(No Model.) 2 Sheets—Sheet 1.

F. F. METZGER.

CENTRIFUGAL MACHINE.

No. 548,717. Patented Oct. 29, 1895.

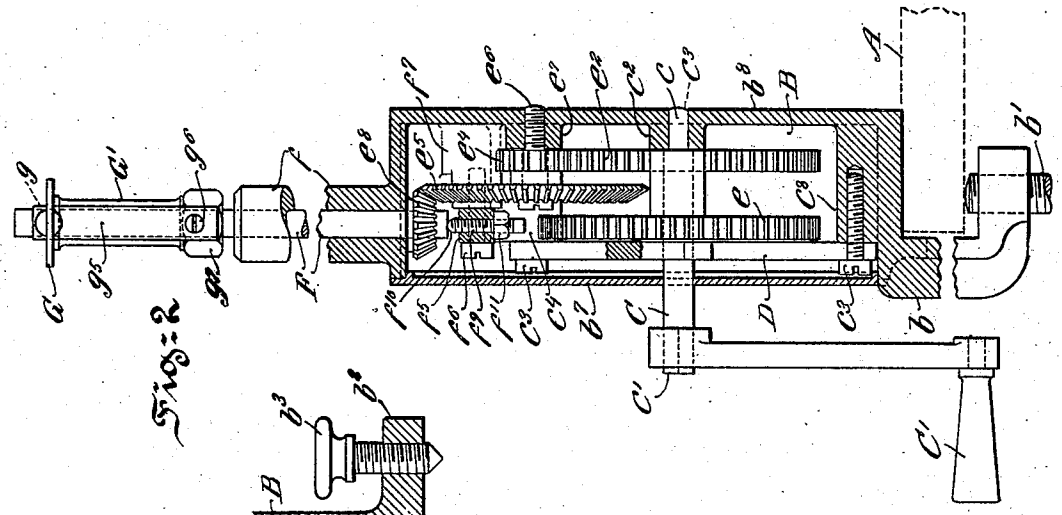

Fig. 2.

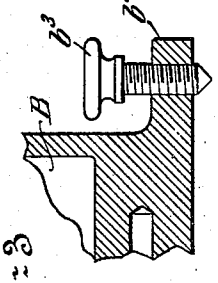

Fig. 3.

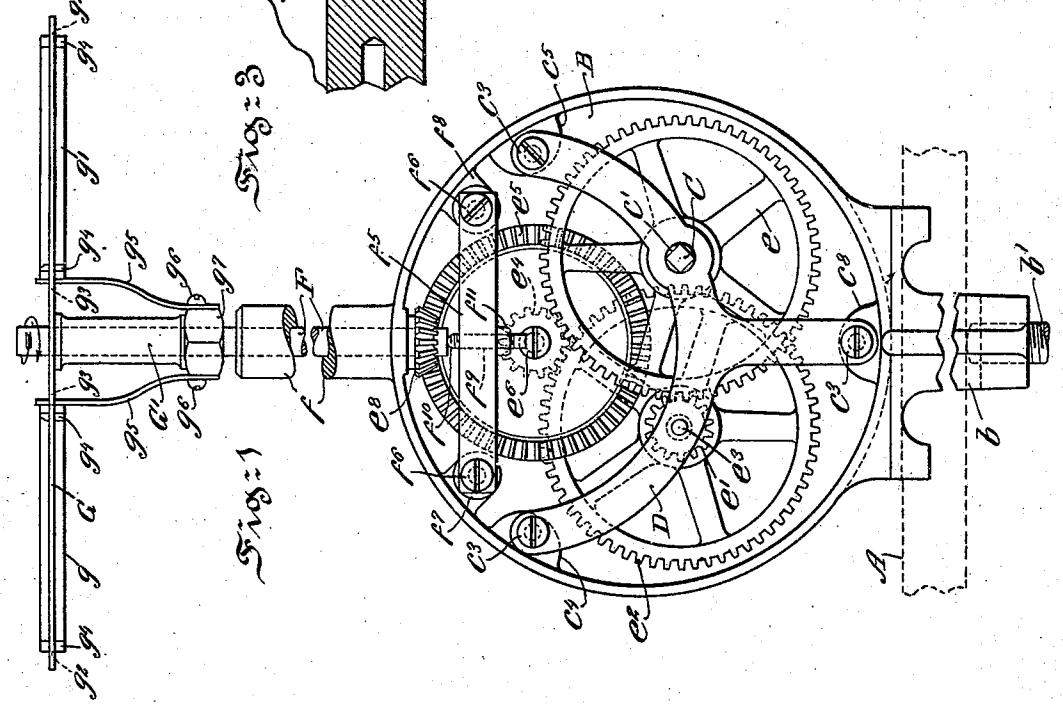

Fig. 1.

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ANDREW B. GRAHAM, PHOTO-LITHO. WASHINGTON, D.C.

(No Model.) 2 Sheets—Sheet 2.

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Fig. 4

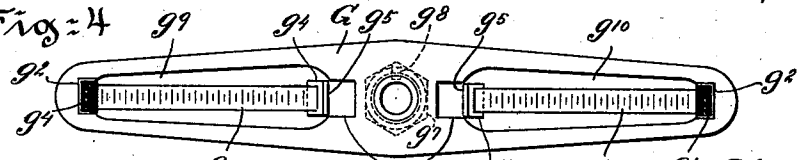


Fig. 5

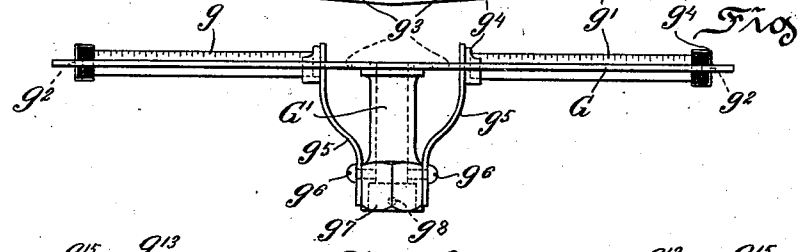


Fig. 6

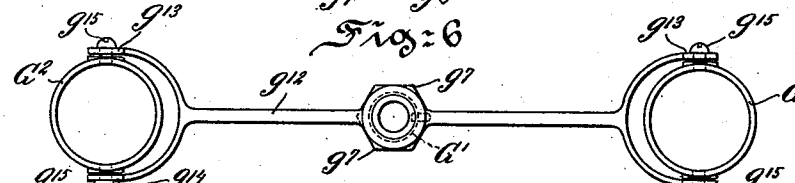


Fig. 8

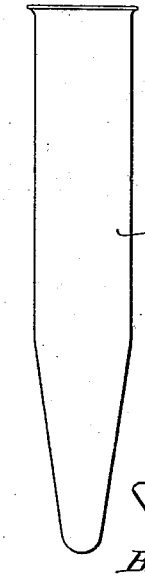


Fig. 7

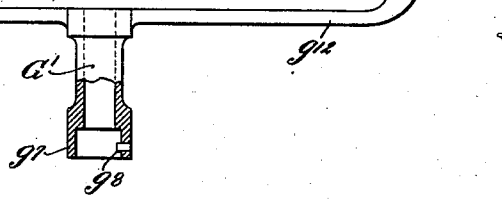


Fig. 9

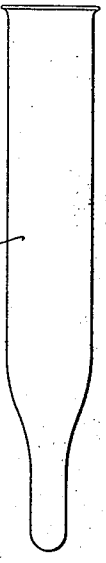


Fig. 10

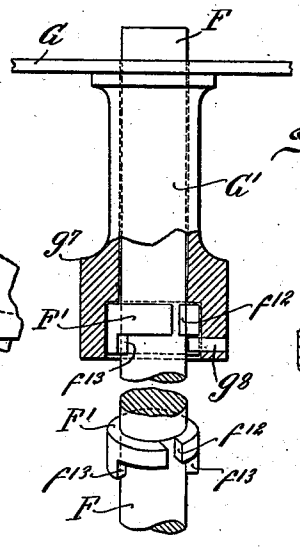


Fig. 11

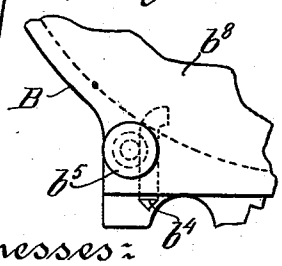
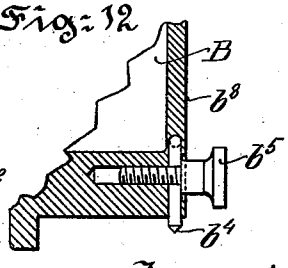


Fig. 12



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UNITED STATES PATENT OFFICE.

FERDINAND F. METZGER, OF PHILADELPHIA, PENNSYLVANIA.

CENTRIFUGAL MACHINE.

SPECIFICATION forming part of Letters Patent No. 548,717, dated October 29, 1895.

Application filed February 27, 1895. Serial No. 539,849. (No model.)

To all whom it may concern:

Be it known that I, FERDINAND F. METZGER, a citizen of the United States, residing at the city of Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented certain new and useful Improvements in Centrifugal Machines, of which the following is a specification.

My invention has relation to a centrifugal machine for precipitating solid bodies of different specific gravities contained in fluids; and it relates more particularly to the construction and arrangement of an apparatus for such purpose.

The principal objects of my invention are, first, to provide a simple, comparatively inexpensive, and efficient apparatus for the volumetric analysis of white and red blood-corpuscles, for precipitating sputum and urine sedimentation, for determining the percentage of fat in lacteal fluids, and in general for bacteriological, chemical, or physiological research; second, to provide a centrifugal machine with attachments for readily adapting the apparatus to either chemical, bacteriological, or physiological research, and, third, to provide a centrifugal machine operating by manual power or otherwise for facilitating the examination of sputum for tubercle bacilli to render such examinations more complete and effective and for readily detecting fibers of elastic lung-tissue or other matter therein.

Among the many applications of the apparatus of my invention may be mentioned that by centrifugal action of the separation of the white from the red blood-corpuscles. It may be here remarked in this connection that the blood is composed of a fluid called "plasma," in which float small solid bodies known as "red" and "white" corpuscles, as above mentioned. The plasma is a fluid composed of salts and albumin dissolved in water. The red blood-corpuscle as a body is round and about four times as broad as it is thick and concave on each side, with rounded edges and having a tendency to form rouleaux. When viewed under the microscope, it is light yellow in color, which is due to the presence of blood pigment or hemoglobin. The white blood-corpuscle is a spherical body, the average size of which is a trifle larger than the red blood-corpuscle. It is colorless and is possessed of the curious property of throwing out processes and retracting them, which is called "amœboid movement." To separate one from the other successfully and effectually has been a desideratum for a long time past, because no reliable or accurate means were at hand to effect such separation. By the employment of the machine of my invention, to be hereinafter fully explained, such separation can be most effectually accomplished and in a short period of time and with remarkable accuracy as to separation of one corpuscle from another. The apparatus can be employed for other operations having for their object bacteriological, chemical, or physiological research with most excellent results, as extended practice of my invention has fully demonstrated.

My invention consists of a centrifugal machine constructed and arranged for operation with attachments applied thereto, as hereinafter more fully described and claimed.

The nature and scope of my invention will be more fully understood from the following description, taken in connection with the accompanying drawings, forming part hereof, in which—

Figure 1 is a view, partly in front elevation with the cover-plate removed and partly in broken section, of an apparatus embodying features of my invention. Fig. 2 is a vertical section through the machine, showing the detail construction and arrangement of the gear mechanism inclosed within a circular box and constituting the actuating mechanism of the machine. Fig. 3 is a broken sectional view of a modified form of the box for gear mechanism of the machine provided with a rear lower ledge or projection having a tightening-screw extending through the same for firmly holding the machine in a clamped position against sidewise movement. Fig. 4 is a top or plan view of one form of holders for graduated test-tubes adapted to be disposed lengthwise therein and said holder detachably connected with the operating-shaft of the machine by a bayonet connection and the holders provided with springs and elastic cushions. Fig. 5 is a side elevational view of said holders, showing the leaf-springs connected therewith and the bearing with an internal pin for en-

gaging a complemental locking device of the operating-shaft of the machine. Fig. 6 is a top or plan view of a modified form of vertical tubular holders in pivotal connection with a forked frame provided with a bearing having an internal pin constituting one member of a bayonet connection. Fig. 7 is a side elevational view of the pivotal holders of Fig. 6. Figs. 8 and 9 are elevational views of different forms of test-tubes adapted to be mounted in the holders of Figs. 6 and 7. Fig. 10 is a view, partly in broken section and partly in elevation, of the bearing of the holders of Figs. 5 or 7, showing the internal pin thereof and the slotted and recessed collar of the operating-shaft, the two constituting the bayonet connection therefor; and Figs. 11 and 12 are sectional and end elevational views of gravity-pin devices connected with the box containing the gear mechanism of the machine for engaging a support and locked to position by tightening-screws to prevent displacement or movement of said box while in position and during rotation of the gear mechanism by the crank thereof for rapidly or otherwise actuating the holder-shaft of the machine.

Referring to the drawings, A represents a table or other suitable support for the machine.

B represents a circular box, wherein is mounted the operative mechanism of the machine.

b is a forked clamp formed integral with the box and provided with a vertical tightening-screw b', as illustrated in Figs. 1 and 2.

In Fig. 3 the box is provided with a rear ledge or projection b^3, having a tightening-screw b^3 extending through the same and adapted to engage the support or table A to firmly hold the same to position and against sidewise or other movement while the machine is in action.

In Figs. 11 and 12 is illustrated a slightly-modified form of a tightening device, in this instance consisting of a pin or screw b^4, extending downward through the wall of the case or box B, and which is adapted to fall by gravity to position and to be clamped by means of a tightening-screw b^5, brought in the path thereof and caused to bear against the same to hold the conical end of the pin or screw b^4, projecting beyond the case or box, firmly in the support or table A.

C is a cross-shaft mounted on and extending beyond the removable front plate or cover b^7 of the box or case B. This shaft has a round portion c and a square portion c'. The said shaft C is journaled at one end in the bearing c^2, formed integral with the rear plate b^8 of the box B, and at the opposite extremital portions in a Y-shaped frame D and the front removable plate or cover b^7 of the box B. C′ is a detachable hand-crank connected with the square portion c' of the shaft C, as clearly illustrated in Fig. 2. The Y-shaped frame D is secured by means of screws c^3 to lugs c^4, c^5, and c^8, formed, preferably, integral with the interior of the box or case B, as clearly illustrated in Fig. 1. Rigidly mounted on the shaft C is a gear-wheel e, which meshes with a pinion e', rigidly connected with a gear-wheel e^2, mounted on a shaft e^3, which is journaled to the Y-shaped frame D and rear wall of the box. The gear-wheel e^2 meshes with a pinion e^4, rigidly connected with a bevel gear-wheel e^5, mounted on a shaft e^6, which is journaled to a lug or projection e^7 of the rear plate b^8 of the box or case B, as clearly illustrated in Fig. 2.

e^8 is a small bevel-gear meshing with the large bevel gear-wheel e^5. This small bevel-gear e^8 is mounted on the operating-shaft F, extending through a tubular bearing f, formed, preferably, integral with the exterior of the box or case B, as clearly illustrated in Figs. 1 and 2.

f^5 is a metal bar extending crosswise through the interior of the case or box B and secured by means of screws f^6 to lugs or projections f^7 and f^8 of the box or case B, as clearly shown in Fig. 1. Extending upward through the bar f^5 is a threaded bolt f^9, having a conical upper end f^{10}, adapted to contact with the lower end of the shaft F to hold the same without undue friction to required position in the tubular bearing f and also for adjusting the same to required position and so that the bevel-gears e^5 and e^8 may mesh with each other. The screw-bolt f^9 is provided at its opposite end with a nut f^{11} for securing it to place in connection with the cross-bar f^5, as clearly shown in Figs. 1 and 2. The upper portion of the shaft F is provided with a slotted and partially-recessed collar F′, as clearly illustrated in Fig. 10, for a purpose to be presently more fully explained.

G is a holder for the reception of vials or graduated test-tubes g and g', as clearly illustrated in Figs. 1, 4, and 5.

The holder G, with reference to Figs. 1, 4, and 5, consists of a thin strip of metal, such as brass or aluminum, tapering from the middle to the respective ends, as shown, and having the body punched or stamped out to conform to the shape or form of a vial or test-tube, with recesses g^2 and g^3 at the ends for the reception of rubber or other elastic cushions g^4, and at the opposite recessed ends g^3 of the holder are introduced leaf-springs g^5, secured at their lower ends by means of screws or pins g^6 to a tubular bearing G′, which projects downward from the central portion of the holder G, as clearly shown in Figs. 1, 2, 4, and 5. This bearing is provided with an enlarged lower end g^7, as clearly shown in Figs. 1, 2, 5, 7, and 10, and it is provided with an internal lateral pin g^8, whereby when the bearing of the holder G is mounted on the operating or driven shaft F by a slight rotative movement of the holder the pin g^8 of the bearing G′ will be caused to enter through the vertical slot f^{12} of the collar F′ and lock by engaging with the recessed portion f^{13} thereof to form a bayo-

net connection between said shaft and holder, as clearly illustrated in Fig. 10, thereby effectually preventing displacement or flying off of the holder G in the rapid rotation of the same on the shaft F, with the graduated test-tubes or vials g and g' supported or clamped to position in the two slotted portions g^9 and g^{10} thereof by means of the leaf-springs g^5 and elastic cushions g^4.

It may be here remarked that it is highly desirable to make the holder of Figs. 1, 2, 4, and 5 for testing, among other fluids, the corpuscles in blood of light metal and very thin or delicate, so as to reduce friction to a minimum in the rapid actuation of the same—say from three to ten thousand revolutions per minute—through the intervention of the hand-crank C, imparting motion to the train of gears described and operating the shaft F in the manner indicated by the arrow in Figs. 1 and 2.

With reference to Figs. 6 and 7, G^2 and G^3 are two tubular vertical metal holders having a frame or bar g^{12}, with a central depending tubular bearing G', of the same general construction and arrangement as in Figs. 1, 2, 4, and 5. The frame or bar g^{12} is provided with forked extremities bent upwardly, forming bearings g^{13} and g^{14}, through which pivots g^{15} extend on both sides into the wall of each of the said suspended holders G^2 and G^3, adapted for the reception of tapering test-tubes or vials H and H', as clearly illustrated in Figs. 8 and 9. In the rapid rotation of the holders G^2 and G^3, with their respective test-tubes H and H' mounted therein for separating urinal sedimentation and for other uses, the holders will assume an inclined or horizontal position and be maintained in such position during the rapid rotation of the machine, thereby expeditiously separating in the case of urine any sedimentation contained therein, or in the case of sputum any fibers of elastic lung-tissue or other matter contained therein and in either instance with an accuracy that extended practice has demonstrated to be highly satisfactory in every way to the physician from a bacteriological as well as other standpoints.

It will be manifestly obvious to those skilled in the art to which my invention appertains that as to minor details modifications may be made in some of the parts of the machine without departing from the spirit and scope of my invention, and hence I do not wish to be understood as limiting myself to the precise construction and arrangement of all the parts as illustrated; but,

Having thus described the nature and objects of my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In a centrifugal machine, a shaft, mechanism for actuating the same, a holder carrying test tubes, a pin projecting from said holder and a collar secured to said shaft and provided with a recess and with a vertical slot, substantially as and for the purposes set forth.

2. In a centrifugal machine, a holder for a test tube arranged so as to receive and maintain the test-tube in a horizontal position, said holder mounted on a vertical shaft and locked thereto by a bayonet connection, an elastic cushion secured to said holder in a recess provided therefor and adapted to bear against one end of said test-tube, a leaf spring adapted to bear against the other end of said test-tube, and mechanism for rotating said shaft, substantially as and for the purposes set forth.

3. In a centrifugal machine, a shaft and means for rotating the same, a collar secured to said shaft, a tubular bearing embracing said shaft, means for locking said bearing to said collar, a test-tube holder carried by said bearing and consisting of a thin strip of metal stamped out to receive and support the test-tube in a horizontal position, and means for securing said tube in said holder so as to permit of slight longitudinal movement therein, substantially as and for the purposes set forth.

4. In a centrifugal machine, a box or case containing actuating mechanism, a support for said box or case, a tightening device consisting of a pin or screw extending through the wall of said case or box and adapted to fall by gravity to position and to be clamped by means of a tightening screw brought in the path thereof and bearing against the same, thereby holding the end of said pin or screw projecting beyond said case or box firmly in said support, substantially as set forth.

In testimony whereof I have hereunto set my signature in the presence of two subscribing witnesses.

FERDINAND F. METZGER.

Witnesses:

THOMAS M. SMITH,

RICHARD C. MAXWELL.