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Conn

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[54] **GAS INSTRUMENT LIQUID SEPARATOR**

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[52] **U.S. Cl.** **55/219,** 55/325, 55/426, 55/DIG. 25

[51] **Int. Cl.** **B01d 50/00**

[58] **Field of Search** ..... 55/218, 219, 325, 55/337, 424, 426, DIG. 25

[56] **References Cited**

UNITED STATES PATENTS

2,311,697	2/1943	Samiran	55/219 X
2,390,841	12/1945	Longden	210/304 X
2,742,156	4/1956	Spangler	210/115 X
3,192,691	7/1965	Ely	55/325
3,464,186	9/1969	Hankison et al.	55/316 X

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[57] **ABSTRACT**

A separator for removing liquid hydrocarbons from a gas instrument line is disclosed. The miniature and compact separator utilizes impingement and centrifugal action for primary removal of entrained liquids, as well as a shredded coalescing material for further separation. The outlet chamber utilizes a probe to further prevent liquid carryover. Straightening vanes and a float chamber are provided for removal of the liquids.

9 Claims, 4 Drawing Figures

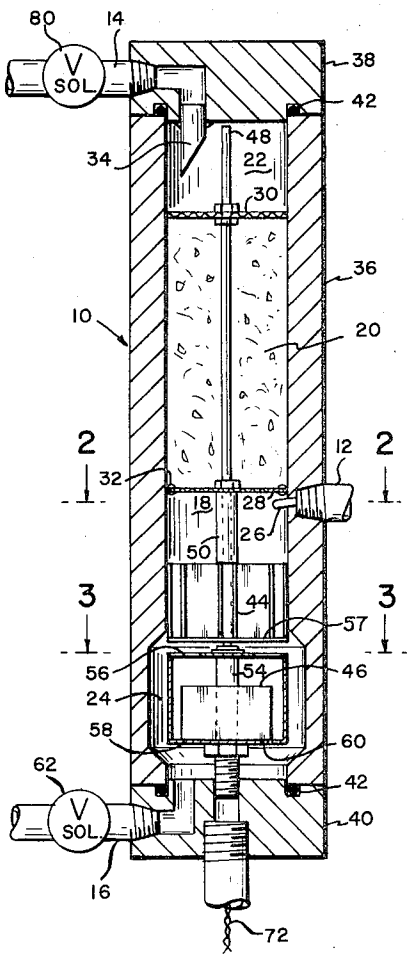


FIG. 1

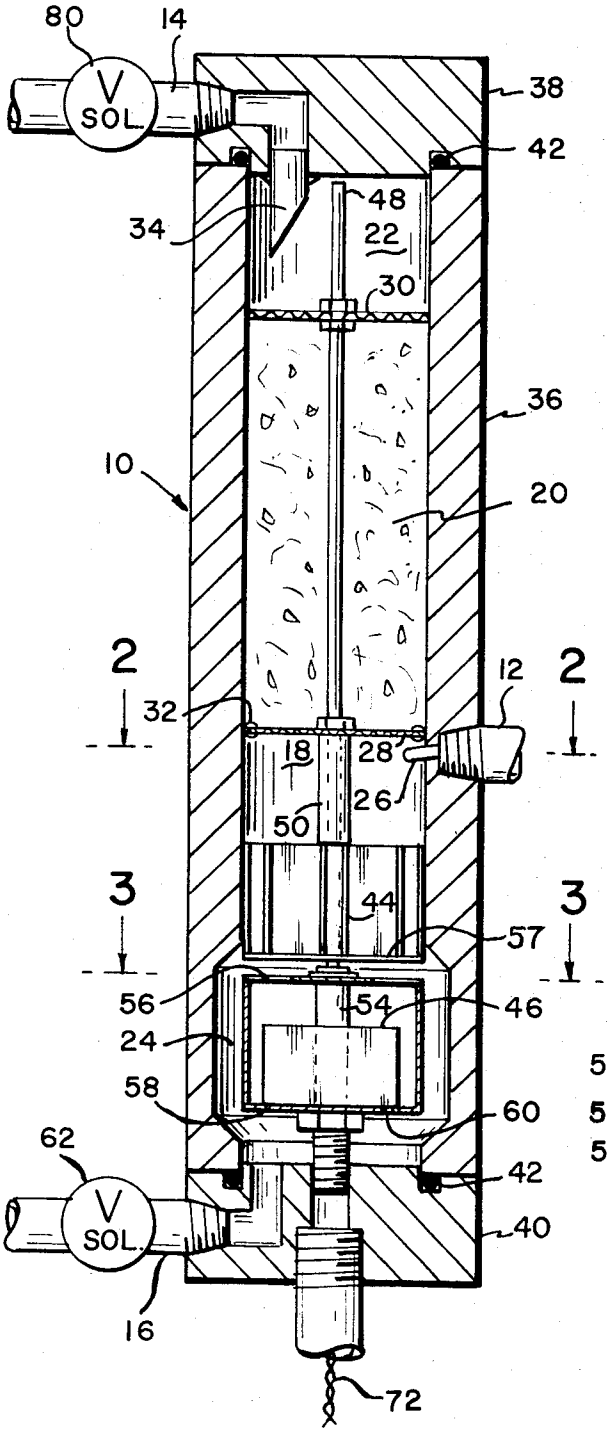


FIG. 2

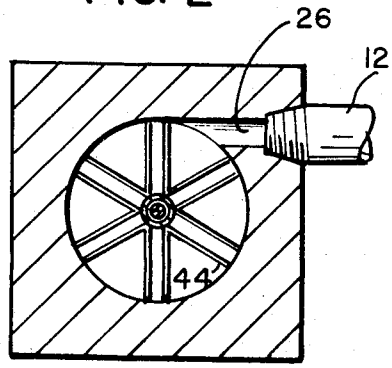


FIG. 4

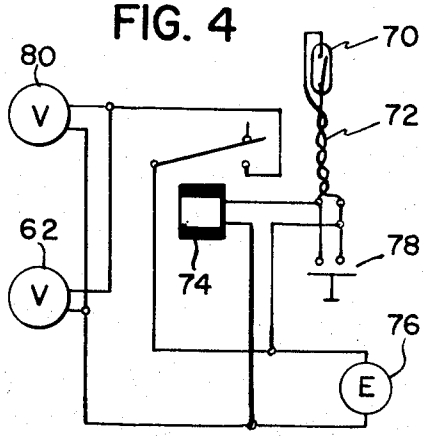
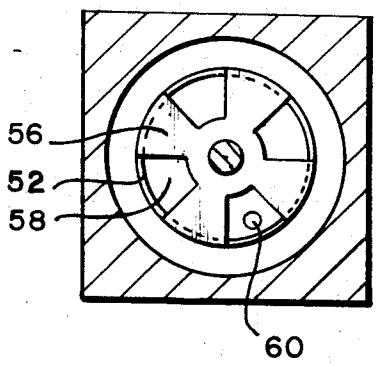


FIG. 3



GAS INSTRUMENT LIQUID SEPARATOR

BACKGROUND OF THE INVENTION

The present invention generally relates to a liquid separator, and more specifically to a miniature separator for removing liquid hydrocarbons from a gas instrument line.

Prior art separators are illustrated in such U.S. Pat. Nos. as those to Longden, 2,390,841; Spangler, 2,742,156; and Ely, 3,192,691. The prior art devices are designed for high volume separation. The prior art devices are not designed for use with instruments wherein the rate or volume of gas flow is very low.

SUMMARY

In the processing, distribution and utilization of gas, small quantities of the gas are often needed for analysis of chemical and physical properties. For these purposes, only a very small volume of gas is needed, typically at regular intervals, and it is most desirable to be able to separate from the gas any entrained liquid hydrocarbons. Thus, it is a principal object of the present invention to remove entrained liquid hydrocarbons from a gas instrument line.

This object is accomplished by providing a compact and miniature separator in accordance with the present invention, which accomplishes the separation process by a combination of impingement and centrifugal action, as well as by passing the gas through a coalescing material. Further, the gas is removed from the separator in a relatively low velocity area by means of a probe which is inserted into the chamber in such a manner as to prevent liquid creep into the probe.

The invention further includes straightening vanes and a float for automatically operating a sump dump valve, and may also include an automatically operated gas discharge closing valve. The float is contained within a float cage which serves to dampen float oscillation, and provision is also made for rapid actuation of the float should a slug of liquid enter the separator.

Other and further objects, features and advantages will be apparent from the following description of the presently-preferred embodiment of the invention, given for the purpose of disclosure when taken in conjunction with the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Like character references designate like parts throughout the several views of the drawings, which are:

FIG. 1 is an elevational view, partially in section showing the layout of the present invention.

FIG. 2 is a partial sectional top view, taken along the line 2—2 of FIG. 1.

FIG. 3 is a partial sectional top view, taken along the line 3—3 of FIG. 1.

FIG. 4 is a schematic view of the electrical circuitry.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings, and particularly to FIG. 1, the reference numeral 10 generally designates the separator of the present invention, into which leads the input conduit 12, and from which leads the gas output conduit 14, and the liquid conduit 16. The separator 10 generally consists of a central tube 36, which may be of any desired outer configuration, but having

a cylindrical bore therein. The tube 36 is enclosed at the top by the top head 38 and at the bottom by the bottom head 40, both heads being appropriately sealed to the tube 36, as by means of the O-rings 42.

The interior of the separator is basically divided into four zones or chambers, namely the centrifugal chamber 18, the coalescing chamber 20, the gas discharge chamber 22, and the sump and float chamber 24. To give an idea of the size of the separator 10, for particular use with gas instrument lines, the diameter of the centrifugal chamber 18 is approximately 1 ½ inches and the total inside length of the separator is approximately 9 inches. The input nozzle is three-sixteenths inch in diameter.

Leading from the input conduit 12 into the centrifugal chamber 18 is the inlet nozzle 26. This nozzle is inclined downwardly from the horizontal approximately 7 degrees. Furthermore, as seen in FIG. 2, the inlet nozzle is arranged at the side of the centrifugal chamber 18, so that input gas impinges tangentially on the inside wall of the centrifugal chamber 18. In this manner, the input gas whirls rapidly about the inside of the centrifugal chamber 18, tending to throw any entrained liquid hydrocarbons against the wall of the chamber, from whence they may drain downwardly into the float chamber 24. Further, the inclination from the horizontal of the inlet nozzle 26 further serves to urge the liquid hydrocarbon components downwardly.

Immediately above the centrifugal chamber 18 is the coalescing chamber 20 which contains a material particularly suited to coalesce any remaining liquids within the gas, causing them to form droplets which will flow downwardly to the float chamber 24. In particular, the coalescing material found to be well suited for this purpose is shredded Teflon, which is maintained within the coalescing chamber 20 by the use of screens 28 and 30. Screen 28 further includes a gasket 32 about its outer periphery. This gasket 32 may comprise a sufficient length of Teflon tubing which has been slit along its length and the slit is applied over the screen 28. The purpose of the gasket 32 is to prevent liquid hydrocarbons creeping up the wall of the centrifugal chamber 18 into the coalescing chamber 20, during periods of heavy liquid input.

Extending vertically into the discharge chamber 22 is the probe tube outlet 34 which leads to the gas outlet conduit 14. Preferably, the probe opening is cut at an acute angle from the axis of the probe, such as 30 degrees, in order to substantially increase the open inlet area of the probe. This larger area will, in turn, result in lower discharge velocity of the output gas, and therefore less likelihood of carrying over any liquid hydrocarbons which may be in the discharge chamber 22. It is for this reason that the probe also extends into the discharge chamber.

Situated below the centrifugal chamber 18 are the straightening vanes 44. The purpose of these vanes is to help eliminate the whirling action of the separated liquid hydrocarbons, as well as reducing turbulence, which would otherwise tend to affect the action of the float 46. Between the straightening vanes 44 and the top 56 of the float cage 52 may be situated a washer 57 for the same purposes. An end view of the straightening vanes 44 is depicted in FIG. 2. Mounted centrally in the screens 28 and 30 is a rod 48 which extends from the top head 38 to the bottom of the straightening vanes 44, and is provided to support the screens, and through

the medium of the spacer **50** to space the straightening vanes **44** from the bottom screen **28.** These various elements may be suitably attached to the rod **48.**

Within the float chamber **24** is a float cage **52** having a sensor tube **54** centrally mounted therein. The float **46** surrounds the sensor tube **54** and is arranged to float upwardly about the tube **54** depending upon the level of liquid hydrocarbons within the float cage **52.** As will be noted hereinafter with reference to FIG. **4,** the float **46** also includes a magnet therein.

The float cage **52** generally comprises a cylindrical member having a perforated top **56,** best seen in FIG. **3.** The disc-like bottom **58** of the float cage includes a small damper hole **60** therein. In operation, as the liquid level rises in the float chamber **24,** the liquid will enter the float cage **52** through the damper hole **60,** thus causing the float **46** to rise about the sensor tube **54.** However, if a large volume of liquid suddenly enters through the inlet nozzle **26,** thus rapidly filling the float chamber **24,** this liquid will flow over the perforated top **56** of the float cage, and rapidly fill the float cage **52,** causing the float **46** to immediately rise.

Attached to the liquid outlet conduit **16** is a valve **62,** which may be an electrically operated solenoid valve of the normally closed configuration. When this valve **62** is opened, liquid which has collected within the float chamber **24** is drained therefrom through the liquid outlet conduit **16,** and, of course, any liquid within the float cage **52** is drained therefrom through the damper hole **60** as well.

Referring now to FIG. **4,** the electrical schematic for automatic operation of the separator **10** is shown. A magnetically actuatable switch **70** is provided, and this switch is mounted within the sensor tube **54,** in the upper portion thereof. This switch **70** may be a conventional reed switch, which is actuated by the magnet, previously mentioned, within the float **46.** The leads **72** from the switch **70** lead to a relay **74** and to a source of electrical energy **76,** in a conventional manner. The closing of the switch **70** results in actuation of the relay **74.** There may be also provided a push button **78** to provide a test for actuation of the relay **74** manually. Actuation of the relay **74** closes the circuit, in a conventional manner, thereby actuating solenoid valve **62,** to open the liquid discharge line. Thus, it is seen that when the float **46** rises about the sensor tube **54,** the magnet therein will actuate the switch **70,** resulting in opening of the valve **62,** and the dumping or discharge of the liquid hydrocarbons collected within the float chamber **24.**

In addition, a further solenoid valve **80** may be provided in the gas discharge conduit **14.** This valve is of either the normally open variety or the normally closed variety held open electrically. Thus, gas entering through the inlet nozzle **26** will be continuously discharged through the probe tube **34** and valve **80** while the liquid hydrocarbons are separated from the gas and collected in the float chamber **24.** Thereupon, when the liquid level rises sufficiently in the float cage **52,** the float **46** would actuate the switch **70** resulting in valve **62** opening. At the same time, valve **80** would close. By this process, the full pressure of the gas entering through the inlet nozzle **26** would be applied to quickly dump the liquid in the float chamber through the liquid outlet **16** and valve **62.** Other variations in the electrical circuitry and valving may be employed to protect downstream instruments in cases of power failures, and the like.

Thus, it is seen that the present invention provides a very compact miniature liquid hydrocarbon separator for particular use with gas instrument lines. The present invention, therefore, is well adapted to carry out the objects and attain the ends and advantages mentioned, as well as others inherent therein. While a presently preferred embodiment of the invention has been given for the purpose of disclosure, numerous changes in the details of construction and combination, shape, size and arrangement of parts may be resorted to without departing from the spirit and scope of the invention as hereinafter claimed.

What is claimed is:

1. A liquid hydrocarbon separator for use with a gas instrument line including:

an elongate hollow body having an internal cylindrical wall,

a substantially horizontally disposed gas inlet nozzle arranged adjacent the cylindrical wall of the body, whereby gas and liquid hydrocarbons entering the body are tangentially impinged against the wall,

a coalescing material situated above the nozzle,

straightening vanes situated below the nozzle and spaced from the coalescing material,

the space between the straightening vanes and coalescing material defining a centrifugal chamber,

a top closure member sealing the top of the body, the space between the top closure member and the coalescing material defining a discharge chamber,

an outlet probe extending into the discharge chamber,

a gas outlet conduit leading from the outlet probe,

a bottom closure member sealing the bottom of the body, the space between the straightening vanes and the bottom closure member defining a float chamber,

a cup-like float cage mounted in the float chamber,

said cage having a damper outlet in the bottom thereof,

a float floatably situated in the float cage,

a liquid hydrocarbon outlet conduit leading from the bottom of the float chamber,

a liquid valve situated in the outlet conduit, and

means for actuating the liquid valve when the float floats adjacent the top of the float cage.

2. The invention of claim **1** wherein the inlet nozzle is inclined downwardly into the centrifugal chamber.

3. The invention of claim **1** wherein the probe tube extends vertically into the discharge chamber.

4. The invention of claim **3** wherein the probe tube extension into the discharge chamber is cut at an acute angle with respect to the tube axis.

5. The invention of claim **1** wherein the coalescing material is shredded Teflon.

6. The invention of claim **5** including a lower screen and an upper screen confining the coalescing material, said lower screen having a gasket about its periphery engaging the cylindrical wall.

7. The invention of claim **1** wherein the float cage includes a perforated top, and a dampening hole in the bottom.

8. The invention of claim **1** wherein the means for actuating the liquid valve includes:

a magnet situated in the float,

a sensor tube extending into the float cage,

a magnetically actuatable switch in the sensor tube arranged to be actuated by the float magnet when the float floats adjacent the top of the float cage,

the liquid valve being electrically actuatable,

electrical means for actuating the liquid valve when the switch is actuated.

9. The invention of claim **8** including

an electrically actuatable gas outlet valve situated in the gas conduit,

said gas valve actuated when the liquid valve is actuated.

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