Dec. 11, 1956 D. E. KING ET AL 2,773,747

MANOMETRIC APPARATUS FOR DETERMINING THE GAS CONTENT OF LIQUIDS

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FIG. 1.

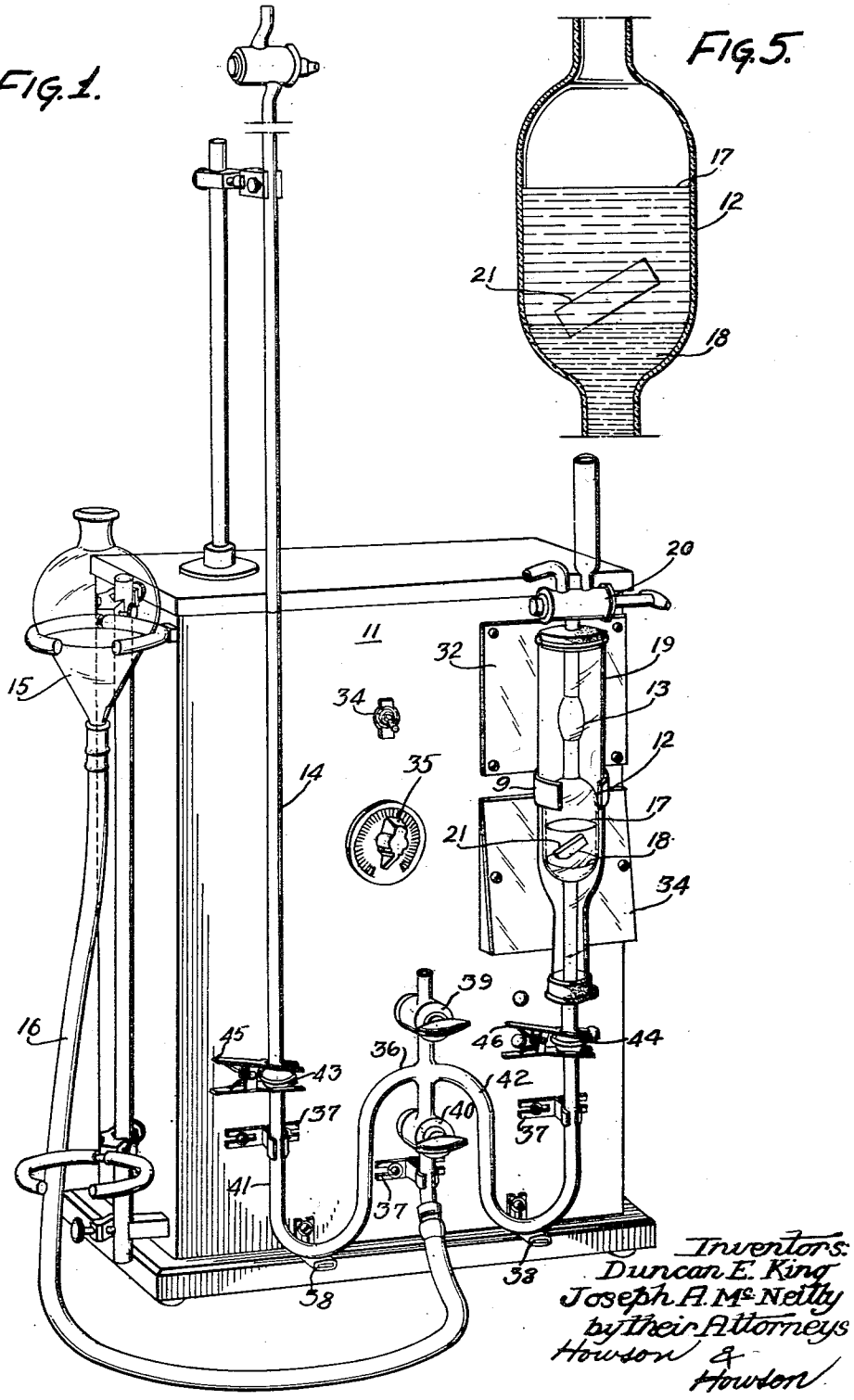


FIG. 5.

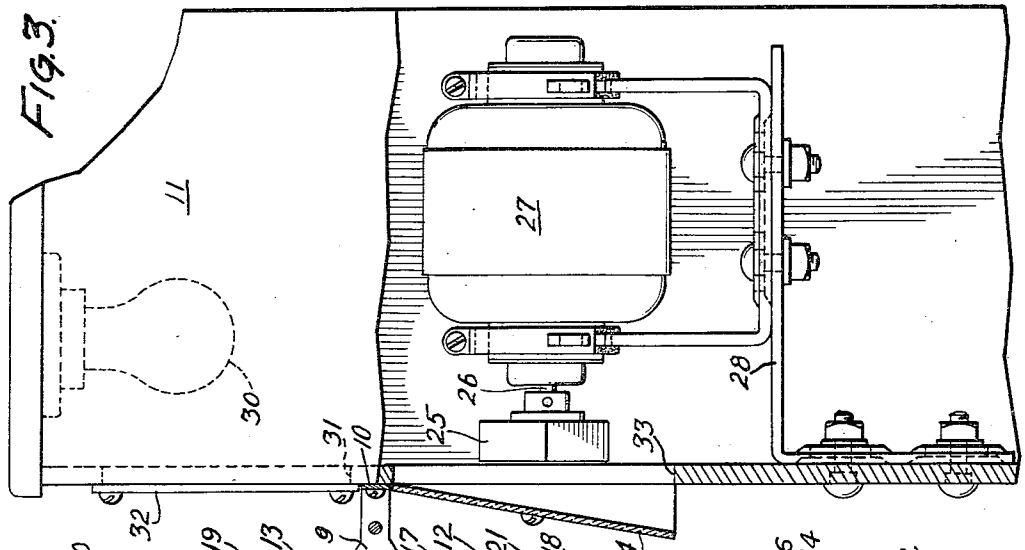
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Fig. 3.



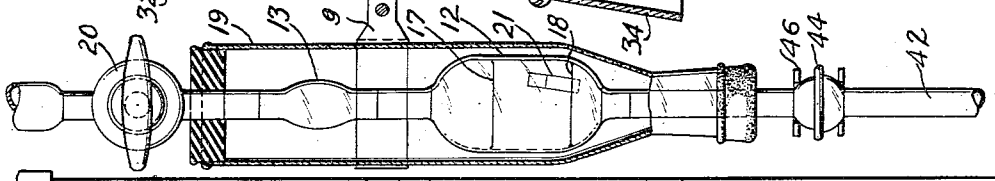


Fig. 2.

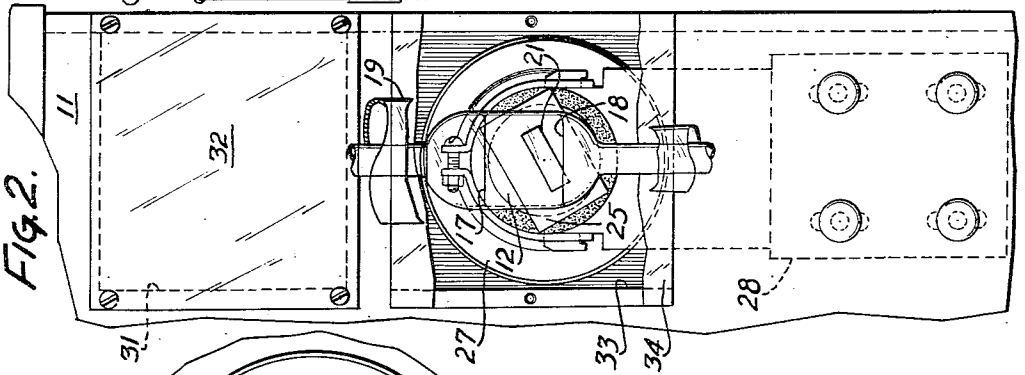


Fig. 4.

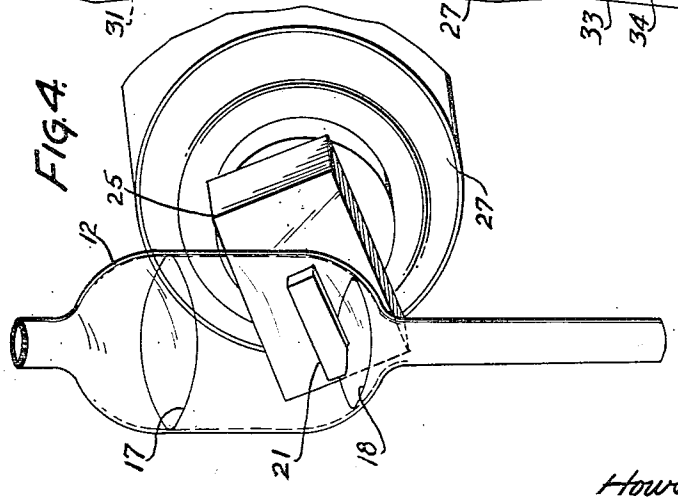
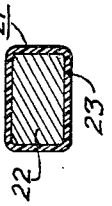


Fig. 6.



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MANOMETRIC APPARATUS FOR DETERMINING THE GAS CONTENT OF LIQUIDS

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Application November 19, 1953, Serial No. 393,181

1 Claim. (Cl. 23—253)

The present invention relates to clinical apparatus and has particular application to manometric apparatus in which a body fluid is agitated with given reagents under reduced pressure to determine certain physical or chemical properties of the body fluid.

In clinical apparatus of the type for determining the gas content of blood, the blood is mixed with chemical reagents in an extraction chamber and agitated to drive off the gas contained in the blood. In conventional apparatus, to provide for agitation for blood in the extraction chamber, the extraction chamber and its associated apparatus are vibrated. To this end, the apparatus is mounted on a hinged backing plate which is connected to an eccentric driven by an electric motor. Apparatus of this character is not entirely satisfactory since the vibration necessitates reinforcement of the fragile tubes and connections to reduce the possibility of breakage. In addition, the vibration of the backing plate has a tendency to cause the apparatus to "walk" on the laboratory bench and to overcome this tendency, it is necessary to bolt or otherwise clamp the apparatus to the bench. This method of agitation is also wasteful of power since the motor for causing the agitation, must vibrate the whole apparatus.

With the foregoing in mind, a primary object of the present invention is to provide, for agitating body fluids with reagents, clinical apparatus which obviates the necessity for vibrating the apparatus itself.

Another object of the present invention is to provide clinical apparatus for extracting gas from blood and like fluids in which the extraction chamber is fixedly mounted on a stationary stand, and agitation is accomplished by an element contained in the chamber.

A further object is to provide apparatus of the stated type which is economical of power and is of simple and inexpensive construction.

More specifically, the invention contemplates clinical apparatus having an extraction chamber in which a magnetized element is contained for free rotation under the action of a rotating magnetic field.

Another object of the invention is to provide apparatus having the features and characteristics set forth which is fully efficient and effective in operation and use.

These and other objects of the invention and the various features and details of the construction and operation thereof are more fully set forth hereinafter with reference to the accompanying drawings in which:

Fig. 1 is a perspective view of blood gas testing apparatus embodying an agitator made in accordance with the present invention;

Fig. 2 is a fragmentary front elevational view of the apparatus shown in Fig. 1;

Fig. 3 is a side elevational view partially in section of the apparatus;

Fig. 4 is a detached fragmentary perspective view of the extraction chamber showing the operation of the agitator;

Fig. 5 is a sectional view of the extraction chamber embodying a magnetic agitator made in accordance with the present invention; and

Fig. 6 is a sectional view of the agitating element.

Referring now to the drawings, the blood gas testing apparatus illustrated therein comprises a casing 11 which mounts thereon by means of spring clip 9 which is secured to casing 11 by bolt 10 an extraction chamber 12 having gas-measuring pipette 13 formed integrally therewith. The extraction chamber 12 is maintained under a given pressure by a mercury column 14 and to this end is closed at the top by a stop cock 20. The mercury is supplied from a reservoir 15. Thus, a flexible tube 16 extends to a bent connecting tube 36, which is of glass, the flexible tube 16 being slip-fitted over the lower open end of bent connecting tube 36. Connecting tube 36 is carried on casing 11 by means of spring clips 37 and is supported by means of angle flanges 38, which are preferably encased in rubber or other resilient elastomeric material to provide cushioning against shock and the like.

Connecting tube 36 is generally in the shape of a cross with the horizontal arms of the cross being bent into the form of U-arms. Stop cocks 39 and 40 are provided in the vertical arms of the connecting tube 36, and each of the U-arms 41 and 42 are connected by respective ground glass ball-and-socket joints 43 and 44 to graduated tube 14 and to extraction chamber 12. Graduated tube 14 constitutes a manometer for indication of pressure in the system. The ball and socket joints are held in gas-tight seal alignment by means of conventional pinch clamps 45 and 46 respectively. The height of the column of mercury within graduated tube 14 may be regulated by raising or lowering the mercury reservoir 15, thereby regulating the pressure within extraction chamber 12.

In accordance with the usual practice, blood and the desired reagents, indicated at 17, are floated on the mercury 18 in the extraction chamber. A water jacket 19 surrounds the extraction chamber 12 and the pipette 13 to maintain a constant temperature during the agitation of the liquid. In the present instance, the water jacket 19 is closed, but it is within the scope of the invention to provide tubulatures at the top and bottom of the jacket for admitting and discharging a constant stream of water.

In accordance with the present invention, a magnetic agitating element 21 is contained in the extraction chamber. As seen in Fig. 6, the agitating element 21 comprises a bar magnet 22 having a coating 23 which is non-reactive with the blood and reagents. The coating 23 must also be non-magnetic so that it will not shield the magnetized element 22 from the magnetic field.

The element 21 is free to be rotated in the extraction chamber by a rotating magnetic field. In the present instance, the rotating magnetic field is provided by a permanent magnet 25 mounted on the shaft 26 of a motor 27. The motor is mounted in the casing on a suitable bracket member 28, as clearly illustrated in Fig. 3. As the motor rotates the magnet 25, a rotating magnetic field is created to act upon the agitating element 21 in the extraction chamber. The field causes the element 21 to rotate and agitate the liquid 17 to drive off the gas contained therein. Thus, the liquid is agitated in an extraction chamber that is rigidly mounted on the casing, and the invention obviates the necessity for vibrating the chamber and the casing.

It is desirable to illuminate the extraction chamber and the pipette to facilitate accurate operation of the apparatus. To this end, a lamp 30 is mounted in the casing 11. An opening 31 is provided behind the pipette 13 and a translucent plastic window 32 is secured over the opening to illuminate the pipette 13 and exclude dirt and other foreign material from the casing. A similar opening 33

is provided between the magnet 25 and the extraction chamber 12 and is also covered by a plastic window 34. It is noted that the window 34 is mounted to slant outwardly of the casing to provide a vent for admission of air to the interior of the casing. A switch is provided at 34 for controlling the light 30 and a motor speed control rheostat 35 is provided for controlling the speed of the motor and thereby the amount of agitation afforded by the agitating element 21.

Inasmuch as both the extraction chamber 12 and the bent connecting tube 36 remain stationary during use, it is possible to secure them to the casing 11 in the manner indicated, namely by the spring clips 9 and 37. Moreover, the bent connecting tube may be secured by the ball-and-socket joints 43 and 44 to the graduated tube 14 and to the extraction chamber 12. The use of spring clips and ball-and-socket joints permits the rapid assembly, cleaning, disassembly, and replacement of the component elements of the subject invention. In contradistinction, slip-fitted elastomeric material connections, such as the rubber stoppers and hoses used in all prior manometric apparatus for measuring the gas content of liquids, are frequently exceedingly difficult to disassemble, clean, and assemble.

The use of a magnetic stirrer with spring clips and ball-and-socket joints permits the flexible apparatus embodiment of the subject invention, since the need for secure anchorage concomitant to prior devices involving the use of shaking apparatus is avoided. Notwithstanding the use of spring clips in place of more rigid anchorage means, and reinforcement means the incident of breakage in use is markedly decreased, since the apparatus is subjected to far less stress and strain. All of the foregoing is accomplished without any loss in accuracy whatsoever. In fact, as a practical matter, due to the ease of cleaning attendant to the subject apparatus, the accuracy of the apparatus is improved, since a major source of error in use arises due to contamination resulting from infrequent or careless cleaning.

By virtue of the ease of disassembly of the subject apparatus, and by virtue of the substitution of shaking by magnetic agitation directly within the fluid, the subject apparatus may be made smaller in size to accomplish a given task and is therefore more portable than prior related devices. The portability is increased further since a smaller motor need be used in the apparatus of the subject invention than in prior devices, as the motor in the subject invention merely agitates a relatively small bar magnet, whereas in prior devices the motor was forced to drive the entire extraction chamber. Furthermore, because of the elimination of shaking in the subject device lighter support mounts, and reinforcements for the glass tubing may be utilized. The need for clamping the device to the laboratory bench to prevent "walking" is obviated.

While a particular embodiment of the invention has been herein illustrated and described, it is not intended to limit the invention to such disclosure, and changes and modifications may be made therein and thereto within the scope of the following claim.

We claim:

A manometric apparatus for ascertaining the gas content of a liquid of the Van Slyke type including in combination a casing, an extraction chamber, a gas measuring pipette extending upwardly from said extraction chamber, stop cock means at the upper extremity of said gas measuring pipette, means defining a jacket around said extraction chamber and gas measuring pipette for maintaining the same at a substantially constant temperature, a spring clip mounted to said casing, said spring clip resiliently operatively grasping said jacket means whereby said extraction chamber is retained in vertical disposition, a graduated tube for a column of mercury vertically mounted in respect to said casing, a connecting tube beneath said extraction chamber and graduated tube, spring clip means secured to said casing and resiliently operatively grasping said connecting tube and maintaining it in operative alignment and in liquid communication in respect to said extraction chamber and said graduated tube, said connecting tube being operatively and liquid-tightly joined to said extraction chamber by a readily disassembled ball-and-socket joint and operatively and liquid-tightly joined to said graduated tube by a readily disassembled ball-and-socket joint, means for adjusting the height of mercury within said graduated tube whereby the pressure within said extraction chamber may be adjusted, said water jacket, graduated column, extracting chamber, and pipette being formed of transparent non-magnetic material, a magnetized element comprising a permanent bar magnet having an inert coating, said magnetized element being disposed within the extraction chamber, a motor mounted within said casing with its rotary shaft extending into proximity to said extraction chamber, and a permanent magnet mounted on said shaft operable upon rotation of said shaft to create a rotating magnetic field to act upon said magnetized element and effect rotation of the latter within the extraction chamber whereby liquid within the extraction chamber may be agitated.

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