No. 684,179. Patented Oct. 8, 1901.

P. VON BOECKMANN.

SPIROMETER.

(Application filed Apr. 6, 1900.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 1.

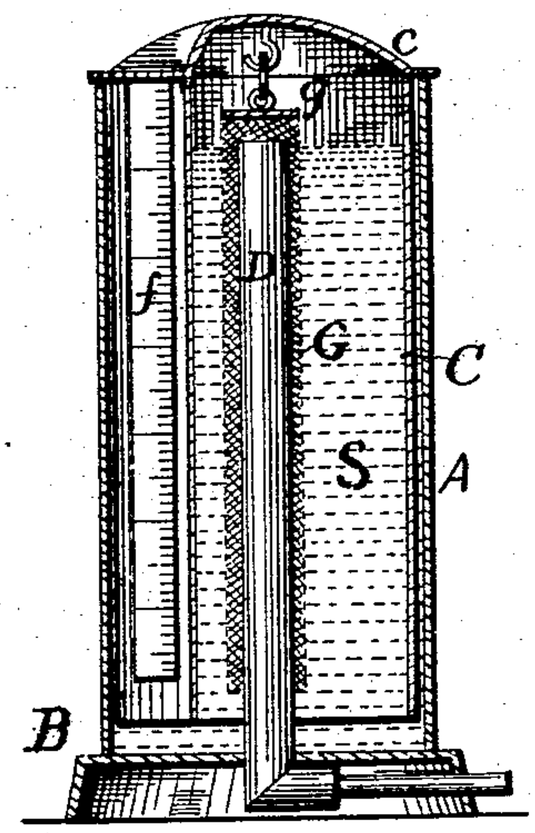


Fig. 2.

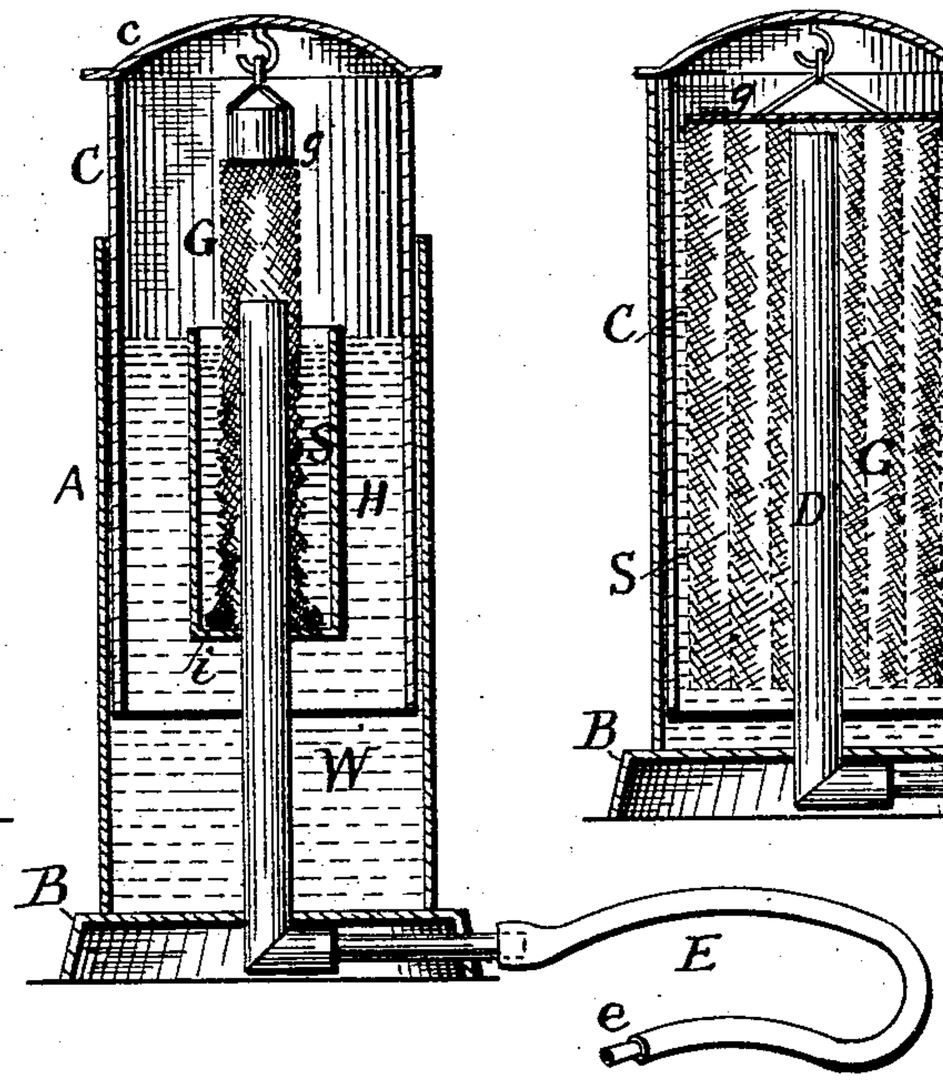


Fig. 3.

Fig. 4.

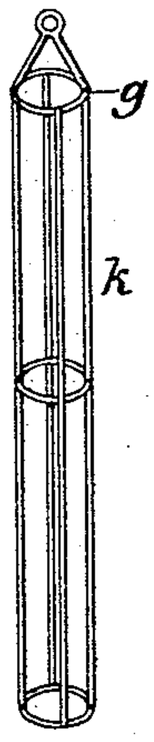
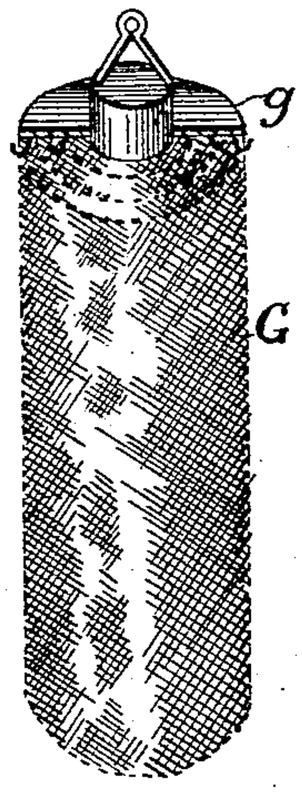


Fig. 5.



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(No Model.) 2 Sheets—Sheet 2.

Fig. 6.

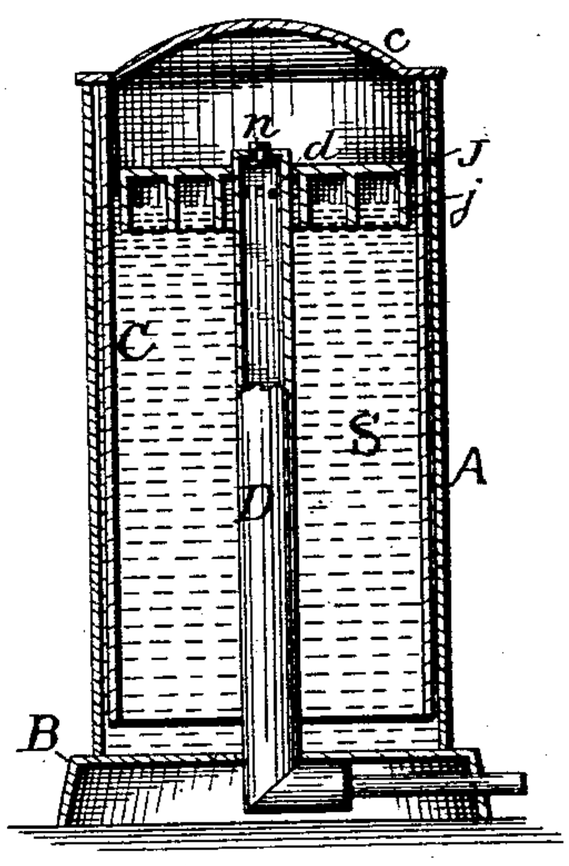


Fig. 7.

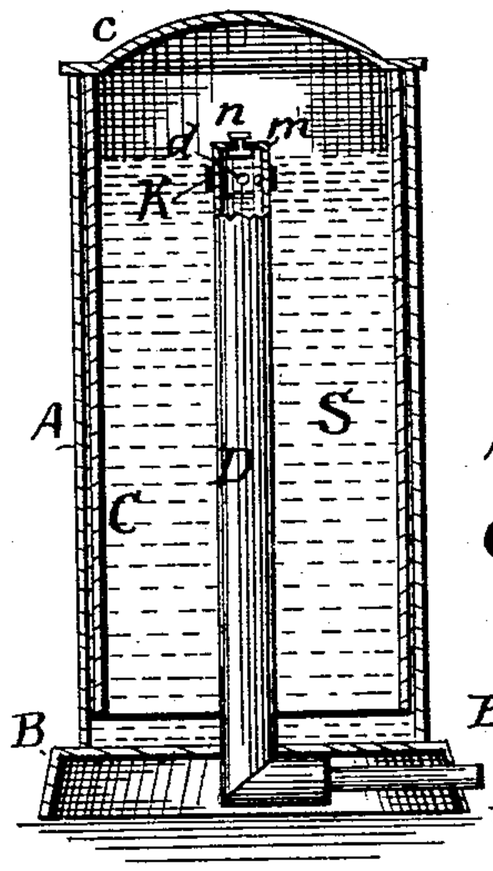


Fig. 8.

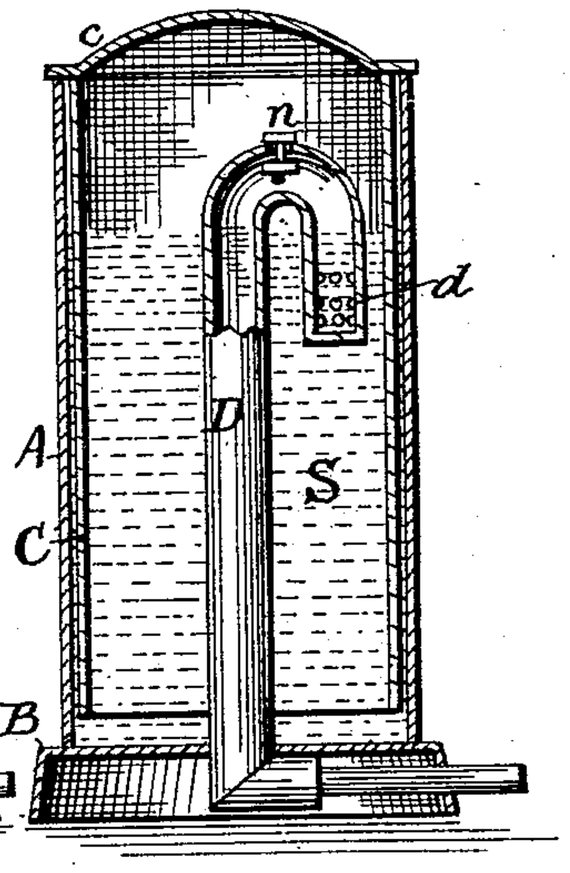


Fig. 9.

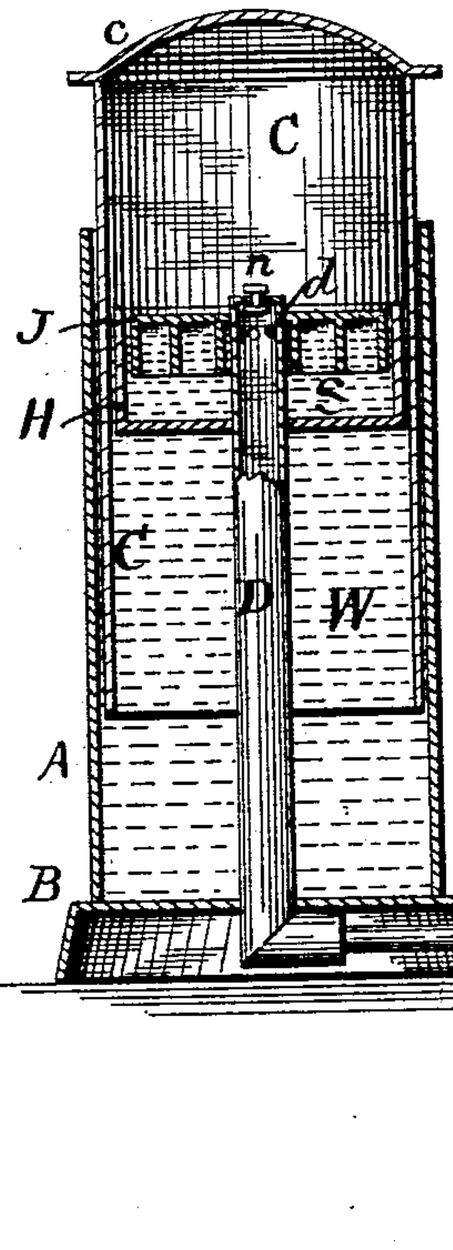


Fig. 10.

Fig. 11.

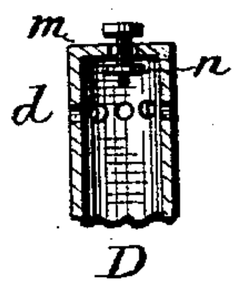
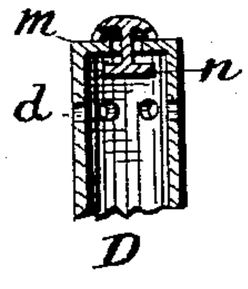
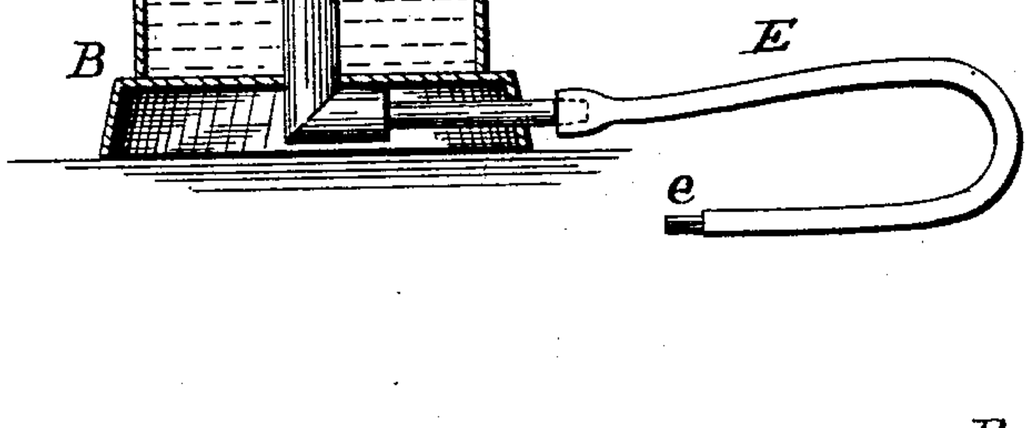
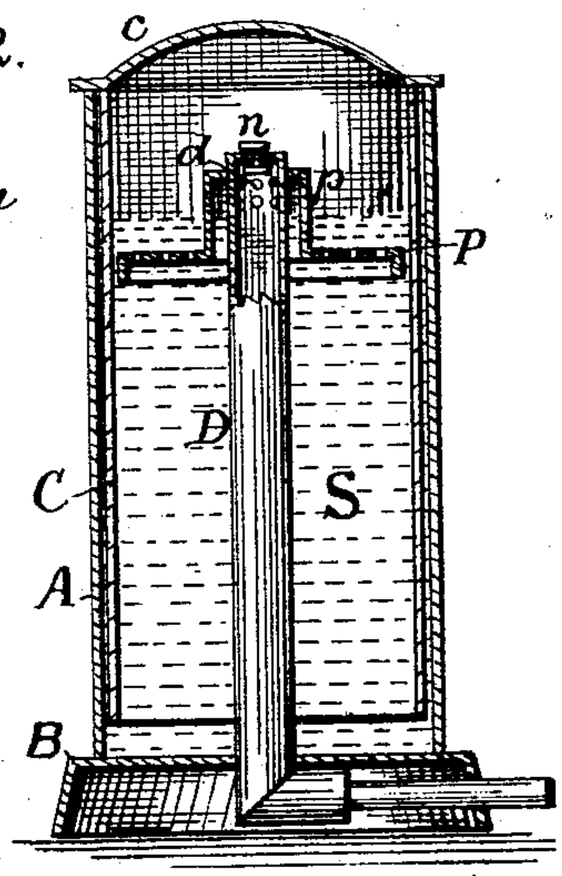


Fig. 12.







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UNITED STATES PATENT OFFICE.

PAUL VON BOECKMANN, OF WASHINGTON, DISTRICT OF COLUMBIA.

SPIROMETER.

SPECIFICATION forming part of Letters Patent No. 684,179, dated October 8, 1901.

Application filed April 6, 1900. Serial No. 11,858. (No model.)

To all whom it may concern:

Be it known that I, PAUL VON BOECKMANN, a citizen of the United States, residing at Washington, in the District of Columbia, have invented certain new and useful Improvements in Spirometers, of which the following is a specification, reference being had therein to the accompanying drawings.

This invention relates to devices used to exercise the lungs and measure the breathing capacity of persons; and the objects of my invention are to provide such devices with means to purify and render substantially aseptic the air after it leaves the lungs and is breathed into the spirometer by various persons in succession, so as to also render the apparatus innocuous even if the lungs of some of said persons are not free of contagious germs, and thereby render the apparatus particularly well adapted for use in public places, in the offices of physicians, in gymnasiums, and in schools. I attain these objects by the construction illustrated in the accompanying drawings, in which—

Figure 1 is a vertical section of the spirometer constructed in accordance with my invention, the air-chamber being partly in elevation to show the scale thereon, and antiseptic liquid within the telescopic chambers, with air-permeable casing or filter, of cloth, partly submerged in said liquid and surrounding the double-acting induction and eduction air-tube in the center. Fig. 2 is a vertical central section of the spirometer with the air-chamber partly elevated, but showing a modification in the size of the vessel holding the antiseptic liquid, said vessel being mounted upon and around the air-tube and surrounded by plain water. Fig. 3 is a vertical section of the spirometer, showing an air-permeable casing or filter of greater capacity than in Fig. 1. Fig. 4 is a perspective view of a wire frame which may be used to support the cloth filtering medium of the spirometer. Fig. 5 is a perspective view of a loose coil or series of rings of the cloth filter suspended from a metal disk, shown in section and substantially similar to that shown in Fig. 3. Figs. 6, 7, 8, 9, and 10 show modifications of the air-permeable casing around the induction-passage, said casing being made of metal and also partly submerged in antiseptic liquid. Figs. 11 and 12 are sections, on a large scale, of the valves used on top of the induction passage or pipe.

In said drawings, A indicates a vertical cylinder, open at the top and closed at the bottom, resting upon and attached to a hollow base B. Within the cylinder A there is placed a cylinder C, of smaller diameter than the cylinder A, so that it can be made to ascend and descend within the cylinder A without any sensible friction against its walls. The cylinder C has an open bottom and its top closed by a cap *c*, the projecting edge of which rests upon the edge of the cylinder A and prevents any dust from falling in the interior and also prevents the bottom edge of the cylinder C from resting on the bottom of the cylinder A. Said edge of the cap *c* also provides simple means by which the cylinder C can be grasped and lifted out of the cylinder A to add to or change the liquid within the cylinder. The cylinder A is to contain a liquid, while the cylinder C is to be partially filled with air conducted from the lungs of persons when using the device; but normally the walls of the cylinder C are submerged nearly up to the top within the liquid of the cylinder A.

To allow persons to blow a portion of the air and gases contained in their lungs into the cylinder C, there is projecting vertically from the bottom of the cylinder A and soldered to said bottom a tube D, the upper end of which extends above the level of the liquid contained in the spirometer. The lower end of the tube D has an elbow and is extended under the base B and beyond its wall, where it is connected to a flexible tube E, provided with a mouthpiece *e*. To indicate the number of cubic inches (or it may be cubic centimeters) of air blown into the device, a scale *f*, of thin metal, is soldered or otherwise secured vertically to the side of the cylinder C, the zero of which is at the top and the highest number, generally four hundred, near the bottom.

So far as above described and with water in the apparatus it does not differ materially from ordinary spirometers, an important defect of which is due to the contamination of the interior of the inner chamber, and particularly of the inner tube D, leading to and

from the mouthpiece, by the breath of persons having germs of phthisis or of other contagious diseases.

My improvement consists in the employment, in connection with an antiseptic liquid to surround the inner tube D or a portion thereof, of an air retarding and permeable casing or air-filter normally dipping into said antiseptic liquid, which liquid may be a weak solution of bichlorid of mercury, salicylic acid, compounds of formaldehyde, or any other well-known disinfecting or antiseptic solution. In Figs. 1 and 3 said solution is shown at S and nearly fills the cylinder A. The air retarding but permeable casing consists of a tube G of textile material and may be fine wire-cloth, surrounding the induction and eduction tube D. Said tube G is pendent from a metal disk *g*, which is removably suspended from the under side of the cap *c* of the inner cylinder C. Although the upper portion of the tube G is not under the liquid, it remains well soaked with that liquid by capillarity. The construction is similar in Fig. 3; but in said figure a series of concentric tubes G are used to increase the area of exposure of the air and gases to the antiseptic liquid.

In the modifications shown in Fig. 2 the cylinder A is nearly filled with water W, (or a weak disinfecting solution,) and a smaller vessel H is mounted upon the tube D, so that its top is above the level of the water in the cylinder A, and in the said vessel H antiseptic liquid is placed for the textile tube G to soak in. As the vessel H is shown of less depth than the cylinder A, the lower end of the tube G is preferably weighted down by a metal ring *i* to counteract the crinkly condition of the tube G within the vessel H. By this arrangement a smaller quantity of antiseptic liquid may be used in the spirometer. The textile tube G can be kept in a substantially cylindrical form by a wire frame, as shown at *k* in Fig. 4.

In Fig. 5 the air-permeable casing G of textile is shown in concentric or spiral layers suspended from a disk *g*, which may be of metal or of hard rubber or other suitable material.

In Fig. 6 the air-retarding casing around the inner tube D consists of a disk J, having pendent therefrom a series of air-deflectors *j*, arranged concentrically to cause the air blown out of the tube D to be deflected into the antiseptic liquid S, the upper portion of said tube D having in its wall under the disk J a series of small perforations *d* to disperse the air blown through them into fine globules while passing through the antiseptic liquid. The top of the tube D is closed by a small disk *m*, which has a central perforation to receive loosely therein the stem of a double-head valve *n* of light weight, which may be of aluminium or of hard rubber. The perforation in the disk *m* is normally open when the spirometer is not in use or as soon as a person ceases blowing into the tube D and falls by gravity into the position clearly shown in Figs. 11 and 12. In Fig. 11 the valve *n* is shown supported by a pin or wire passing horizontally through the walls of the tube D. In Fig. 12 the valve is shown supported by its head resting upon the disk *m*, the under side of said head having serrations for the passage of air. In either form the bottom disk attached to the valve-stem is the valve proper or stopper, which closes the opening in the disk *m* by becoming lifted by the breath of a person as soon as air is blown into the tube D.

In Fig. 7 the perforations *d* in the tube D are normally closed by a thin ring of elastic rubber K, surrounding the tube D over said perforations, the thin rubber expanding when air is blown into the tube D, allowing said air to pass into the antiseptic liquid S in fine globules and immediately closing the perforations *d* when the pressure of air is stopped. The top of the tube D is provided with a valve *n*, as above described.

In Fig. 8 the upper end of the tube D is bent down and its end closed, but provided with fine perforations *d* for the passage of air in minute streams. In the upper bend of the pipe there is a valve *n*, as above described.

In Fig. 9 the air-deflectors J *j* are similar to those shown in Fig. 6; but they are partly submerged in a shallow vessel H, attached to the tube D and containing antiseptic liquid S, which vessel is partly submerged in the water W contained in the cylinder A.

In Fig. 10 the air deflector and strainer consists of a perforated disk P, having a pendent rim around its periphery and a cap *p*, that is attached to the tube D above the small perforations *d* made in the walls, the parts being partly submerged into the antiseptic liquid S.

In either one of the forms shown the air blown in the apparatus is forced through the tube D in contact with the antiseptic liquid S and in contact with the air deflecting and permeable parts, which are partly submerged into said antiseptic liquid and after being thus purified is returned through the same pipe D into the outer air.

Having now fully described my invention, I claim—

1. A spirometer having its induction and eduction tube surrounded by antiseptic liquid, and an air-permeable and air-retarding casing for said induction-tube normally dipping into said antiseptic liquid substantially as and for the purpose described.

2. A spirometer having its induction air-tube surrounded by antiseptic liquid and an air-permeable casing for said induction-tube normally dipping into said antiseptic liquid.

3. In a spirometer the combination of an outer cylinder having an open top, an inner cylinder having a closed top, a vertical tube passing through and extended above the bottom of said cylinders and secured to the bottom of the outer cylinder, an antiseptic liq-

uid surrounding the tube and an air-permeable casing surrounding said tube substantially as described.

4. In a spirometer the combination of an outer cylinder having an open top, an inner cylinder having a closed top, a tube secured to the bottom of the outer cylinder and extended within said cylinders, an antiseptic liquid surrounding the tube an air permeable and retarding casing surrounding a portion of said tube and its air-retarding casing, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

PAUL VON BOECKMANN.

Witnesses:

E. E. MASSON,

E. W. HART.