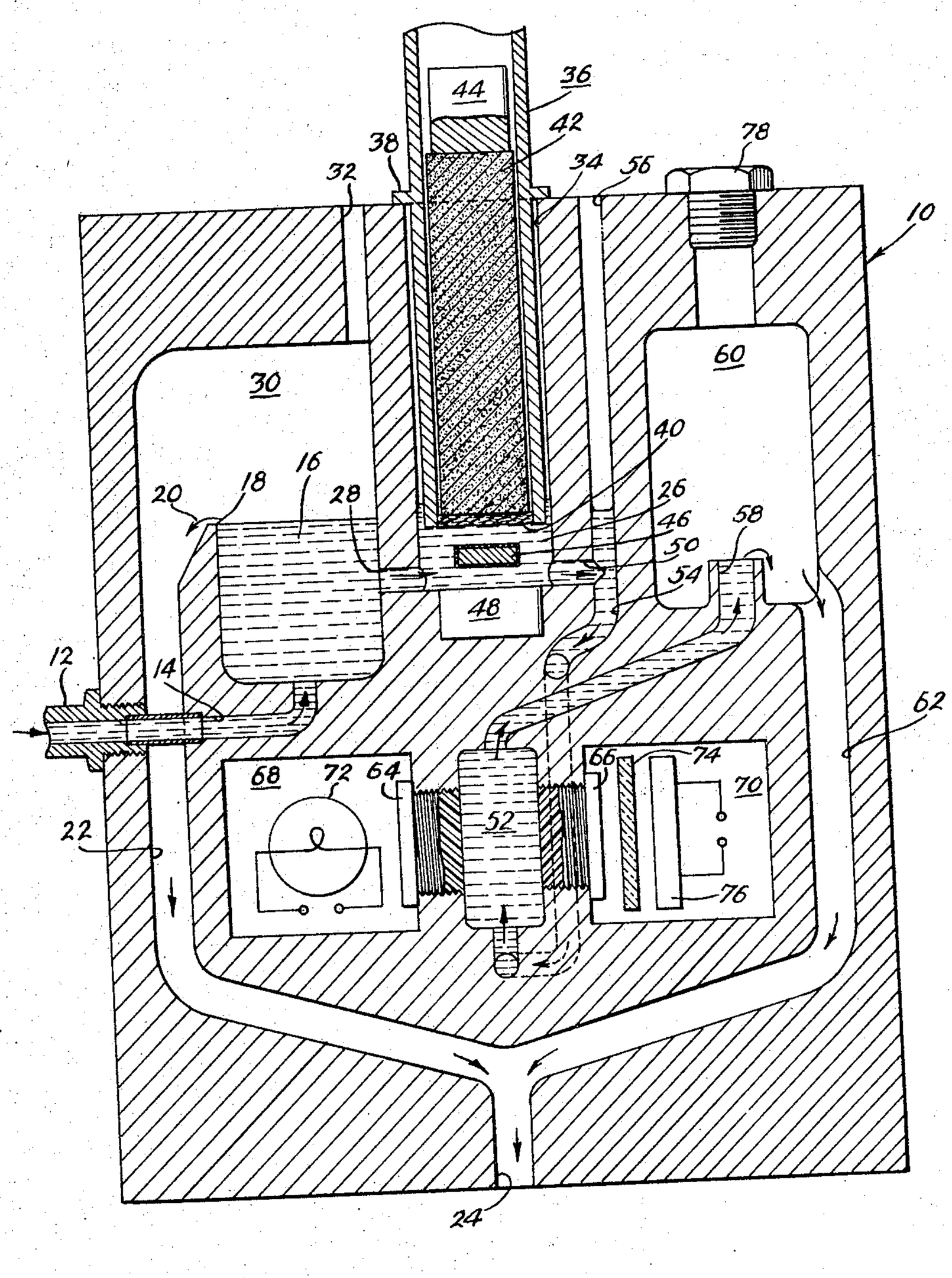
Aug. 8, 1961 H. FUHRMANN 2,995,425

APPARATUS FOR CONTINUOUSLY COLORIMETRICALLY ANALYZING FLUIDS FOR CHEMICAL COMPONENTS

Filed Dec. 18, 1958



INVENTOR:
HANS FUHRMANN

BY
Howson & Howson
ATTYS.

United States Patent Office

2,995,425

Patented Aug. 8, 1961

2,995,425

APPARATUS FOR CONTINUOUSLY COLORIMETRICALLY ANALYZING FLUIDS FOR CHEMICAL COMPONENTS

Hans Fuhrmann, Hamburg, Germany, assignor to S.L.F. Engineering Company, Philadelphia, Pa., a partnership

Filed Dec. 18, 1958, Ser. No. 781,378
Claims priority, application Germany Dec. 24, 1957
4 Claims. (Cl. 23—253)

The present invention relates broadly to apparatus for determining continuously chemical components or constituents in fluids, and more particularly to apparatus for continuously and automatically determining chemical components in fluids by colorimetric analysis.

Heretofore apparatus has been utilized to determine chemical contents of fluids in a continuous and fully automatic process by introducing reagents, indicators, buffers and the like into, or into contact with, a fluid having chemical components therein. Such apparatus have been utilized to test for hardness of water for different applications, silica, phosphate, chlorine content, etc.

Some known apparatus of this nature based upon a colorimetric principle have utilized reagents in the nature of solid rods which act as indicators, buffers, etc., and which solid rods are openly introduced into a mixing vessel wherein they are contacted by the fluids that are to be tested. Color of the fluid contacted by the solid reagent rods is affected by the reagent which is washed off or dissolved into the fluid, and this results in a color change depending upon the chemical constituent in the fluid being sought, and which color is brought about by a chemical reaction between the chemical content and the reagent. In some intances the amount of color change is measured colorimetrically to give a quantitative value of content of the chemical being sought. The composition of the reagent rod used is varied, dependent upon requirements for colorimetrically indicating specified chemicals in the fluid. Additionally, the reagent rods can contain additional substances in the nature of buffers etc. Such reactions, and chemical reagents required, to bring about color changes for indicating chemical components carried in the fluid are well-known.

Apparatus heretofore known, have for the most part included open vessels or chambers, and used agitators for insuring a proper mixing of reagent in the fluids.

The present invention, while broadly related to such previously known apparatus, includes structure whereby the reagent reaction rod is physically separated from a mixing chamber or vessel by means of a fluid pervious diaphragm in such a manner that reagent from the reagent rod is mixed with the liquid by diffusion through the diaphragm, thus providing improved results by preventing contamination of the reagent rod, or accumulation of crystals or the like on the rod which might otherwise alter its effective transmission of the reagent to the fluid. Additionally, the present invention, due to the arrangement of the reagent rod out of direct contact or immersion in the fluid, insures an equal reactance face area of the rod with respect to the fluid through the diaphragm.

Additionally, the present invention teaches apparatus for colorimetrically testing fluids continuously, and which has outstanding reliability in action due to lack of moving parts and valves or the like, the entire system and apparatus functioning automatically, continuously and by gravitational flow of the fluid, which flow can be regulated as desired.

Other features and advantages of the present invention will be more readily apparent from the following detailed description of an embodiment thereof when

taken together with the accompanying drawing in which the single figure of the drawing schematically depicts an embodiment of the invention.

Referring now in detail to the drawings, the apparatus includes a housing generally designated **10**, and which can consist of a block of desired material in which various chambers and passages are provided. An inlet fitting **12** for fluid to be tested is connected into housing **10** and opens into an inlet fluid channel **14**, which discharges the sample fluid into an overflow chamber **16** adapted for maintaining a constant volume or head of fluid. Excess fluid flows over a weir lip **18** or the like as indicated by arrow **20**. The overflow passes into a fluid discharge channel **22** and drains out of outlet opening **24**. A mixing chamber **26** is provided in housing **10** and is interconnected with the overflow chamber **16** by channel **28**. As shown in the drawing, the overflow chamber **16** is situated in a plenum chamber **30** in open communication with the atmosphere by means of vent pipe **32**.

The mixing chamber **26** extends upwardly through the top wall of housing **10**, terminating in an opening **34**. A tubular casing or the like **36**, preferably open at both ends, extends downwardly into the upper portion of mixing chamber **26**, through opening **34**, and is positioned therein by means of flange **38** coacting with the top of housing **10** around opening **34**. The lower end of tubular casing **36** has a liquid pervious diaphragm **40** secured in the open end thereof. A stick or rod of solid reagent **42** is slidably confined within tubular housing **36**, with its lower end resting on and supported by the diaphragm **40**. A weight **44** rests on the upper end of reagent rod **42** and maintains the lower end thereof in contact with the diaphragm **40** at all times. In operation, as liquid passes into and through mixing chamber **26**, the lower end of reagent rod **42**, being in contact with the liquid pervious diaphragm **40**, will mix the reagent into the liquid by diffusion through the diaphragm.

In order to insure a proper and thorough mixing of the sample fluid with the reagent in the rod, agitation means are provided including a permanent magnet reagent mixing bar or rod **46**, enclosed in glass or plastic, and which is freely movable in all directions in mixing chamber **26**. An air gap transformer **48** or the like is disposed externally of mixing chamber **26** and has a big leakage field. When the transformer is actuated by means of A.C. current of for example 50 to 60 cycles, the transformer will cause movement and rotation of the mixing bar **46**, which therefore constitutes means for mixing the liquid and reagent which has diffused through the diaphragm **40**.

The so mixed fluid and reagent upon reaction with the chemical provides a color change in the sample fluid dependent upon the chemical constituent being sought, and the nature of the reagent in the reagent rod, in a known manner to provide a colorimetrically suitable test sample. The so mixed fluid passes from the mixing chamber **26** through channel **50** into an optical measuring chamber **52** through inlet conduit **54** which is open at its upper end **56** to the atmosphere. The fluid then passes from the measuring chamber **52** through a discharge conduit **58** which acts as an overflow pipe in overflow chamber **60**. Fluid flowing out of conduit **58** into chamber **60** passes into discharge channel **62** flowing to outlet opening **24**. Measuring chamber **52** is connected to the atmosphere by means of the open upper end **56** of conduit **54**.

The liquid levels in overflow chamber **16** and overflow chamber **36** are fixed by the respective positions of weir **18** and the outlet of conduit **58**. This provides a constant water level or fluid level in mixing chamber **26**. If desired, the various overflows can be made adjustable

so as to permit use of the appliance for different types of analysis. The speed of flow of the sample fluid also depends upon the level difference of the two overflows at 20 and 58. Flow of sample fluid is constant and it will be seen that the dissolved reagent from the reagent rod 42 is constantly and substantially instantly mixed and dispersed in the mixing chamber 26 by agitator bar 46.

The measuring chamber 52 has plastic windows 64 and 66 connecting opposed sides thereof with chambers 68 and 70 respectively. These plastic windows 64 and 66 are removable and interchangeable. A light source 72 is housed in chamber 68. A suitable filter 74 is mounted in chamber 70 which can for example permit transmittance of between 675 and 725 millimicrons. A photoelectric cell 76 is mounted in chamber 70 behind filter 74. The light source and photoelectric call are connected in operative circuits for their energization. As the sample fluid flows through the apparatus in the manner indicated by arrows, the speed of flow being adjusted as hereinbefore set forth, reagent in substantially equal amounts will be introduced into the fluid and mixed therein to provide a substantially homogeneous mixture. The reagent will cause a color change in the fluid dependent upon the chemical constituent and/or amounts therein. When measuring contents for hardness such as in boiler feed water, the mixture will take a color tint between red and blue in the mixing chamber 26, and flow into the measuring chamber 52 through the various channels shown. It will be noted that a closure plug 78 is provided for overflow chamber 60.

The rod of reagent being loaded is guided vertically in the tube 36, and presses with its free end against the wet diaphragm 40 thereby mixing the chemical reagent with the fluid by diffusion. The quantity of dissolved reagent may possibly fluctuate within small limits, however this does not affect the measuring procedure which is adapted to work on a "yes-no" method of indication in the apparatus, with blue or red colors or others dependent upon the chemical constituent being sought and the constituents in the reagent rod. By altering the contents of the reagent rod, the instrument can be used for testing various fluids.

In use, after the reagent rod has been substantially reduced in size by constantly feeding reagent into the sample fluid as explained above, the reagent rod can be easily replaced by a new one so that the appliance is able to continue to act continuously.

It will be noted that the present apparatus permits testing of fluids continuously for chemical constituents therein without the necessity of any moving parts or valves. Of the essence of the invention, the reagent rod does not dip directly into the sample fluid but only touches the surface through the pervious diaphragm. Therefore, in very hard water, for example, an accumulation of calcium and magnesium crystals or the like which would tend to alter dissemination of the reagent in the sample fluid is positively avoided. Additionally, compared to apparatus having a reagent rod dipping into the fluid and which tends to decrease the area of the rod in contact with the sample fluid due to wear, the present apparatus insures an equal dissolving of the face area through the diaphragm for substantially constant results.

The light transmission qualities of fluids being tested for chemical constituents by a colorimetric analysis method are well-known, and the use of the photocell for this purpose likewise being well-known, a detailed description thereof is not considered necessary.

The apparatus of the present invention has been only schematically shown in the drawings for sake of simplicity and clarity. It is felt that the basic concepts and structure, however, are clearly understandable therefrom. Manifestly many minor changes in details of construction and arrangement can be effected within the scope and spirit of the invention without departing therefrom, as limited solely by the appended claims.

I claim:

1. Apparatus for continuous colorimetric analysis of fluids for chemical constituents comprising a housing, a mixing chamber in said housing, an optical measuring chamber in said housing in communication with said mixing chamber, means for introducing a sample fluid into said mixing chamber, a chemical reagent chamber opening into said mixing chamber, fluid pervious means mounted at the reagent chamber opening adjacent the mixing chamber and in contact with fluid in said mixing chamber, and a fluid soluble solid reagent rod in contact with and supported by said fluid pervious means, reagent being introduced into said sample fluid in said mixing chamber by diffusion through said fluid pervious means.

2. In apparatus for continuous colorimetric analysis of fluids for chemical contents thereof, a sample fluid and chemical reagent mixing chamber, means for continuously passing sample fluid through said chamber, said chamber having an opening therein, an open end reagent container inserted in said opening and extending into fluid contact in said chamber, a fluid pervious diaphragm closing the fluid contacted end of said container and a fluid soluble solid stick of chemical reagent slidably retained in said container and supported to said diaphragm out of direct contact with fluid in said chamber.

3. An apparatus for automatically analyzing chemical components in fluids comprising a circuit for continuously circulating sample fluid to be analyzed, said circuit comprising in the direction of flow a first overflow chamber, a mixing chamber, an optical measuring chamber, and a second overflow chamber, fluid levels in said overflow chambers controlling rate of flow through said circuit and fluid level in said mixing chamber, a reagent container having a lower open end extending in fluid contacting relation into said mixing chamber, fluid pervious means closing said open end with the lower end thereof in fluid contact, a stick of fluid soluble solid reagent in said container resting on the end of said fluid pervious means remote from said fluid, and indicating means for indicating color change in fluid in said measuring chamber resulting from reaction between the reagent and chemical components in the fluid.

4. Apparatus as claimed in claim 1, and a weight on the upper end of said reagent rod for maintaining diffusing contact thereof with said fluid pervious means.

References Cited in the file of this patent

UNITED STATES PATENTS

2,102,282	Roy	Dec. 14, 1937
2,650,256	Lingane	Aug. 25, 1953
2,797,149	Skeggs	June 25, 1957
2,855,280	McConnaughey	Oct. 7, 1958
2,880,070	Gilbert	Mar. 31, 1959