United States Patent [19]

Froreich

[11] **3,844,662**

[45] **Oct. 29, 1974**

[54] **SEDIMENTATION INSTRUMENT FOR BODY FLUIDS AND METHOD OF MICROSCOPIC EXAMINATION OF THE SEDIMENT**

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[21] Appl. No.: **425,082**

Related U.S. Application Data

[63] Continuation of Ser. No. 271,007, July 12, 1972, abandoned.

[30] **Foreign Application Priority Data**

July 13, 1971 Germany 2134884

[52] **U.S. Cl.** **356/246,** 233/26, 350/94, 350/95, 356/39, 356/197

[51] **Int. Cl.** **G01n 1/10,** G01n 21/24

[58] **Field of Search** 356/246, 38, 39, 197; 350/9, 90, 95, 94; 233/26

[56] **References Cited**

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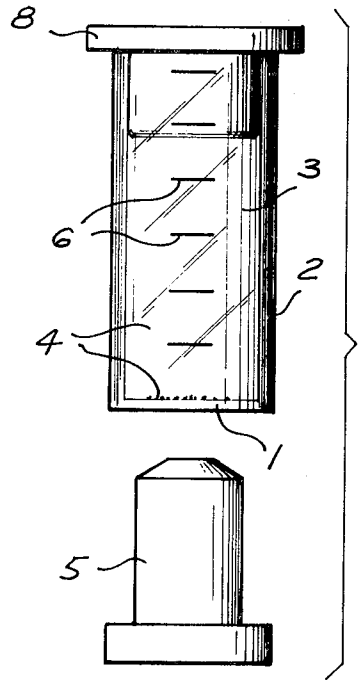
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Primary Examiner—Vincent P. McGraw
Attorney, Agent, or Firm—Erich M. H. Radde

[57] **ABSTRACT**

An instrument useful for the microscopic examination of the sediments of body fluids, especially of urine is provided with a planar or rounded transparent bottom of uniform thickness permitting direct examination of the sediment settled at the bottom of the instrument by means of a microscope. The bottom may have a grating dividing the bottom into areas of predetermined size and the instrument may be graduated at its side walls to determine the height to which the specimen of body fluid is filled thereinto.

8 Claims, 2 Drawing Figures



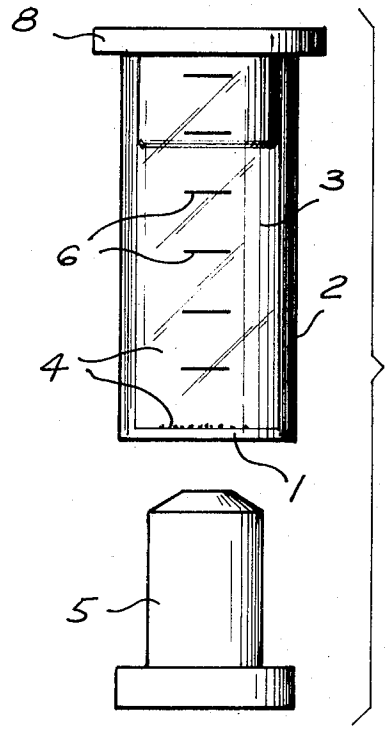


FIG. 1

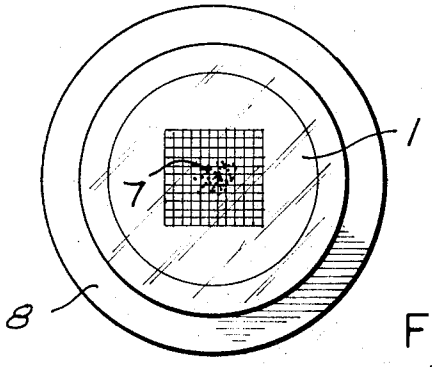


FIG. 2

SEDIMENTATION INSTRUMENT FOR BODY FLUIDS AND METHOD OF MICROSCOPIC EXAMINATION OF THE SEDIMENT

This is a continuation of application Ser. No. 271,007, filed July 12, 1972 and now abandoned.

BACKGROUND OF THE INVENTION

1. FIELD OF THE INVENTION

The present invention relates to an instrument useful in the microscopic examination of urine and more particularly a tubular instrument in which the formed elements of urine are caused to settle by gravity or by exposure to centrifugal forces so as to permit microscopic examination of the sediment, and to a method of using such an instrument in the microscopic examination of the urinary sediment.

2. DESCRIPTION OF THE PRIOR ART

In order to microscopically examine the organized and unorganized sediments of urine such as the various casts, for instance, nyaline casts, granular casts, waxy casts, epithelial casts, blood cell casts, pus casts, fatty casts, cylindroids, epithelial cells, leucocytes or pus cells, erythrocytes or red blood cells, and the unorganized sediments such as magnesium ammonium phosphate, calcium oxalate, calcium phosphate, calcium sulfate, calcium carbonate, uric acid, urates, cystine, cholesterol hippuric acid, leucine, tyrosine, the urine is filled into a conical centrifuge tube or in a glass tube with a round bottom. The urine is filled into these tubes and is exposed to centrifugal forces. As a result thereof the particles contained in the urine, the specific gravity of which is higher than that of the suspending urine fluid, are forced to settle at the bottom of the tubes. The supernatant urine fluid is poured off, the sediment is shaken up and suspended in the remaining few drops of urine, is placed on a slide, covered with a cover slip, and examined under the microscope. This procedure, however, is rather complicated, the danger of infection is considerable, and the results of counting the particles in the field of vision or, respectively, for each unit area are rather inaccurate.

SUMMARY OF THE INVENTION

It is one object of the present invention to provide a method which considerably simplifies microscopic examination of the urine sediment, reduces the danger of infection, and renders the results obtained on counting always reproducible.

Another object of the present invention is to provide an instrument for carrying out the method according to the present invention, said instrument having the purpose of collecting the organized and unorganized particles present in the urine in the form of a sediment at the bottom of said instrument and to render said sediment directly available for microscopic examination.

Other objects of the present invention and advantageous features thereof will become apparent as the description proceeds.

In principle, the object of the present invention comprises provisions the instrument used for settling the urine components, with an optically planar bottom or a bottom that is rounded corresponding to the radius of the centrifuge. Said bottom must be transparent and of uniform thickness. The bottom must be relatively thin, for instance, of a thickness of about 0.4 mm. and must permit direct microscopic examination of the sediment from the underside or bottom side of the instrument by means of a so-called reverse design of the microscope.

Preferably lateral markings are provided at the instrument in order to indicate the height to which the instrument is to be filled. This is of importance in order to obtain quantitative data regarding the density of the sediment.

In order to further increase the accuracy of counting the various particles of the sediment, the transparent bottom of the instrument is provided with a grating. Said grating also facilitates orientation on microscopic examination of the sediment.

The sidewall of the instrument has projections to facilitate and improve its mounting in a centrifuge or microscope inset or holder. Said projections permit free suspension of the sedimentation instrument in a corresponding holding device or mounting support, so that the bottom of the instrument is readily accessible for microscopic examination.

The advantages which can be achieved by using the instrument for urinalysis and microscopic examination of urine according to the present invention are quite evident. Instead of a multitude of operational steps which have to be carried out when microscopically examining a urine sediment according to known methods, namely to fill the urine into a centrifuge tube, to subject the tube to centrifugal forces, to decant excess urine fluid, to shake up and suspend the sediment in residual urine, to place the sediment onto a slide, to cover the sediment on the slide with a cover slip, and to examine the sediment under the microscope, the method according to the present invention requires only a few operational steps, namely filling the urine into the centrifuge tube, subjecting the tube to centrifugal forces, and examining the sediment directly under the microscope.

In addition to the savings in time achieved thereby, the further advantage is obtained that the person carrying out these steps and handling the urine, is in contact with the urine to be examined which frequently is of an infectious nature, for a very considerably reduced period of time. Furthermore, the steps of decanting excess urine and subsequent shaking up of the sediment, placing it on a slide, and covering the sediment drop thereon with a cover slip are liable to cause many errors. Thus, according to the known method it is quite difficult, if not impossible, to correctly recalculate the amounts of cellular components in the urine as determined on microscopic observation of the sediment drop, in relation to the amounts of such components present, for instance, in a 24 hour specimen of urine.

A further advantage of the present invention is that the organized urine elements such as red cells, leucocytes, epithelial cells, casts, mucous threads, bacteria, and the like present in a predetermined urine column settle on the surface area upon which the urine column rests, and thus permit directly to count said elements present on each unit area and to calculate the contents of such elements in the urine for each unit of volume. As a result thereof the method and instrument according to the present invention offer further diagnostic possibilities which cannot be achieved by means of the conventional methods and instruments.

BRIEF DESCRIPTION OF THE DRAWING

The above objects, features, and advantages of the present invention will appear from the following description which is given below by way of example, taken in connection with the accompanying drawing in which

FIG. 1 illustrates a cross-sectional view of the sedimentation instrument and of the objective of the reverse design of a microscope while

FIG. 2 illustrates the sedimentation instrument seen from its bottom side.

Like numerals in said drawings refer to like parts of the instrument.

DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. 1 shows a sedimentation instrument for urine in the form of a tube with an optically planar and transparent bottom of uniform thickness. The bottom is relatively thin. Its thickness preferably does not exceed about 0.4 mm. The wall of this instrument **2** is provided with a projection or shoulder **8** and with graduation markings **6.** The instrument is filled with urine **3** forming a liquid column which contains the formed elements **4.** On allowing the urine to stand in said instrument or on subjecting it to centrifugal forces, the formed elements **4** settle at bottom **1** of the instrument. They can be examined by means of the reverse design of a microscope of which only the objective **5** is illustrated. Markings **6** serve to determine the height to which the urine is filled into the instrument. They permit to calculate the volume of urine above each unit area of bottom **1.**

Projection or shoulder **8** provided at the side wall **2** of the instrument serves to mount and suspend the instrument in a suitable holder or mounting device and renders bottom **1** accessible to microscopic examination.

FIG. 2 shows the same tubular instrument as seen from its underside with a grating **7** provided at bottom **1,** i.e., the instrument on the bottom of which there are ruled with a diamond a number of lines which cross each other and divide the surface into areas, for instance, of 0.05 sq.mm. in size.

When microscopically examining urine, between about 0.05 ml. and 0.2 ml. of the urine collected during **24** hours are transferred by means of a micropipet into the exactly calibrated sedimentation tube **2.** Said tube has an inner diameter, for instance, of 7.98 mm. corresponding to a cross-sectional area of 50 sq.mm. and is graduated to indicate a height of the urine column of 1 mm., 2 mm., and 4 mm. corresponding to a volume of 0.05 ml., 0.1 ml., and 0.2 ml. of urine. When using a tube of the inner diameter of 5.64 mm. corresponding to a cross-sectional area of 25 sq.mm., the tube is graduated to indicate a height of the urine column of **2** mm. and **4** mm. corresponding to a volume of 0.05 ml. and 0.1 ml. of urine. Such tubes permit examination of the sediment present in predetermined amounts of urine.

It is advisable to centrifuge the tubes so that the meniscus, i.e., the curved upper surface of the column of urine in tube **2** flattens out. In this manner it is assured that the height of the urine column above the bottom is well defined.

It is, of course, essential that the bottom of tube **2** is in vertical position with respect to the radius of the centrifuge rotor and that said radius passes through the center of the bottom to achieve optimum results.

Preferably the centrifugal force to which the sedimentation tube is subjected is between about 100 G and about 200 G. Usually centrifuging for about 10 minutes is sufficient to form the sediment at the bottom of the tube.

The following example serves to illustrate the present invention without, however, being limited thereto.

EXAMPLE

The urine of a patient excreted within 24 hours is collected. It amounts to 1,240 ml.

A urine sedimentation tube **2** of an inner diameter of 7.98 mm. and a cross-sectional area of 50 sq.mm. provided with lateral graduation markings at 1 mm., 2 mm., and 4 mm. is used. Its bottom is provided with a Neubauer grating divided into areas of 1 sq.mm. each.

With a micropipet 0.1 ml. of the urine is transferred to the sedimentation tube to fill it up to a height of 2 mm.

The urine column above each area of 1 sq.mm. amounts to 2 cu.mm.

The tube is centrifuged at 100 G for 10 minutes and the settled particles are counted under the microscope.

Three erythrocytes and
four leucocytes
are counted on each **1** sq.mm. of counting area.

Calculation:

Three erythrocytes × 2 cu.mm. × 1,240,000 cu.mm.(1240 ml. of urine) = 1,860,000 erythrocytes/24 hours.

Four leucocytes × 2 cu.mm. × 1,240,000 cu.mm. (1240 ml. of urine) = 2,480,000 leucocytes/24 hours.

Of course, the instrument according to the present invention cannot only be used for the microscopic examination of the sediment of a urine specimen. It may also be employed for the cell count in a specimen of cerebrospinal fluid and for counting the cellular elements in other body fluids containing relatively few formed elements which are concentrated and collected at the bottom of the instrument in the form of a sediment.

It is understood that the instrument according to the present invention may be not only of round cross-section but it may have a square, rectangular, polygonal, and the like cross-section depending upon the centrifuge and/or the microscope holding device into which it is inserted.

Preferably the grating or ruling **7** at the bottom **1** of the instrument is of the "Neubauer" type as it is conventionally used in the red blood cell count on microscopic examination of the ruled red cell counting area of the counting chamber. Said ruled red cell counting area is subdivided into a square network or grid, the length of the sides of each square being 1/20 mm.; thus the area of 1 × 1 mm., i.e., of 1 sq.mm. is subdivided into 16 squares each of 1/400 sq.mm. Although such a fine "Neubauer" grid is not required in the determination of the number or kind of formed elements settled from urine, its use has the advantage that it allows the use of conventional tools to provide the bottom of the instrument of the present invention with a grating or grid permitting easy counting of said formed elements.

The bottom of the instrument may, of course, be provided with any other type of grating or grid.

The instrument of the present invention is preferably made of glass. It may, however, also be made of a suitable plastic material such as an acrylic polymer and copolymer, polystyrene, and the like. Plastics are useful as material for disposable tubes and the like instruments.

I claim:

1. A tubular receptacle for examining the sediment of body fluids, said receptacle being closed at one end by a thin optically planar transparent bottom of uniform thickness throughout thereby permitting microscopic examination of the body fluid in said receptacle from its lower side, said bottom of said receptacle being provided with a grating which permits the particles settling to the bottom in a predetermined area defined by said grating to be counted whereby the sediments in the entire body fluid sample can be calculated.

2. The receptable of claim **1** wherein graduations are provided on the side wall of the receptacle to determine the height to which the receptacle is filled with the body fluid to be examined.

3. The receptacle of claim **1** in which the side wall of the receptacle is provided with means to permit suspensiontype mounting of the receptacle in a holding device of a centrifuge.

4. The receptacle of claim **3** wherein said mounting means comprises an annular, laterally extending shoulder at the top of said receptacle.

5. The receptacle of claim **1** wherein the thickness of said transparent bottom does not exceed about 0.4 mm.

6. The method of examining the sediment of body fluids by causing the solid particle sediment to settle, comprising the steps of:

a. transferring a predetermined amount of such body fluid to a receptacle having a bottom wall formed of a thin optically planar transparent material of uniform thickness throughout, said wall being formed with a grating covering a predetermined area on said bottom wall,

b. allowing the sediment in said body fluid to settle on said bottom wall, and

c. examining microscopically the sediment on said grating of said bottom wall from beneath said bottom wall, the total amount of sediment in a known quantity of body fluid being calculable from the sediment count on said bottom wall.

7. A tubular receptacle for examining the sediment of body fluids, said receptacle being closed at one end by a thin optically planar transparent bottom of uniform thickness throughout thereby permitting microscopic examination of the body fluid in said receptacle from its lower side, said bottom permitting the particles settling thereon to be counted by said microscopic examination whereby the sediments in the entire body fluid sample can be calculated.

8. The tubular receptacle of claim **7** wherein the thickness of said transparent bottom does not exceed about 0.4 mm.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,844,662 Dated October 29, 1974

Inventor(s) ANDRE VON FROREICH

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 1, line 21: "nyaline" should read -- hyaline --.

Column 1, line 61: "provisions" should read -- providing --.

Signed and sealed this 31st day of December 1974.

(SEAL)
Attest:

McCOY M. GIBSON JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents