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METHOD OF MEASURING BLOOD SEDIMENTATION RATE

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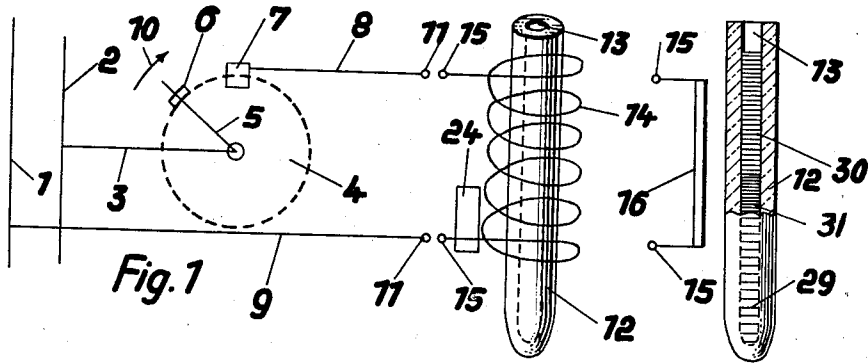


Fig. 1

Fig. 2

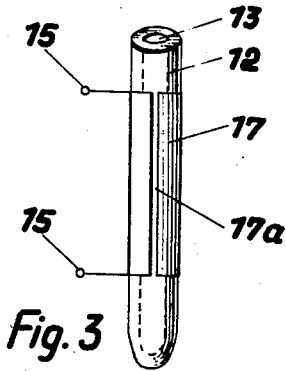


Fig. 3

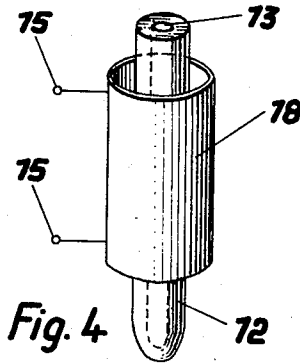


Fig. 4

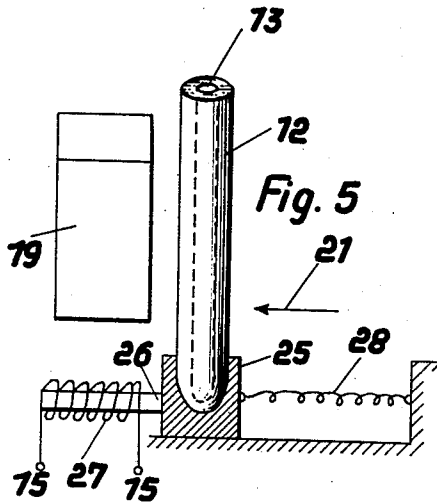


Fig. 5

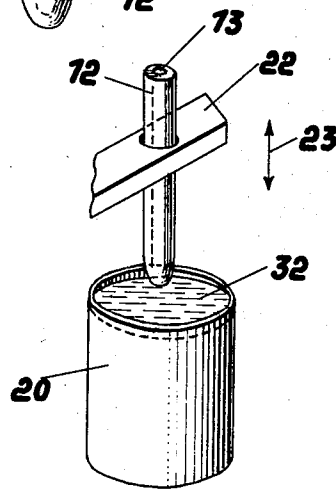


Fig. 6

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METHOD OF MEASURING BLOOD SEDIMENTATION RATE

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2 Claims. (Cl. 167—84.5)

This invention relates to a method and apparatus for the automatic recording of the speed at which larger molecules or particles (e. g. blood cells) settle to the bottom in liquid colloidal disperse systems, such as suspensions or emulsions, e. g. blood.

With each sedimentation the homogeneous structure of the colloidal disperse liquid (e. g. blood-blood plasma plus blood cells) existing at the beginning of the experiment undergoes a change in such a way that—beginning at the surface of the liquid—a column of liquid (e. g. blood plasma) which is nearly free from particles is formed by the fact that the particles (e. g. the blood cells) sink downwards or settle to the bottom of the recipient. In the course of time the column of liquid which is free from particles is steadily growing in height. The rate of sedimentation can be stated for instance by measuring at any time the apertaining height of the liquid column which is free from particles. The height of the liquid column which is free from particles (e. g. blood plasma), however, does not increase in a linear proportion to time. In order to compare the rate of sedimentation in various colloidal disperse liquids (e. g. blood of a sick or healthy person), the height of the liquid column which is free from particles (e. g. blood plasma) is measured after a predetermined generally agreed period of time. Thus, for instance, according to international agreement the rate of sedimentation of the blood is measured by the height of the column of blood plasma after one hour. However, in practice it causes considerable trouble to measure this height of the liquid column after a predetermined length of time.

It is an object of the present invention to provide a device which renders it possible to read off at any time the height of the plasma or other liquid column which has been existing at a predetermined adjustable time.

A special object of the invention is to provide means for automatically stopping the sedimentation after a predetermined adjustable period of time.

A further object of the invention is to provide an apparatus which is adapted to heat or cool the test liquid at a predetermined time for the purpose which will be hereinafter described.

With these and other objects in view, this invention consists in the details of construction, combination of elements and operation hereinafter set forth and then specifically designated by the claims.

In order that those skilled in the art to which this invention appertains may understand how to make and use the same I will describe its construction in detail, referring by numerals to the accompanying drawing forming part of this application, in which:

Fig. 1 is a diagrammatic representation of an arrangement for carrying out the invention,

Figs. 2, 3, 4 and 5 are similar diagrammatic representations showing modified methods of heating, and

Fig. 6 is a perspective view showing a still further embodiment of the invention.

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Similar reference numerals denote similar parts in the different Figures.

In order to make it clear how the apparatus according to the present invention works, it will be better to explain at first the principles on which it is based. According to the present invention the sedimentation can be stopped in two different ways:

Either the liquid is heated to a predetermined temperature whereby in certain colloidal disperse systems, e. g. blood, the whole liquid is solidified and the sedimentation is stopped. Or the liquid is cooled to a predetermined temperature whereby the liquid freezes and the sedimentation is also stopped.

The heating of the liquid according to the present invention may be effected by any of the following methods:

(1) Electrically operated heating means are provided within or outside of the test tube or other vessel in which the sedimentation takes place.

(2) The test tube or other vessel in which the sedimentation takes place consists of an electrically conductive material. An electric current is passed directly through the wall of the tube in order to heat the liquid.

(3) The surface of a sedimentation vessel of an electrically non-conductive material is coated with an electrically conductive layer, for instance, of metal or metal oxide deposited on the wall of the vessel in a thin layer from the vapor phase, or by a spraying or galvanizing process or by burning in. In order to heat the liquid, an electric current is passed directly through this surface layer of the vessel.

(4) The vessel in which the sedimentation takes place, is treated by the heat rays of an electric heat radiator, e. g., a glow wire.

(5) The vessel in which the sedimentation takes place is brought into heat-exchanging relationship with a solid body, liquid bath, gas space or gas current of an elevated temperature.

The cooling of the liquid according to the invention may be effected in such a way that the vessel in which the sedimentation takes place is brought into contact with a solid body, liquid bath, gas space or gas current of a reduced temperature.

Referring now to the drawing in greater detail, in which these various methods are exemplified, it will be seen that a wire 3, Fig. 1, leads from a conductor 2 of a power supply 1, 2 to a clock switch 4 which may be driven electrically or by a spring mechanism. Provided on the movable pointer 5 of the clock switch 4 is a contact 6 which on rotation of the pointer 5 in the direction of the arrow 10 temporarily engages the counter contact 7 from which a conductor 8 leads to one of the contact sleeves of a plug socket 11. A second wire 9 leads directly from the conductor 1 to the second contact sleeve of the plug socket 11. This clock switch serves to close the electric circuit at a predetermined adjustable point of time, and for a predetermined adjustable length of time, i. e., as long as the contact 6 engages the contact 7. This clock switch can be used in connection with any of the heating devices shown in Figs. 1, 2, 3, and 4.

12 is a sedimentation tube having an internal free bore 13 for the reception of the particles to be deposited.

In the embodiment of my novel apparatus as per Fig. 1 a heating coil 14, consisting, for instance, of a chromium-nickel alloy, is arranged around the tube 12 and supplied with current through two contact plugs 15 adapted to be plugged into the plug socket 11.

The operation is as follows: On rotation of the pointer 5 with the contact 6 in the direction of the arrow 10 the coil 14 is heated for a certain length of time. During this time the stopping of the sedimentation of the tube

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12, i. e. the solidification of the liquid contained therein is being effected.

In the embodiment according to Fig. 2 an electrically operated heat radiator 16 is provided adjacent to the tube 12 for heating same. The scale or graduation is indicated at 29 and the columns of blood plasma 30 and sediment 31 are also indicated.

In the embodiment shown in Fig. 3 the tube 12 is provided with a coating 17 serving as a resistance.

The coating 17 is interrupted by a slot 17a, so that the process of sedimentation or of the stopping thereof, respectively, can be observed through the slot 17a.

In the embodiment shown in Fig. 4 a resistance in the form of a cylindrical tube 18 is arranged around the tube 12.

Fig. 5 shows a device in which a heating or cooling element 19 is stationarily arranged. The test tube 12 is seated in a slide or lever 25 which can be moved in the direction of the arrow 21 by action of a magnetic core 26 reaching into a solenoidal coil 27, against action of a tension spring 28, so as to come into the sphere of action of the heating or cooling element 19.

In the arrangement according to Fig. 6, the tube 12 is suspended from a lever 22 which can be moved in the direction of the arrows 23, by an electromagnetic mechanism similar to that shown in Fig. 5, for dipping the tube 12 for a certain length of time into a vessel 20 which is filled with a heating or cooling liquid 32.

It is also possible to arrange several tubes 12 side by side in a common carrier lever 22 so that several sedimentation processes can be stopped simultaneously.

The method of solidification by heating can be applied, for instance, in case of blood which has been made non-coagulable. Blood consists among others of red blood cells and transparent blood plasma. The blood cells settle in the blood plasma. With time an upper liquid column is formed which consists only of blood plasma free from blood cells, while the lower liquid column consists of blood, i. e. blood plasma plus blood cells. If the entire blood liquid is heated to 50 to 100° C., by means of any of the arrangements shown in the figures, both the blood and the blood plasma are solidified. After cooling to room temperature this state is retained. This process is irreversible.

The vessel 12 is accordingly filled with the test blood, the clock switch 4, 5, 6, 7 is adjusted to the period of time after which the sedimentation is to take place (e. g., one hour), and a contact member 6 of proper length is attached to the pointer 5 so that the circuit is closed, after the predetermined period of time, (e. g., one hour) for a length of time (e. g., one minute) which is sufficient to cause solidification of the blood and blood plasma in the vessel. The vessel 12 may now be removed from its heating device 14, or 16, or 17, or 18, or 19, or 20, respectively, and the height of the liquid column 30, Fig.

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2, which has been reached after one hour, consisting, for instance, of blood plasma containing no particles, can be read from the scale 29 provided on the vessel 12, Fig. 2.

It will be understood that in case of the arrangements shown in Figs. 1 to 4 the heating device itself is supplied with current for the length of time (e. g., one minute) required for the process of stopping the sedimentation whereas in the arrangements shown in Figs. 5 and 6 the solenoid coil 27 is energized for this length of time to attract the magnetic core 26 and to draw the vessel 12 into the sphere of action of the source of heat 19, or 20, respectively.

Where the blood is to be solidified by cooling, it may be cooled down to a temperature of plus 5° C. to minus 30° C.

By way of alternative, the length of time during which the heating device 14, or 16, or 17, or 18, is connected to the source of current 1, 2, may be determined by a thermostatic device 24, Fig. 1, automatically interrupting the circuit as the desired temperature is reached.

While the invention has been described in detail with respect to certain now preferred examples and embodiments of the invention it will be understood by those skilled in the art after understanding the invention that various changes and modifications may be made without departing from the spirit and scope of the invention and it is intended, therefore, to cover all such changes and modifications in the appended claims.

I claim:

1. In a method for measuring the rate of sedimentation in blood samples, permitting settling of red blood cells to take place in a column of the sample over a predetermined time period, and then heating the column to a temperature within the range from 50° C. to 100° C. to irreversibly solidify the blood and to arrest further settling whereby thereafter the height of that portion of the column containing settled red blood cells remains constant.

2. A method as in claim 1 in which the heating to said temperature occurs within a short period of time of the order of one minute, where the time period for settling is of the order of one hour.

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