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Enfield et al.

[11] **3,874,379**

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[54] **MANIFOLD NEBULIZER SYSTEM**

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[73] Assignee: **Becton, Dickinson and Company,** East Rutherford, N.J.

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[21] Appl. No.: **388,486**

[52] **U.S. Cl.** **128/194,** 128/145.8

[51] **Int. Cl.** **A62b 7/02**

[58] **Field of Search** ..... 128/194, 186, 187, 201, 128/203, 209, 142.2, 142.3, 142.4, 145.8, 2.08, DIG. 2, 192; 248/290, 291, 324, 339

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Primary Examiner—Richard A. Gaudet
Assistant Examiner—Henry J. Recla
Attorney, Agent, or Firm—Kane, Dalsimer, Kane, Sullivan and Kurucz

[57] **ABSTRACT**

A manifold nebulizer system for use in a breathing circuit. The system includes a nebulizer module and an exhaust module. The nebulizer module consists of a vial to contain liquid and has structure for producing an aerosol of liquid particles for entrainment in a stream of gas. The exhaust module has a valve for facilitating inhalation of the aerosol by the patient and removal of exhaled gases received from the patient. Adjustable surfaces are on the modules to permit relative movement therebetween. In this manner, the manifold nebulizer is capable of assembly into a multiplicity of flow line arrangements and positions.

1 Claim, 9 Drawing Figures

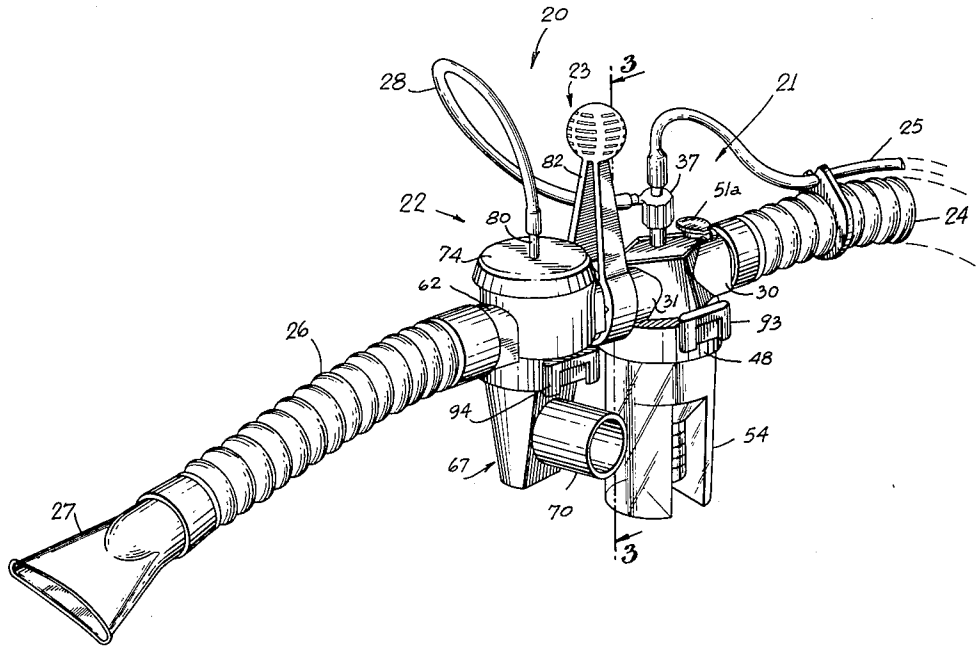


Fig. 1

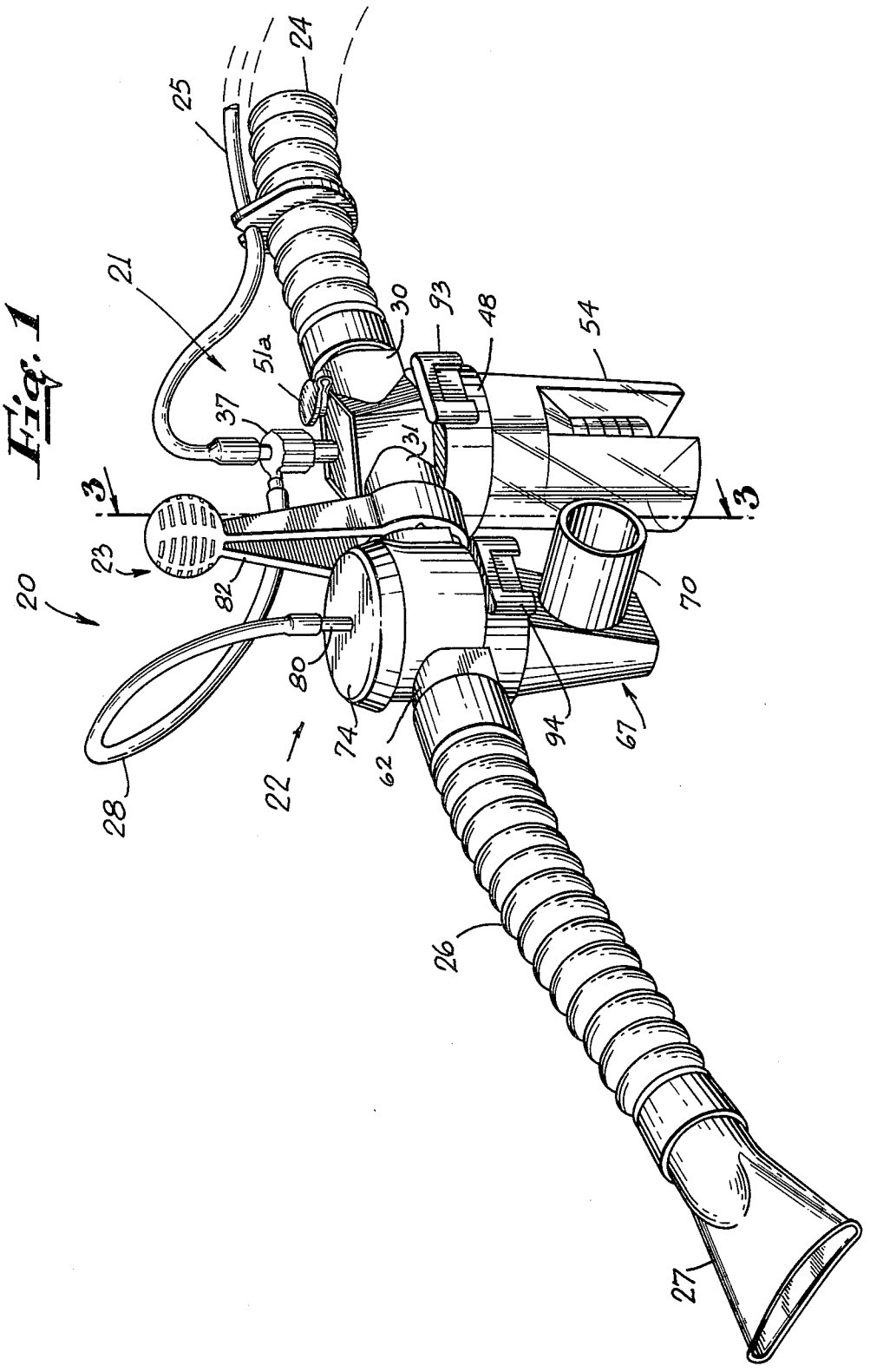


Fig. 2

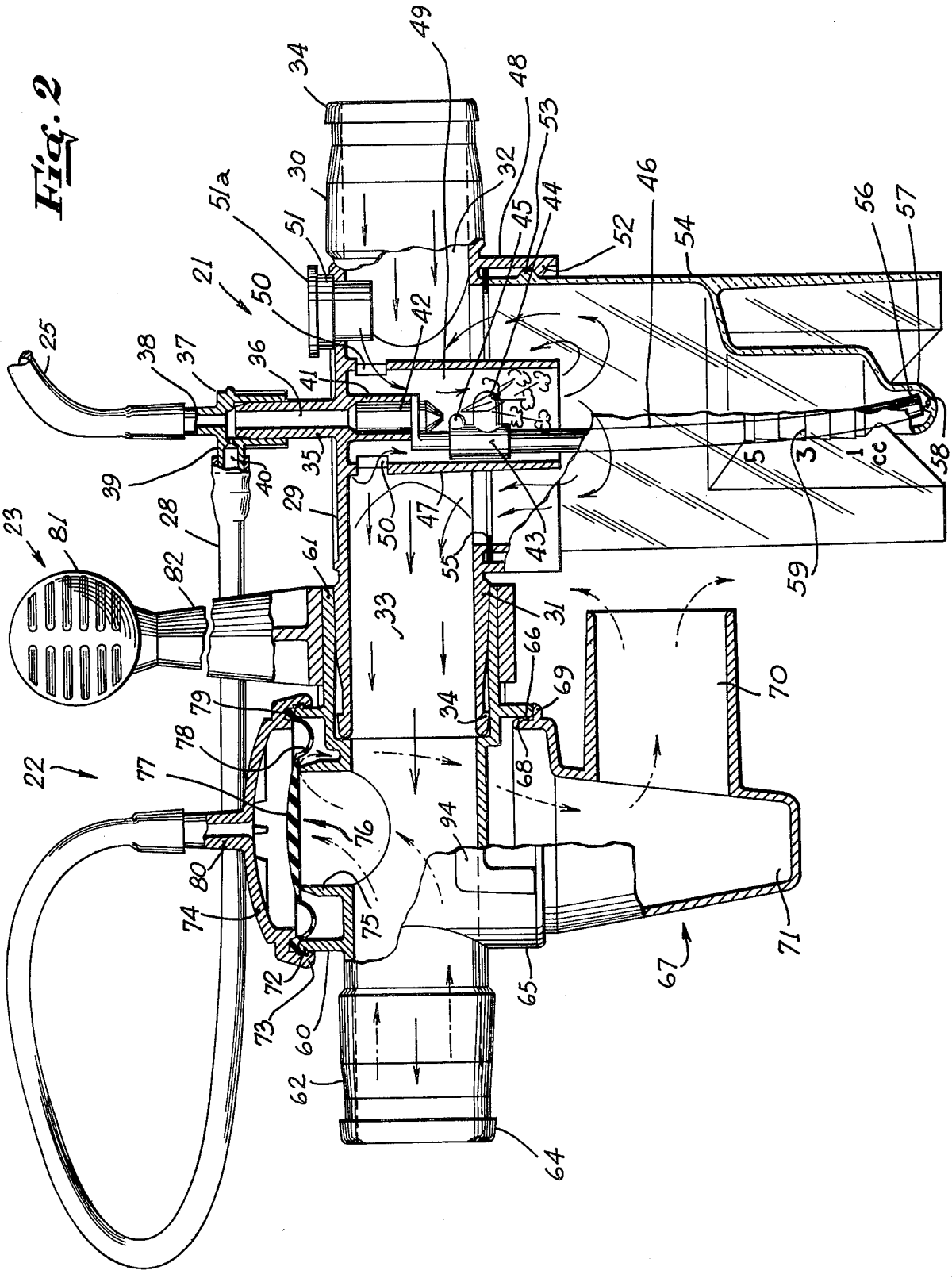

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Fig. 4

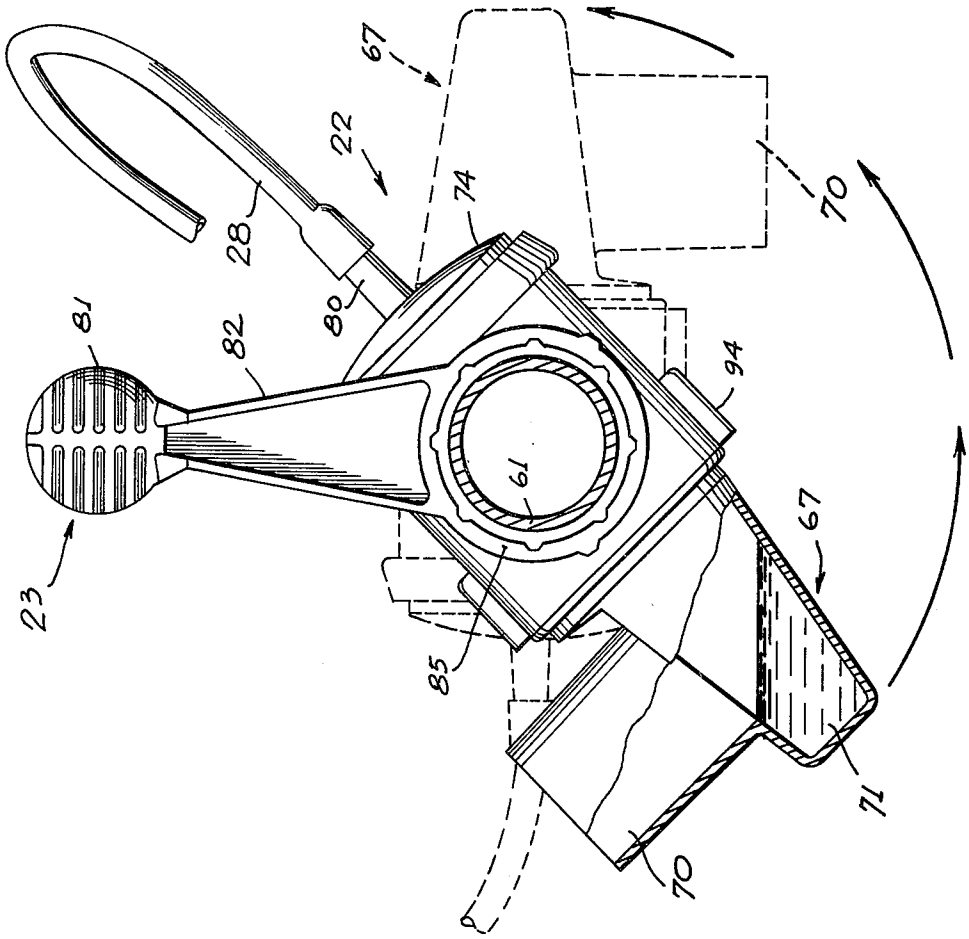
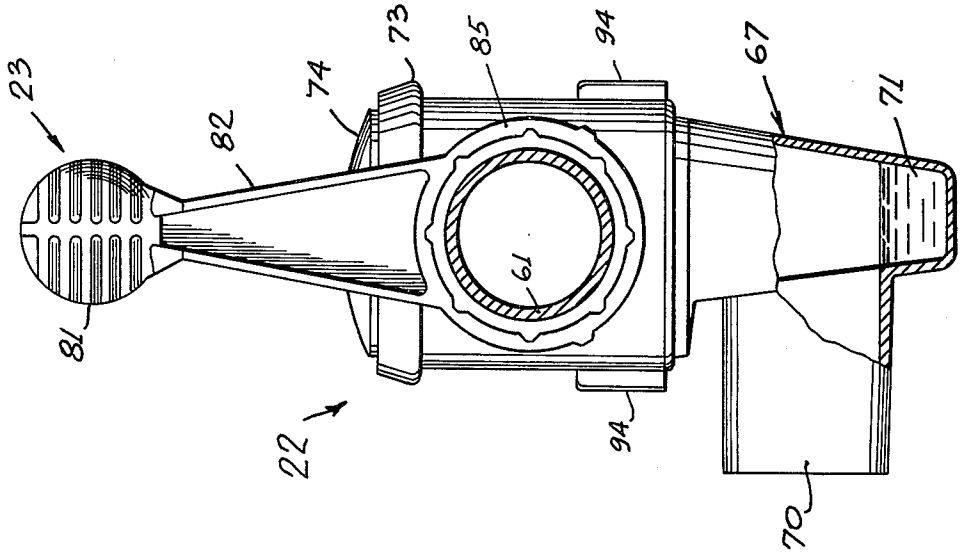

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Fig. 3


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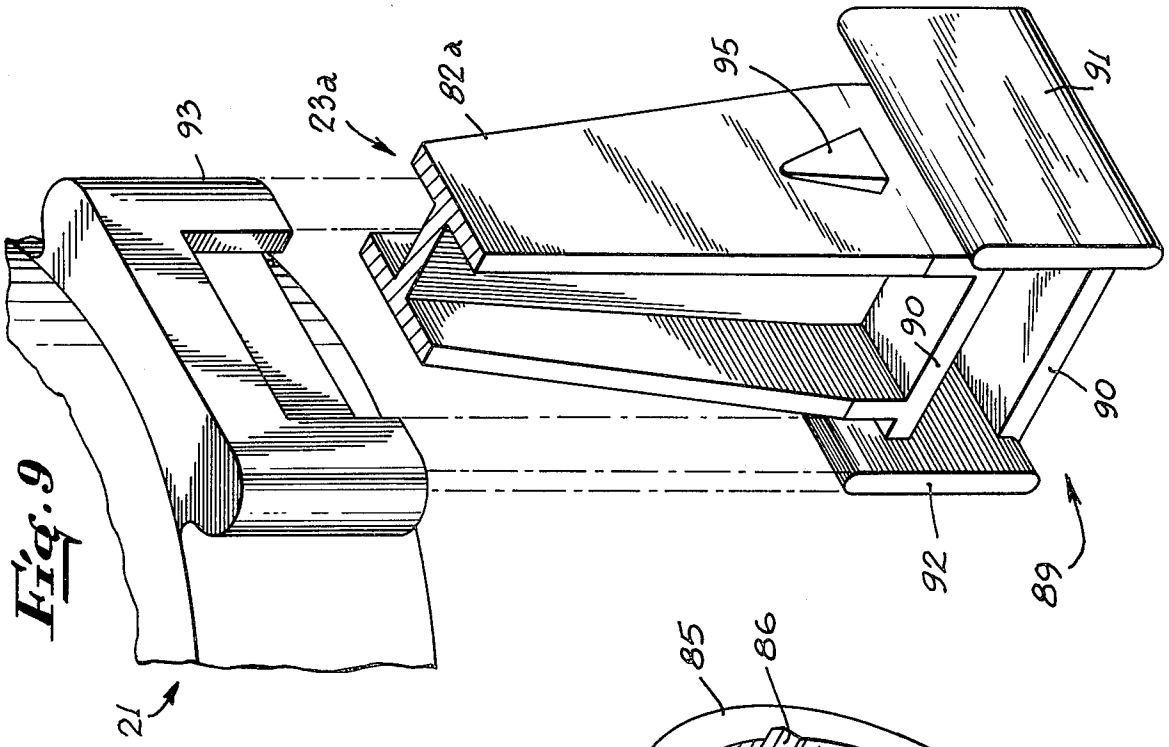


Fig. 9

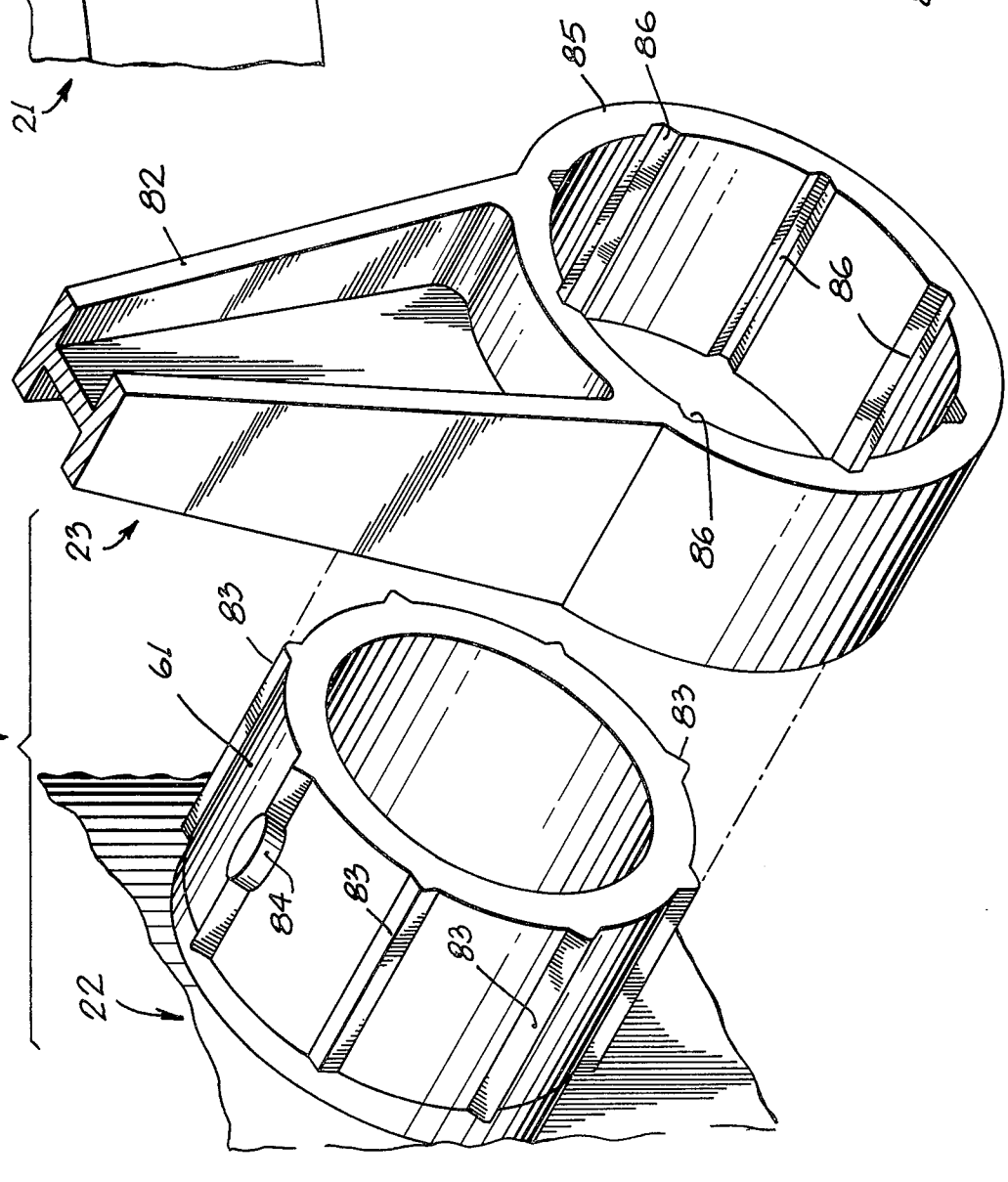


Fig. 5

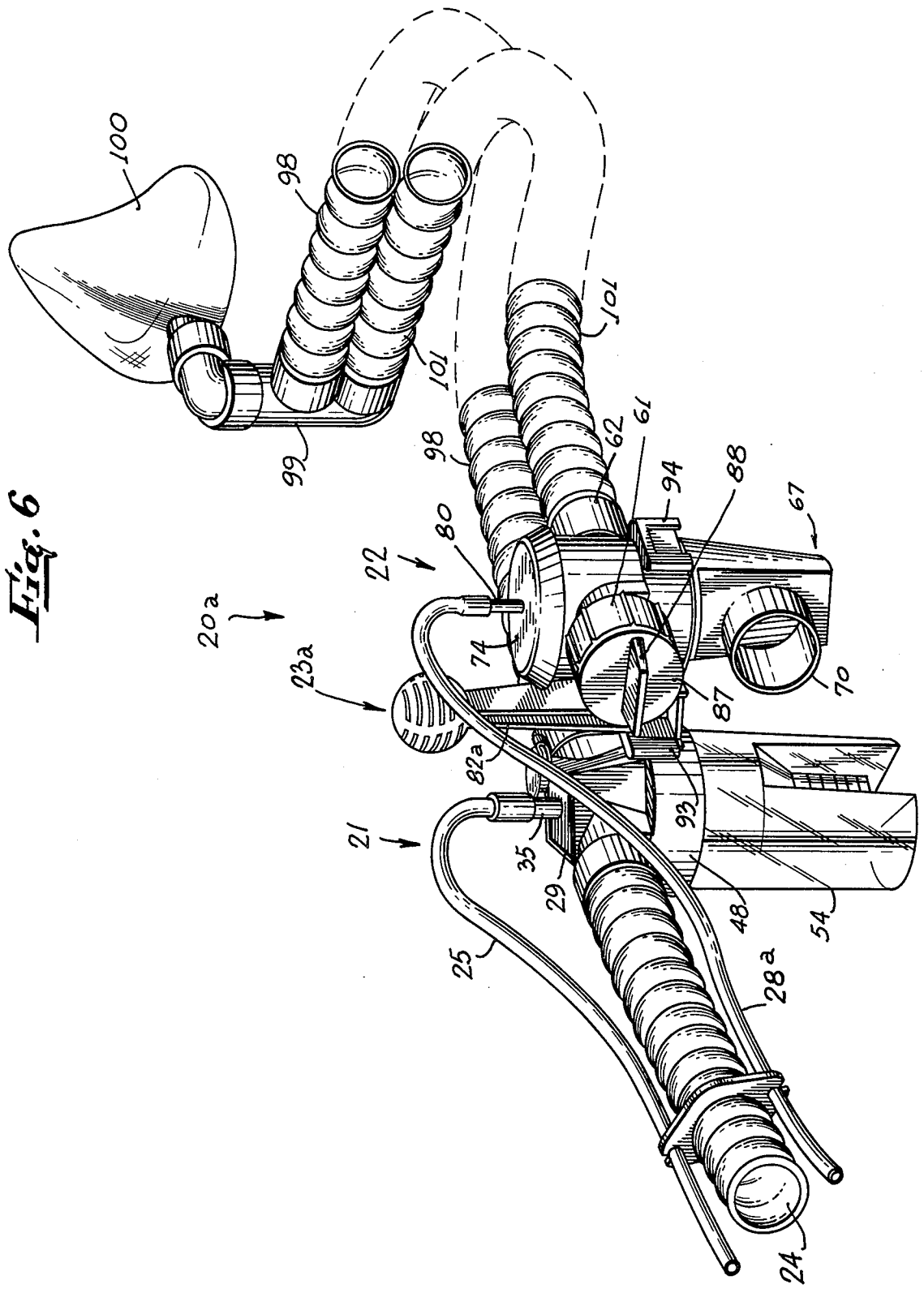

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Fig. 6

Fig. 7

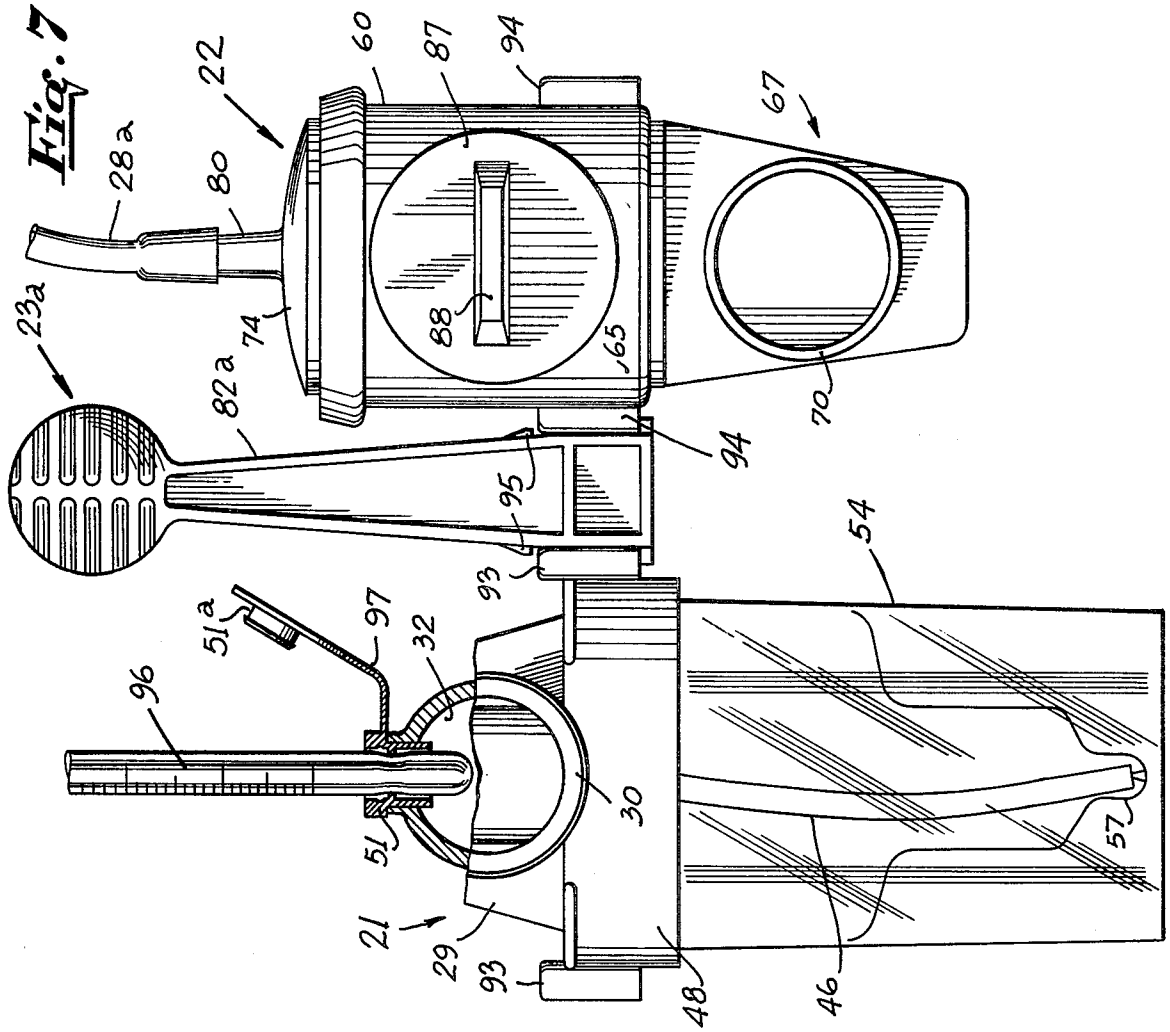
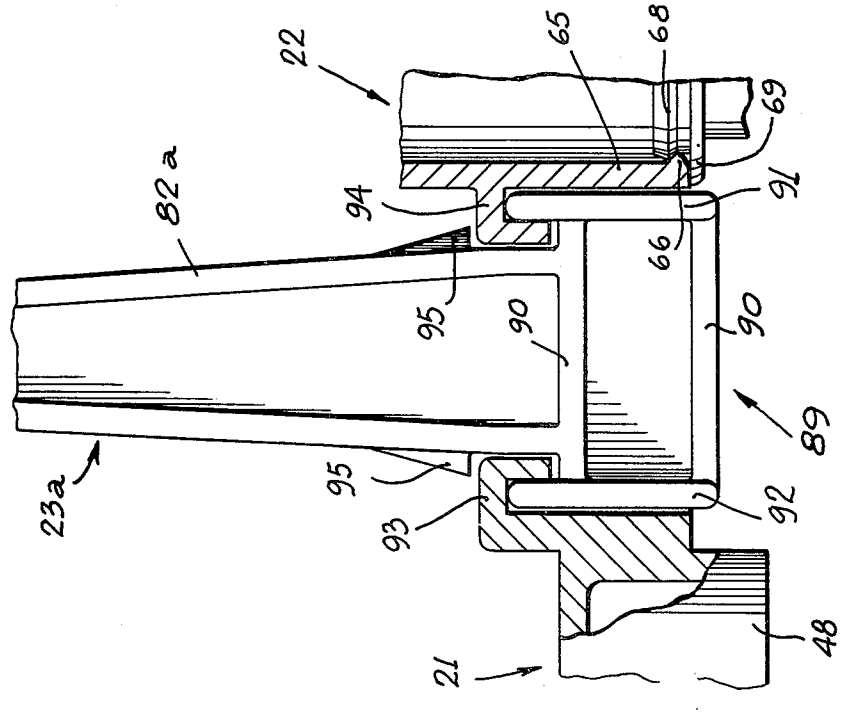

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93
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Fig. 8


22
65
68
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82a
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91
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89
23a
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MANIFOLD NEBULIZER SYSTEM

BACKGROUND OF THE INVENTION

There are many breathing systems in the marketplace today; in a multiplicity of designs depending upon the particular use for a particular patient. This is especially true when dealing with manifold nebulizer embodiments. In general, manifold nebulizers are used to add moisture or medicament to a gaseous flow to be inhaled by a patient. Need for introducing moisture or medicament into the gas stream in the most efficient and effective manner has brought about the development of a variety of different complicated and expensive devices.

It has also been determined that exhaust of the expired air from the patient can often create a problem in the more complicated and unwieldy systems. For maximum patient comfort and safety, it is necessary that upon inhalation he receive only unused (fresh) gas and medicament or moisture and upon exhalation means be provided for quickly and efficiently removing the exhaled gases.

With the above thoughts in mind, it is readily apparent that rather complicated and costly nebulizer systems are presently in use today. Additionally, these systems are usually relatively inflexible in design so that assembly into a complete air flow system can often become quite difficult.

It should also be kept in mind that, in view of the complicated and expensive systems presently in use, disposability has become relatively prohibitive. It would be desirable to have a disposable manifold nebulizer arrangement which is capable of adaption for a variety of different in-line connections and arrangements of its component parts and which can then be discarded after single patient use.

SUMMARY OF THE INVENTION

With the above discussion in mind, the present invention deals with an inexpensive single patient manifold nebulizer system designed primarily to provide the user with the versatility necessary to conform to the numerous in-use configurations and functional requirements without the high cost inherent in reusable units.

In general, a manifold nebulizier designed for use in gas flow circuitry such as in a breathing circuit includes a nebulizer module consisting of a cap portion containing a nebulizing chamber therein and a through passageway thereacross. Means are provided on the cap portion for connection to a main source of gas and to facilitate passage of said gas through the cap portion. The cap includes a depending skirt to receive in sealed relationship a vial designed to contain liquid. A means for connection to a gas source to drive the nebulizer means is provided. A nozzle depends inwardly of the cap in communication with the gas from the secondary source so as to direct the gas at high velocity into the nebulizing chamber. An aspiration tube is adjacent to and in fluid communication with the nozzle and extends into the liquid so that when gas passes through the nozzle the venturi effect will draw the liquid through the tube and facilitate entrainment of said liquid in particulate form within the gas. A baffle means depends from the nozzle to remove large liquid particles and provide the desired particle size distribution. Secondary means are in the cap to divert a portion of main gas flow into the nebulizing chamber and to direct a portion of the main flow of gas into communication with the aerosol created therein to aid in transferring the aerosol into the main gas flow passageway for discharge from the nebulizer module.

The manifold nebulizer also includes an exhaust module having a body portion which is removably connectable to the nebulizer module. An exhaust valve assembly is on the body portion and includes an exhaust opening. One end of the exhaust module is adapted to be coupled to a mouthpiece assembly for use by a patient. Adjustable surfaces are on the manifold nebulizer to permit relative movement between the modules thereof to thereby facilitate use of the nebulizer in a breathing circuit.

When the nebulizer is connected to a gas source and a patient inhales, a nebulized aerosol of gas and liquid particles will be inhaled. When the patient exhales, the valve assembly will open permitting the expired gas to pass through the exhaust opening and out of the circuit.

More specifically, the versatile modular configuration consisting of a nebulizer module and an exhaust module including a valve assembly are each capable of functioning independently. Alternatively, they can be combined to conform to the classical series configuration of modules or in a parallel nebulizer module and exhaust module configuration. The system is designed for intermittent positive pressure or ventilator usage.

With the above objectives, among others, in mind, reference is had to the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

FIG. **1** is a perspective view of a series embodiment of the manifold nebulizer system of the invention shown in connection with a source of gas and a conduit for passage to a patient;

FIG. **2** is a fragmentary sectional view of a series embodiment of the manifold nebulizer of the invention with arrows showing the direction of gas flow through the system in use;

FIG. **3** is a fragmentary sectional end elevation view thereof taken along the plane of line **3—3** of FIG. **1**;

FIG. **4** is a fragmentary sectional end elevation view thereof taken along the plane of line **3—3** of FIG. **1** and showing alternative positions of the exhaust module portion of the system;

FIG. **5** is an enlarged fragmentary perspective view of the post and post mounting portion of a series embodiment of FIGS. **1** to **4**;

FIG. **6** is a perspective view of a parallel embodiment of the manifold nebulizer system of the invention shown in connection with an air supply source and a patient;

FIG. **7** is a side elevation view of a parallel embodiment of the manifold nebulizer as shown in FIG. **6** with the thermometer port open to receive a thermometer;

FIG. **8** is a fragmentary sectional view of the post portion of a parallel embodiment of the manifold nebulizer in connection with the two modules of the system; and

FIG. **9** is an enlarged fragmentary perspective view thereof showing how the post is removed from the bracket portion of a module.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

A manifold nebulizer system **20** as depicted in FIGS. **1** and **2** includes two major component modules. There

is a nebulizer module 21 and an exhaust module 22. The two modules are connected together and at the connection joint is a removable mounting post 23. The opposite side of the nebulizer module 21 is connected to a supply hose 24. A source of gas under pressure supplies gas through supply hose 24 and to the system. A secondary small supply hose 25 is also connected to the source of gas.

The exhaust modules has its outlet side opposed to the nebulizer module which can be connected to a breathing hose 26 which terminates in a mouthpiece 27 or other connector for transmittal to the patient. In one embodiment of the series configuration a small tube 28 connects the top of nebulizer module 21 to the top of exhaust module 22 via a pressure reducer 37. In a second embodiment, tube 28*a* may be connected directly to the source of gas. All of the above discussed components of the system are of a disposable plastic material so that they may be used for a single patient and then disposed of after use.

Turning to consideration of specific details of the nebulizer module 21, particular attention is directed to FIG. 2 of the drawings. The upper portion of the module includes a cap 29. A cylindrical inlet connection 30 extends laterally from one side of cap 29 and an outlet connection 31 extends laterally from the diametrically opposite side of cap 29. The central portion of cap 29 is predominantly hollow on the inside. Connectors 30 and 31 are aligned and have aligned through passageways 32 and 33 respectively. The connectors are open to the exterior of the cap and passageways 32 and 33 communicate to provide a continuous through passageway in cap 29. This is demonstrated by the arrows in FIG. 2.

Connectors 30 and 31 each have an annular flange 34 at the extreme end to form a grip ring for interconnection with the cuff of hose 24 as shown in FIG. 1. This prevents blow-off of the hose 24 during operation of the system.

Extending upward from the central portion of cap 29 is a tubular projection 35 with a passageway 36 therethrough. A pressure reducer 37 can be attached on the open upper end of tubular extension 35 in frictional engagement therewith. A supply tube 25 can be attached directly to projection 36 or to projection 38 on reducer 37 as shown. Reducer 37 also includes a lateral tubular portion 39 which has a passageway 40 therethrough communicating with the interior of reducer 37. Lateral projection 39 is adapted to receive one end of hose 28 thereon to provide fluid communication between the interior of hose 28 and the interior of cap 37. Projection 35 extends inwardly of cap 29 to form a nozzle housing 41. A nozzle 42 having a passageway therethrough and terminating in a restricted opening is mounted in nozzle housing 41 and communicates with passageway 36 and ultimately with secondary gas source 25.

A baffle assembly 43 is affixed to the nozzle housing 41 and includes a lateral baffle member 44 in alignment with the exit opening of nozzle 42 and an orifice 45 located intermediate baffle 44 and the opening of nozzle 42 and substantially perpendicular to the flow of gas from nozzle 42.

The baffle assembly 43 receives an aspiration or suction tube 46 therein with the passageway through tube 46 in communication with orifice 45. The nozzle, nozzle housing and baffle assembly are housed within a tubular chamber 49 defined by wall 47 extending downwardly from cap 29 and concentric with the cylindrical skirt 48 of cap 29.

The chamber 49 is open at the bottom to facilitate exit of exhaust gases as shown by the arrows in FIG. 2 and has a pair of diametrically opposed openings or orifices 50 adjacent the top of the chamber. Each opening 50 is in alignment with one of the aligned connector portions of cap 29. These openings provide an inlet means for additional gas from the main supply tube 24 to enter the chamber 49 and pass therethrough to facilitate mixing and transfer of aerosol from the nebulizer chamber out through lateral connector 31. This flow path is depicted by arrows in FIG. 2.

Between inlet connector 30 and the walls of chamber 49 is an opening in the upper surface of cap 29 which normally contains a removable bushing 51. Plug 51*a* can be hinged to bushing 51 in any convenient fashion to alleviate the danger of its loss when it is removed from the opening in the cap. When plug 51*a* is removed from the opening in bushing 51, a thermometer can be inserted to determine mainstream temperatures or medicaments can be introduced for use in the system. The plug 51*a* can be replaced in a tight leak-proof fashion when bushing 51 is not in use.

The interior surface of skirt 48 contains threads 52 which interengage with threads 53 on the outer surface of a vial 54. The top of vial 54 is open and the upper rim of the vial engages with a gasket 55 in cap 29 to provide a sealed engagement point between the upper edge of the vial and the cap 29. Vial 54 is transparent and is designed to contain liquid to be introduced into the gas flow during operation of the manifold nebulizer. Suction tube 46 extends downward into vial 54 and has its bottom edge 56 located in a bulb-like reservoir 57 in the bottom of the vial. The dimensions of reservoir 57 are less than the dimensions of the remainder of the vial so that complete liquid usage is obtained. In many environments, the liquid would contain a medication for use in the system. In turn, to prevent occlusion of lower open tip 56 of suction tube 46, a rib 58 is present on the bottom of reservoir 57. In this manner, the tube is prevented from occluding on the reservoir bottom while still being close enough to the bottom of the vial to remove substantially all of the liquid from the vial. A graduated scale 59 is on the transparent reservoir so that liquid levels can be closedly controlled for medical applications.

In operation, a major supply of gas is forced through tube 24 and through the major horizontal passageway through cap 29 to exit from the open end of connector 31. A portion of that main gas flow is deflected through openings 50 into the chamber 49. Gas from the secondary source tube 25 passes through nozzle 42 and the venturi effect produced by flow through orifice 43 aspirates fluid through suction tube 46 and out through aperture 45. The liquid is then directed with the gas flow from nozzle 42 against baffle 44 where it is further broken up into small particles in the gas within chamber 49 producing an aerosol. The aerosol within the chamber then passes from the chamber out the bottom end thereof and into the mainstream flow again for exit from cap 29 in the manner described above. In this manner, aerosol passes from the nebulizer module 21 through the remainder of system 20 to the patient receiving tube 26. The operation of the activity within the

nebulizer chamber is consistent with well known procedures for providing aerosol in a gaseous medium.

Exhaust module **22** includes a cylindrically shaped body portion **60** which is open at the top and bottom. A lateral tubular connector **61** extends from one side of body **60** and a second lateral tubular connector **62** extends from the other side of body **60**. The tubular connectors on the exhaust module are diametrically opposed and communicate on one end with the interior chamber of the exhaust module and at the other end with the exterior of the exhaust module. In this manner, a through passageway exits through the exhaust module in a lateral direction. The arrows in FIG. **2** depict gas flow through the lateral passageway.

Tubular connector **61** has an inner diameter large enough so that connector **31** of the nebulizer module **21** can be received therein in tight frictional engagement. In this manner, a lateral passageway is provided in manifold nebulizier **20** from the rear tip of connector **30** to the forward tip of connector **62**. The end portion **63** of connector **61** is flared outwardly on the inner surface to facilitate a snap-in fit with connector **31** of the nebulizer module. In this manner, reliable connection between the modules is assured.

Connector **62** on the opposite side of the exhaust module **22** has a flanged outer rim **64** which facilitates the provision of a lock ring type of engagement with the cuff of a connected hose such as hose **26**. FIG. **1** displays connector **62** in engagement with hose **26** for transmittal to and from the patient.

A peripheral rim **65** surrounding the bottom opening of a body portion **60** has an inner flange **66** adapted to receive collection chamber **67** in a snap fit arrangement. The upper rim of collection chamber **67** contains a similar exterior flange **68** together with a spaced annular shoulder **69**. Flanges **68** and **69** interchange with rim **65** and flange **66** in a snap-in arrangement for assembly of the exhaust module. The collection chamber **67** can be removed by merely deforming the plastic slightly to disengage the interengaged flanges. Collection chamber **67** is hollow and terminates in a lateral exhaust tube **70** which is open to the exterior of the manifold nebulizer **20**. The top of the collection chamber **67** is open so that it communicates with the interior of body portion **60** when attached thereto and exhaled gases can be transmitted through the body and out of the exhaust outlet tubes **70** as shown by the arrows in FIG. **2**. As shown, a down draft exhaust configuration is provided. A sump **71** is provided in the interior base of collection chamber **67** below the exhaust tube **70** for accumulation of condensate. The exhaust port and tube **70** is of a desirable size for ready connection to a hose attachment used in conventional spirometry procedures. (not shown). As shown in FIGS. **3** and **4** with the exhaust module being rotatable about the nebulizer module and the mounting post **23**, it is possible to position the exhaust in any desired direction in a **360°** vertical plane of revolution. In this manner, the effective sump area **71** can be varied as depicted in FIG. **4**. Collection chamber **67** can also be rotated in a 360° horizontal plane.

The upper outer rim **72** of body **60** contains a bead on its circumference for interengagement with the beaded rim **73** of a cap **74**. Once again the nature of the resilient plastic materials facilitate the snap-on engagement of cap **74** on rim **72** of body **60**. Concentric with rim **72** is a central tubular valve seat **75** open at the top and bottom to permit communication with the interior of body **60** and the exterior thereof. Seated over the upper edge of tubular valve seat **75** is a resilient diaphragm valve member **76**. The central portion **77** of valve member **76** is of larger diameter than the valve seat **75** and occludes seat **75** when pressure is applied within the internal portion of cap **74** so as to prevent gases from flowing out of the interior of body **60**. The remainder of valve member **76** extends outwardly from the center portion through a convolution portion **78** and a rim portion **79**. The convolution portion is designed to permit the diaphragm **77** to be moved away from seat **75** with a minimum of force. The rim portion **79** is fixed in position between cap **74** and rim **72** on the upper edge of body **60** thus sealing this joint. This forms a rolling convolution valve diaphragm which is sensitive to small pressure changes and has a low exhalation retard.

The valve actuating pressure is provided through tube **28** which is connected to the secondary gas supply source and is mounted on upright hollow extension **80** on cap **74**. Thus, the tube **28** communicates with the interior of cap **74** above valve member **76**.

As stated above, on inhalation, dome pressure seats the valve. When the patient exhales, the dome pressure is relieved and central portion **77** of the valve is forced upward and unseated from the upper rim of valve seat **75**. Gases can then escape into the main body portion **60** of exhaust module **22** and down through exhaust attachment **67** and out through exhaust port **70**. This action is depicted by the phantom arrows in FIG. **2**.

As previously stated, mounting post **23** is positioned on the exhaust module at the point where the exhaust module interengages with the nebulizer module. The interengagement between connectors **31** and **61** is of a frictional type and permits rotation therebetween so that the nebulizer module can rotate 360° with respect to the exhaust module without disconnecting the two modules or providing a leakage condition. The details of mounting post **23** are best depicted in FIG. **5** of the drawings with the exception of mounting knob **81** on the distal end of the handle portion **82** of post **23**. Knob **81** provides a means for mounting of the entire assembly during use.

As shown in FIG. **5**, the outer surface of connector **61** contains a plurality of spaced longitudinal triangular ribs **83** about its circumference. The top and bottom diametrically opposed ribs include a central bead **84** for keying of the post in an upright position with respect to the exhaust module. The handle **82** of the post terminates at the end distal from the end containing knob **81** in a ring portion **85**. Ring portion **85** has an inner diameter substantially the same as the outer diameter as connector **61** but slightly larger. A plurality of grooves **86** about the inner circumference of ring **85** are provided for alignment with ribs **83** of connector **61**. As shown, there are eight ribs and eight grooves so that post **23** can be oriented in eight different directions about a 360° revolution with respect to the exhaust module. This adds versatility to the modular arrangement of the system and is particularly useful in orienting the exhaust portion so that sump **71** is in any desired position as shown in FIG. **4**. In fact, the rotation orientations of the system are many fold. By permitting 360° rotation between the nebulizer module **21** and the exhaust module **22** and also providing eight different positions for the post **23** on the exhaust module **22**, it

can be readily seen how many varied positions can be employed while still retaining the same flow paths for the system.

In actual operation with the arrangement of FIGS. **1** and **2**, gas under pressure is supplied through tubes **24** and **25** into the nebulizer module **21**. The main flow of gas continues through the nebulizer module and on through the exhaust module through the interconnection of the lateral connectors as described above. The secondary source of gas through tube **25** is passed through nozzle **41** which aspirates liquid medicament into the chamber **49**. Baffles are provided to break down particle size to the desired degree. A portion of the main flow of gas is directed through ports **50** into the chamber where it helps to gather the aerosol and carry it out of the bottom of the chamber and up into the main gas flow for transmittal to the patient. The aerosol flows through the exhaust module with the valve assembly closed by dome pressure exerted by the second gas source to the patient as he inhales.

When the patient exhales, the valve sealing dome pressure is relieved and the pressure of the exhalation gases unseat valve **76** and permit exit down through the exhaust passageways of body **60** and out through exhaust tube **70**. Condensate is collected in sump **71**. When the exhalation is completed, the valve will once again return to its relaxed position **77** over valve seat **75**.

The above described arrangement is used when it is desired to have the nebulizer module **21** and the exhaust module **22** in a series arrangement as for intermittent positive pressure breathing. The modular system is also adaptable for use in a parallel arrangement for ventilator procedures with the assistance of an alternate post **23***a*. This type of system is depicted in FIGS. **6–9** of the drawings. Modules **21** and **22** are virtually identical with the modules of the previously discussed embodiment. There is no need for a pressure reducer **37** and secondary supply tube **25** is fastened directly to tubular extension **35** of cap **29**. Tube **28***a* can come from the original supply source as another secondary supply means and can be connected in a similar manner as in the previous embodiment to tubular extension **80** of the cap.

The one difference in the exhaust module lies in the provision of a removable plug **87** placed in the open end of connector **61** for sealing purposes since that opening is not required in this alternate embodiment. Plug **87** has an appropriate handle **88** and may be removed if the module **22** is to be used in another fashion as in the previous embodiment where lateral connector **61** is employed.

The remaining portions of modules **21** and **22** are identical to the previous embodiment. The modified post **23***a* is best depicted in FIG. **9**. Mounting knob **81** is not changed however handle arm **82***a* now terminates in a connector base **89** which is different in structure than ring **85** of post **23**. The base **89** includes a pair of spaced horizontal rectangular plates **90** which support a pair of opposed rectangular shaped tongues **91** and **92**. Each tongue is designed to receive one of the modules **21** and **22** so that both modules are mounted to post **23***a*. Module **21** has a pair of opposed cup shaped brackets **93** formed on the outer skirt portion of the cap. Brackets **93** are positioned on the cap of nebulizer module **21** so that when a bracket **93** is positioned on a tongue of the post, the lateral through passageway of the nebulizer module will be perpendicular to the position of the post mounting. Brackets are open on the underside thereof so as to receive either tongue **91** or **92** of post **23***a* therein. In this manner, nebulizer module **21** is mounted on tongue of the post.

Similarly, exhaust module **22** has a pair of opposed brackets **94** of the same configuration and size as receptacles **93** so that the exhaust module can also be mounted on either of the two tongues **91** and **92** of post **23***a*. Brackets **94** are on the exterior of the body portion of the exhaust module and are diametrically positioned so that the lateral through passageway of the module is perpendicular to the point at which the post **23***a* is mounted. In this manner, the through passageways of both modules are parallel which is in contrast to the previously discussed embodiment where the modules are in series. It can be readily seen how the modules can be interchanged with respect to the mounting position on post **23***a*.

The specific interengaging structural features of the post **23***a* and the modules can be best seen in FIG. **8**. Tongues **91** and **92** extend upwardly into cup shaped brackets **93** and **94** so as to be captured within the U-shaped configuration of the brackets. Since the bracket is seated on the tongue in each case, the modules cannot be displaced in a downward direction and the end sides of each bracket retains the modules in a lateral position on the tongues of the post. Removal of the modules is retarded in an upward direction by the presence of beveled ribs **95** on the handle portion of post **23***a*. The resilient nature of the plastic modules and post make it possible for the bracket to be deformed and snapped in and out of position around the tongues and past the interference caused by beveled ribs **95**. The ribs will retain the modules in position from removal in an upward direction until sufficient force is applied to cause deformation of the part at which time the modules can be removed from the post.

FIG. **7** depicts the thermometer bushing **51** in open position with cap **51***a* having been removed from the opening in the top of the bushing **51**. A thermometer **96** can then be passed through the opening and into the interior of the nebulizer module for the purpose of taking a gas temperature reading. When thermometer **96** is removed, the integrally mounted cap **51***a* can then be replaced in position sealing the opening in the bushing **51**. Cap **51***a* can be mounted to the bushing **51** in any convenient fashion such as by being integrally molded with the port with the addition of flexible resilient arm **97** as depicted in FIG. **7**.

FIG. **6** shows the parallel embodiment **20***a* in assembled condition in a breathing system. Main supply tube **24** is connected as in the previous embodiment to nebulizer module **21**. However, exit connector **31** of module **21** is connected to a first manifold hose **98** which terminates in connection with a manifold **99**. One end of the manifold **99** is connected to the patient via currently used practice (for example, the mask **100** as shown). A further opening is in manifold **99** and is connected to an exhaust hose **101**. The opposite end of the exhaust hose **101** is mounted on connector **62** of exhaust module **22**.

Secondary supply hoses **25** and **28***a* provide secondary gas to power the nebulizer module **21** and the valve module **22** respectively.

Consequently, when air is being supplied through main supply hose **24** and secondary supply hoses **25**

and **28** and the patient inhales, gas will be drawn into manifold nebulizer **20***a* and transmitted to the patient in the following manner.

Aerosol is produced within nebulizer module **21** in the same manner as in respect to nebulizer **20** and exits from nebulizer module **21** into hose **98.** It then passes through manifold **99** and mouthpiece **100** to the patient. When the patient exhales, the valve assembly in exhaust module **22** will be opened in the same manner as in respect to manifold nebulizer **20** and the exhaled gases and other matter will pass through tube **101** into exhaust module **22.** It will then pass out of the exhaust module in the same manner as in respect to manifold nebulizer **20.**

Thus, the above discussed objectives of the invention are effectively attained.

We claim:

1. A disposable plastic manifold nebulizer system for use in a breathing circuit comprising:

a nebulizer module including a cap portion having a chamber therein and a through passageway thereacross;

means on the cap portion forming at least one side of said through passageway for removal connection to a main source of gas to facilitate passage of gas through the cap portion;

the cap having a depending skirt with means thereon for receiving in sealed relationship a vial designed to contain liquid;

means forming an opening in the cap and for the cap to be removably connected to a secondary source of gas;

a nozzle depending inwardly of the cap in alignment with the opening in the cap and in fluid communication with the gas from the secondary source passing through the opening in the cap so as to direct the gas at high velocity into the chamber;

a tube in the cap and extending beyond the depending skirt so as to extend into the vial connected with the cap with one open end adjacent to and in fluid communication with the nozzle and the other open end in liquid contained in the vial so that when secondary gas passes from the nozzle it will entrain liquid from the tube and atomize said liquid into the gas stream baffle means in the cap to assist in removing large liquid particles in the chamber and to direct a portion of the primary flow of gas into the cap into communication with the aerosol to provide a homogenized mixture into the main gas flow passageway for discharge from the nebulizer module;

an exhaust module having a body portion with a through passageway;

an exhaust valve assembly on the body portion including an exhaust opening;

means for removably coupling the part of the exhaust module containing one end opening of the through passageway therein to a patient connection;

adjustable surfaces on the manifold nebulizer to permit relative movement between the modules thereof; and

releasable connection means on the nebulizer module and the exhaust module to permit the interconnection therebetween to provide an interchangeable configuration which could take the form of serial and parallel relationship between the modules thereby facilitating function of the manifold nebulizer with the nebulizer module and exhaust module in desired relative position to thereby facilitate use of the nebulizer in a variety of different breathing circuit configurations whereby when the nebulizer is connected to a primary gas source and a patient inhales an aerosol of liquid particles will be inhaled, and when the patient exhales, the valve assembly will open permitting the expired vapors to pass through the exhaust opening and out of the circuit.

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