United States Patent

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[72] Inventor **Rudolf Oberli**
Langenthal, Switzerland

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[73] Assignee **Greiner Electronic AG,**
Langenthal, Switzerland

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[31] **876/69**

[54] **TEST TUBE HAVING INTEGRAL MIXING MEANS**
7 Claims, 2 Drawing Figs.

[52] **U.S. Cl.** **259/75,** 23/259
[51] **Int. Cl.** **B01f 11/00**
[50] **Field of Search** ..... 259/56, 75, 76, 80, (Digest), 42; 68/154, 174

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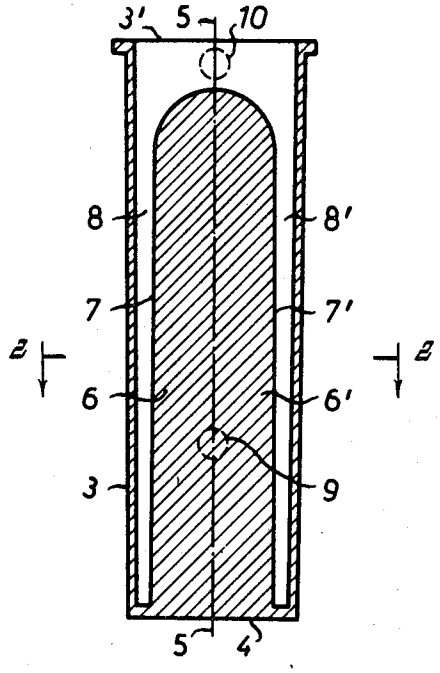
Primary Examiner—Walter A. Scheel
Assistant Examiner—Alan I. Cantor
Attorney—Lawrence E. Laubscher

ABSTRACT: A test tube for mixing liquids, characterized by the provision of integral stirring means extending longitudinally from the bottom wall in spaced relation to the sidewall of the tube. The stirring means preferably is of knifelike configuration including a longitudinal edge adjacent and spaced from the internal surface of the sidewall whereby upon oscillation of the test tube about its longitudinal axis, a vortex is formed adjacent the edge to effect rapid thorough mixing. Preferably the test tube has a capacity of between about 0.5 and 5 milliliters and is designed for disposal after a single use.



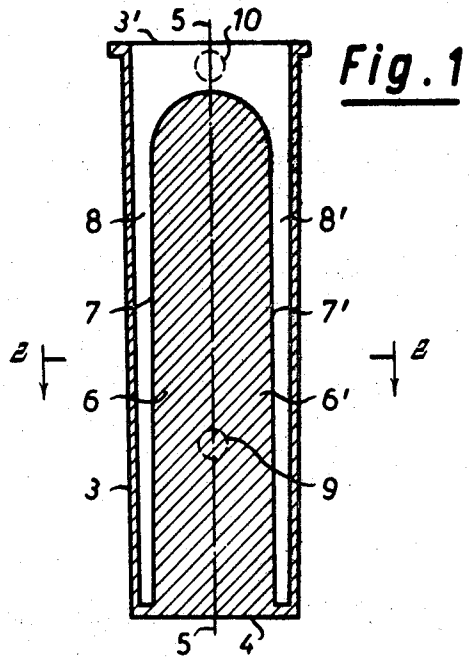


Fig. 1

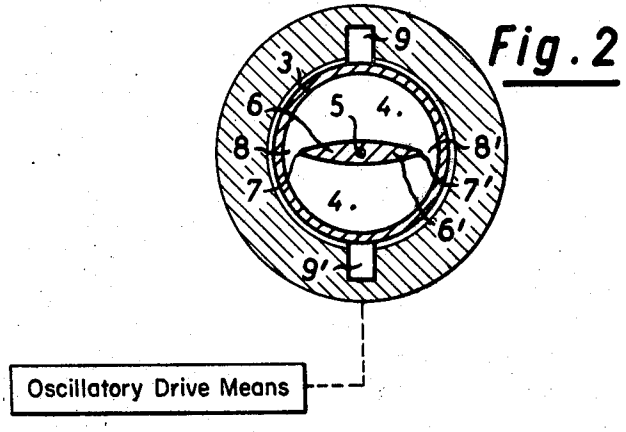


Fig. 2

INVENTOR.
Rudolf Oberli

BY
Lawrence E. Laubscher
ATTORNEY

TEST TUBE HAVING INTEGRAL MIXING MEANS

When performing chemical and/or physical analyses, it is frequently necessary to thoroughly mix or to stir the samples present in a container. Stirring or mixing blades or paddles are disposed in the container for this purpose and are driven by conventional drive means to produce rotary oscillations with respect to the container. Furthermore, in order to enhance the effect of the stirring paddles, it has been proposed to provide radially inwardly directed baffles adjacent the inner wall of the container. In this case, the container may also be subjected to rotary oscillations which have an opposite direction relative to the rotary oscillations of the stirring paddles. The containers suitable therefor have a capacity of from several liters to a few deciliters, and in order to avoid spillage during the mixing operation, the containers can be filled to only a fraction of their actual capacity.

For numerous investigations, however, only limited quantities of the samples are available and are therefore introduced into test tubes which usually have a capacity of between approximately 0.5 and 5 milliliters. The test tubes themselves are intended generally to be used only once, and must therefore be relatively inexpensive. These and other requirements arising in the case of test tubes prevent the use of the prior mixing means that are customarily employed in larger containers for the purpose of stirring or thoroughly mixing the samples, and in view of the relatively small capacity of the test tubes, the use of stirring paddles which are moved relative to the inner wall of the test tubes is out of the question.

Accordingly, the present invention relates to a test tube having a capacity within the milliliter range which is designed preferably for being used only once and consists of an essentially cylindrical tube having an integral bottom wall. In accordance with the primary object of the invention, in order to obtain thorough mixing of the contents of the test tube by merely subjecting the test tube as a whole to oscillatory movement about the longitudinal axis thereof, at least one integral knifelike stirring means is disposed coaxially within the test tube of the present invention, which stirring means extend radially outwardly from the longitudinal axis of the tube to define a gap between its outer pointed extremity and the inner surface of the test tube wall. The stirring means are integral with the bottom of the test tube and extend upwardly in spaced relation to the test tube sidewall. According to a preferred embodiment of the invention, the stirring means has a double-knife configuration including a pair of pointed portions that extend diametrically radially outwardly from the longitudinal axis of the test tube. Preferably the inner wall surface of the tube is smooth throughout, whereas the outer extremities of the pointed projections are provided with sharp edges that extend longitudinally adjacent and spaced from the wall surface. Preferably, the sidewall surfaces of the stirring means are also smooth.

Other objects and advantages of the invention will become apparent from a study of the following specification, when viewed in the light of the accompanying drawing, in which;

FIG. 1 is a longitudinal cross section view of the improved mixing test tubule of the present invention; and

FIG. 2 is a sectional view taken along line 2–2 of FIG. 1, illustrating diagrammatically the means for supporting and oscillating the test tube.

The test tube according to FIGS. 1 and 2 is made preferably of an inexpensive impervious material, such as polypropylene for example, and includes a tubular sidewall portion 3 and an integral bottom wall portion 4. The upper surface of the bottom wall is planar and is arranged at a right angle with respect to the longitudinal axis 5. Disposed within the tube 3 are double knife edge stirring means including symmetrical pointed portions 6, 6′ that extend diametrically radially outwardly from the longitudinal axis 5 and terminate in longitudinal edges 7, 7′ that are adjacent and spaced form the inner wall surface to define narrow gaps 8, 8′. The stirring means is integral with and extends upwardly from the bottom wall 4 in concentrically spaced relation to the tubular wall 3. Preferably, the inner wall surface of the tube 3, the upper surface of the bottom 4 and the lateral surfaces of the stirring means 6, 6′ all have completely smooth surfaces. Finally, the tube 3 is provided with guide pins 9 and 9′ and 10, 10′ that project laterally outwardly from the tube for reception in the tube holder means that are driven by conventional oscillatory drive means as shown in FIG. 2. The test tube illustrated in the drawing is intended for a capacity within the milliliter range, the height of the tube 3 being on the order of 5.0 centimeters, for a tube having an inside diameter of approximately 1.3 centimeters.

During actual use, the test tube is axially inserted or slid downwardly into the supporting means within which it is held securely against torsion by means of the guide pins 9, 9′ and 10, 10′. The holder is oscillated about its longitudinal axis 5 by the oscillatory drive means. In the case of a test tube having the dimensions set forth above, it has been found advantageous to employ an amplitude of the rotary oscillations of approximately ±40 radians if the frequency of the rotary oscillations is between 5 and 10 cycles per second.

When a liquid to be mixed is inserted into the test tube and sinusoidal rotational oscillations are imparted to the tube, considerable relative velocities of the liquid with respect to the tubular wall are temporarily produced in the gaps 8 and 8′. A vigorous vortex formation is produced adjacent the sharp edges 7 and 7′ which, in turn, brings about a rapid and thorough stirring or intermixture of the liquid. It is a particular advantage of the present invention that there will be no formation of bubbles and no spilling of the liquid. The test tube may therefore be filled to a point near the upper rounded-off portion of the tongues 6 and 6′ (FIG. 1). On the other hand, the desired stirring or intimate mixing effect will be produced also if the test tubule is filled only for a very small fraction of the tubular height thereof.

While in accordance with the provisions of the Patent Statutes I have illustrated the preferred form and embodiment of the invention now known to me, it will be apparent to those skilled in the art that various modifications may be made in the disclosed apparatus without deviating from the inventive concept.

I claim:

1. In a test tube adapted for mixing a liquid and including integral bottom 4 and tubular sidewall 3 portions defining a cavity within the milliliter range, the improvement wherein said test tube includes at least one stirring portion 6, 6′ arranged in coaxially spaced relation within said tubular portion and integrally connected at one end with said bottom portion, said stirring portion having a knifelike configuration including in transverse cross section at least one radially outwardly extending pointed portion defining a longitudinal edge 7, 7′ adjacent and spaced form the inner wall surface of said tubular portion, whereby when said test tube is oscillated about its longitudinal axis, a vortex is formed in the gap 8, 8′ adjacent the edge to effect rapid mixing of the liquid in the test tube.

2. A test tube as defined in claim 1, wherein the inner surface of said cylindrical sidewall portion is smooth.

3. A test tube as defined in claim 2, wherein the opposed sidewall surfaces of said stirring portion are smooth.

4. A test tube as defined in claim 1, wherein the surface carried by said bottom wall defining the bottom of said cavity is planar and arranged at right angles to the longitudinal axis of said test tube.

5. A test tube as defined in claim 1, wherein the stirring means has a double knife edge configuration including a pair of symmetrical pointed portions extending diametrically radially outwardly from the longitudinal axis of the test tube to define longitudinal edges adjacent and spaced form the inner surface of said sidewall portion, respectively.

6. A test tube as defined in claim 1, wherein the test tube has a capacity of between 0.5 and 5 milliliters, and further including means for oscillating said tube about its longitudinal axis through an angle of about ±40 radians at a frequency of oscillation of from 5 to 10 cycles per second.

7. Apparatus as defined in claim 6, wherein the length and the internal diameter of the tubular sidewall portion are about 5.0 centimeters and 1.3 centimeters, respectively.