United States Patent

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[54] DEVICE FOR USE WITH APPARATUS FOR THE COUNTING OF PARTICLES IN SUSPENSION

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[52] **U.S. Cl.**.....**137/576,** 324/71, 134/166

[51] **Int. Cl.**.....**G01n 27/02,** G01n 27/06

[58] **Field of Search** .....137/561, 576; 324/71 PC; 138/92, 103; 73/211; 251/122, 124; 134/166

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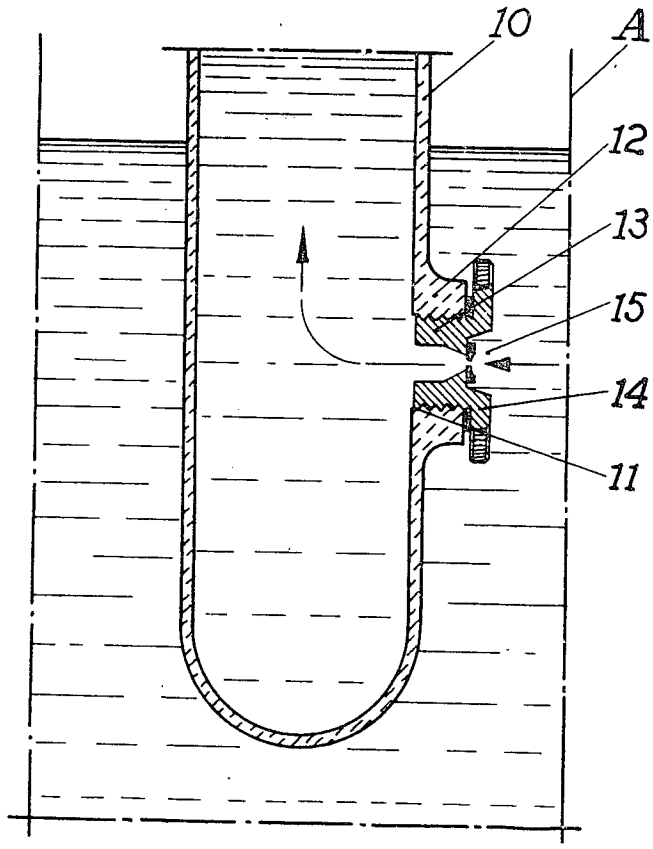
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[57] **ABSTRACT**

Device for use with apparatus for counting microscopic particles, which apparatus includes a phial having a ruby in a wall thereof wherein the ruby has a microscopic hole through which must pass a suspension of the particles to be counted, which device comprises an apertured plug removably seated in the wall of the phial, and wherein the ruby is itself removably mounted in the aperture of the plug, whereby the ruby is easily removed for replacement or for unblocking of the hole.

5 Claims, 4 Drawing Figures



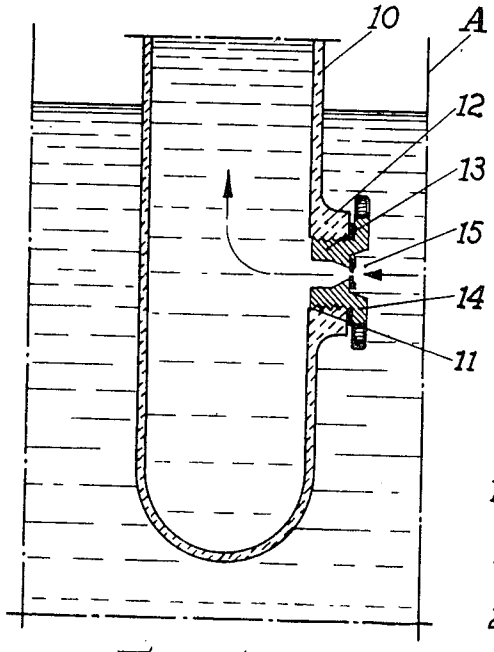


Fig. 1

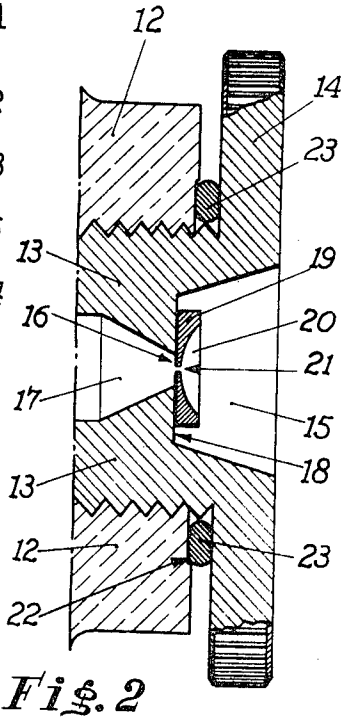


Fig. 2

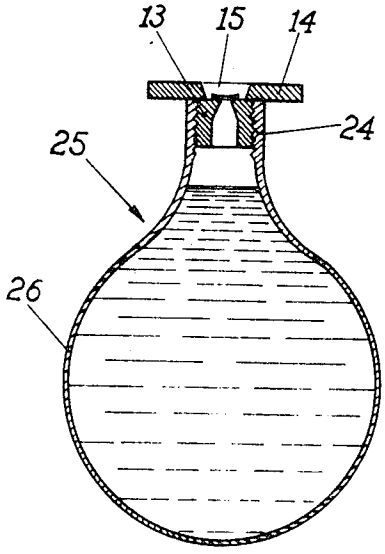


Fig. 3

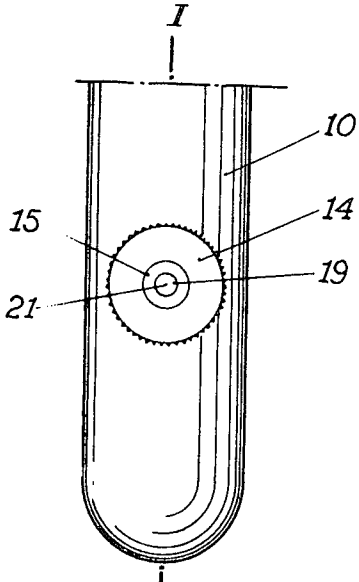


Fig. 4

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DEVICE FOR USE WITH APPARATUS FOR THE COUNTING OF PARTICLES IN SUSPENSION

The present invention relates to apparatus for the counting of particles in a suspension, and especially for the counting of white and red corpuscles contained in a certain quantity of blood suitable dispersed in a saline solution.

In the said counting apparatus the liquid containing the particles in suspension must flow in a very uniform manner through a microscopic aperture, and, moreover, it must be possible to measure exactly the passage of a very precise quantity of liquid.

Normally such counting apparatus are substantially constituted by an exterior container or beaker containing the solution in which the particles to be counted are suspended and in which is immersed an electrode connected to one of the poles of a source of electric current. In the solution there is also immersed the lower closed end of a tube which constitutes a phial, which tube is suitable connected to a source of suction.

Such a phial is of an electrically insulating substance. In its cavity is placed the electrode fitted to the opposite pole of the said source of electric current, and in its wall is made a microscopic hole, usually formed in a ruby, and of dimensions comprised between 30 and 120 microns, through which hole the suspension passes from the container to the interior of the phial when the said source of suction comes into function.

Normally the source of suction is constituted by a mercury pump formed by a U-shaped tube full of mercury attached to one of the ends of a tube suitably connected to the said phial, and by a suction pump fitted to the other end of the said tube and able to bring about a variation in the level of the mercury in the said U-shaped tube. When the functioning of the suction pump is interrupted, the mercury tends, by gravitation, to be brought to the same level in the two branches of the U-shaped tube, thus causing a slight suction at the top of the closed phial, which suction forces the suspension to pass from the container to the interior of the phial itself through the said hole.

As has already been stated, the two electrodes are connected to the two poles of a source of electric current, and therefore between these two poles there tends to be a passing of current which, by virtue of the insulating characteristics of the phial, can take place only through the solution coming through the said microscopic hole provided in the ruby, which solution has a certain resistance. This resistance, however, is subject to a sharp rise when there passes into the hole one of the corpuscles or particles contained in suspension in the solution.

The variation of current caused by the increase in resistance determines the reduction in the ohmic fall in a resistor inserted in the circuit of the electrodes, and consequently an impulse is produced of the order of a millivolt each time that a corpuscle passes through the hole. The counting of such impulses, suitably amplified, obviously provides the number of particles contained in a given quantity of solution taken through the hole by suction.

In apparatus of such a type, especially in those intended for counting blood corpuscles in analytical laboratories, the inconvenience is frequently encountered that the hole becomes blocked, and up to the present time this has constituted a substantial loss of time because it has been necessary to stop the functioning of the apparatus in order to dismantle the phial, unblock the hole, replace the phial, and prepare the apparatus for a new count.

The present invention concerns more particularly a device which eliminates the above-mentioned inconvenience by rendering it possible, in the event of blockage of the said hole, quickly to put the apparatus for counting the particles into operation again. This is done by inserting the ruby in which the hole is formed, in a "plug" or ferrule capable of being rapidly and tightly mounted and removed from a suitable aperture made in the wall of the said phial.

With such a system it is obvious that the counting apparatus remains out of action only for the period necessary to remove the plug, the hole of which is blocked, to insert in its place another similar element with an open hole, and to replace the solution in the phial itself.

For the rapid unblocking of the blocked hole, the invention also makes provision for the use of a pump element filled with fluid and having a rigid neck, on which can be mounted the plug in which the hole is blocked. On the operation of the pump the fluid exerts pressure on the blockage of the hole in a direction opposite to that taken by the normal passage of the particles, thus unblocking the hole itself.

The present invention will now be described more particularly with reference to the annexed drawing, in which:

FIG. 1 is a section, along the line I—I of FIG. 4, of a tube or phial with closed base of an apparatus for counting particles immersed in a receptacle containing a suitable saline solution with the particles in suspension;

FIG. 2 is a section, on a larger scale, of the ferrule carrying in the center the drilled ruby of the apparatus in FIG. 1;

FIG. 3 is an axial section showing the ferrule carrying the ruby screwed on to the rigid neck of the pump which serves to unblock the hole of the ruby; and

FIG. 4 is a front elevation of the ferrule carrying the ruby.

Referring now in greater detail to FIGS. 1 and 2, it will be seen that, on the cylindrical wall of the phial **10**, there is provided an aperture **11** having a neck **12** projecting outwards and with inside thread for receiving a ferrule **13** with corresponding thread having an enlarged head to facilitate the grip. On the exterior face of the ferrule **13** there is an axial cavity **15** of substantially truncated form, on the base of which is formed an aperture **16**, which puts it into communication with another truncated cavity **17** which opens on the interior face of the ferrule.

On the base **18** of the cavity **15** is fitted a ruby **19** having the form of a meniscus, which has a cavity **20** on its exterior face and which is provided with a hole **21** to correspond with the axis of the two cavities **15** and **17**. The said hole **21** constitutes the passage through which pass the particles and corpuscles to be counted.

To ensure the hermetic seal between the neck **12** and the ferrule **13**, between the head **14** of the ferrule and the annular exterior face **22** of the neck there is disposed a packing **23** of rubber or other suitable material, which tightly holds the ferrule in position. Such a packing is preferably constituted by a toroidal ring.

In the event of the hole **21** being blocked, it is obvious that the ferrule can be easily unscrewed and replaced by another in order not to interrupt for long the functioning of the apparatus, and the hole can thus be freed from the blockage by making use of the pump which has previously been mentioned.

Now with reference to FIG. 3, this shows the ferrule **13** screwed on the rigid neck **24**, suitably threaded, of the pump **25** used to unblock the hole of the ruby. The pump **25** is constituted essentially by a bulb of impermeable elastic material terminating in a rigid neck **24**, in which is placed a fluid which almost completely fills it.

The hole **21** is unblocked by exerting pressure on the elastic wall **26** of the bulb in such a manner that the fluid contained in the pump **25** is forced to pass through the said hole in the direction opposite to that usually taken by the saline solution containing the particles to be counted, which is located on the exterior of the phial **10** in a suitable container A.

It is obvious that modification and alterations can be made to the embodiment illustrated without departing on this account from the scope of the invention.

For example, the element which serves to unblock the blocked hole, instead of being a bulb of elastic material, can be constituted by a cylinder and piston unit.

I claim:

1. A device for use with apparatus for counting particles by passage of a solution containing said particles in suspension through a microscopic hole in a ruby, said apparatus including a phial having an aperture in a wall thereof wherein said ruby is positioned, said device comprising an apertured plug for

removable seating in said opening, said ruby being mounted on said plug so as to close the aperture thereof and to provide communication between said microscopic hole and the interior of said phial.

2. A device in accordance with claim 1, in which the aperture of the phial is provided with an internally threaded neck, and the plug is provided with an exterior thread corresponding to the interior thread of the said neck and an enlarged head with knurled periphery to facilitate positioning and removal of said plug from said neck.

3. A device in accordance with claim 2, in which is inserted between the exterior surface of said neck and the interior surface of the enlarged head of said plug an elastic packing which exerts pressure between the said surfaces to ensure a tight connection.

4. A device in accordance with claim 1, including as a separate element for unblocking the microscopic hole in said ruby when blocked, a container formed of impermeable and flexible material filled with fluid and having an apertured rigid neck provided with connection means capable of receiving said plug upon which is mounted said ruby, whereby, upon compression of said container, said fluid is forced through and unblocks the microscopic hole of said ruby.

5. Apparatus in accordance with claim 4, in which the said rigid neck of the element for unblocking the blocked hole is internally threaded for correspondence with the outside thread of said plug.

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