United States Patent [19]

Shea

[11] **3,861,198**

[45] **Jan. 21, 1975**

[54] **FLUID ANALYZER WITH SELF-CLEANING VIEWING WINDOWS**

[75] Inventor: **James J. Shea,** Dearborn Heights, Mich.

[73] Assignee: **Gam Rad, Inc.,** Detroit, Mich.

[22] Filed: **Nov. 3, 1972**

[21] Appl. No.: **303,631**

[52] **U.S. Cl.** ..... **73/61 R,** 137/238, 137/240, 250/239, 350/63, 356/208, 356/246

[51] **Int. Cl.** **G01n 21/26,** G02b

[58] **Field of Search** ..... 137/240, 238; 73/36, 61 R, 73/DIG. 11, 355; 350/63 X; 251/118, 61; 356/208, 246, 207; 250/239, 218; 138/46, 44, 45; 116/117 C; 134/166 C

[56] **References Cited**

UNITED STATES PATENTS

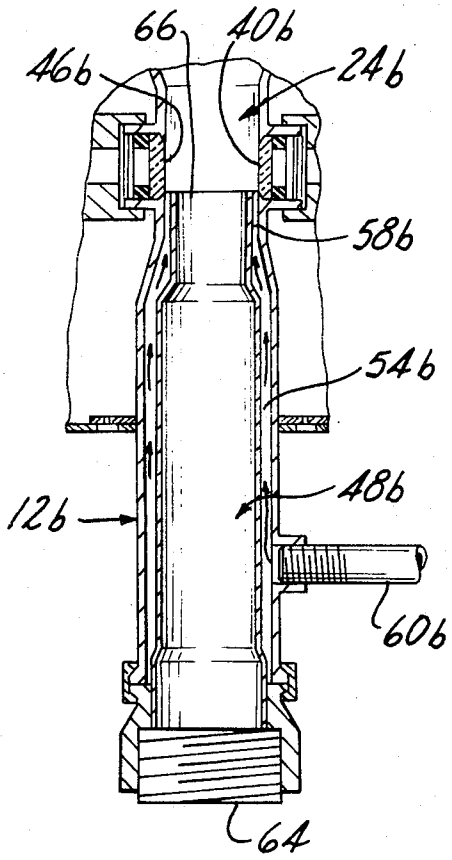
1,924,139	8/1933	Thomas	250/218 X
2,185,361	1/1940	Towne	250/218
3,398,023	8/1968	Jacobsen et al.	350/63 X
3,404,284	10/1968	Doolittle	350/63 UX
3,453,049	7/1969	Wager, Jr.	350/63 X
3,628,028	12/1971	Thorsheim	250/239 X

Primary Examiner—Alan Cohan
Assistant Examiner—Robert J. Miller
Attorney, Agent, or Firm—Zwerdling, Maurer, Diggs & Papp

[57] **ABSTRACT**

A turbidimeter or fluid analyzer having the light transmitting windows maintained clean by apparatus directing a flow of fluid thereupon.

10 Claims, 5 Drawing Figures



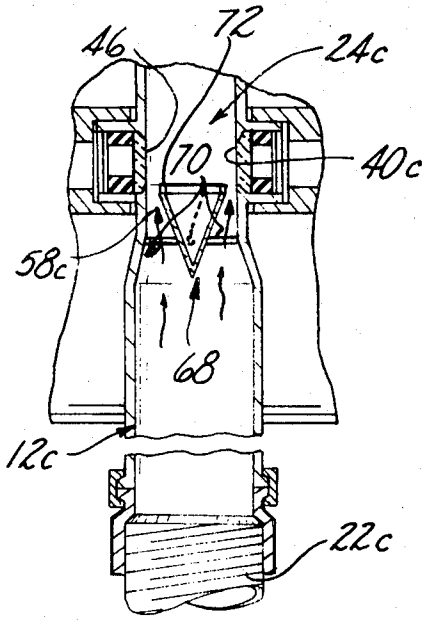


Fig - 1

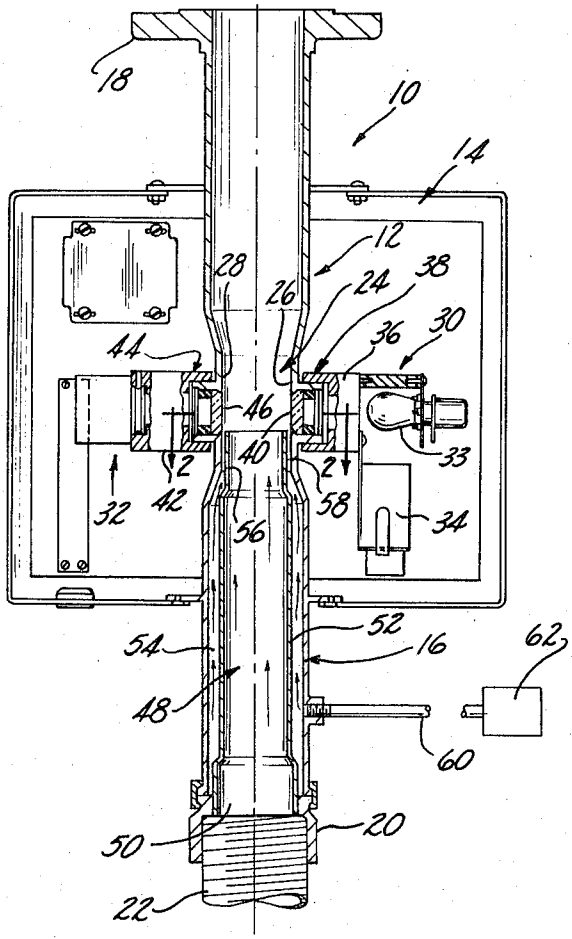


Fig - 4

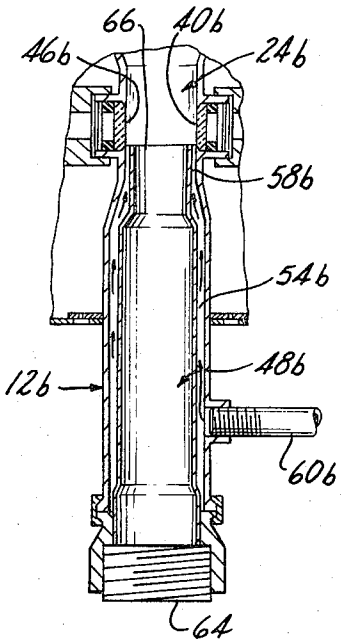


Fig - 5

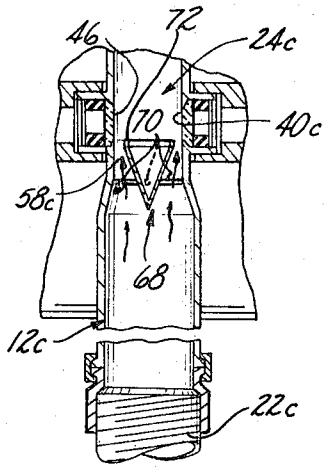


Fig - 3

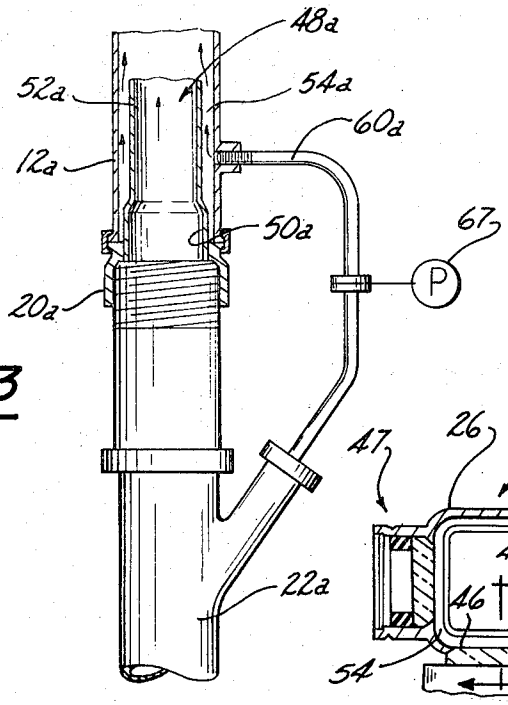
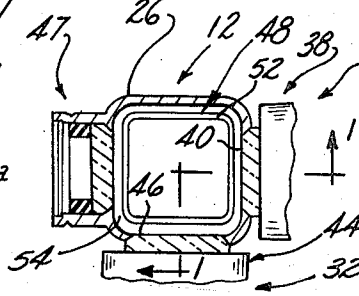


Fig - 2



FLUID ANALYZER WITH SELF-CLEANING VIEWING WINDOWS

SUMMARY BACKGROUND OF THE INVENTION

The present invention relates to turbidimeters and more particularly to a turbidimeter having apparatus for cleaning the light transmitting windows.

With the recent emphasis on pollution control the potential applications for turbidimeters or fluid analyzers as fluid flow monitors has increased. In some applications, however, the fluid to be monitored or analyzed can be such as would deposit particles on or eventually coat the windows; clearly the effectiveness of the device could be maintained only through periodic cleaning. In the present invention, this problem is solved by utilizing a flow of fluid over the window to clean and/or insulate the window from contamination.

Therefore, it is an object of the present invention to provide a new and improved turbidimeter having means for maintaining the light transmitting window clean.

In one form of the invention the window is maintained clean by providing, in a sense, a curtain of water or other clean fluid, different from the monitored or analyzed fluid, across the window to maintain a thin protective film or barrier thereacross. Thus it is another object of the present invention to provide a turbidimeter of the above described type having apparatus for providing a curtain or film of fluid, different from the monitored fluid, across the light transmitting windows to maintain them clean.

In another form of the invention, apparatus is provided to increase the flow of the monitored fluid on the area adjacent the windows and then to maintain the windows clean by the velocity of the fluid or in a different form by turbulence. Thus it is another object of the present invention to provide a turbidimeter having apparatus for cleaning the light transmitting windows by using the monitored fluid and by increased velocity across the windows and/or turbulence at the windows.

It is still another general object to provide for an improved turbidimeter.

Other objects, features, and advantages of the present invention will become apparent from the subsequent description and the appended claims, taken in conjunction with the accompanying drawings, in which:

FIG. **1** is a longitudinal sectional view taken generally along the lines **1—1** of FIG. **2** of a turbidimeter having apparatus for providing a film of fluid across the transmitting windows, which film of fluid is different from the fluid being analyzed;

FIG. **2** is a sectional view of a portion of the turbidimeter of FIG. **1** and taken generally along the lines **2—2** of FIG. **1**;

FIG. **3** is a fragmentary view of a modified flow tube for a turbidimeter similar to that of FIG. **1** having a construction for providing a separate flow of fluid across the transmitting windows which is the same fluid as that being analyzed;

FIG. **4** is a fragmentary view of a different, modified flow tube in which all of the fluid to be monitored is directed through a restriction adjacent the windows; and

FIG. **5** is a fragmentary sectional view of still another form of the invention for providing a restriction adjacent the transmitting windows.

Looking now to FIG. **1**, a turbidimeter or fluid analyzer is generally shown and is indicated by the numeral **10** and includes a flow tube assembly **12** and a support housing **14.** The tube assembly **12** includes a main outer tube **16** which has a flange **18** at its outlet end and a threaded adaptor **20** secured to its inlet end. The adaptor **20** receives the end of a pipe **22.**

The main tube **16** has a necked down portion **24** intermediate its ends, which necked down portion is provided with a plurality of flats including flats **26** and **28** which facilitate the mounting of a light source assembly **30** and a sensor assembly **32.** The light source assembly **30** includes a lamp **33** which can be energized in a suitable source of electricity and the output of which can be sensed and regulated via a regulator **34**; regulator **34** can be of a type well known in the art and hence the details thereof have been omitted for purposes of simplicity. The lamp **33** is connected to transmit its light through a lense assembly **36** and thence into the necked down portion **24** of the flow tube **16** via a window assembly **38.** The window assembly **38** is connected to the flat portion **26** and includes a window **40** which has its inner surface generally flush with the flat portion **26.**

As can be seen from FIG. **2,** the flat portion **28** is at quadrature with flat portion **26.** Looking again to FIG. **1,** the sensor assembly **32** is connected to a lense assembly **42** which in turn is connected to a window assembly **44.** The window assembly **44** is connected to the flat portion **28** and includes a window **46** which has its inner surface generally flush with the flat portion **28.** The sensor assembly **32** includes a suitable photoresponsive member and can be connected to suitable output indicating apparatus (not shown) whereby an indication of the turbidity of the fluid being analyzed can be obtained. The output indicating apparatus can be of construction well known in the art and hence a description thereof has been omitted for purposes of simplicity.

As noted the turbidimeter **10,** having the light source and photosensitive member at a relative angle of 90° operates on the Tyndall Effect. It should be understood, however, that the present invention is not limited to Tyndall Effect turbidimeters but can be used generally with any turbidimeter or fluid analyzer having a window exposed to the fluid being analyzed. A window assembly **47** (FIG. **2**) provides for pass through of the light from source **30** and minimizes errors from reflected light from that opposite wall.

An inner smaller diameter tube **48** has an enlarged end portion **50** which is snugly, sealingly held to the inside diameter of adaptor **20.** The tube **48** extends generally up to the windows **40** and **46** and is in direct communication with the pipe **22** such that the fluid to be analyzed will be carried by the inner tube **48** and transmitted into the main tube **16** at the windows **40** and **46** whereby the fluid will be exposed for analysis via the light means **30** and sensor means **32.**

The inner tube **48** has a reduced diameter portion **52** which defines an annular passageway **54** with the main tube **16**; the inner tube **48** terminates in a reduced diameter end portion **56** which is located in close clearance relation to the necked down portion **24** and defines therewith a restricted passageway **58** which terminates just ahead of the windows **40** and **46.**

The end portion **56** is also provided with flats similar to the reduced diameter portion **24.**

An inlet pipe **60** is connected to the main tube **16** at a position to communicate the annular passageway **54** and a source **62** of fluid. The source **62** can be varied to vary the pressure of the fluid to regulate the velocity of fluid across the windows **40** and **46.** While the preferred fluid from source **62** could be clean water any fluid which would not adversely affect the analysis of the fluid from pipe **22** can be used.

In operation, the clean fluid from source **62** is directed to flow across the windows **40** and **46**; the pressure of the clean fluid from the source **62** is selected such that the velocity of clean fluid from the restricted passage **58** is sufficient to provide a thin film or curtain across the windows **40** and **46** to, in a sense, insulate them from the fluid being analyzed. The pressure at the exit of passageway **58** is also selected to be sufficiently high to assure that the fluid to be analyzed, from pipe **22,** will not back up into passageway **54.** Thus with the design of FIG. **1,** the windows **40** and **46** will be maintained clean from contamination by the film or curtain of clean water or other suitable fluid from source **62.**

in the embodiments of FIG. **3–5** a separate fluid is not utilized and the windows are maintained clean providing a curtain of film of the fluid being analyzed at an increase in velocity in the area adjacent the window so that the windows are maintained clean by a scrubbing action caused by the increased velocity and/or by turbulence. In the description of the embodiments of FIG. **3, 4** and **5,** elements similar to like elements in the embodiment of FIG. **1** and **2** have been given the same numeral designation with the addition of the letter postscripts *a*, *b* and *c*, respectively.

Looking now to FIG. **3,** the need for fluid source **62** has been eliminated and pipe **60***a* is now connected as a shunt from between passageway **54***a* and pipe **22***a*. Thus, a portion of the fluid to be analyzed flowing in pipe **22***a* is bypassed into passageway **54***a* while the remainder flows through inner tube **48***a*. The remainder of the construction is generally the same as that of FIG. **1.** It is known that the velocity of a fluid in a pipe is greater at the center than at the outer extremity. However, by use of the fluid flow through the restriction (similar to restricted passageway **58** of FIG. **1**) the velocity of the fluid is increased over what it would have been if the outer tube **12***a* had been used alone in the conventional manner. Thus, the fluid in passage **54***a* is discharged adjacent the windows and at an increase in velocity; hence, the windows are maintained clean by the scrubbing action of the film of fluid flowing thereacross at an increase in velocity.

In the embodiment of FIG. **3** an auxiliary pump **67** is supplied in line **60***a* to raise the pressure in line **60***a* to a level to provide the desired flow through the restriction (similar to **58**) for the cleaning purpose noted. Alternatively a flow restriction could be provided (in lieu of pump **67**) in tube **50***a* to provide the necessary differential in pressure between the fluid on tube **50***a* and that in tube **60***a* to provide the desired flow through the restriction (similar to **58**).

Looking now to FIG. **4,** again the fluid to be analyzed is used to maintain the windows clean. Here the inner tube **48***b* is blocked at opposite ends by plugs **64** and **66** and all of the fluid to be analyzed is transmitted to the passageway **54***b* and pipe **60***b*. Now all of the fluid to be analyzed is transmitted through the restricted passageway **58***b* and flows across the windows **40***b* and **46***b* at an increased velocity. In addition because the fluid from restricted passageway **58***b* includes all of the fluid flowing through the main tube **12***b* and the restricted passageway **58***b* opens abruptly into an enlarged volume as defined by the necked down portion **24***b* adjacent the windows **40***b*, **46***b*, there will be turbulence in this enlarged volume. The turbulence and increase in velocity across the windows **40***b*, **46***b* will assist in maintaining the windows **40***b*, **46***b* clean.

In the embodiment of FIG. **5** the inner tube has been omitted and now all of the fluid to be analyzed flows directly through the inner tube **12***c* from the inlet pipe **22***c*. However, a flow restrictor **68** is supported generally in the necked down portion **24***c* adjacent the windows **40***c*, **46***c* and defines a restricted passageway **58***c*. In the embodiment shown in FIG. **5** the flow restrictor **68** is generally conically shaped and is supported in the main tube **12***c* via a plurality of legs **70.** The restrictor **68** terminates at its large or base end in a plurality of flats **72** having an outer contour generally similar to the contour of the confronting surface of the flated, necked down portion **24***c*. The action of the restrictor **68** is similar to that of the closed inner tube **48***b* of FIG. **4** in that it provides for both an increase in velocity of fluid across windows **40***c*, **46***c* and also provides for turbulence in that area. This action will assist in maintaining the windows **40***c*, **46***c* clean.

Note that the analysis or indication or turbidity is not affected by the velocity of the fluid or by the turbulence of the fluid and hence the apparatus of the embodiment of FIGS. **1–5** will not affect the analysis being made.

Thus, in each of the embodiments shown, there is provided apparatus for self-cleaning of the windows whereby the frequency of maintenance can be reduced.

While it will be apparent that the preferred embodiments of the invention disclosed are well calculated to fulfill the objects above stated, it will be appreciated that the invention is susceptible to modification, variation and change without departing from the proper scope or fair meaning of the invention.

I claim:

1. A fluid analyzer comprising an annular, elongated flow tube, said tube having at least one window whereby the fluid can be analyzed, and flow means operatively connected to said flow tube for directing fluid flow across the surface of said window in said tube whereby said surface of said window will be maintained clean, said flow tube including means for transmitting the fluid to be analyzed through a first passageway past said window whereby the analyzed fluid can be viewed and with said flow means comprising separate passage means for directing fluid across the surface of said window via a second passageway separate from said first passageway, said flow means comprising a different annular elongated tube supported within said flow tube and defining with said flow tube said first and second passageways.

2. A fluid analyzer comprising a flow tube, said tube having at least one window whereby the fluid can be analyzed, and flow means operatively connected to said flow tube for directing fluid flow across the surface of said window in said tube whereby said surface of said window will be maintained clean, said flow tube including means for transmitting the fluid to be analyzed through a first passageway past said window whereby the analyzed fluid can be viewed and with said flow means comprising separate passage means for directing

fluid across the surface of said window via a second passageway separate from said first passageway, said flow means comprising shunt means for receiving a portion of the fluid to be analyzed and directing that portion across the surface of said window.

3. A fluid analyzer comprising a flow tube, said tube having at least one window whereby the fluid can be analyzed, and flow means operatively connected to said flow tube for directing fluid flow across the surface of said window in said tube whereby said surface of said window will be maintained clean, said flow means directing fluid to be analyzed across the surface of said window.

4. The analyzer of claim **1** with said flow means transmitting all of the fluid to be analyzed.

5. A fluid analyzer comprising a flow tube, said tube having at least one window whereby the fluid can be analyzed, and flow means operatively connected to said flow tube for directing fluid flow across the surface of said window in said tube whereby said surface of said window will be maintained clean, said flow means comprising flow restrictor means located approximate to said window for providing fluid flow at an increased velocity.

6. The analyzer of claim **5** with said flow restrictor means defining a restricted passageway and with said tube adapted to transmit all of the fluid to be analyzed through said restricted passageway.

7. The analyzer of claim **6** with said restricted passageway terminating adjacent said window and communicating therewith a substantially increased volume whereby the fluid flow will be turbulent in the vicinity of the surface of said window.

8. The analyzer of claim **7** with said flow restrictor means comprising a closed tube supported within said flow tube and located to define said restricted passageway.

9. The analyzer of claim **7** with said flow restrictor means comprising a generally conically shaped member located to define said restricted passageway with the base downstream.

10. The fluid analyzer of claim **9** with said base having a contour similar to the contour of the confronting surface of said flow tube.

* * * * *