

[54] **RESPIRATORY DEVICE WITH  
VARIABLE EXPIRATORY PRESSURE  
RESISTANCE**

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[58] Field of Search ..... **128/2, 25 R; 272/57 R, 57 F**

[56] **References Cited**

**UNITED STATES PATENTS**

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**FOREIGN PATENTS OR APPLICATIONS**

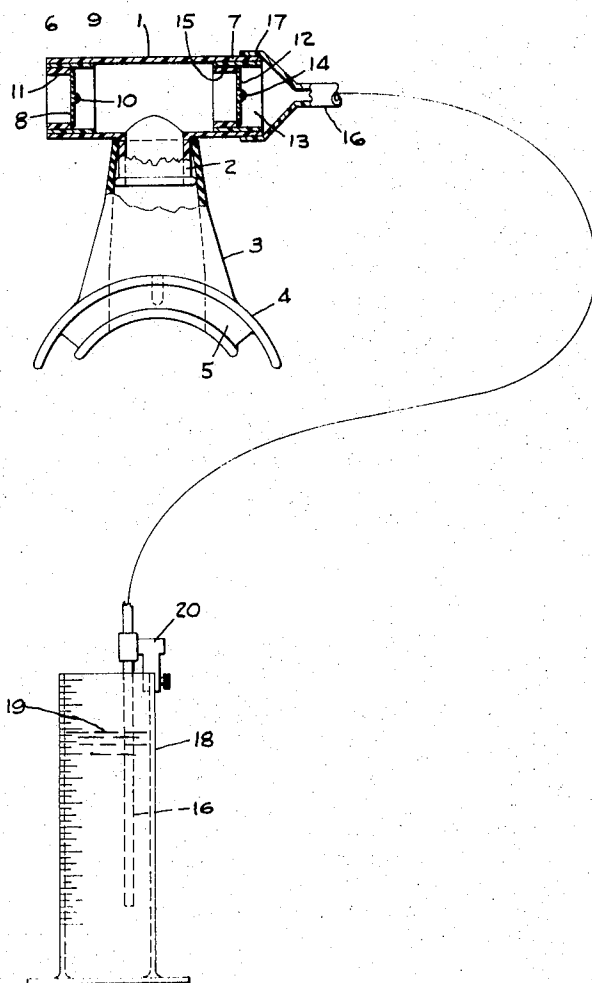
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[57] **ABSTRACT**

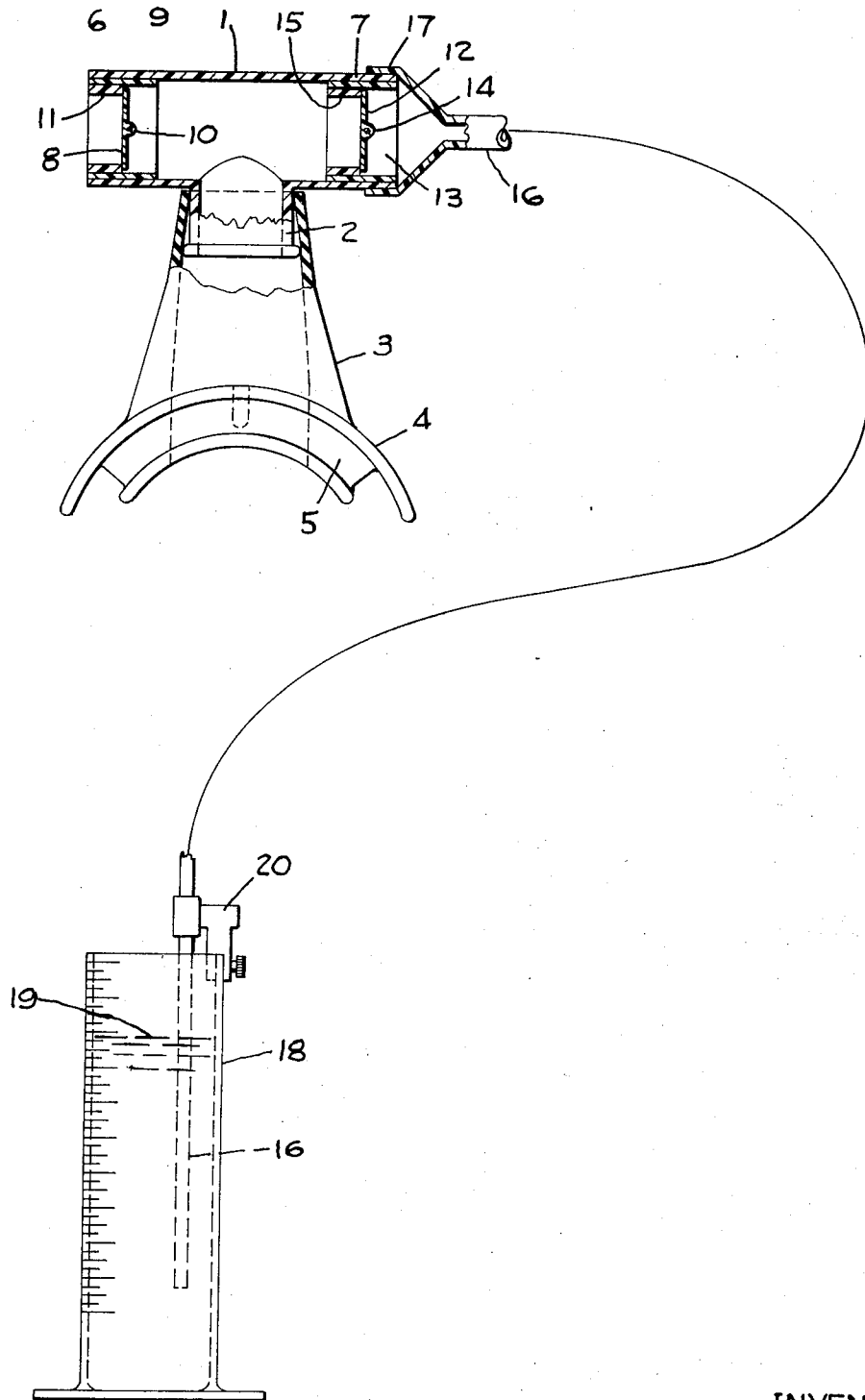
A device to permit more efficient breathing by medical patients comprising a mouthpiece having a passage portion for communication with the patient's mouth and inlet and outlet passages communicating with the first passage portion. The inlet and outlet passages are provided, respectively, with inlet and outlet check valves. A flexible conduit extends from the outlet check valve portion of the mouthpiece to a receptacle containing a liquid and the outlet end of the flexible conduit is immersed in the liquid to an adjusted depth to interpose a predetermined variable fluid resistance to air flow from said mouthpiece outlet passage by way of said conduit.

**6 Claims, 1 Drawing Figure**



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## RESPIRATORY DEVICE WITH VARIABLE EXPIRATORY PRESSURE RESISTANCE

### BACKGROUND OF THE INVENTION

This invention relates to apparatus particularly for use by patients with respiratory problems, as for instance, post-operative patients, and those with atelectasis, pneumonia, chronic bronchitis, and emphysema.

In certain medical cases patients tend to breathe shallowly, clear their pulmonary secretions poorly, or have some obstruction to satisfactory oxygenation of their blood, and there is a need to promote more efficient breathing. Present methods with this end in view are makeshift and unsatisfactory. For instance, there is what is known as a rebreathing device wherein the patient inhales from and exhales into a closed chamber, such as a bag. Since the air supply thus available increases rapidly in carbon dioxide content, and lowers in oxygen content, the patient must breathe more to survive. However, it usually results in the patient breathing faster rather than deeper, and this technique is actually dangerous in some cases due to the limited oxygen supply.

In another method the patient uses a mouthpiece for breathing and forced blasts of air under pressure are introduced into the mouthpiece during inspiration to promote deeper inhalation. This method is known in the medical arts as intermittent positive pressure breathing and is objectionable for several reasons: it requires costly and complicated equipment and trained personnel to administer, it is frequently uncomfortable and distressing to the patient, air may be driven into the stomach instead of into the lungs and secretions may be pushed deeper into the air passages.

### SUMMARY OF THE INVENTION

The apparatus of the present invention includes a mouthpiece through which the patient breathes. The mouthpiece has air inlet and outlet portions and the inlet portion is provided with an inwardly directed check valve which opens freely when the patient inhales to permit inhalation of ambient air for breathing. The outlet portion has an outwardly directed check valve which opens freely when the patient exhales to permit free passage of exhalation. In addition to the outwardly directed check valve the outlet portion of the mouthpiece includes a tube or conduit which leads from just beyond the outwardly directed expiratory valve and has its discharge end immersed in a body of water. Thus, upon exhalation, the patient must produce sufficient expiratory pressure to discharge exhalation from the tube into the body of water against the head of liquid which is present between the bottom discharge end of the tube and the surface of the body of water. The depth of immersion of the tube in the water is controlled and adjustable to provide accurately regulated fluid resistance to exhalation.

Thus the patient must exert a predetermined controlled degree of expiratory pressure in order to move the exhalation out of the discharge tube and through the head of water. The exhalatory pressure thus generated dilates the patient's bronchi, thus permitting better mixture and absorption of inspired air, and more efficient clearing of trapped secretions.

## BRIEF DESCRIPTION OF THE DRAWING

A single FIGURE of the drawing is a somewhat schematic showing of one form of the apparatus of the present invention showing a mouthpiece assembly in top plan view with portions shown in cross section for clearer illustration and an associated receptacle adapted to contain an open body of water into which the outlet conduit from the mouthpiece discharges.

### DESCRIPTION OF THE ILLUSTRATED EMBODIMENT

In the drawing the numeral 1 designates a cylindrical valve body having a conduit portion 2 extending medially therefrom. A mouthpiece 3 is fitted over conduit portion 2 and has a mouth-engaging portion 4 with opposed arcuate channels 5 into which the patient's teeth fit in gripping the mouthpiece orally. The portion of mouthpiece 3 which fits over conduit portion 2 of valve body 1 is preferably of somewhat elastic material so as to stretch over and fit snugly about conduit portion 2.

Valve body 1 has an inlet end 6 and an outlet end 7. Inlet end 6 is provided with a freely flexible disc valve 8 which is fixed medially in a tubular insert 9 by means of a transverse pin 10. The two halves of valve 8 may flex freely to the right as viewed in the drawing under external air pressure but seat against a bushing or collar 11 under air pressure from within the valve body.

The outlet end 7 of valve body 1 is provided with a freely flexible disc valve 12 which is fixed along a diametral line to a cylindrical insert 13 by a transversely extending pin 14. The two halves of valve 12 may flex freely to the right as viewed in the drawing under air pressure from within valve body 1 but seat against a collar 15 under pressure from the right-hand side of valve 12 as viewed in the drawing.

A flexible conduit 16 extends from the outlet end of valve body 1 and in the present instance has an enlarged end portion 17 which fits snugly thereover. Conduit 16 extends to a receptacle 18 which may comprise a graduated transparent cylinder containing water to a predetermined level as indicated at 19. The outlet conduit 16 from the valve body extends into the water 19 and is supported at the upper end of receptacle 18 by a bracket 20 which permits free vertical adjustment of conduit 16 to determine the depth of immersion of the end of conduit 16 in the water.

Since the fluid resistance to discharge of air into the water from conduit 16 is directly proportional to the head of water above the discharge end of conduit 16, the resistance to discharge of air from conduit 16, and consequently from valve body 1, may be accurately regulated.

A preferred embodiment has been described herein and shown in the accompanying drawing to illustrate the underlying principles of the invention but it is to be understood that numerous modifications may be made without departing from the broad spirit and scope of the invention.

I claim:

1. Respiratory apparatus for conducting more efficient breathing by medical patients, said apparatus comprising a mouthpiece having an inlet and an outlet passage for mouth breathing, a check valve in said inlet passage permitting air flow into said mouthpiece but

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closable under retrograde flow, a liquid containing receptacle, a conduit leading from said outlet passage and terminating in a portion projecting into the liquid in said receptacle to a predetermined depth, whereby exhalation by the patient through said mouthpiece and said conduit is effected against a liquid head as measured by the depth of immersion of said outlet conduit terminal portion in said liquid, and means preventing retrograde fluid flow from said conduit to said outlet passage.

2. Respiratory apparatus as in claim 1 wherein said means for preventing retrograde fluid flow from said conduit to said outlet passage comprises a check valve in said outlet passage.

3. Respiratory apparatus as in claim 1 wherein said check valve comprises a flexible disc connected to said inlet passage at opposite diametral points whereby the two halves thereof flex freely in the direction of fluid flow, and an annular seat portion adjacent to said valve

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at the outer side thereof to prevent flexure thereof in the opposite direction.

4. Respiratory apparatus as in claim 2 wherein said check valve comprises flexible discs connected to said passages at opposite diametral points whereby the two halves of each valve flex freely in the direction of air flow, and annular seat portions in said passages adjacent to said valves to prevent flexure thereof in the opposite direction.

5. Respiratory apparatus as in claim 1 wherein said receptacle is graduated to show the depth of liquid therein and the depth of immersion of said outlet conduit terminal portion.

6. Respiratory apparatus as in claim 5 wherein said receptacle includes adjustable means for supporting said outlet conduit to support the same for immersion to various depths in said liquid.

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