

[54] CONTAINER HOLDING ROTATABLE BODY WITH ADJUSTABLE BALANCING FEATURE

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[56]

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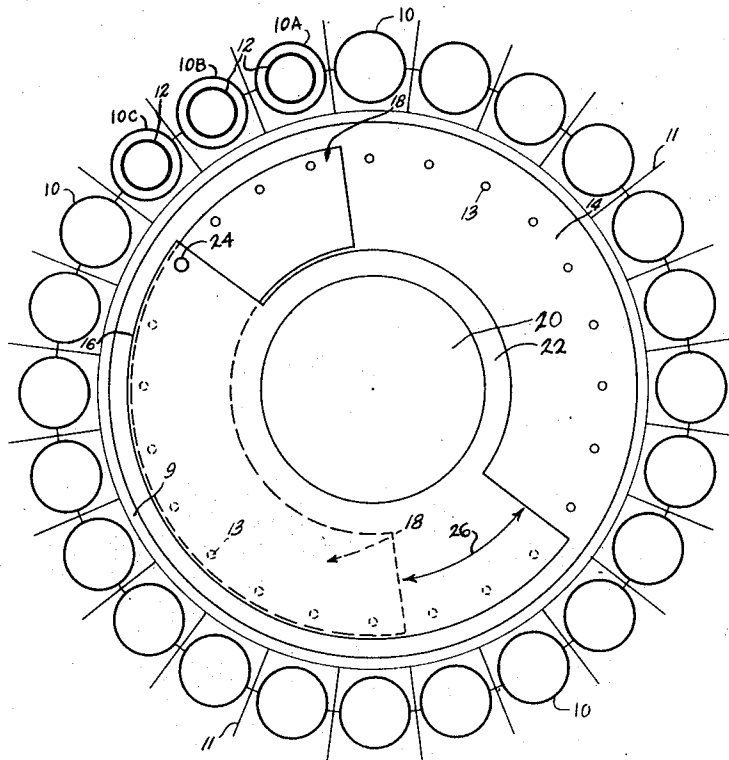
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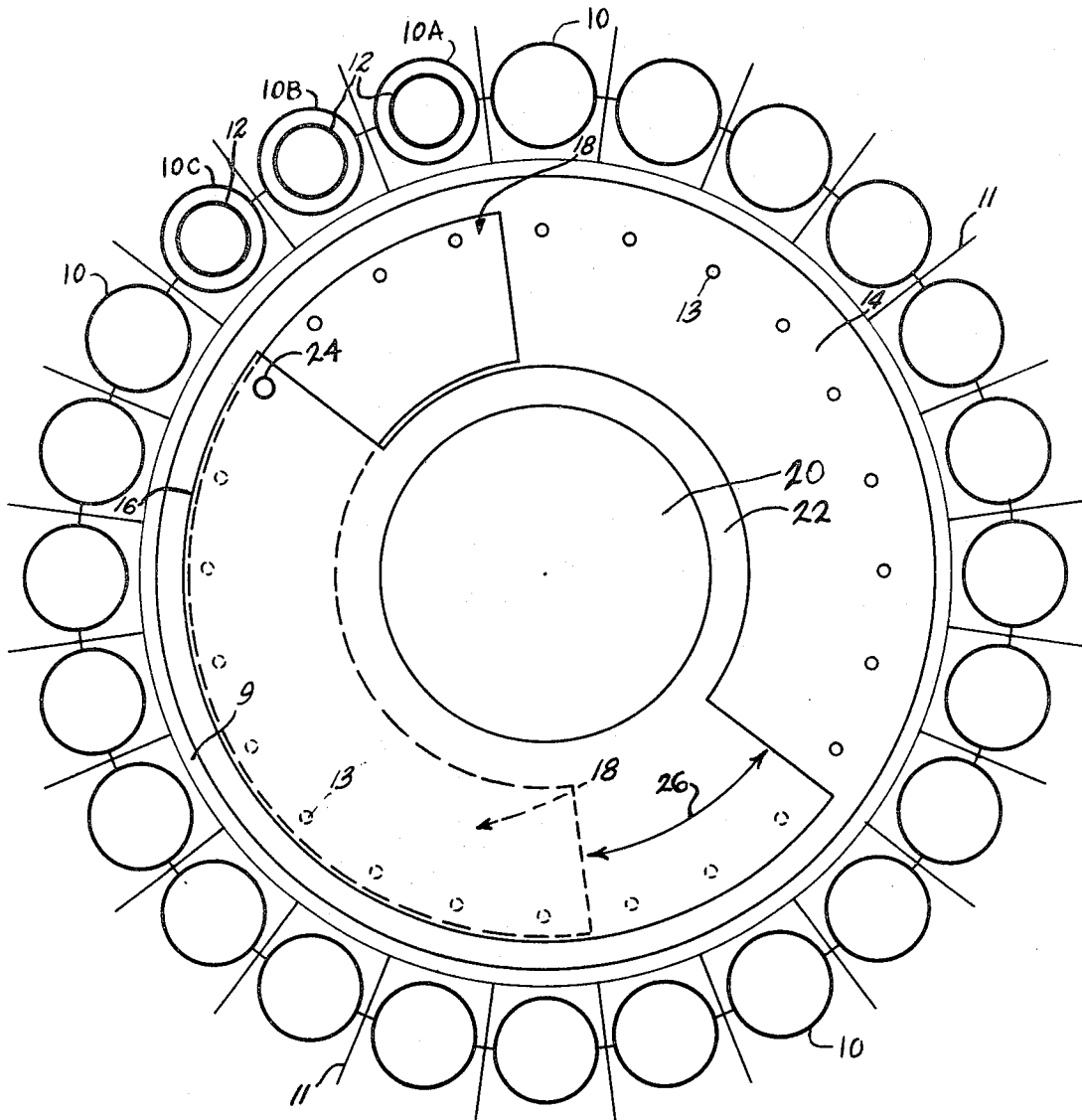
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ABSTRACT

An imbalance of a centrifuge of the type used for a number of separate sample containers is compensated by means of two overlapping semi-circular sector balancing weights, which are adjustable with respect to the axis of rotation of the centrifuge.

6 Claims, 1 Drawing Figure





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## CONTAINER HOLDING ROTATABLE BODY WITH ADJUSTABLE BALANCING FEATURE

This invention relates to an adjustable balancing feature for rotatable bodies which is particularly useful for centrifuges of the type which may be used for separating small sample quantities of chemical or biological fluids such as blood samples, the samples being contained in a plurality of small tubes which are carried at the periphery of the centrifuge wheel.

One of the most serious problems in the operation of rotatable bodies of the above type is the problem of imbalance due to unbalanced loading. The major cause for such unbalance is a failure to fully load the centrifuge, some of the cups or carriers being allowed to remain empty, while others are filled.

Present solutions for this problem are not very satisfactory. One of the most common solutions is to fill all of the centrifuge cups which would otherwise remain empty with "dummy" sample tubes. This is a time consuming procedure. Another solution is to load the centrifuge symmetrically, evenly spacing the full cups and empty cups around the peripheral edge of the centrifuge. This procedure also consumes extra operator time. Furthermore, as explained in a prior related patent application, it is desirable to have the samples loaded in a continuous series for ease of identification and for use of the centrifuge in conjunction with automatic sampling apparatus. The prior related patent application is application Ser. No. 70,199 filed on Sept. 8, 1970 by Stanley L. Livshitz, Alvin Engelhardt, and Stanford L. Adler for a "New and Improved Sample Processing and Supply Apparatus" and assigned to the same assignee as the present application.

Accordingly, it is an important object of the present invention to provide an improved rotatable body with an adjustable balancing feature whereby an otherwise unbalanced rotatable body may be very quickly and accurately balanced.

Another object of the invention is to provide an adjustable balancing feature which is particularly useful for use with centrifuges of the type which are arranged to handle a plurality of discrete samples.

Other objects and advantages of the invention will be apparent from the following description and the accompanying drawings.

The single drawing is a schematic top view of a preferred embodiment of the apparatus.

Referring particularly to the drawing, the rotatable body is illustrated as a centrifuge wheel 9 having a plurality of sample cups 10 arranged around the peripheral edge portion thereof. Each of the sample cups 10 is arranged to receive a tube 12 containing a liquid sample to be separated. While the centrifuge 9 is illustrated in the drawing as having just 24 cups 10, it will be understood that any desired number of cups may be provided, a typical convenient number being 40, for instance.

Each of the cups 10 is preferably fastened to the edge of the centrifuge wheel between adjacent radially extending arms 11 in a pivoted fashion so as to swing outwardly in the well known manner as the centrifuge is operated.

In the drawing, sample tubes 12 are illustrated as having been loaded only in the first three of the cups 10A, 10B, and 10C. This would normally result in a seriously unbalanced condition of the centrifuge wheel 9. However, in accordance with the present invention, two semi-circular sector balancing weights 14 and 16 are provided for the centrifuge wheel 9. The balancing weight 14 is fixed with relation to the wheel and the balancing weight 16 is rotatably adjustable with respect to the centrifuge wheel 9. The fixed balancing weight 14 is referred to as a semi-circular balancing weight because it is provided on the left side in the drawing with a semi-circular slot indicated at 18. Accordingly, since this member is circularly uniform except for that slot 18, the unslotted right semi-circular portion constitutes the semi-circular balance weight. The adjustable balancing weight 16 is rotationally adjustable about a central hub 20, being confined upon that hub by means of an annular portion 22 extending around the hub. It is obvious from the drawing that the remainder of the balancing weight 16 defines a semi-circular sector having essentially the

same rotational inertia as the unslotted semi-circular sector of the fixed balancing weight 14. By means of a spring biased pin 24, the adjustable balancing weight may be fixed in selected rotational positions by raising the pin and then permitting it to enter holes 13 provided in the centrifuge wheel 9 and fixed balancing weight 14 at the desired indexed positions.

The balancing weights are designed so that the sector width of each balancing plate corresponding to the sector of the centrifuge wheel 9 occupied by one of the cups 10 provides an inertial weight equal to one half of the inertial weight of one full tube 12. Thus, for instance, in the embodiment as illustrated in the drawing, with 24 cups 10, each cup occupies a 15° sector and thus each 15° segment of each balancing weight possesses an inertial weight equivalent to half of a full sample tube 12. With this relationship, adjustment for the unbalance caused by only partially loading the centrifuge wheel 9 is quickly accomplished by moving the adjustable balancing weight 16, to a position such as illustrated in the drawing so that the edge of the adjustable balancing weight is just beyond the last loaded cup. When this condition is achieved, the overlapping sector of the balancing weights, such as indicated at 26, is positioned exactly diametrically opposite to the loaded cups 10A, 10B, and 10C and exactly balances for those loaded cups. Thus, by simply advancing the adjustable balancing weight to a position just beyond the last loaded cup, the centrifuge wheel 9 is always properly balanced.

Furthermore, it will be apparent that this device also works perfectly to maintain a balance by means of the same mode of operation when the centrifuge wheel 9 is more than half loaded, for then the overlapped sector of the balancing weights will begin to decrease as diametrically opposed cups are loaded and counterbalance one another. Finally, when the centrifuge wheel 9 is fully loaded, the balancing weights are positioned so that there is no overlap and the balancing weights thus balance one another in the fully balanced centrifuge.

While we have shown and described the preferred embodiment of our invention, it will be understood that the invention may be embodied otherwise than as herein specifically illustrated or described, and that certain changes in the form and arrangement of parts and in the specific manner of practicing the invention may be made without departing from the underlying idea or principles of this invention within the scope of the appended claims.

We claim:

1. The combination of a rotatable centrifuge wheel adapted for receiving loaded tubes of liquid along its periphery and in spaced uninterrupted sequential order, which liquid is to be spaced by centrifugation said wheel having a central axle portion at the axis of rotation thereof and including balancing means comprising two semi-circular sector balancing weights, each of said balancing weights being connected to said body with the sector center positioned at said axis of rotation and arranged for rotation with said body, at least one of said weights being rotatably and independently adjustable about said axis with respect to said body and in overlapping relationship with the other one of said balancing weights to provide a net increase in rotational inertial weight at the sector defined by the overlapped portions of said balancing weights, said overlapping portions of said balancing weights being positioned diametrically opposite to said tubes of liquid received on said wheel, the rotational inertial weight of the angular sector of each of said balancing weights corresponding to the sector occupied by each tube of liquid corresponding to one-half of the rotational inertial weight of a loaded tube of liquid to be received on said centrifuge wheel, whereby the rotational adjustment of said adjustable balancing weight through a sector angle corresponding to the peripheral angle occupied by all of said tubes of liquid received on said centrifuge wheel provides for a counterbalancing of the weight added to the centrifuge wheel by

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said received tubes of liquid by the overlapped portions of said counterbalancing weights diametrically opposite to said received tubes of liquid.

2. The combination as claimed in claim 1 wherein one of said semi-circular sector balancing weights is rigidly fastened to and forms a part of said rotatable body.

3. A combination as claimed in claim 2 wherein said centrifuge wheel includes separate cups equally spaced around the periphery thereof, said cups being arranged to individually receive loaded tubes of liquid in uninterrupted sequential order starting from a fixed cup position upon said centrifuge wheel, the first and succeeding successive cup positions beginning just beyond the semi-circular sector of said centrifuge wheel corresponding to the semi-circular sector position of said fixed balancing weight and continuing around the

periphery of said centrifuge wheel to first fill the semi-circular sector opposite to the semi-circular sector corresponding to the position of said fixed balancing weight.

4. The combination as claimed in claim 2 wherein a temporary fastening means is provided for fastening said rotatably adjustable balancing weight to said rotatable body in a selected adjusted rotational position.

5. A combination as claimed in claim 4 wherein said fastening means comprises a pin carried by said adjustable balancing weight, said rotatable body having a plurality of holes for receiving said pin at selected rotationally adjusted positions.

6. A combination as claimed in claim 1 wherein said rotatably adjustable balancing weight comprises a substantially flat semi-circular sector plate.

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