylinder and is aligned coaxially therewith, an inward hemispherical recess which leads from the small end of the frusto-conical recess of the plug, and a fluid passageway through the body of the plug which extends from the cylinder interior to the outside.

c. a free piston coaxially aligned within the cylinder and located between the cylinder plugs, the end of the piston towards the recessed plug having an outward frusto-conical taper at an included angle which matches that of the inward frusto-conical recess of the cylinder plug, the small end of the piston taper having an inward hemispherical recess with the same diameter as the hemispherical recess in the cylinder plug, and

d. a ball between the recessed plug and the piston which floatingly fits into the hemispherical recesses of the cylinder plug and the piston.

2. Apparatus as in claim **1** wherein the other plug at the opposite end of the piston has a fluid passageway through the body of the plug which extends from the cylinder interior to the outside.

3. Apparatus as in claim **1** and including at least two piston rings which seal between the piston and the wall of the cylinder.

4. Apparatus as in claim **3** wherein the rings are O-rings.

5. Apparatus as in claim **1** wherein the ball is magnetically attracted and including means for moving the ball back and forth within the interior of the cylinder magnetically.

6. Apparatus as in claim **1** wherein the diameter of the ball is at least about one-fourth as large as the inside diameter of the cylinder.

7. Apparatus as in claim **2** and further comprising:

a. valve means for starting and stopping a flow of pressurized fluid through the passageway of the recessed plug, and

b. valve means for starting and stopping a flow of pressurized fluid through the passageway of the other plug.

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