

[54] **ADJUSTABLE PRESSURE IPPB
VENTILATOR**

[72] Inventor: **Joseph G. Glenn**, 1523 S. Delaware Place,
Tulsa, Okla. 74104

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1968, Pat. No. 3,581,742

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[58] Field of Search 128/145.6, 145.5, 145.7, 145.8,
128/145 R, 28, 194, 201, 203, 208, 185; 137/102,
63 R

[56]

References Cited

UNITED STATES PATENTS

2,678,044	5/1954	Szekely et al.	128/194
2,918,917	12/1959	Emerson	128/145.6
3,301,255	1/1967	Thompson	128/194
3,537,448	11/1970	Liston	128/145.5
3,580,249	5/1971	Takaoka	128/194

Primary Examiner—Richard A. Gaudet

Assistant Examiner—J. B. Mitchell

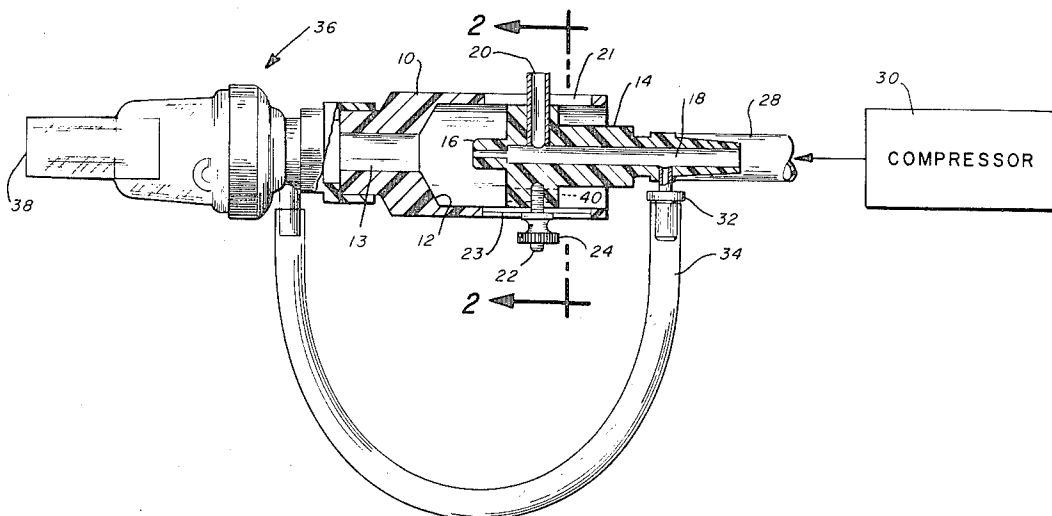
Attorney—Head & Johnson

[57]

ABSTRACT

A breathing apparatus in which gas is delivered to a patient under pressure intermittently. Air or oxygen delivered into a venturi tube includes an adjustable nozzle for changing pressure as required for a particular patient's demand.

8 Claims, 3 Drawing Figures



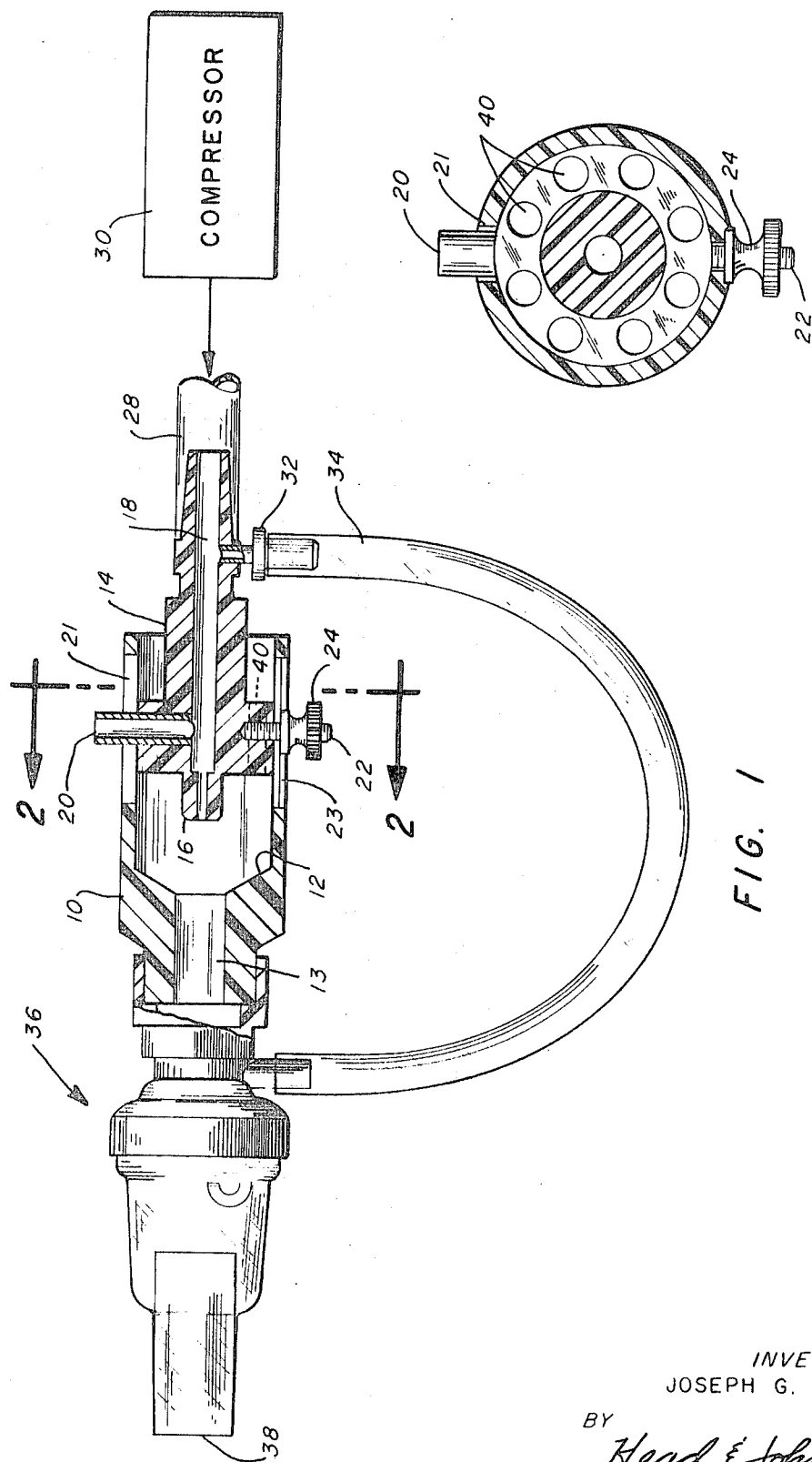


FIG. 1

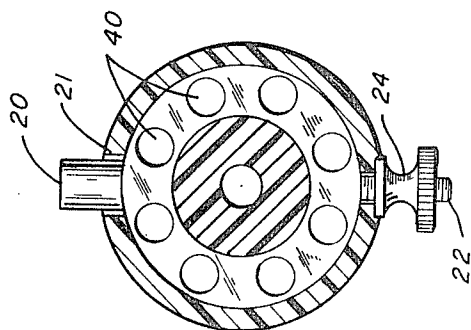


FIG. 2

INVENTOR.
JOSEPH G. GLENN

BY
Head & Johnson
ATTORNEYS

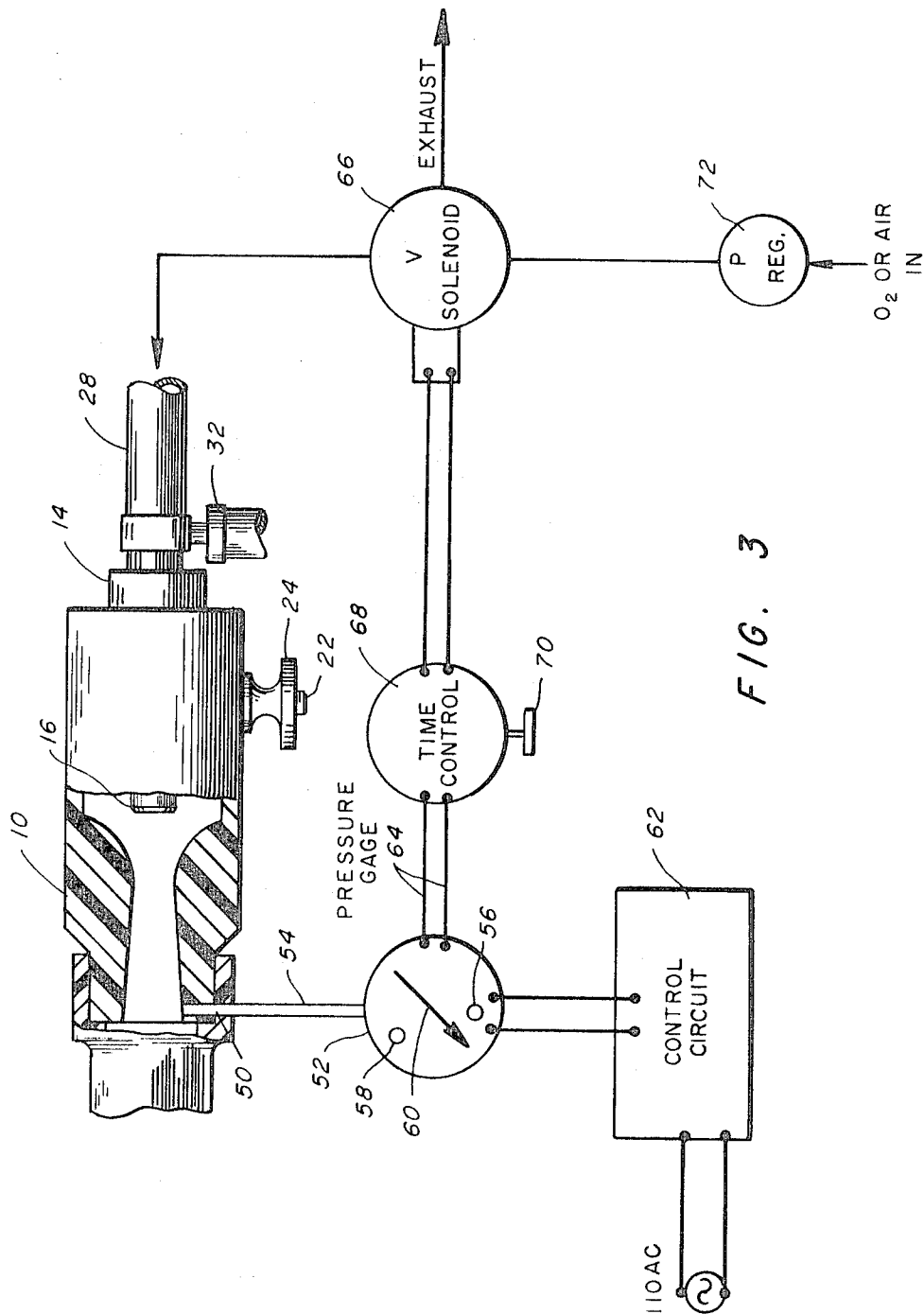


FIG. 3

INVENTOR.
JOSEPH G. GLENN

BY
Head & Johnson
ATTORNEYS

ADJUSTABLE PRESSURE IPPB VENTILATOR

CROSS REFERENCES TO RELATED APPLICATIONS

This application is a continuation-in-part upon the teachings of copending application Ser. No. 736,173 filed June 11, 1968, and now U.S. Pat. No. 3,581,742.

BACKGROUND OF THE INVENTION

This invention relates to and includes the subject matter of the aforesaid application which is incorporated by reference without repeating same. This invention like the copending application relates to apparatus for treating respiratory ailments of patients such as chronic pulmonary emphysema, chronic bronchitis, bronchitis, asthma and others. Many, if not all, of the prior devices incorporate a venturi tube in which an injector nozzle directs a stream of air. Such a device uses Bernoulli's principle to entrain atmospheric air and deliver same to a patient at a rate of flow higher than the basic source to the nozzle. Such a source being a compressor or high pressure contained gas source. Flow through the nozzle creates a pressure differential relative to the sides of the venturi tube which entrains additional air. As pressure rises downstream of the venturi chamber, i.e., in the patient's upper airway, the pressure differential becomes reduced along with flow rate. This principle, which has proven useful in treating respiratory diseases, is designed to reduce the work of breathing by delivering air and medication via a nebulizer into the lungs under mild pressure.

Prior to this invention limits of pressure to the patient's lungs have been a function of limiting the input pressure delivered to the injector which directs a stream of air into the venturi. In some instances regulators have been used to change or limit the pressure. However, such prior art devices are cumbersome and provide no means of changing pressure into the venturi from a constant inlet pressure source.

SUMMARY

This invention has for its primary purposes and objects to overcome problems associated with known prior art devices and to provide an intermittent positive pressure breathing (IPPB) device which permits independent adjustment and control over the patient's inspiratory flow pressure and flow rate in accordance with his needs and condition. This is accomplished by varying the position of the injector nozzle relative to an orifice or throat or venturi tube without making changes in the inlet pressure. As such, changes in downstream pressure are delivered to the patient without a great deal of variation in the maximum flow rate and without effecting the rate of nebulization. Further, by using a constant inlet pressure the compressor, which is supplying the source gas, is not subjected to excessive pressure load. Further, there is no need for regulation or adjustment of the inlet pressure. The position of the injector nozzle is adjusted to calibrated ranges of pressure normally prescribed by physicians for therapy. The nozzle may be locked in a desired position by a thumbscrew yet may be removed for cleaning and/or replacement. As a result the pressure delivered to the patient's upper airway is substantially predictable based on the position of the nozzle.

A further object of this invention is to provide an automatic or demand valve which is dependent upon the patient's inspiratory effort which either supplies the inlet gas to the nozzle and patient's lung system or exhaust depending upon that effort.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a partial sectional view of the apparatus of the invention.

FIG. 2 is a sectional view taken along the line 2—2 of FIG. 1.

FIG. 3 represents another embodiment for automatic control of the IPPB cycle.

DETAILED DESCRIPTION

The apparatus of this invention basically includes a body portion 10 which defines the chamber 12 therein. The downstream end of the chamber includes either an orifice or throat 13 or as shown in FIG. 3 a venturi. Slidably received therein is the movable manifold 14 which includes the nozzle 16 at the forward end and connects with the air or gas inlet conduit 18 at the rearward end. A finger coverable exhaust 20 interconnects with the conduit 18. Slot 21 permits movement of exhaust 20 therein. The manifold 14 further includes a threaded shaft 22 extending from the body 10 through slot 23. Lock nut 24 retains the manifold 14 and hence nozzle 16 in a variety of positions relative to the chamber 12 and throat 13. The outlet from the chamber connects with nebulizer generally designated by numeral 36. The upstream end of inlet conduit 18 includes means for attaching conduit 28 which is ultimately connected to a compressor 30 (diagrammatically shown) or other gas pressure source such as an oxygen tank. An inlet connector 32, if needed, is adapted to bleed a portion of the air or gas within conduit 18 into flexible conduit 34 to nebulize medicament. The nebulizer typically includes a mouthpiece 38 for a patient. The nebulizer may be of any of those readily available such as that sold under the trademark "Vaponefrin."

The adjustable nozzle body 14 further includes a plurality of circumferentially spaced openings 40 which are best shown in FIG. 2.

In typical operation gas (air) from compressor 30 or from a pressurized oxygen supply is supplied to tubing 28 of conduit 18 of the adjustable manifold 14. Gas exiting from the forward end of nozzle 16 enters the venturi chamber 12 drawing in further air flow through openings 40. The ultimate flow of air then moves downstream through throat 42 through the nebulizer and mouthpiece to the patient. The patient is advised to cover exhaust port 20 by a finger at the same time inhaling gently through the mouthpiece. Once stopped, the patient is advised to continue flow for 2 to 4 seconds to allow air and medication to be delivered into the lungs. Thereafter the finger is removed from port 20 and the patient exhales. By varying the location of the adjustable manifold 14 variations and ultimate downstream flow pressures to the patient are achieved. That is, when the nozzle is positioned upstream or to the right in the view shown, higher pressures, e.g., 25 cm. are capable of being supplied to the patient whereas at the other extreme to the left on the drawing 10 cm. pressure is provided. Suitable indicia on the body 10 or means may be provided for the various settings. The range above given covers a majority of pressures prescribed by physicians for patients using IPPB therapy. The thumbscrew 24 is used for locking the position of the adjustable nozzle. A further advantage of this apparatus is that by the action of the manual or the automatic demand valve type the compressor is under no load whatsoever which usually increases its life expectancy.

In some instances the valve of this invention can be used as a resuscitator which in many instances requires a higher pressure range.

Some advantages to the manual or finger control valve allow the patient to be easily trained to inhale gently, stop for a few seconds, then exhale slowly. With this, the patient can control inspiratory time without basically changing the pressure delivered to the other airway. Hence, the patient's lungs need not be subjected to excessively high pressure to accomplish proper ventilation. A further advantage of this system is that the pressure required to operate the nebulizer is no way decreased as would occur with changes in the compressor input.

Referring now to FIG. 3 an automatic system is depicted. As such the manual exhaust flow port 20 is closed or omitted from the construction of adjustable manifold 14, and an opening 50 is provided to provide monitor pressure downstream of the venturi. Pressure gauge 52 is attached thereto via conduit

54. The gauge includes adjustable electrical low pressure contact 56 and high pressure contact 58 which makes electrical contact with indicator hand 60. Electricity (110 AC) is supplied to a control circuit 62 which, among other things, reduces voltage to a low control voltage, e.g., 24 volts to the pressure gauge contacts. From the pressure gauge electrical leads 64 function to actuate solenoid valve 66. The valve is normally open to exhaust when used with a compressor otherwise it is normally closed. A timer control 68, which is adjustable using knob 70, is electrically attached to leads 64. Oxygen or air under pressure is regulated at 72, if necessary, to a lower pressure and caused to travel through valve 66, being normally open, to exhaust.

The schematic diagram of FIG. 3 shows the various means to achieve timed control of inspiratory time to the patient. In one embodiment the time the valve 66 is open to flow gas to the nozzle 16 is a function of the adjustable setting of contacts 56 and 58. In another embodiment time controller 68 is actuated by the initial inspiratory low pressure to close contact 56. The timer is set to add a slight additional flow for a few seconds to the patient even though his normal inhalation has ceased. This added time fills ailing lungs with air and medication beyond which that the patient can do.

An advantage of this embodiment is that it is isolated from the breathing circuit so that the control console is not subject to any cross-contamination between patients in addition to the complete control and adjustment to a particular patient's demands and capabilities.

The invention above described should be understood as not limited in its application to details of construction and arrangement of parts illustrated in the accompanying drawings, since the invention is capable of other embodiments and of being practiced or carried out in various ways. Also it is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation.

What is claimed:

1. Apparatus for IPPB therapy comprising:

- a body portion defining therein a gas flow passage chamber and a downstream orifice;
- a mouthpiece attached downstream of said orifice;
- a manifold received within said chamber and slidable therein toward and away from said orifice, said manifold including a nozzle at its forward end directed toward the center of said orifice;
- an inlet conduit providing communication with said nozzle and a pressure gas source;

an exhaust conduit and port in communication with said inlet conduit rearwardly of said nozzle, and
a plurality of circumferentially spaced openings in said manifold providing communication from the atmosphere to said chamber.

2. Apparatus of claim 1 including means to retain said manifold and nozzle in a desired axial position relative to said orifice.

3. Apparatus of claim 1 including a medicament nebulizer between said mouthpiece and said outlet passageway, and a conduit to supply said gas from said inlet conduit to said nebulizer.

4. Apparatus of claim 1 wherein said orifice is a venturi.

5. Apparatus for IPPB therapy comprising:

- a body portion defining therein a gas flow passageway chamber and a downstream orifice;
- a mouthpiece attached downstream of said orifice;
- a manifold received within said chamber and slidable therein toward and away from said orifice said manifold including:
 - a nozzle at its forward end directed toward the center of said orifice;
 - an inlet conduit providing communication with said nozzle and a pressure gas source;
 - a plurality of circumferentially spaced openings in said manifold to provide communication from the atmosphere to said chamber;
 - an electrically timed means to control flow of said gas to said inlet conduit including:
 - means to sense the pressure of said gas downstream of said orifice;
 - means responsive to said pressure sensing means to activate an electrical circuit at a first pressure and deactivate said circuit at a second higher pressure; and
 - valve means responsive to said electrical circuit at said first pressure to cause the flow of said gas to said inlet conduit and response at said second pressure to stop the flow of said gas to said inlet.

6. Apparatus of claim 5 wherein said means responsive to said pressure activates a timer which controls said valve and the flow of said gas for a desired period.

7. Apparatus of claim 5 wherein said orifice is a venturi.

8. Apparatus of claim 5 wherein said means responsive to said pressure is adjustable to a desired first pressure and a desired second pressure.

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