

METHOD FOR DILUTING AND MIXING LIQUID SPECIMEN

CROSS REFERENCE TO RELATED APPLICATION

This application is the parent application of divisional application, Ser. No. 07/913,455, filed Jul. 15, 1992.

BACKGROUND OF THE INVENTION

The present invention relates to a method and apparatus for diluting and mixing a liquid specimen (for example, blood) and a reagent.

In a specimen analyzing apparatus such as a blood analyzer, a sampling valve is used to obtain a specific volume of specimen. The mechanism of a sampling valve is explained below with reference to FIG. 1. Numeral 10 refers to a sampling valve. Numerals 12, 16 refers to fixed elements, and 14 to a movable element enclosed by the fixed elements 12, 16.

The movable element 14 has a penetration passage P2 for quantitative determination (hereinafter called passage P2 or passage P2 for determination). The movable element 14 moves on the fixed elements (linear reciprocal motion or normal and reverse rotary motion). Accordingly, the sampling valve 10 forms a first state and a second state. The first state is the suction mode for sucking or aspirating specimen into the sampling valve. The second state is the transfer mode for pushing out or delivering the measured specimen by the liquid from outside.

FIG. 1 shows the first state. The fixed elements 12, 16 are provided with passages P1, P3 which communicate with the passage P2 in the first state. A suction probe (suction capillary) 18 is connected to the passage P1, and a suction means C1 such as a syringe is connected to the passage P3 through a valve V1. Numeral 24 refers to a washing liquid vessel filled with washing liquid, and 20 is a specimen container filled with blood specimen.

The fixed elements 12, 16 have other passages P4, P5. The second state is a state in which the movable element 14 is moved by a specific distance or a specific angle from the first state, and the passage P2 for determination communicates with the passages P4, P5. A reaction vessel 22 is connected to the passage P4 so as to induce reaction between the specimen and the reagent, and a discharge means C2 such as a syringe is connected to the passage P2 through a valve V2. Numeral 26 refers to a reagent vessel containing a reagent for reaction for mixing with the blood specimen, and vessel 26 connected to the passage P5 through a reagent line 27 having the valve V2.

As the suction means C1 operates to suck in or aspirate in the first state, the specimen in the specimen container 20 is charged to fill the passage P2 for determination of the sampling valve 10 via the suction probe 18.

Coming sequentially to the second state, as the discharge means C2 operates to discharge, the specimen in the passage P2 is pushed out together with the reagent to be transferred into the reaction vessel 22, where both are mixed to react. The mixed solution is measured in a measuring unit (not shown).

In a particle counter, for example, to count leukocytes in the blood, it is necessary to destroy erythrocytes. Hitherto, accordingly, a small amount of hemolyzing agent was added to a diluted solution of blood to

dissolve the erythrocytes. The hemolyzing agent is, for example, a surface active agent.

However, in the method of adding a small amount of hemolyzing agent to a large volume of specimen suspension, the reaction fluctuates. The hemolyzing agent not only dissolve the erythrocytes but also affects the leukocytes more or less (such as a reduction of size), and hence the effects on leukocytes may also fluctuate. It poses problems when counting by classifying the leukocytes.

To minimize such reaction fluctuations, therefore, consideration has been given to hemolyze and dilute simultaneously in a diluted solution containing a hemolyzing agent. For this purpose, in FIG. 1, the reagent should be a diluted solution containing a hemolyzing agent.

FIG. 2 is a magnified sectional view of the passage part of the sampling valve 10 in the second state (transfer mode). Numeral 28 is a nipple provided in the passage P4 of the fixed element 12, and 30 is a tube connected to the nipple 28. Usually the blood must be diluted several hundred times or more, and the inside diameter of the passage P2 for determination is about 1 mm (or smaller depending on the specification).

When pushing out the specimen in a narrow passage by the liquid from outside in this way, a large fluid pressure acts in this narrow passage. In other words, stress is applied to the blood cells, which may exert some adverse effect or other. Such an effect will not be ignored if the cell membrane of the blood cells is weak due to disease or because it has been left a long time after blood sampling, and when using a liquid reagent that may cause a reaction on the blood cells. Of course, when the reagent is pushed in slowly, the stress will be reduced. But it takes too much time, so that the processing capacity of the analyzing apparatus is lowered.

OBJECT AND SUMMARY OF THE INVENTION

It is hence a primary object of the invention to provide a method and apparatus for diluting and mixing liquid specimen, without lowering the processing capacity of the apparatus and without damaging the specimen by fluid pressure.

To achieve the above object, in one preferred embodiment, the invention provides a method for diluting and mixing specimen by preparing a mixed solution of a specimen and a reagent at a specific ratio including feeding a liquid specimen into a passage for quantitative determination in a sampling valve, changing over the sampling valve, aspirating the specimen in slices, and discharging the specimen with a specific volume of a reagent, wherein

the specimen is discharged by the reagent at a low speed until the specimen comes out of the sampling valve, and at a usual speed thereafter.

In this case, "discharging at a low speed" means to discharge at a speed slower than the usual speed.

The invention also provides an apparatus for diluting and mixing specimen comprising a sampling valve for aspirating a liquid specimen in slices, specimen suction means connected to the sampling valve, reagent discharge means and a reaction vessel, thereby preparing a mixed solution of specimen and reagent at a specific ratio, wherein

second reagent discharge means which is very slight in discharge capacity, is connected parallel to the reagent discharge means (hereinafter called first reagent discharge means).