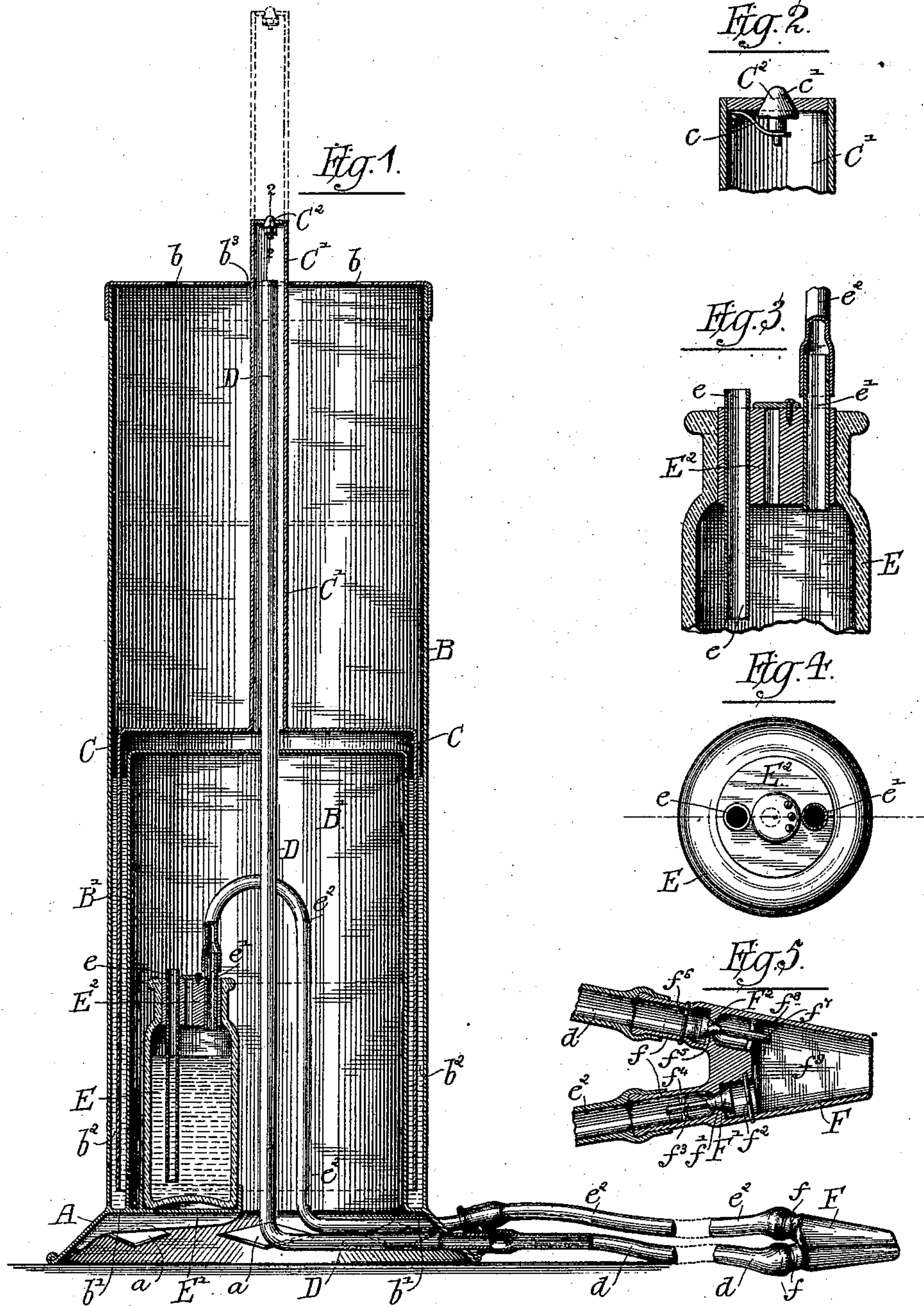


(No Model.)

W. A. SHEPARD.
COMBINED INHALER AND SPIROMETER.

No. 492,973.

Patented Mar. 7, 1893.



Witnesses:-
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UNITED STATES PATENT OFFICE.

WILLIAM A. SHEPARD, OF ELGIN, ILLINOIS.

COMBINED INHALER AND SPIROMETER.

SPECIFICATION forming part of Letters Patent No. 492,973, dated March 7, 1893.

Application filed December 8, 1890. Serial No. 373,895. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM A. SHEPARD, of Elgin, in the county of Kane and State of Illinois, have invented certain new and useful Improvements in a Combined Spirometer and Inhaler; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

This invention relates to improvements in the construction of a combined spirometer and inhaler, the object of the invention being to provide means whereby the advantages of medical inhalation and exercise of the lungs, and a test of the breathing capacity may be combined.

In a prior patent granted to me July 29, 1890, No. 433,153, I have illustrated a combined spirometer and inhaler of the same general construction as the form which I have selected for illustration in connection with the present invention, although so far as my invention is broadly concerned, different forms of spirometers and inhalers may be employed.

In the accompanying drawings illustrating my invention: Figure 1 is a vertical section of a combined spirometer and inhaler embodying my invention. Fig. 2 is an enlarged sectional view showing in detail the valve through which the air from the interior of the spirometer is permitted to escape. Fig. 3 is an enlarged sectional view of the top of the bottle for containing the medicated liquid, showing the connection for the air tubes. Fig. 4 is a plan view of the same. Fig. 5 is an enlarged sectional view of the mouth piece showing the arrangement of valves therein.

In said drawings, A indicates an annular base provided with openings *a a* for the admission of air.

B indicates a vertical cylinder mounted upon the base A and having openings *b b* at its top to permit the escape of air.

B' is a cylinder of considerably smaller diameter than the cylinder B, located concentrically within the latter and closed at its upper end. The cylinders B and B' are connected at their lower ends by an annular diaphragm *b'*, thereby forming a chamber *b²* between the cylinders B and B'.

C is a cylinder open at its lower end and

closed at its top, said cylinder being of larger diameter than the cylinder B', and smaller than the cylinder B. The chamber *b²* is partially filled with sealing fluid and the lower end of the cylinder C is immersed therein, as shown.

D is an air inlet pipe extending vertically through the center of the upper closed end of the cylinder B', being fitted air tight therein.

C' is a similar pipe or tube extending vertically from the top of the cylinder C and connected with an opening into the latter, said tube C' being located concentrically outside of the air tube D and passing through an opening *b³* in the top of the cylinder B.

C² is an upwardly closing valve located in the top of the tube C' and held normally closed against the escape of air by a spring *c*. The valve C² is preferably formed with a projecting portion *c'* extending through the end of said tube C' by which the valve C² may be conveniently depressed by the hand of the operator to permit the free escape of air from said tube. It is obvious from this construction that air being blown through the tube D will fill the tube C' and the space between the closed upper ends of the cylinders B' and C and will operate to raise the cylinder C and tube C'. The annular chamber *b²* is sealed by the liquid therein against the escape of air. This construction constitutes a meter or holder.

A bottle E for medicated liquid is located within the innermost cylinder B', being supported upon a suitable bracket or support E', and provided with a stopper E², in which stopper are secured an air inlet tube *e* and an air exit tube *e'*. To the latter tube I connect a suitable flexible tube *e²* leading to a mouth piece F. The mouth piece F is also connected to one end of a flexible tube *d*, the other end of which is connected with the lower end of the air tube D, as shown more particularly in Fig. 1.

The mouth piece F is preferably constructed with two tubular branches *f f* to which the tubes *e²* and *d* are fitted. A valve F' opening outwardly is located in that branch which is connected with the inhaler tube *e²*, said valve being fitted to a tapered seat *f'* in said branch of the mouth piece. A stop *f²* is provided to limit the movement of the valve F' away from its seat and prevent displacement. The valve is further provided with a shank *f³* which

passes through a guide f^4 and serves to keep said valve in a central position within the branch f . A similar valve F^2 is provided in that branch (f) to which is attached the end of the air tube d , said valve being arranged to open inwardly or in a direction opposite to the valve F' . This valve is also fitted to a tapered seat f^5 in the branch f and is provided with a stop f^6 and shank f^7 working through a guide f^8 in the same manner and for the same purpose as the like parts of valve F' above described. The two branches f open into a common passage f^9 within the mouth piece F .

The operation of my device is as follows: The operator places the mouth piece F to his mouth, after having expelled the air from his lungs, and inhales through said mouth piece. It is evident that the valve F' will immediately open and the valve F^2 will close when such inhalation begins, and that the air in the inner cylinder B' will pass freely through the tube e^2 , being drawn through the tube e into the interior of the bottle E , thence through the liquid contained therein, passing upward and out through the outlet tube e' and then into the inhaler tube e^2 . By this construction the operator is enabled to fill his lungs with air medicated by its passage through the liquid in the bottle E . After filling his lungs with medicated air, as described, the operator begins to expel the air from his lungs without removing the mouth piece F from his mouth, whereupon the valve F' will be immediately closed and the valve F^2 simultaneously opened, thus permitting the air to pass freely through the tubes d and D to the interior of the tube C' and into the cylinder C , raising said cylinder C and the tube C' upward into the position shown by dotted lines, Fig. 1. Upon the outside of the tube C' a suitable scale or series of marks may be placed by which the degree of elevation of the cylinder C and tube C' , with respect to the outer cylinder B , may be ascertained. When the operator ceases to expel air from his lungs through the tube d the back pressure of the air within the cylinder C will instantly close the valve F^2 and prevent the escape of any air from the interior of said cylinder. If desired the operator may repeat the exercise of inhaling the air through the medicated liquid in the bottle E and expelling it from his lungs into the holder C until said holder is entirely full and is raised to the topmost limit of its movement. When it is desired to return the cylinder or holder C to its normal position, the operator presses down the valve C^2 by means of the projection c' , thus opening said valve and permitting the air to escape freely through the tube C' from the cylinder or holder C . By pressing upon the upper end of the tube C' he may cause the cylinder C to sink rapidly to its normal position and the air to be quickly expelled from its interior, in which condition the apparatus remains in readiness for a repetition of the operation.

A main advantage gained by the construction herein described is, that by the employment of the mouth piece provided with the separate air inlet and outlet passages having oppositely closing valves and connected with separate inhaler and air exit tubes, the operator is enabled to fill his lungs each time with freshly medicated air drawn through the liquid in the receptacle E and to expel the air into the meter or holder without the liability of inhaling a second time any of the air which has been previously expelled from his lungs into the holder, and without the possibility of any of the air expelled from his lungs passing into the bottle. Furthermore, by the employment of the outwardly closing valve in the air exit tube and the valve in the top of the receiver or holder, as described, the air expelled from the lungs into said receiver is all retained within the latter until the valve at the top is opened, thereby enabling accurate measurements of the volume of air thus expelled to be obtained. The apparatus is, also, cheap to manufacture, simple in construction and easy of operation.

It is obvious that in carrying out my invention any other form of check valve may be substituted for either or both of the valves in the mouth piece with the same general result as is obtained by the use of the particular form of valve herein illustrated.

Having described my invention, what I claim is—

1. In a combined inhaler and spirometer, the combination of an exhaling tube connected with the spirometer, an inhaling tube connected with the inhaler, a single tubular mouthpiece with which both of said tubes are connected, said mouthpiece being provided with an inlet passage connected with the inhaling tube and with an outlet passage connected with the exhaling tube, an inwardly opening check valve located in said inlet passage of the mouthpiece and an outwardly opening check valve located in the exit opening of said mouthpiece, whereby the single mouthpiece may be used for both the inhaler and spirometer, substantially as described.
2. A spirometer comprising an expansible receiver for exhaled air, an exhaling tube provided with a check valve, and a valve located in said receiver, substantially as described.

3. A spirometer comprising an expansible receiver for exhaled air, an exhaling tube provided with a check valve, and an inwardly opening spring valve located in the said receiver and provided with a projecting finger-piece, substantially as described.

In testimony that I claim the foregoing as my invention I affix my signature in presence of two witnesses.

WILLIAM A. SHEPARD.

Witnesses:

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JOHN E. WILES.