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TROMBAY,

MUMBAI - 400 085

सत्यमेव जयते

GOVERNMENT OF INDIA

BHABHA ATOMIC RESEARCH CENTRE

DIVISION OF REMOTE HANDLING & ROBOTICS (DRHR)

Ref: DRHR /APD/ENQ/2017/193 Date: 6/9/2017

Sub: Minor Fabrication - Invitation of Quotation for Fabrication, Supply and Guarantee of Computer Controlled Portable Air Blower Unit.

1. Quotations are invited for the minor fabrication job: Fabrication, Supply and Guarantee of Computer Controlled Portable Air Blower Unit as per specification attached and Annexure-I.
2. The quotation includes procurement of standard components, fabrication of parts, calibration of sensors, assembly and delivery of the system to DRHR, BARC, Trombay, Mumbai.
3. **No Free issue material will be supplied by BARC.**
4. Taxes other charges, if any, shall be quoted separately.
5. The quotation must reach Head, DRHR, BARC by **September 15th, 2017** and must be sent in a sealed envelope superscribed with the reference number & the due date given above.
6. Quotation should be sent by **speed post only.** Hand delivery or deliver by private courier will not be accepted.
7. The address on the envelope should read:

Head, DRHR,

BARC, Trombay, Mumbai - 400 085.

(Attn.: Amaren P Das, SO (F), DRHR)

8. The fabrication and assembly work shall be subjected to inspection by our engineer. The finished unit shall not be dispatched prior to approval by our engineer at bidder's premises. The unit shall be delivered by the bidder at **DRHR, BARC, Trombay, Mumbai.- 400085.**
9. Head, DRHR, BARC reserves the right to accept / reject any or all quotations without assigning any reason.
10. Incomplete offer / offer received after the due date shall not be considered.
11. The bidder shall provide break-up cost **for material and fabrication** in the quotation.
12. Quotations should be preferably neatly printed and corrections are not acceptable.
13. Quotation must indicate the **delivery period** and the **validity of offer**.
14. Quotation received in computer-generated form shall not be acceptable.
15. Quotation must be submitted in printed letterhead, mentioning clearly GST registration no., PAN No. Submission of challan and Invoice shall also comply the same, in case, work order is placed.
16. Drawings must be returned along with the offer.

Encl.: Annexure – I
Annexure – II

Annexure-I

(A) Scope of work:

Fabrication, assembly, demonstration and supply of **Computer Controlled Portable Air Blower Unit** as per attached specification

Material required for manufacturing and procedure qualification shall be arranged by supplier.

Minor fabrication. Job description	Quantity	Reference document
Fabrication and assembly of Computer Controlled Portable Air Blower Unit	1Unit	General Specification
Supply of Spares as per list attached	1 Set	Spares list

(B) Delivery and Guarantee

1. **Consignee**: DRHR**,** BARC, Trombay, Mumbai. .
2. **Guarantee:** The items under the work order shall be guaranteed for a satisfactory performance against manufacturing defects and faulty workmanship, for a period of 12 months from the date of final acceptance.
3. All work shall be done with good workmanship. Our supervisor will supervise the quality of work.

(C) General Specifications

1. ***Quality surveillance, inspection***

1.1. All work covered shall be subject to quality surveillance / inspection by the purchaser or his authorized representative.

1.2. No Insurance policy is required for the material as the job is to be done by supplier's material.

2. ***Delivery***

2.1. The bidder shall finish the work after approval by our engineer within 3 months from the date of firm Work order is issued to the bidder**.**

2.2. Any delay which is attributable to the supplier is liable for penalty @ 0.5% per week (max.5%) to be imposed on supplier.

2.3. In case any extension in delivery is to be granted to the supplier. The supplier should request for the extension before expiry of the work order. The same may be justified by the Division, whether extension granted is with or without levy of liquidated damages.

3. ***Sub-Contract***

3.1. The fabricator shall not sub-contract any or all the work without written consent from the purchaser. The fabricator shall be responsible to the purchaser for all work carried out the sub-contractor, of the fabricator, if allowed by the purchaser.

4. ***Payment***

4.1. Payment will be made only after satisfactory completion of work and against submission of original bill in triplicate and advance stamped receipt.

5. ***Tax***

5.1. Income Tax of 2% on the bill amount and surcharge on IT as applicable and education Cess @ 3% (on IT& SC) shall be deducted in payment.

5.2. On request, exemption form for payment of Octroi tax and Excise duty shall be provided to the supplier.

6. ***Confidentiality***

6.1. No party shall disclose any information to any third party concerning the matters under this contract generally. In particular, any information identified as **"Proprietary**" in nature by disclosing party shall be kept strictly confidential by the receiving party and shall not be disclosed to any third party without the prior written consent of the original disclosing party.

6.2. This clause shall apply to sub-contractors, consultants, advisors or the employees engaged by a party with equal force.

7. **"Restricted information" categories under section 18 of the Atomic Energy Act,1962 and "Official Secrets" under section 5 of the Official Secrets Act, 1923:-**

7.1. Any contravention of the above mentioned provisions by any contractor, sub-contractor, consultant, advisor or the employees of the contractor will invite penal consequences under the aforesaid legislation.

8. **Publication against use of BARC's name without permission for publicity purpose:-**

The contractor or sub-contractor, consultant, advisor or the employees engaged by the contractor shall not use BARC's name for any publicity purpose through any public media like Press, Radio, T.V. or Internet without the prior written approval of BARC.

System specification

System general

- Classification : Class 1 equipment
- IP classification: IP20
- Compliant with Medical device directive 93/42/EEC

Power Supply :

- Main:230 VAC
- Battery: to provide backup upto 6hours.

Air Deliver system Specification

- Tidal volume stting: 100 -2000ml
- Flow Rate: (l/min): 0.5-60
- PEEP (cm H2O): 0-50
- PC/PS Above PEEP (cm H2O):0-120
- CVM Frequency (Breadth per min) : 4 -100
- SIMV Frequency (Breadth Per Min) : 1-60
- I:E ratio: 1:10- 4:1
- T Inspiration (s): 0.1-5
- Flow trigger sensitivity (fraction of bias flow) : 0-100%
- Pressure trigger sensitivity (cmH20) -20-0

Over all weight not to exceed : 10 Kg
Overall size : 250x300x300 With out compressor

Display and User Interface

- 7" Display Touch screen
- Mechanical rotary knob
- Display Controller : Raspberri Pi

Trolley with castor and over all height of 1m.

- Height 1 m
- Material of Construction : MS Tubes Powder coated : White
- Castor wheel with lock

Scope or work for the supplier

Assembly and fabrication of portable mechanical ventilator Unit which include, procurement of the standard components as given in bill of material, table A , assembly of pneumatic circuit, wiring, fixing Display , programming of the user interface and sipulator, fabrication of parts as per details given in table B and supply of spares. The fabricator will also be responsible for programming the controller and design of user interface. Testing of the system with 500cc Latex Free test Lungs/ Rebreating bag is also in the scope of the fabricator.

Description of pneumatic circuit Fig 1

Delivery of the air and oxygen will be done using the pneumatic circuit given in figure 1 controlled by microcontroller. The block diagram of the pneumatic circuit is given below. The required components, as per the bill of material attached below, are to be procured by the supplier.
The ventilator will have different modes which are available in any modern unit such as

- Assist Control Mode (AC)
- Synchronous intermittent mandatory ventilation (SIMV)
- Pressure Support Ventilation (PV)

The details of these are presented below under control system design.

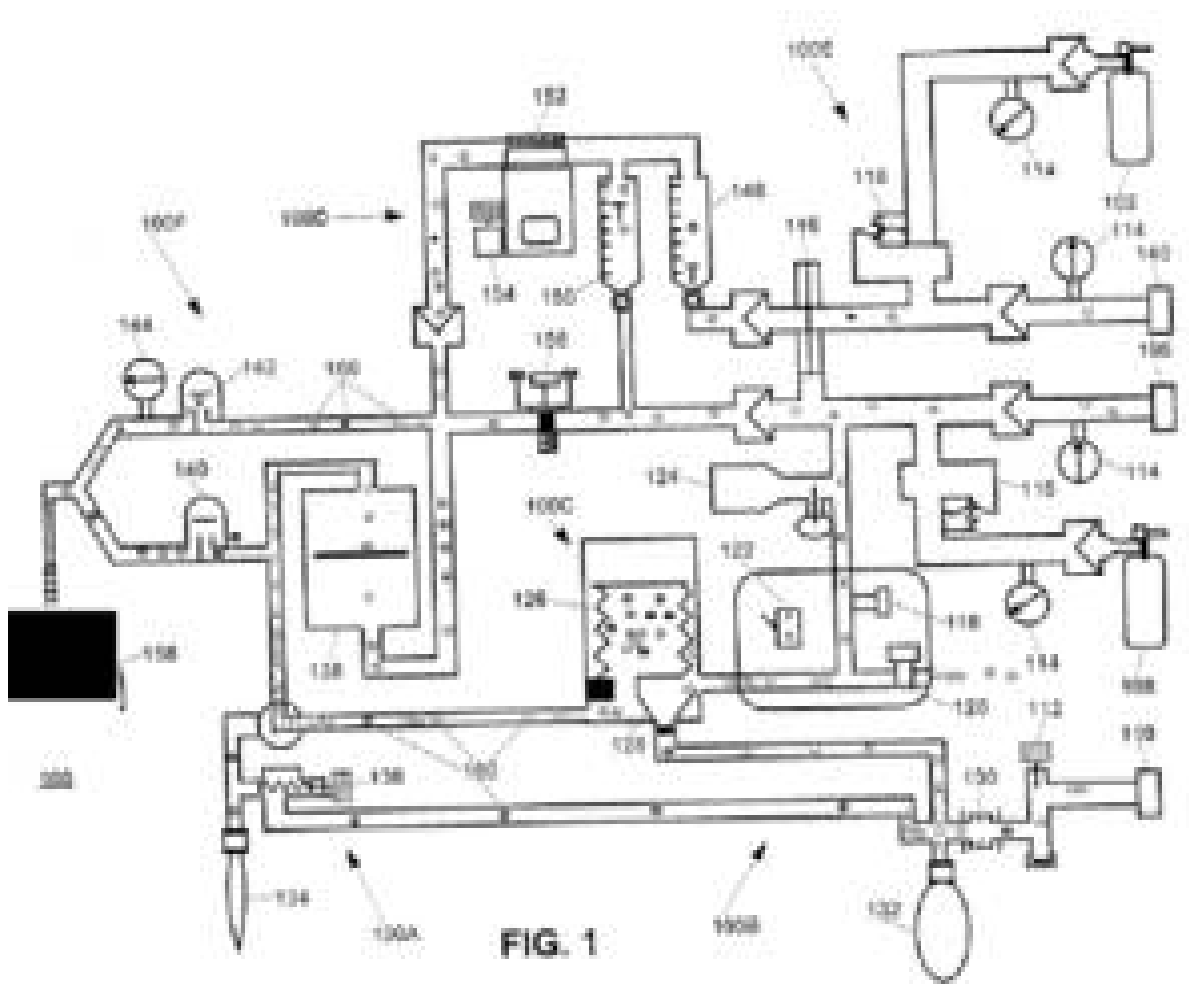


FIG. 1 is a schematic representation of a pneumatic system.

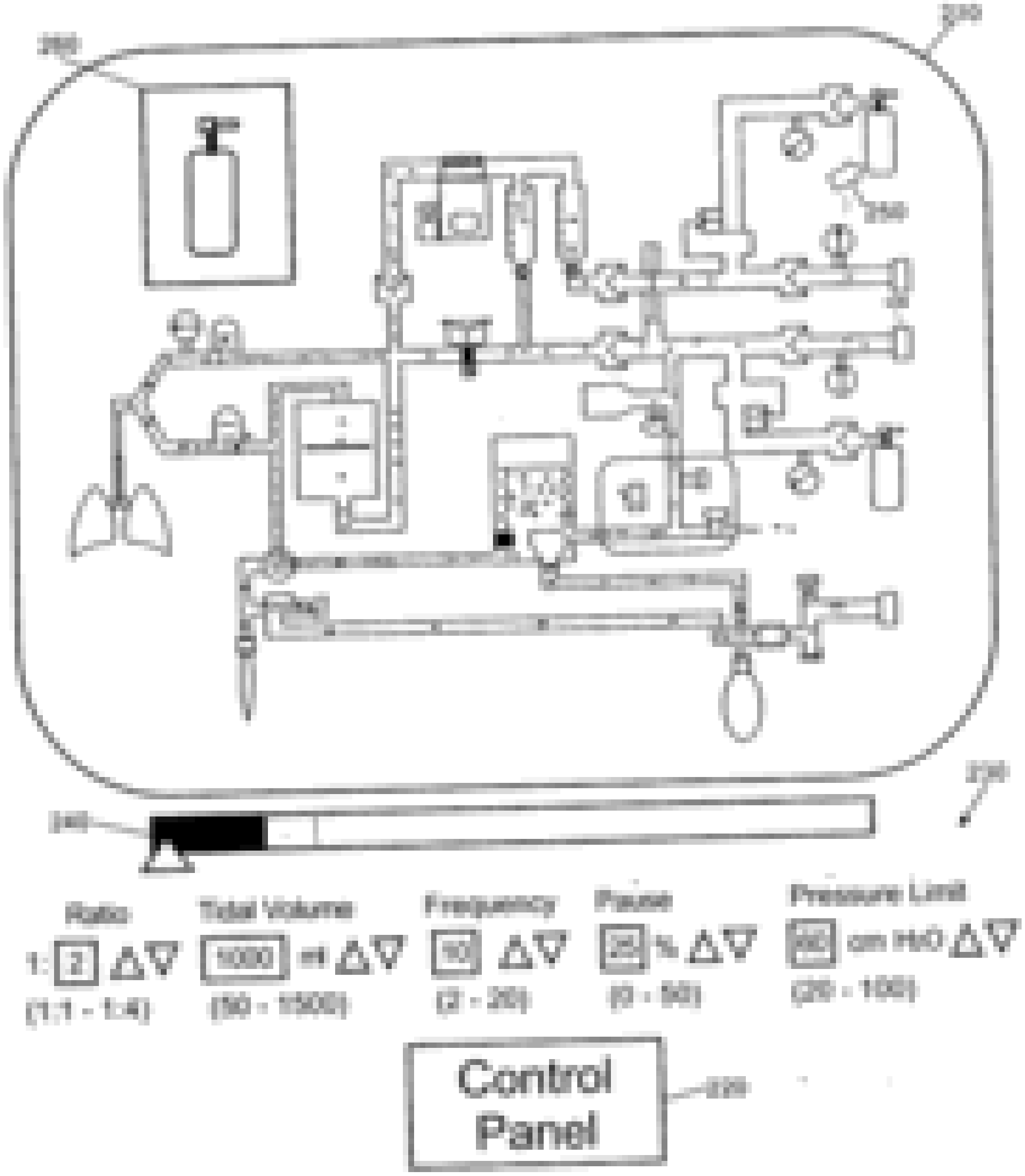


FIG. 2

FIG. 2 is a pictorial illustration of a pneumatic system display incorporating the exemplary iconic representation of FIG. 1.

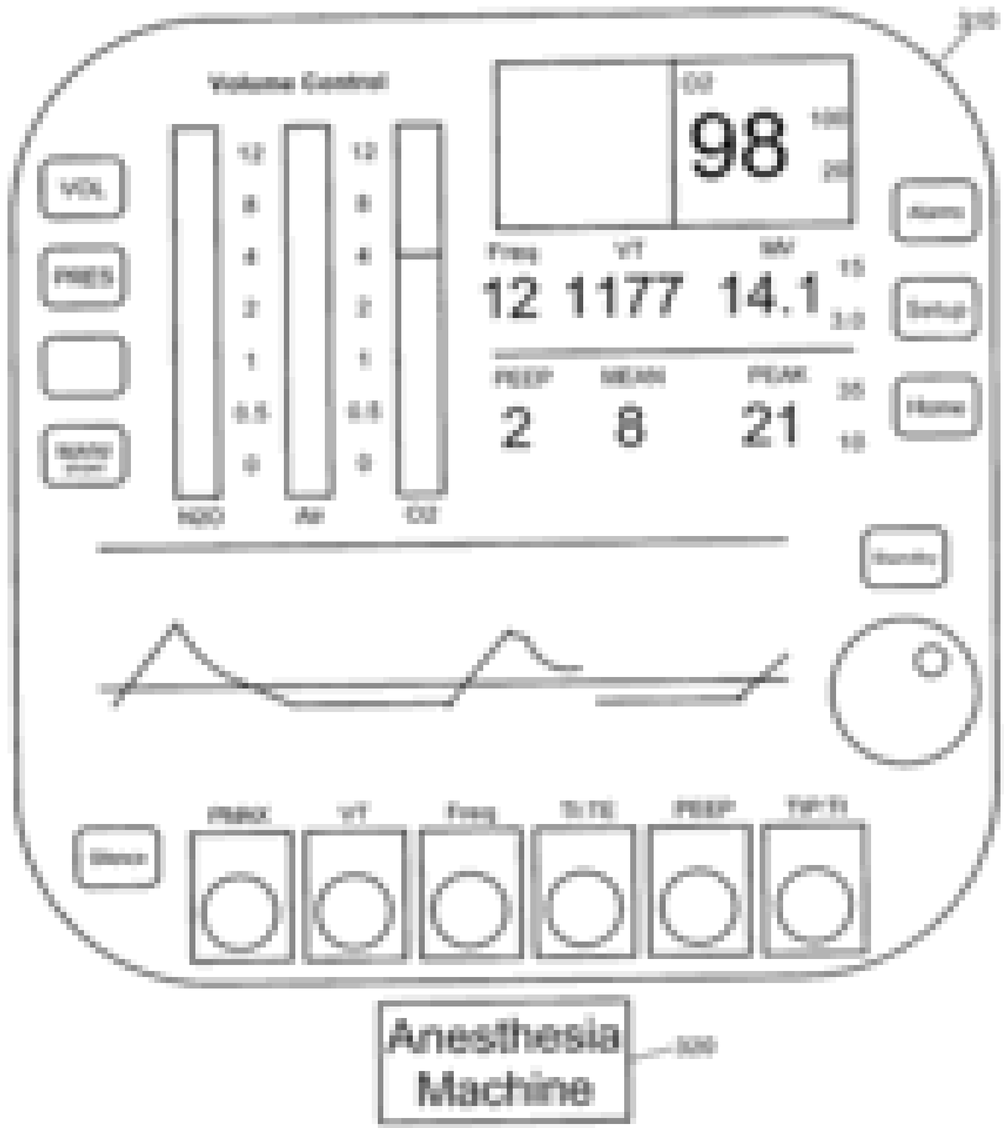


FIG. 3

FIG. 3 is a pictorial illustration of a user interface configured to accept user interaction for establishing operational settings and parameters for the pneumatic system display of FIG. 2

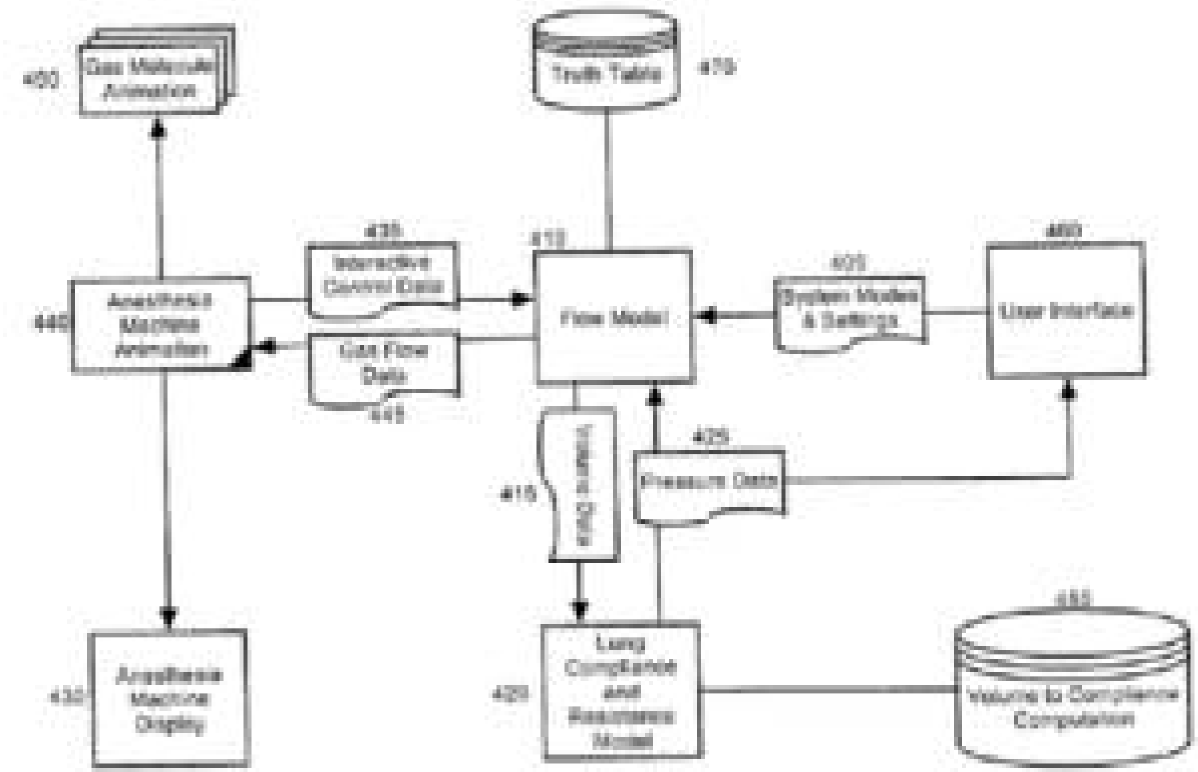


FIG. 4

FIG. 4 is a block diagram illustrating the system and method for interactively simulating a pneumatic system.

DETAILED DESCRIPTION Simulator and User Interface

Referring to FIG. 1, the pneumatic system **100** include a compilation of individual representations associated with specific components in the pneumatic system. Sets of the individual representations can be grouped so that the pneumatic system can be logically partitioned into six logical groupings: a manual ventilation system **100**A, a scavenging system **100**B, a mechanical ventilation system **100**C, a low pressure gas distribution system **100**D, a high pressure gas distribution system **100**E, and a breathing circuit **100**F.

The high pressure gas distribution system **100**E can receive selected gases from gas supply sources including fixed supply lines **106**, **140** and gas tanks **102**, **108**. In a conventional arrangement, for instance, both oxygen and nitrous oxide can be provided. Pressure gauges **114** can monitor pressure readings in the plumbing through which each of the gasses passes in the high pressure gas distribution system **100**E. Pressure regulators **116** can regulate the pressure of gas flowing through the high pressure gas distribution system **100**E. Moreover, a gas failsafe switch **146** can ensure that in the absence of pressure from the gas sourced from the fixed oxygen supply line **106** and the oxygen gas tank **108**, nitrous oxide flow from gas source **140** and **102** is interrupted. Also, a low gas supply pressure alarm **124** further can alert the end user to a low gas flow condition stemming from the fixed supply line **106** and the gas tank **108**. In any case, subject to the operation of the gas failsafe switch **146**, gases such as oxygen and nitrous oxide can flow from the gas supply sources through check valves into the low pressure gas distribution system.

The low pressure gas distribution system **100**D can receive pressure regulated gasses from the high pressure gas distribution system **100**E. Flow meters **148** can monitor the flow of the individual gases into the low pressure gas distribution system **100**D. Moreover, the rate of flow of each gas can be tuned using flow meter knobs affixed to the flow meters **148**. A vaporizer **152** can ensure a particular volatile anesthetic content for the mixed gasses exiting from the vaporizer **152**. Subsequently, the mixed gases can be passed through a check valve into the breathing circuit **100**F. Importantly, a gas flush valve **156** can be provided such that the activation of the flush valve can introduce dramatic flows of gas sourced from the gas supply line **106** and gas tank **108**.

The breathing circuit **100**F can process gas flows as the gas mixture provided by the low pressure gas distribution system **100**D both during an inhalation cycle in which gases are inhaled into lungs **158**, and also during an exhalation cycle in which gases are exhaled from the lungs **158**. One way valves **140**, **142** can be provided to direct gas flow during the inhalation/exhalation cycles. During the inhalation cycle, inspiratory valve **142** can open while the expiratory valve can remain closed. Conversely, during the exhalation cycle, expiratory valve **140** can open while the inspiratory valve **142** can remain closed. Of course, a pressure gauge **144** can provide visual feedback for monitoring the gas pressure in the plumbing leading from the inspiratory valve **142** into the **158**. Finally, a carbon dioxide absorber can be provided for removing carbon dioxide from exhaled gases prior to their reintroduction into the plumbing leading to the inspiratory valve **142**.

Notably, the virtual gauges **114**, **144**, **148**, **150**, **152** of the pneumatic system **100** can zoomably activated by operation of a selection device such as a mouse pointer. In this regard, each individual virtual gauge **114**, **144**, **148**, **150**, **152** can be enlarged when selected so that each individual virtual gauge **114**, **144**, **148**, **150**, **152** can be read with ease. Similarly, individual operable switches and buttons **112**, **122**, **124**, **136**, **154**, **156** can be zoomably activated so that each operable switch and button **112**, **122**, **124**, **136**, **154**, **156** can be manipulated by an end user with ease. Yet, while in a normal mode, the details of each operable switch and button **112**, **122**, **124**, **136**, **154**, **156** can be obscured so as to not consume the display of the pneumatic system.

Referring again to FIG. 1, the breathing cycle of inhalation and exhalation can be induced either manually, spontaneously, or automatically. In this regard, a mechanical ventilation system **100**C can drive the automatic inducement of the breathing cycle. The mechanical ventilation system **100**C can include an activation switch **122** which, responsive to user selection, can activate and deactivate the mechanical ventilation system **100**C. A ventilator proportional flow control valve **118** can control a proportion of bellows drive gas flow from the high pressure system **100**E. Similarly, a ventilator exhalation valve **120** can permit the release of bellows drive gas from the pneumatic ventilator **126** into the surrounding atmosphere.

Central to the mechanical ventilation system **100**C, a bellows **126** or piston can drive the flow of gas from the breathing circuit **100**F through the mechanical ventilation system **100**C through a pumping action. A pressure relief valve **128** can be coupled to the bellows **126** to facilitate the expulsion of exhaled gases from mechanical ventilation system **100**C into the scavenging system **100**B in which excess gases can be removed from the pneumatic ventilator **100** via vacuum line **110**. In this regard, the scavenging system **100**B can include each of a scavenging bag **132**, both positive and negative pressure relief valves **130**, and an adjustment valve **112**. Each can operate in concert in order to assure the proper disposal of excess gases through the vacuum line **110**.

Finally, the manual ventilation system **100**A can provide for the manual driving of the inhalation and exhalation cycles in the breathing circuit through the manual operation of a breathing bag **134**. More specifically, a selector switch can divert the flow of gas provided by the breathing circuit **100**F from the mechanical ventilation system **100**C into the manual ventilation system **100**A. The continual squeezing of the breathing bag **134** can drive the flow of gas from the breathing circuit **100**F through the manual ventilation system **100**A in the same manner as the bellows **126** of the mechanical ventilation system **100**C. Notably, an adjustment valve further can be provided to regulate the flow of gases into the scavenging system **100**B. Still, the manual ventilation system **100**A differs in some respect from the mechanical ventilation system **100**C. For instance, in manual ventilation, excess gas is spilled during inspiration, as opposed to end expiration for mechanical ventilation.

During spontaneous ventilation, the patient initiates the flow of gas into the lungs by generating a sub-ambient pressure during inspiration. Spontaneous inspiration is independent of the position of the manual/ventilator selector knob. When the selector knob is set to manual, the APL valve can be forced closed during inspiration. When the selector knob is in ventilator mode, the bellows can be forced downwards during inspiration. When the selector knob is set to ventilator mode and the ventilator has been switched on, the ventilator will interfere with the spontaneous breathing of the patient. Thus, to produce a realistic simulation, the interaction between spontaneous breathing and the ventilator has been modeled and simulated, including the effects on airway pressure and bellows volume.

Significantly, the flow of gases within the pneumatic system **100** can be simulated based upon various valve and switch settings applied by the end user. In particular, representations of the gas molecules **160** in the system can be provided to indicate not only the presence of gas in any particular portion of the pneumatic system **100**, but also the relative concentration of the gas species in any particular portion of the pneumatic system. In this regard, the relative number of gas molecules illustrated in a portion of the pneumatic system can be proportional to the concentration of gas in that portion. Moreover, different types of gases can be represented within the pneumatic system **100** by different colors, shadings, shapes or other visibly discernible characteristics of the iconic representations of the gas molecules **160**. In any case, the gas molecules **160** can be rendered “invisible” where no visual indication of gas is desired.

Importantly, the flow rate and flow direction of gases in the pneumatic system **100** can be simulated by the rendering and animation of representative gas molecule images **160** in the conduit sections of the pneumatic system, for instance within a straight section of plumbing. Individual gas molecule images **160** can be coupled to programmatic logic in the form of a script. The script can process flow rate data to determine a direction of animation for the gas molecule image **160**, in addition to an animation rate, in terms of speed of animation. When the gas molecule image **160** encounters a boundary edge of the conduit, the script with reference to the truth table can identify a suitable new conduit in which the gas molecule **160** can be animated. At that juncture, the gas molecule image **160** can be rendered in the identified conduit. Notably, the truth table can specify animation gas flow data based upon provided gas volumes and pressures.

Importantly, the pneumatic system **100** of FIG. 1 can be disposed in a graphical user interface through which end users can interact with the operable portions thereof while observing the effects of their interactions on gas flow in the pneumatic system **100**. To that end, FIG. 2 is a pictorial illustration of a simulator display incorporating the exemplary iconic representation of FIG. 1. The graphical user interface principally can include an iconic representation **210** of the pneumatic system, a machine settings panel **230**, a breathing cycle slider **240**, and a toggle element **220**. The machine settings panel **230** can provide a user interface through which an end user can establish the basic parameters of operation for the iconic representation **210**. In the case of an anesthesia machine, the breathing cycle slider **240** can provide a visual indication of the progress of the breathing cycle by automated movement from one color coded region to the next. This representation is applicable to an actual user interface in an actual ventilator.

Notably, a photographic presentation region **260** can be established in which actual digital imagery of an element of the iconic representation **210** can be displayed when an end user passes a pointing element **250** in proximity to or atop the element. In this way, the end user can establish a mental association between an actual component of a pneumatic system and its corresponding representation in the iconic representation **210** of the pneumatic system. Finally, the toggle element **220** can provide a quick mechanism for causing the toggled display of a control panel for operating the iconic representation **210**. In this way, both the control panel and the iconic representation **210** need not be concurrently displayed in the same crowded graphical display.

In further illustration of the toggled display of the iconic representation **210** and a control panel, FIG. 3 depicts a control panel **310** configured to accept user interaction for establishing operational settings and parameters for the iconic representation **210** of the pneumatic system of FIG. 2. The control panel **310** includes visual feedback elements including flow meters and digital gauges for indicating the flow rate of gases within the pneumatic system, breathing rates, and pressure and volume measurements in a format that may replicate GUIs on existing machines. The control panel **310** further includes a visual charting of the breathing cycle and provides audible feedback in addition to visual feedback. Importantly, as in the case of the iconic representation **210** of FIG. 2, the toggle element **320** of FIG. 3 can be disposed in or in association with the control panel **310** so as to provide a quick mechanism for causing the toggled display of the iconic representation **210** of the pneumatic system as shown in FIG. 2. The direction and nature of gas flow within the pneumatic system is to be simulated through the application of a semi-quantitative flow model. In the semi-quantitative flow, the direction and animation rate of individual gas molecule images is to be determined in reference to a truth table in which pneumatic system valve and flow rate settings and pressure data can be correlate to gas flow data necessary to properly animate each gas molecule image. Moreover, to accommodate the inherent limitations of a graphical computerized display, the gas flow data, particularly the animation speed, can be scaled to within acceptable ranges which can be accommodated by the graphical user interface of the present invention. In further illustration of the animation of the gas molecule images in the pneumatic system of the present invention, FIG. 4 depicts a system and method for interactively simulating a pneumatic system.

The system includes at its core a flow model **410**. The flow model **410** is coupled to each of anesthesia machine animation logic **440**, a user interface **460**, a lung compliance and resistance model **420**, and a truth table specifying gas flow paths through the anesthesia machine display **470**. The flow model object **410** can generate gas flow data **445** and gas volume data **415** by modeling gas flow based on interactive control data **435** received from the anesthesia machine animation logic **440**, pressure data **425** received from the lung compliance and resistance model object **420**, and ventilation modes and settings **405** received through the user interface **460**. Specifically, the flow model **410** can correlate the pressure data **425** and ventilation modes and settings **405** with specific gas flow data **410** within the truth table for gas flow paths **470**. In this way, a semi-quantitative analysis can produce the required gas flow data **445**.

Notably, the flow model **410** ensures that the simulation of the pneumatic system is responsive to a multitude of user settings and machine controls. In contrast to the flow model **410**, the lung compliance and resistance model object **420** process the volume data **415** to simulate the operation of a patient's lungs. More particularly, the lung compliance and resistance model object **420** generates pressure data **425** for use by the flow model **410** by modeling lung pressure based upon the received volume data **410**, the interactive control data **435**, as well as the volume of gas previously present in the patient's lungs. A volume to pressure equation **480** coupled to the lung compliance and resistance model **420** in used for this purpose.

In addition, to providing pressure data **425** to the flow model **410**, the lung compliance and resistance model **420** can provide pressure data **425** to the user interface **460** for display in the user interface **460**. The user interface **460** includes a control panel which interactively simulates an anesthesia workstation. Using the control panel of the user interface **460**, an end user can alternately control the simulation and view the simulation. Specifically, the end user can toggle between a view of the pneumatic system and the control panel in order to control and monitor the simulation. In this regard, control information is passed to the flow model **410** in the form of the ventilation modes and settings **405**.

Significantly, the anesthesia machine animation logic **440** can pass gas flow data **445** to the gas molecule animation scripts **450** coupled to corresponding gas molecule imagery (not shown) configured for rendering in the anesthesia machine display **430**. Using the gas flow data **445**, the animation scripts **450** can determine a direction and speed of animation for the corresponding gas molecule imagery in order to simulate a concentration of gas and the direction of flow of gas in the pneumatic system. Moreover, the animation scripts **450** can determine in which conduit to render the imagery as individual gas molecule images reach the graphical and logical boundary of a conduit in the anesthesia machine display **430**. Finally, depending upon whether any gas flows at all through the conduit, the animation scripts **450** can remove a gas molecule image from display in the conduit so as to simulate a lack of gas in the conduit.

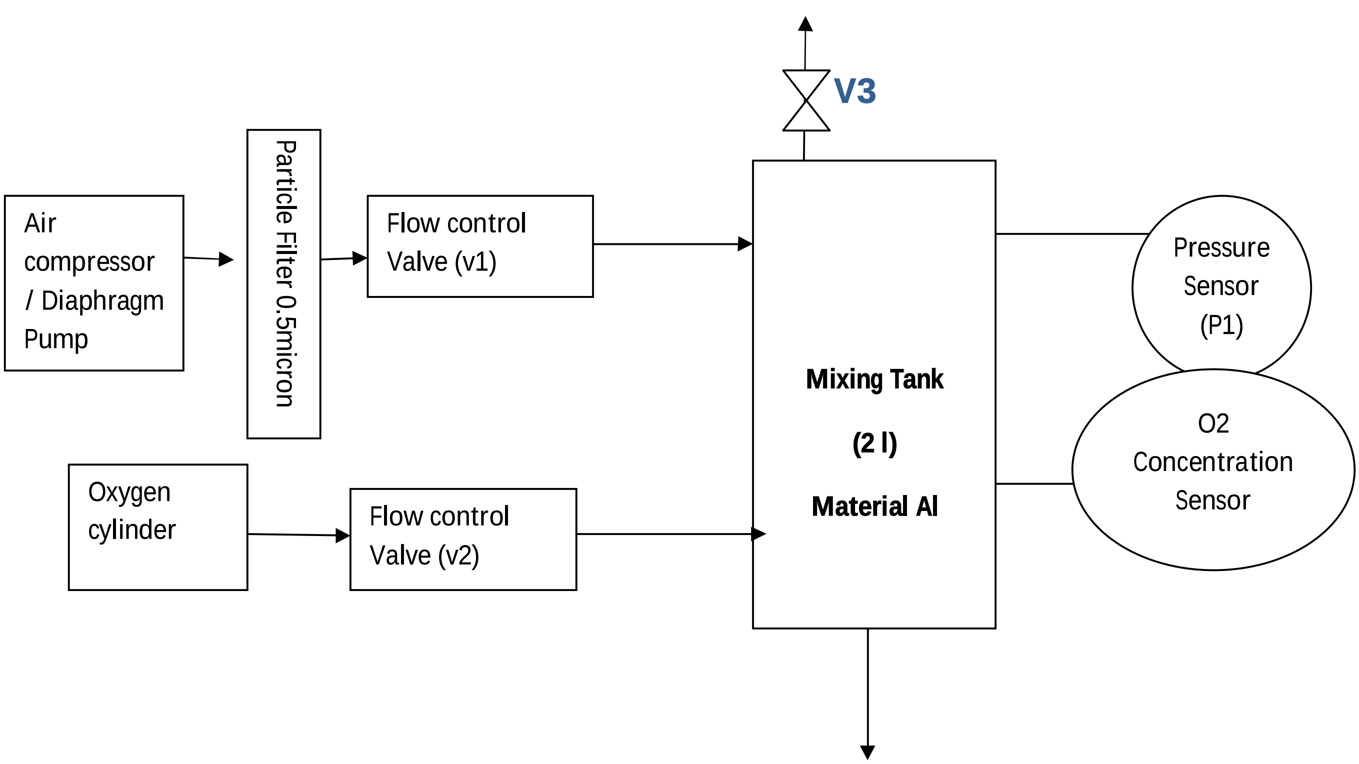
Testing and Acceptance criterion

The testing will be performed for the ventilation modes at the supplier's site, the supplier must have sufficient space for the same. Following facilities are to be provided by the supplier for testing of the system.

Power supply : Single Phase 230VAC

Oxygen supply: Medical oxygen cylinder

Basic representative digram



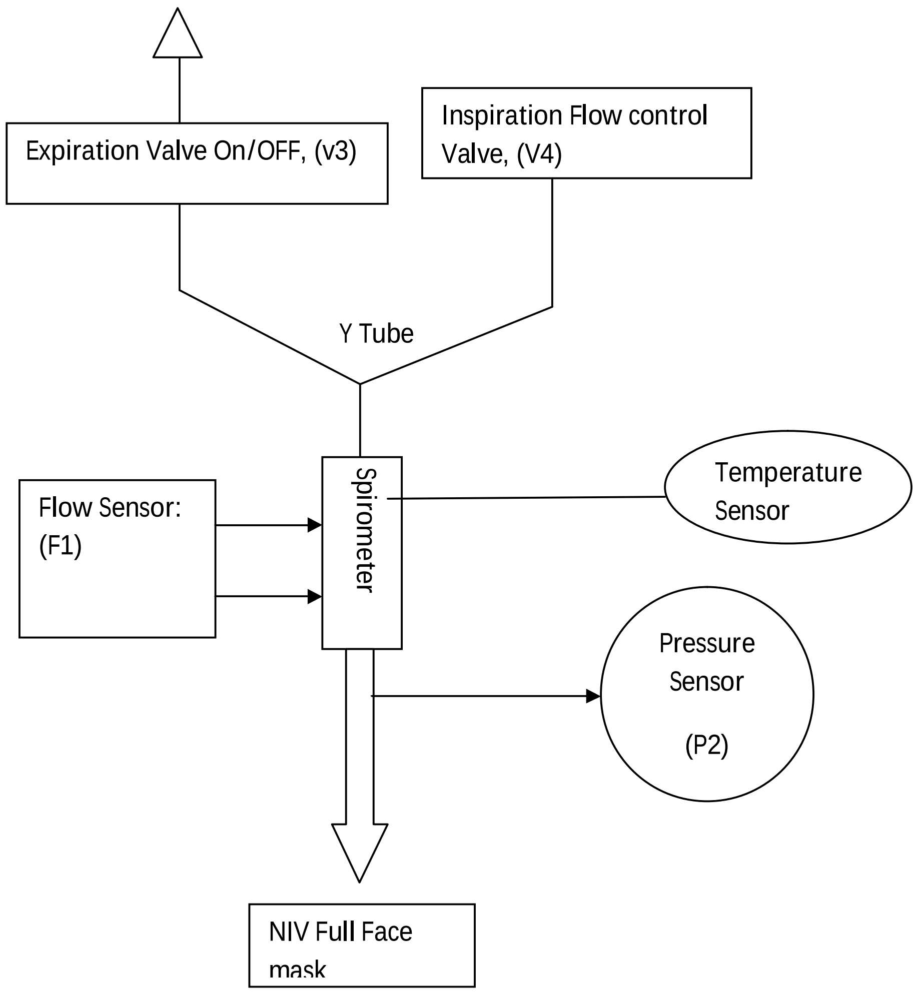


Figure 1

Compressor Unit Specification

General:

- Noise: <50dB(A) at 1m distance
- Dimension : 40X40X 30cm (decided based on foot print of the m/c)
- Weight : 30Kg (approx)
- Compliance: Device should be compliant with medical device directive 93/42/EEC

Power supply

- : 230VAc Single Phase

Compressor Capacity

- Continious flow rate: 30l/min at 350kPa
- Operating Pressure: 350-450kPa (3500- 4500 cmH20)
- Due point suppression at 30l/min: >5deg C temp diff at 350Kpa

- Built in reservoir : 2l

Alarms

- High temperature : Activates if compressoer over heats
- Low/High pressure: Activates if outlet pressure falls below specified range
- Power failure alarm:

Fabrication and Assembly:

Above system is to be assembled inside a 250x300x400mm powder coated (Gray) casing of SS. The fabricator will take care of fabrication and machining of connector and adapter for matching different size of tubing.

Development of the control System

Control system to be developed using the Raspberry Pi and the control strategy should be as follows.

Start of Inspiration (Trigger variable)	Start of Expiration (Cycling Variable)
Patient triggered: *Whenever the P2 sensor senses a predefined negative pressure , Inspiration is initiated*	Flow Cycled: *inspiration phase is terminated as soon as the inspiration flow has reached the defined share of maximum inspiration flow. This is detected by F1*
Machine triggered : *Timed Cycle based on the Respiratory Rate (RR) and inspiration /expiration ratio (I:E)*	Time cycled: *Timed Cycle based on the Respiratory Rate (RR) and inspiration /expiration ratio (I:E)*

GUI Development for VC and PC control Mode

Volume Control (VC): Deliver set Tidal Volume

Setting: Tidal Volume (calculated using (F1) and time)
Flow rate controlled by (V4) valve.
No of mandatory breaths (RR)
Inspiration time (Ti) or I:E
FiO2 Level
PEEP

Alarm : P2 should not cross the Set value.

Pressure Controlled (PC): Delivers required volume to reach the set Pressure level (P-insp)

Setting: Peak Inspiration pressure (P-ins) --- controlled by P2
No of mandatory breaths (RR)
Inspiration time (Ti) or I:E
FiO2 Level
PEEP

Alarm: Max /min Tidal volume limit
Max / Min minute Volume
Max RR

Different Mode of The ventilator to built in the control system.

Volume Control Mode/Ventilation (VCV): Traditional Mode

- Assist Control Ventilation (ACV) or Continuous mandatory Ventilation (CVM) : Each breath is either assist or control breath , each breadth is of same volume (tidal volume is fixed)
- Synchronized intermittent Mandatory Ventilation(SIMV): Number of mandatory breaths are time cycled. In between breaths initiated by patient is not assisted by the ventilator, hence the volume intake depends on the lungs muscle capacity. If the patient initiates breath matches with the mandatory breath timing, the ventilator assisted breath is delivered.

Pressure Control: Traditional mode

- Pressure control Ventilation(PCV)
- Pr. Support Ventilation (PSV)
- Airway Pressure Release Ventilation (APRV)

Dual Mode: Modern Modes

- Pressure Regulated Volume Control (PRVC)
- Volume assured pressure support(VAPS)

Alarm

Airway pressure (upper):

- Invasive ventilation: 16 – 120 cmH2O
- Non Invasive Ventilation: 16 - 40 cmH2O

Expired minute volume: 0.5 – 60 l/min (Upper alarm limit):
Expired Minute Volume: 0.5 – 40 l/min (Lower alarm limit):
No patient effort (Apnea) alarm: 15 – 45 s
Automatic return to support mode on patient triggering
Respiratory frequency: 1 – 160 breaths/min
High end expiratory pressure: 0 – 55 cmH2O
Low end expiratory pressure: 0 – 47 cmH2O.
High continuous pressure:

- Set PEEP level + 15 cmH2Oexceeded for more than 15seconds.

O2 concentration: Set value ±5 vol% or 18 vol%
Gas supply:

- Below 200 kPa / 2.0 bar /
- 29 PSI and
- above 650 kPa / 6.5 bar / 94 PSI

Battery:

- Limited battery capacity:10 min.
- No battery capacity: less than 3 min.
- Low battery voltage.

End-tidal CO2 (upper and lowerlimit):

- 0.5 – 20%.
- 4 – 100 mm Hg.
- 0.5 – 14 kPa.

Autoset (alarm limits) specification: Invasive ventilation, controlled modes only
High airway pressure:

- Mean peak pressure +10 cmH2O or at least 35 cmH2O.

Upper minute volume:

- Expiratory minute volume: + 50%.

Lower minute volume:

- Expiratory minute volume – 50%.

Upper respiratory frequency: Breathing frequency + 40%.
Lower respiratory frequency: Breathing frequency – 40%.
High end expiratory pressure: Mean end expiratory pressure + 5 cmH2O.
Low end expiratory pressure: Mean end expiratory pressure – 3 cmH2O.
Upper end tidal carbondioxide concentration (etCO2):

- End tidal carbon dioxide concentration + 25%.

Lower end tidal carbondioxide concentration (etCO2):

- End tidal carbon dioxide concentration – 25%.

SPARE PART LIST

		Make	Model	Specification	Qnty
	Pressur sensor P1	Freescale	MPXv5050GP	0-50 kPa, FS=5VDC	3
	Flow sensor (F1)	Free scale	MPXV7002DP	-2kpa to 2Kpa (0-5VDc O/P)	3
	Pressure sensor (P2)	Free scale	MPXV7025	-25Kpa- 25Kpa (0.2-4.7 VDC)	3
	High Flow diaphragm Pump (T2-01)	Parker	T1-2HD-24-1NEA	Media: Air, Max Free Flow 62 Slpm, Max Cont pr 8bar(8000cmH2O)	1
	2/2 Electro pneumatic valve	Festo	MHP1-M4H-2/2G-M3-TC	½ inch connector	2
	3/2 Electro pneumatic valve	Festo	MHP1-M4H-3/2G-M3-TC	½ inch connector	2
	Air Flow sensor	Honeywell Omeron	AWM90000 D6F—50A6-000	+/-200 L/m 0-50 L/m	2
	Temperature sensor	National Semiconductors	LM94021BIMG		3
	Oxygen concentration meter	Figaro	KE25	0-100% oxygen concentration, response time :15sec, Life 5years	2
	Spirometer hose /CPAP tube	Source MAS		Flexible 22mm dia tubing	1
	NIV Full Face mask	Resmed		Adult	1