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CENTRIFUGE WITH BLOOD SAMPLE HOLDING MEANS

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FIG. 2

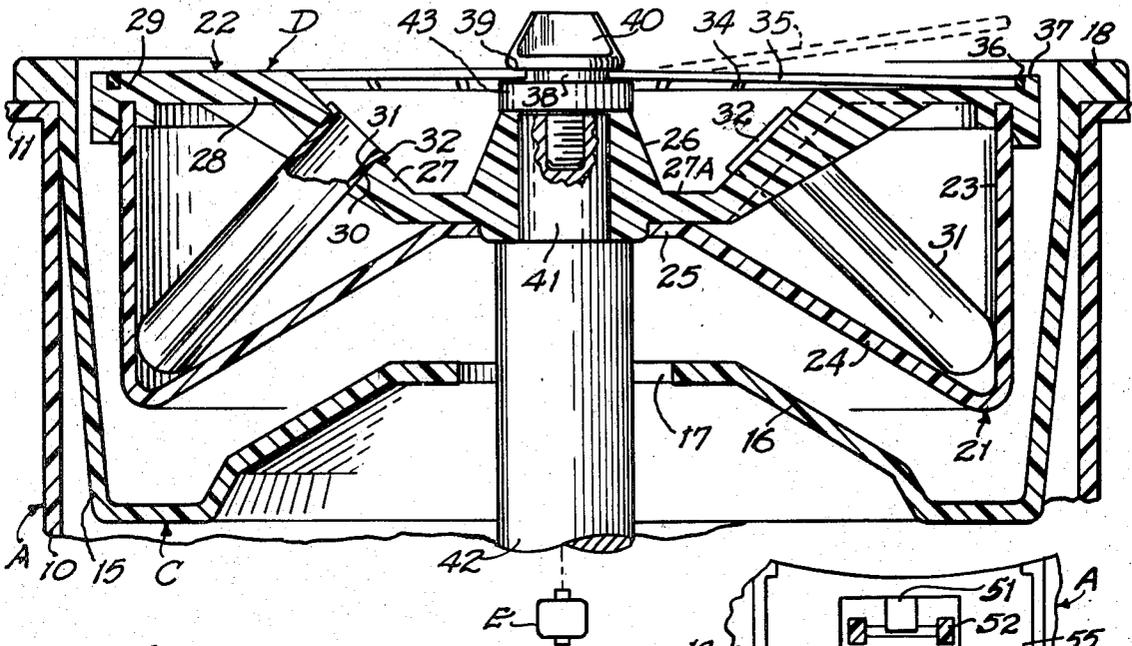
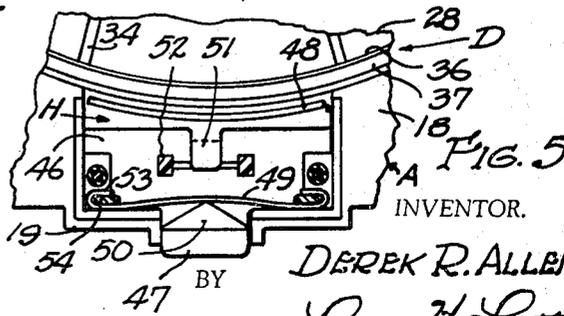
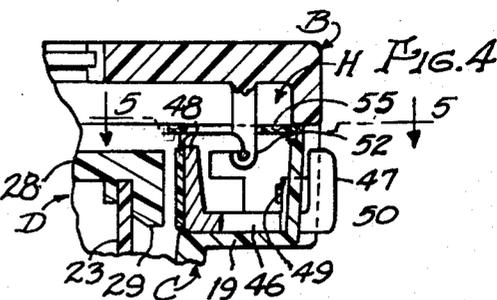
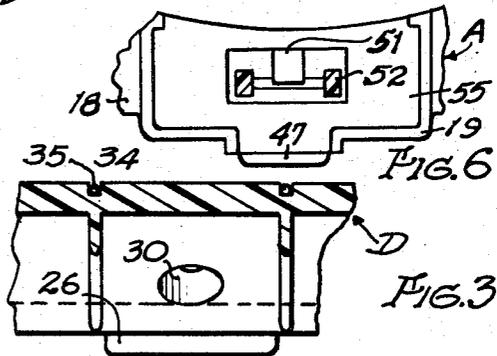
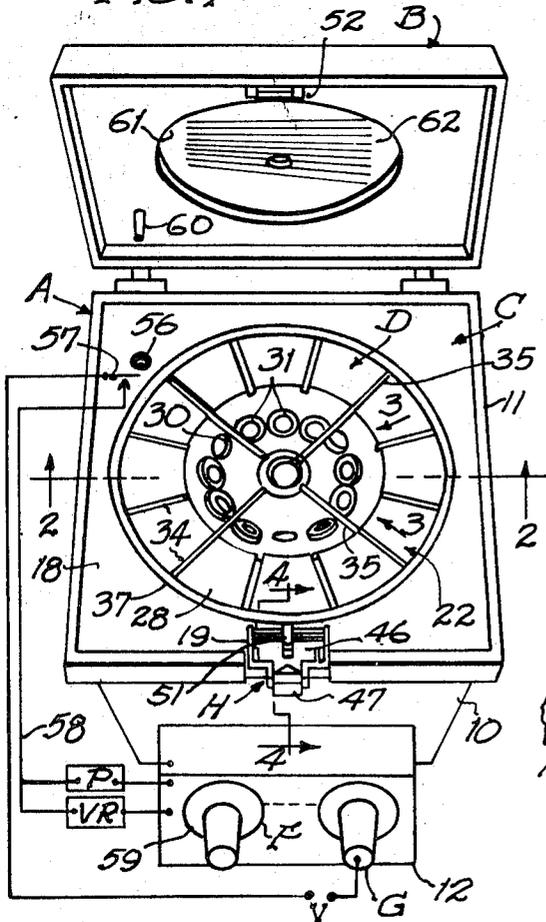


FIG. 1



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CENTRIFUGE WITH BLOOD SAMPLE HOLDING MEANS

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12 Claims

ABSTRACT OF THE DISCLOSURE

A centrifuge with a rotor adapted to simultaneously hold and centrifuge a plurality of blood separation tubes and hematocrit tubes; also provided with speed control over a wide range, from 4,000 r.p.m. for urine specimen centrifugation, up to 10,000 r.p.m. for rapid hematocrit preparation; also provided with a protective lid latch correlated with a combined brake actuator and circuit-opening switch to cut off power when the lid is lifted.

BACKGROUND OF THE INVENTION

Blood separation centrifuges and hematocrit preparacentrifuges are individually well known and in common usage as separate devices. None of them have combined both blood separation and hematocrit preparation in a simultaneous combined operation. Those heretofore available have had a maximum r.p.m. limit of 8,000. A centrifuge operable at variable graduated speeds over a wide range suitable both for low speed urine preparation and high speed rapid blood separation, has not hitherto been available. There has hitherto been no provision for simultaneous lid latch release, braking and power cutoff.

SUMMARY OF THE INVENTION

The invention provides a rotor having a segmental upper face of flat ring form, the segments being separated by a plurality of shallow radial slots adapted to hold respective hematocrits in an annular array in a common plane of rotation, the inner ends of the hematocrits bridging over a central cavity to the rotor hub, where they are held down by engagement in an annular retainer groove. Between the hematocrit slots, in the central cavity, are an equal number of diagonal sockets, equally spaced circumferentially, to receive and hold a plurality of blood separation tubes in a conical array, their open ends facing inwardly and their bottoms outwardly. There are twelve of the sockets, making it possible to centrifuge two, three, four, six, eight, nine, ten or twelve tubes simultaneously in a balanced, vibration-free array. The apparatus is provided with a wide-range speed controller and with a voltage regulator correlated with the speed controller in a manner to provide accurate r.p.m. readings throughout the range of speeds. A brake, operable on the rotor rim, has a pushbutton actuator which also functions to release a lid latch. In immediate response to the latch release, the lid, which is spring loaded, will be raised sufficiently to open the power circuit so as to cut off the power when the brake is applied.

OBJECTS OF THE INVENTION

The general object of the invention is to provide a laboratory centrifuge of improved versatility of function and rapidity of operation, capable of replacing several different centrifuges of older types. Specific objects are to provide a centrifuge:

- (1) having a twelve tube capacity;
- (2) adaptable to vacuum tubes;
- (3) having a twelve hematocrit capacity;
- (4) operable to centrifuge twelve tubes and twelve hematocrits concurrently;

- (5) operate to centrifuge numerous lesser numbers of tubes and/or hematocrits without becoming unbalanced;
- (6) having a top speed of 10,000 r.p.m.;
- (7) which does not require a top plate in addition to its lid;
- (8) having lid release, brake and power cutoff simultaneously in response to operation of a common push-button actuator;
- (9) having a lid scale for hematocrits;
- (10) having graduated speed, variable over a wide range encompassing low-speed urine-preparation as well as high speed blood plasma separation;
- (11) having voltage-compensated speed control;
- (12) having circuit breaker and timer controls.

These and other objects will become apparent in the following specifications and appended drawings, wherein: FIG. 1 is a front perspective view of a centrifuge embodying the invention, the lid being shown in an open position;

FIG. 2 is a transverse sectional view of the rotor and associated parts, taken on line 2—2 of FIG. 1;

FIG. 3 is a detail sectional view through the rotor top, taken on line 3—3 of FIG. 1;

FIG. 4 is a detail sectional view of the latch-brake unit, taken on line 4—4 of FIG. 1;

FIG. 5 is a plan view of the latch-brake unit, with the latch keeper shown in horizontal section as indicated by line 5—5 of FIG. 4, and

FIG. 6 is a plan view of the latch cover.

DESCRIPTION

Referring now to the drawings in detail, I have shown therein, as an example of one form in which the invention may be embodied, a centrifuge embodying, in general, a casing A having a hinged lid B, a rotor chamber C mounted in the top of casing A, a rotor D mounted on the shaft of a motor E (shown schematically) a speed controller F and a timer G arranged in a common control box at the foot of casing A, and a combined latch and brake H in the front of the casing A at its top.

Casing A has a body 10, an outwardly offset rim 11 to receive and support the rotor chamber C, and a control box 12 at its foot. Motor E is mounted in the lower portion of casing body 10 in a suitable manner of conventional nature (not illustrated).

Rotor chamber C comprises a bowl-shaped body 15 having a domed reentrant bottom 16 with a central opening 17, and a top flange 18 of square periphery to fit snugly within the offset rim 11 of casing A in flush relation to the top of the rim. Body 15 is of a high strength plastic material or equivalent, and of sufficient wall thickness to contain the rotor D in the event of fragmentation thereof while rotating at high speed. In the forward side of top flange 18 is a forwardly projecting pocket 19 to hold the brake-latch unit H.

Rotor D comprises, in general, a bowl-shaped body 21 and a head 22. Body 21 has a generally cylindrical lateral wall 23 and a frusto-conical reentrant bottom 24 having a flat inner lip 25 defining a central opening. Head 22 has a hub 26 with a bottom extension fitted in the opening within lip 25, a bottom web 27A just above such bottom extension, resting on lip 25, a frusto-conical rack web 27 flaring upwardly and outwardly, a flat top annulus 28 extending radially outwardly from the upper extremity of web 27, and a thick rim 29 having in its underside a cylindrical groove snugly receiving the rim of body wall 23.

In the intermediate web 27 are twelve tube rack sockets 30 in the form of cylindrical openings having respective downwardly and outwardly inclined diagonal axes collec-

tively arranged in a conical array coaxial with the rotor axis. Blood sample tubes 31 are snugly receivable in the respective sockets 30 in a downwardly flaring conical array, their bottoms extending into the annular trough defined between lateral wall 23 and bottom 24 of rotor body 21. Tubes 31 have rim flanges 32 which seat against the upper, inner surface of frusto-conical web 27 to position the tubes in balanced array as they are pulled outwardly by centrifugal force.

Top annulus 28 is provided with twelve shallow radial slots 34 for receiving and positioning respective hematocrits 35 of fine, tubular quill form, with closed outer ends and inner ends which are originally open but are closed by respective wax plugs after being filled with respective blood samples. Their outer ends, under centrifugal force, will engage against a cushioning ring 36 of suitable resilient material, which in turn is supported within an annular upstanding lip 37 on cover rim 29. Thus the hematocrits are supported against radial movement during centrifuging. Their inner ends are received in a retaining groove 38 in the upper end of rotor hub retainer screw 40, slightly above the plane of their outer ends, whereby the hematocrits are tilted slightly into a flat conical, with an apex above the plane of their outer ends, just high enough so that centrifugal force, tending to push them radially outwardly and thus to tilt them to higher inclination, will hold their inner ends against an annular shoulder 39 overhanging the retaining groove 38. Shoulder 39 is formed as a radial flange on retainer screw 40 threaded into a reduced tip 41 on the upper end of the motor shaft 42 of motor E. Screw 40 has a radial flange 43 which bears against the upper end of rotor hub 26, and secures the rotor D to shaft 42. The retaining groove 38 is of a satisfactory axial width to loosely receive the inner ends of the hematocrits and the shoulder 39 is located so as to position them at a satisfactory angle of inclination.

Latch-brake unit H comprises a slide 46 mounted in pocket 19 for radial sliding movement, having on its rear end a push button 47 projecting through an opening in pocket 19, and on its forward end a brake shoe 48 contoured for braking engagement with the periphery of rotor head rim 29. A bow spring 49, having end loops 53 mounted on pegs 54 depending from a latch cover 55 and its middle bowed and yieldably abutting a central projection 50 on slide 46 on the forward side of button 47, loads the slide 46 for retraction to the brake-release position shown in FIG. 5 when the button 47 is released. In this retracted position a latch finger 51 projecting rearwardly from shoe 48, makes latching engagement with a keeper loop 52 depending from the rim of lid B, to hold the lid in a closed position as shown in FIG. 4. Latch cover 55 is shown in FIG. 6 but is omitted from FIG. 1 for clarity.

Lid B has a downwardly projecting peg 60 which, when the lid is closed, projects into an opening in rotor chamber top flange 18, engages a spring-loaded plunger 56 in such opening, and depresses the plunger to close a normally open switch 57 in the power circuit 58 of motor E, thereby activating the circuit so that motor E may drive the rotor D under control of speed controller F and timer G. Then the latch is released, the lid B will pop up under the spring loading of plunger 56. The upward movement of the plunger will simultaneously release switch 57 for self-opening movement, thereby cutting off the power, and at the same time a light pressure on push button 47 will gently brake the spinning rotor D.

Lid B has a circular inspection glass 61 and a hematocrit scale 62 inscribed thereon.

Speed controller F utilizes a solid-state potentiometer P to vary the current supplied to the motor, under the regulating control of voltage regulator VR, from a current source V.

I claim:

1. In a laboratory centrifuge:

a rotor disposed on a vertical axis of rotation, said rotor including a head comprising a hub, a bottom web en-

circling said hub, a non-radial annular rack web carried by said bottom web and flaring upwardly and outwardly therefrom, and a flat top annulus extending outwardly from the periphery of said rack web at the top plane thereof;

a plurality of tube sockets in said rack web, disposed in a circumferential array on respective axes directed outwardly so as to hold respective blood separation tubes having inwardly directed mouths and outwardly projecting bottoms;

a plurality of hematocrit holding radial slots in the upper face of said top annulus, in a plane above the mouths of said tubes as mounted in said rack web;

a plurality of hematocrits in said slots;

and means to retain said hematocrits in said slots during high speed rotation of said rotor;

said bottom web and rack web defining a dished space which is open to the top plane of said annulus at all times.

2. A centrifuge rotor as defined in claim 1:

said rack web being of frusto-conical bowl shape;

said sockets consisting of openings in said web, their axes being arranged in a downwardly flaring conical array;

said sockets being disposed so as to position the mouths of said tubes below the plane of said hematocrit holding slots.

3. A centrifuge rotor as defined in claim 2:

said rotor further including a bowl shaped body including a generally cylindrical lateral wall secured at its upper margin to said head;

and a reentrant frusto-conical bottom tapering upwardly and inwardly and secured to said hub;

said body defining an annular space of acute angular cross-section into which said tubes extend when mounted in said sockets.

4. A centrifuge rotor as defined in claim 3:

the bottoms of said tubes being closely adjacent said reentrant bottom and said lateral wall when mounted in said sockets.

5. A centrifuge as defined in claim 1, including:

a casing in which said rotor is mounted, including a hinged lid for covering said rotor when the rotor is in operation;

said dished space being fully open upon opening said lid and removing said hematocrits, so as to provide immediate access to said blood separation tubes.

6. A centrifuge as defined in claim 1:

said hub extending upwardly from said bottom web;

said means to retain said hematocrits comprising a retainer screw having a radial flange defining the lower side of an annular groove in said screw, in which the inner ends of the hematocrits are loosely received;

and a drive motor shaft on the upper end of which said hub is mounted, said screw being anchored in said upper end of the shaft and securing said hub thereto.

7. In a laboratory centrifuge:

a housing having a top opening;

a rotor rotatably mounted in said housing on a vertical axis, said rotor including a tube-holding head and having a circular rim disposed in said opening;

a cover hinged to a back side of said housing for upward opening movement of its front side;

a latch element depending from said front side of the cover;

and a latch-brake unit comprising a slide mounted in said housing in the top front area thereof, for movement radially toward said rotor rim and having an outer end manually engageably for inward projection thereof;

a cooperating latch part carried by said slide and having latching engagement with said latch element in a normal outwardly retracted latching position of said slide and releasably upon inward projection thereof; and a brake element mounted on said slide in opposed

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relation to said rotor rim, for braking engagement with said rim upon latch-releasing inward projection of said slide.

8. A centrifuge as defined in claim 7:
and means yieldingly biasing said slide for movement to said latching position. 5
9. A centrifuge as defined in claim 8:
said housing including a top front pocket in which said slide is slidably received;
said slide including at its outer end a push button and a tapering projection inwardly of said push button;
said biasing means comprising a bow spring extending in a generally circumferential direction with its ends anchored to the housing near the sides of said pocket and its mid-portion engaged under flexure against said projection to exert outward pressure thereagainst. 10 15
10. In a laboratory centrifuge:
a rotor disposed on a vertical axis of rotation, said rotor including a head comprising a hub, a non-radial annular rack web carried by said hub and extending outwardly and upwardly therefrom, and a flat top annulus extending outwardly from the periphery of said rack web at the top plane thereof;
a plurality of tube sockets in said rack web, disposed in circumferential array on respective axes directed outwardly so as to hold respective blood separation tubes having inwardly directed mouths and outwardly projecting bottoms; 20 25
a plurality of hematocrit holding radial slots in the upper face of said top annulus;
a plurality of hematocrits in said slots;
means carried by said head for supporting the inner ends of said hematocrits at a height slightly above the height of the outer ends thereof when resting in said slots, whereby said hematocrits will be disposed in an annular array of shallow conical form, inclined upwardly toward the center thereof; 30 35
retaining means overhanging the inner ends of the hematocrits when resting on said supporting means, to restrain said inner ends from lifting movement in response to centrifugal force; 40

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and means for abutting engagement with the outer ends of said hematocrits to restrain them from radially outward movement in response to said centrifugal force.

11. A centrifuge as defined in claim 10:
said abutting engagement means being free of any obstruction of upward movement of the outer ends of said hematocrits when the rotor is stopped, whereby the hematocrits may be removed by lifting their outer ends clear of said abutting engagement means and then withdrawing their inner ends from beneath said overhanging retaining means.
12. A centrifuge as defined in claim 11:
said abutting engagement means comprising a cushioning ring having a cylindrical internal face engaged by said hematocrits;
and an annular upstanding lip on said head at the periphery of said top annulus, said lip surrounding and providing radial support for said ring;
said supporting means and retaining means for the inner ends of the hematocrits being embodied in and defining an annular groove in a retainer element on the upper end of said rotor hub.

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