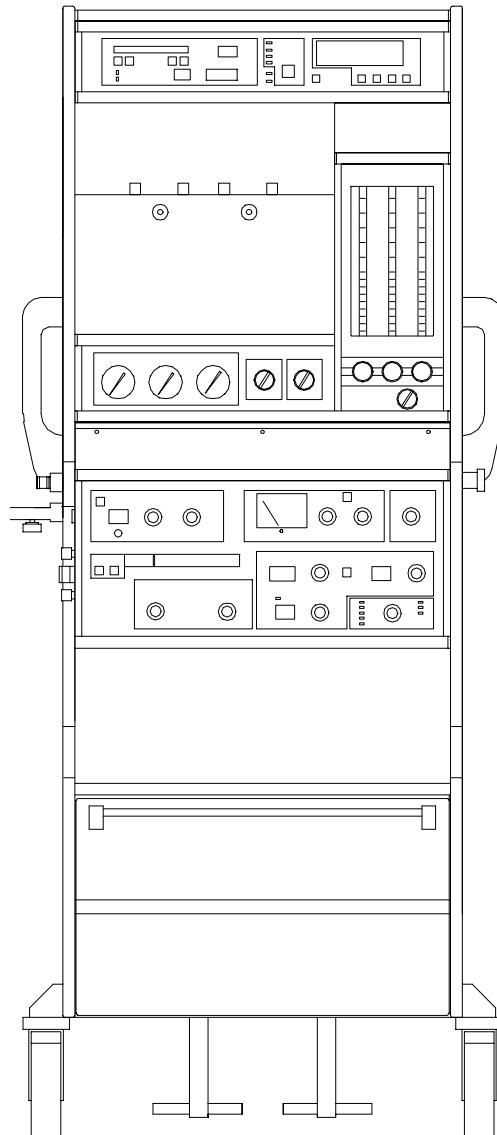


# **PERSEO**

## **ANAESTHESIA WORKSTATION**

### **SERVICE MANUAL**



## GENERAL INDEX

SERVICE MANUAL.....	1
1. USE OF THE SERVICE MANUAL .....	3
<u>1.1. Users of manual</u> .....	3
<u>1.2. General Notes</u> .....	3
<u>1.3. Safety Notes</u> .....	4
WARNINGS.....	4
2. GENERAL MAINTENANCE PROCEDURES.....	6
<u>2.1. General Information</u> .....	6
3. WORKSTATION DESCRIPTION .....	7
<u>3.1 General Information</u> .....	7
<u>3.2 Structure</u> .....	8
<u>3.3 AM5000/3 – AM5000/5 anaesthesia module</u> .....	9
<u>3.4 Breathing System</u> .....	12
3.4.1. OPEN-SEMICLOSED VERSION (NON REBREATHING -REBREATHING).....	12
3.4.2. OPEN VERSION (NON REBREATHING).....	14
<u>3.5. VM 2000 lung ventilator</u> .....	15
<u>3.5.1. A) MODE Section</u> .....	17
<u>3.5.2. B) RATE Section</u> .....	18
<u>3.5.3. C) INSP FLOW - PEEP Section</u> .....	19
<u>3.5.4. D) TIDAL VOLUME Section</u> .....	20
<u>3.5.5. E) AIRWAY PRESSURE section</u> .....	21
<u>3.5.6. F) OXYMETER Section</u> .....	22
<u>3.5.7. G) BELLOW section</u> .....	23
<u>3.6. RM 3000 Breathing Monitor</u> .....	24
<u>3.7. Vaporizer</u> .....	26
<u>3.8 Operating Principal</u> .....	27
4. ASSEMBLY OF VALVE GROUP (BREATHING SYSTEM).....	33
5. CALIBRATION AND TEST.....	43
<u>5.1 Valve Group (Breathing System)</u> .....	43
<u>5.2 Final Test</u> .....	47
6. PNEUMATICS.....	49
<u>6.1. Pneumatic Diagram Of Perseo</u> .....	49
<u>6.2 Pneumatic Components</u> .....	51
<u>6.3 Pneumatic Diagram vm200</u> .....	51
<u>6.4 Pneumatic Diagram AM5000/3 – AM5000/5</u> .....	53
7. ELECTRONICS.....	54

### **Warning**

SIARE is used throughout this manual as an abbreviation for

**SIARE HOSPITAL SUPPLIES S.r.l.**  
**Via Giulio Pastore, 18 - 40056 Crespellano (BO) – ITALY**  
**Tel.: 051/969802**  
**Fax: 051/969101**  
**Manufacturer of the equipment described in this manual**

## 1. USE OF THE SERVICE MANUAL

### **1.1. Users of manual**


This manual is strictly for use by SIARE technicians or qualified technicians authorized by SIARE:

The technician authorized by SIARE has available the appropriate tools and spare parts and is trained with regards to the safety of the product.

SIARE declines all responsibility with regards to technical assistance to the unit without formal authorization of SIARE.

The correct and safe use for the patient and the operator of the unit, requires the knowledge of the instructions and advice written in this manual and the User's manual.

### **1.2. General Notes**

The symbol  placed near an instruction, calls the reader's attention to important information regarding the safety of the patient and operator.

The manual describes the unit and its operation with the help of electrical and pneumatic diagrams.



The following manuals are an integral part of this manual:

- PERSEO'S User Manual
- VM 2000 Service Manual
- RM 3000 Service Manual
- AM5000/3-AM 5000/5 Service Manual

The technician should have available a copy of the User's manual and should know its contents before performing any of the operations described in this manual.

### **1.3. Safety Notes**

#### **WARNINGS**

The unit has been designed and is manufactured in conditions that guarantee the quality of the product and its components, in order to ensure the maximum level of reliability and the safety of the patient and the operator.

Therefore its safety is guaranteed only if it is used as per the instructions contained in this manual and the User's manual which is an integral and unseparable part of the product documentation for the technical assistance.

For safety reasons, it is necessary to strictly follow the scheduled maintenance described in the User's manual.

The maintenance and the replacement of any parts has to be performed by authorized SIARE service dealers and only original SIARE parts or parts checked by SIARE should be used.

SIARE is not civically or criminally liable in the following cases:

- 1) Use in conditions and for reasons not stated or prescribed in this manual.
- 2) Lack or omission of scheduled maintenance as described in this manual.
- 3) Maintenance performed by personnel not authorized by SIARE.
- 4) Use of non original spare parts or spare parts not checked and approved by SIARE.
- 5) Connection with equipment that is not in compliance with relevant directives in effect for safety for the indicated use.



Do not use the equipment in the presence of flammable gases.

In order to avoid risk of explosion this unit should not be used in the presence of flammable anaesthetic gases such as ether or cyclopropane. This unit can operate only with anesthetics that are not flammable as per the directive relative to the electrical safety of the anaesthesia units.



Do not connect the unit to the patient using conductive antistatic tubes.

Due to the fact that this machine cannot be used with flammable anaesthetic agents, such as ether or cyclopropane, the use of antistatic patient tubes is not necessary. Since the use of antistatic tubes can cause burns when using surgical equipment at high frequencies, their use is not allowed in any administration with this equipment.



The unit is not approved for use in areas with danger of explosion.

The unit cannot be used in the presence of explosive gases.

Before connecting the unit with other electrical equipment not described in this manual, check with the manufacturer.

The electrical connection of the unit should be made according to the instructions in this manual in order to eliminate the danger of electric shock to the patient or operator due to an improper installation.

Regarding electro-medical equipment's general safety, it is important to follow all rules regarding the interaction between the equipment and the patient, the operator and the nearby environment.

In order to ensure proper and safe use of the equipment it is crucial to follow the instructions in this manual and the User's manual and pay attention to the notes furnished in this User's manual.

In order to use this equipment, it is vital to know all the instructions in this manual.

The equipment should be inspected and the maintenance performed by SIARE authorized personnel every 6 (six) months. All maintenance performed by SIARE authorized personnel is recorded in the equipment's maintenance log.

Every repair should be performed by SIARE authorized personnel. Siare is not liable for direct or indirect damage to people or things, due to technical assistance by personnel non-authorized by SIARE or improper use of the equipment, that is to say a use not described in the User's manual or technical manual.

In order to repair equipment that is malfunctioning, has defects or is broken, the operator should contact SIARE or its authorized local service dealer. It is important, when requesting service, to specify the model and serial number of the equipment.

Use only the recommended accessories.

The use of other accessories is authorized only by a written authorization from SIARE as per the safety directives in effect.

The equipment's operation is authorized only in areas that conform to the safety directives in effect.

## 2. GENERAL MAINTENANCE PROCEDURES

### 2.1. General Information



In order to ensure the safety of the patient and the operator, the unit should undergo an inspection and test after 800 hours of use or every 6 months, whichever comes first. The inspection and test require a specific knowledge of the unit, and therefore have to be made by specially trained SIARE authorized personnel.

The anesthetist or doctor is responsible for the ordinary maintenance of the unit, as described in this chapter. Cleaning, disinfecting, sterilization and replacement of parts should be done as per the instructions in the user's manual in order to avoid damage to the equipment that could also endanger the safety of the patient and operator.

The components used have been selected after technical and comparative tests in the designing phase of the machine.

Furthermore, the same components are always tested during the manufacturing cycle in order to obtain the maximum level of safety and reliability for the operator and patient.

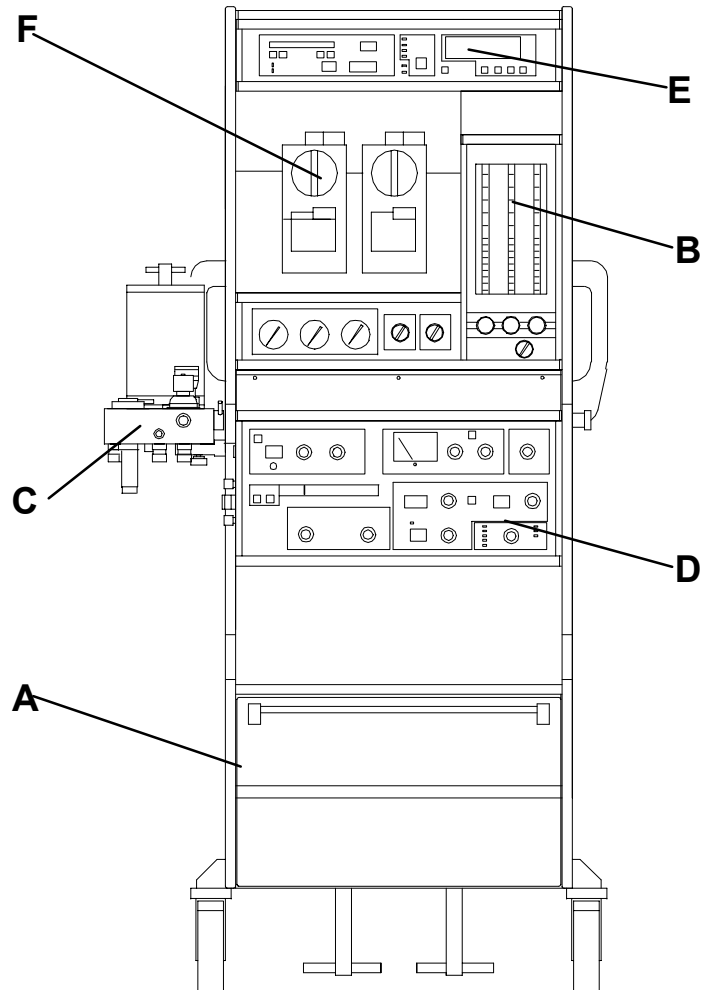
Therefore whenever a part needs to be replaced, it must be an original spare part, which has been checked and tested by SIARE.

SIARE assumes responsibility for all provisions of the law, if the unit is used and maintained as per the instructions in this manual and the technical manual. The Technical Assistance Report, signed by the authorized SIARE technician, is proof of the completion of the scheduled maintenance.

### 3. WORKSTATION DESCRIPTION

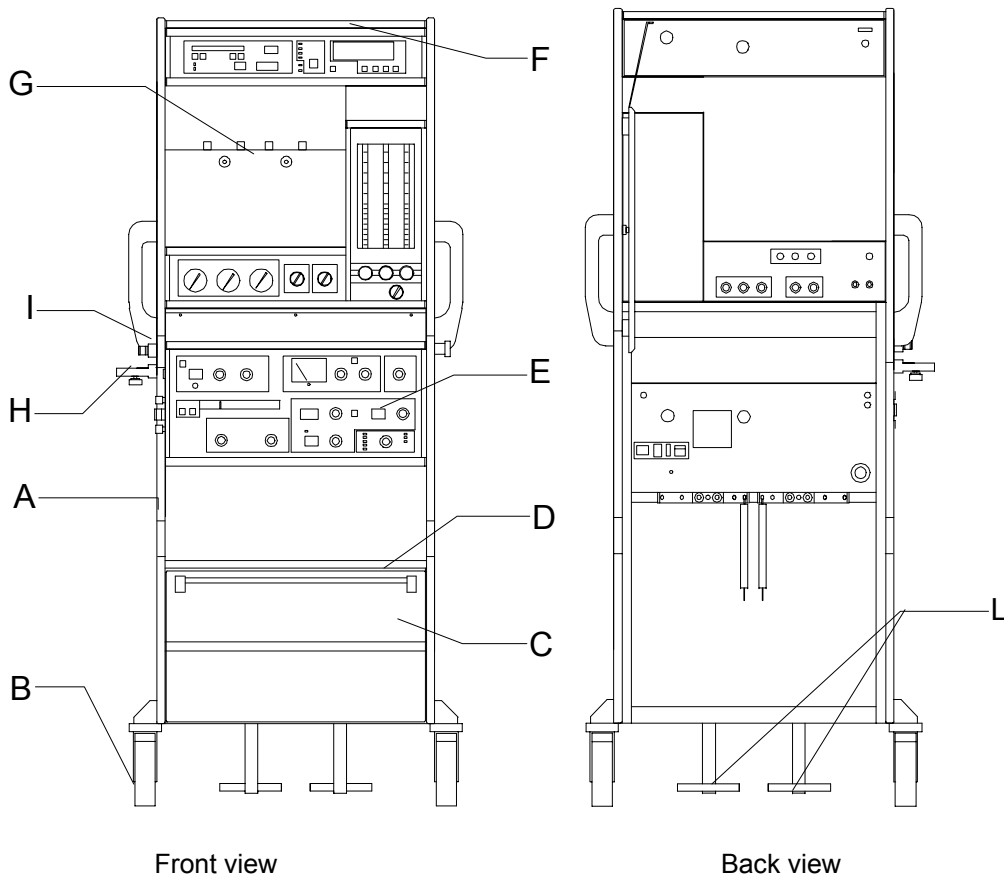
#### 3.1 General Information

The PERSEO unit is composed of modules.  
In its full optional configuration, it is composed of the following sections:



- A Structure
- B AM5000/3 – AM5000/5 anaesthesia module
- C Breathing System
- D VM 2000 lung ventilator
- E RM 3000 breathing monitor
- F Anaesthesia vaporizer

### 3.2 Structure



- A Aluminum and laminated plastic structure
- B Antistatic pivoting wheels (the front wheels are equipped with a pedal brake)
- C Removable drawer
- D Instrument shelf
- E Work shelf
- F Monitor shelf
- G Siaretex base for rapid connection of vaporizers (optional), Selectatec type and compatible with vaporizer with interlock system (connection for second vaporizer is optional)
- H Support bracket for "Breathing System" valve unit
- I Support bracket for patient circuit arm
- L Support for 5.3 Lt. Cylinders
- M auxiliary guide for the assembly of optional accessories



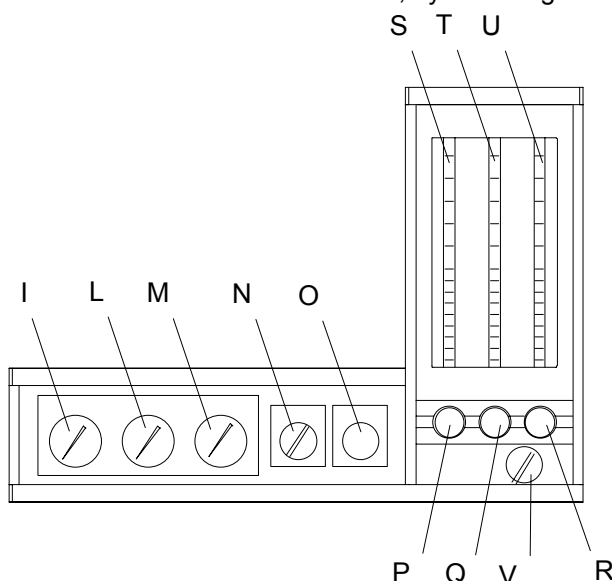
### **3.3 AM5000/3 – AM5000/5 anaesthesia module**

AM5000/3 – AM5000/5 regulates the supply and concentration of the gas mixture (Air, O<sub>2</sub>, N<sub>2</sub>O), and also supplies it to the anaesthetic gas vaporizer.

It also allows the selection of the gas mixture to be supplied (Air-O<sub>2</sub>, or N<sub>2</sub>O-O<sub>2</sub>) and the enrichment (with oxygen) of the supplied gas mixture for emergencies. The AM5000/3 – AM5000/5 is also equipped with the MIX-LIFE device that guarantees a minimum of 25% oxygen in all open-tap conditions.

By using the three gauges located on the front panel, the medical gases supply pressure coming from the central gas installation can be continuously controlled (precision ± 10%).

The flowmeters permit the measurement of the flow the of the corresponding gases with a precision of ± 10% of the displayed value or ± 1% of the bottom of the scale, by choosing the highest of the two values.



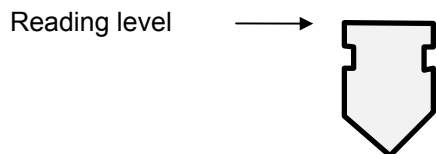
Front view AM5000/3

- I OXYGEN supply gauge.
- L NITROUS OXIDE supply gauge.
- M AIR supply gauge.
- N Selector switch for AIR / NITROUS OXIDE. This safety device: avoids the contemporaneous supply of air and nitrous oxide only the selected gas will be available on the flowmeters.
- O OXYGEN BY-PASS key. By pressing this key pure oxygen is released into the anaesthesia circuit with a flow of approximately 60 l/min.
- P OXYGEN flow regulator for fresh gases. It opens counter-clockwise.
- Q NITROUS OXIDE flow regulator for fresh gases. It opens counter-clockwise. The opening of this regulator automatically supplies a flow of oxygen of about 25% of the total mixture. The flow of oxygen can be viewed on flowmeter (S). This safety device (MIX LIFE) avoid the incorrect administration of hypoxic mixtures.
- R AIR flow regulator for fresh gases. It opens counter-clockwise.
- S OXYGEN flowmeter (Max flow 12 l/min). In the model for low flows, there is a second flowmeter with a lower scale of 1 liter.
- T NITROUS OXIDE flowmeter (Max flow 12 l/min).. In the model for low flows there is a second flowmeter with a lower scale of 1 liter.
- U AIR flowmeter (Max flow 12 l/min).
- V Selector switch for the exit of fresh gases (BREATHING SYSTEM or TO AND FRO).

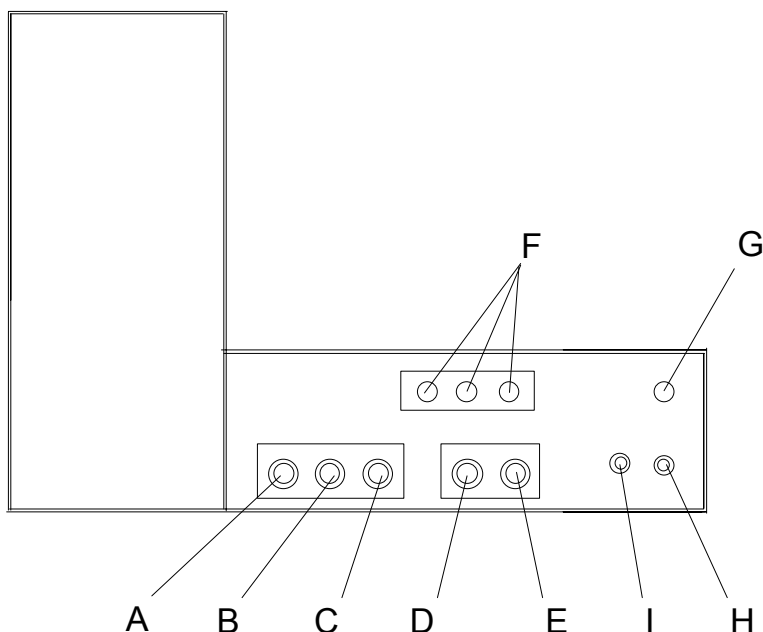
For more details about the scales and the precision of the gauges and flowmeters, please refer to appendix A «Technical data».

Avoid closing the regulators too tightly, so not as to wear or damage them.

The indicated flow value should be read at the upper level of the rim of the flowmeter indicator when it rotates. If there is not rotation ask for technical assistance.



**CUT-OFF ALARM.** If the anaesthesia module sounds a whistle, it means that the pressure of the oxygen is too low. Immediately take action to reset the oxygen pressure. If the pressure of the main system is not available, use the oxygen gas cylinder for emergencies.



Back View

- A OXYGEN inlet from the main medical gas installation.
- B NITROUS OXIDE inlet from the main medical gas installation.
- C COMPRESSED AIR inlet from the main medical gas installation.
- D OXYGEN inlet from the cylinder's pressure reducer.
- E NITROUS OXIDE inlet from the cylinder's pressure reducer.
- F AIR/OXYGEN outlet for the supply of the lung ventilator, of the active scavenging system and the tracheal aspiration unit.  
In optimal conditions these connector supply COMPRESSED AIR.  
If there is no COMPRESSED AIR or there is not enough pressure, the unit automatically switches the distribution to OXYGEN.
- G Emergency OXYGEN outlet.  
These connectors are supplied standard with the machine if the relative accessories are in use
- H Exit of fresh gases connector for TO and FRO.
- I FRESH GAS outlet for the *Breathing System*. (please refer to chapter 4.4 "Breathing System Assembly" in the PERSEO'S user manual)



**DANGER OF FIRE!** Do not connect devices that are not explicitly certified to function with **PURE OXYGEN** to outlets F and G.

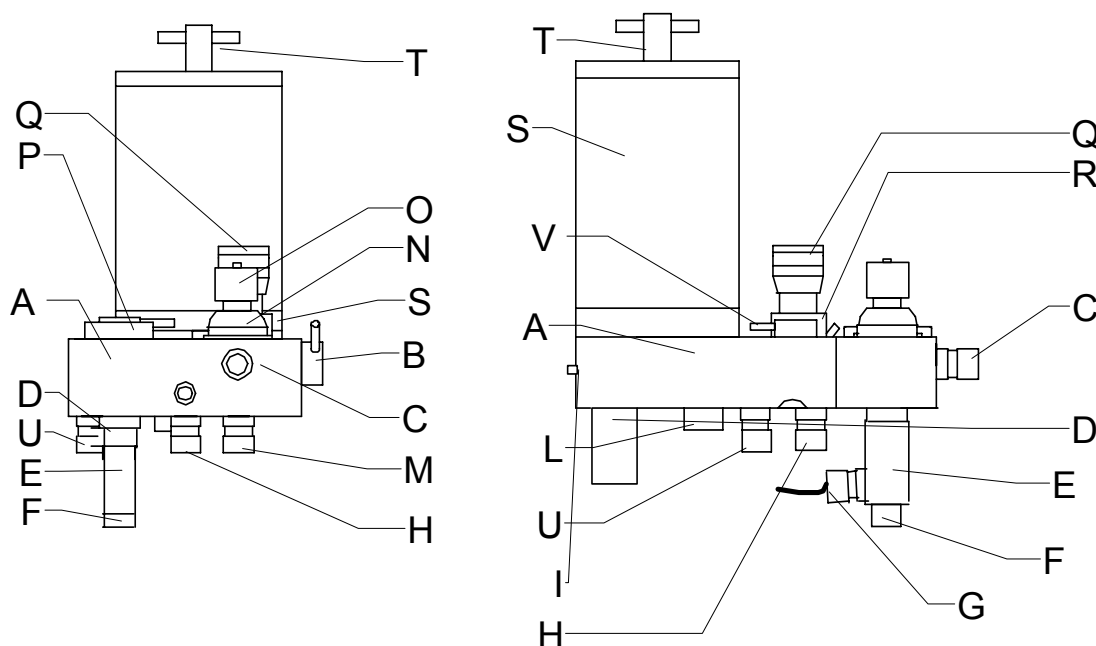


Do not make connections to the main medical gas installation or the gas cylinders before reading section 4.2 “**MEDICAL GAS CONNECTION**” in the PERSEO’S user manual.

### 3.4 Breathing System

#### 3.4.1. OPEN-SEMICLOSED VERSION (NON REBREATHING -REBREATHING)


It is the device that takes fresh gases towards the patient and that collects the expired gases towards the CO<sub>2</sub> absorber and then to the lung ventilator to be supplied to the patient. The fresh gases supplied by the AM5000 anaesthesia module are also added to the *Breathing System*. With this circuit it is also possible, by simply rotating the selector (V), to change the system into an OPEN or NON-REBREATHING. The manual ventilation is possible directly from the valve group or with the TO AND FRO system.



- A Structure of the *Breathing System*.
- B Selector form AUTOMATIC SPONTANEOUS or MANUAL (AUT.SPONT-MAN) ventilation.
- C Inspiratory line connection to the patient circuit.
- D Water trap
- E Expiratory flow sensor.
- F Expiratory line connection to the patient circuit.
- G Mounting bracket for the flow sensor.
- H Reservoir balloon connection.
- I Connection for fresh gas input hose from AM 5000 anaesthesia module.
- L Ambient air aspiration valve. Opens automatically when the quantity of fresh gases in the breathing circuit is not enough to guarantee the set current volume.
- M Connection to lung ventilator.
- N Inspiratory valve plastic cover
- O Oxygen sensor. It measures the O<sub>2</sub> concentration of the inspiratory mix, therefore right before the mix reaches the patient.
- P Expiratory valve.
- Q APL valve. It regulates the maximum airway pressure during manual ventilation. The pressure increases by turning the knob of the valve clockwise and lowers by turning it counter-clockwise. The range of regulation is from approximately 2 to 30 cmH<sub>2</sub>O.

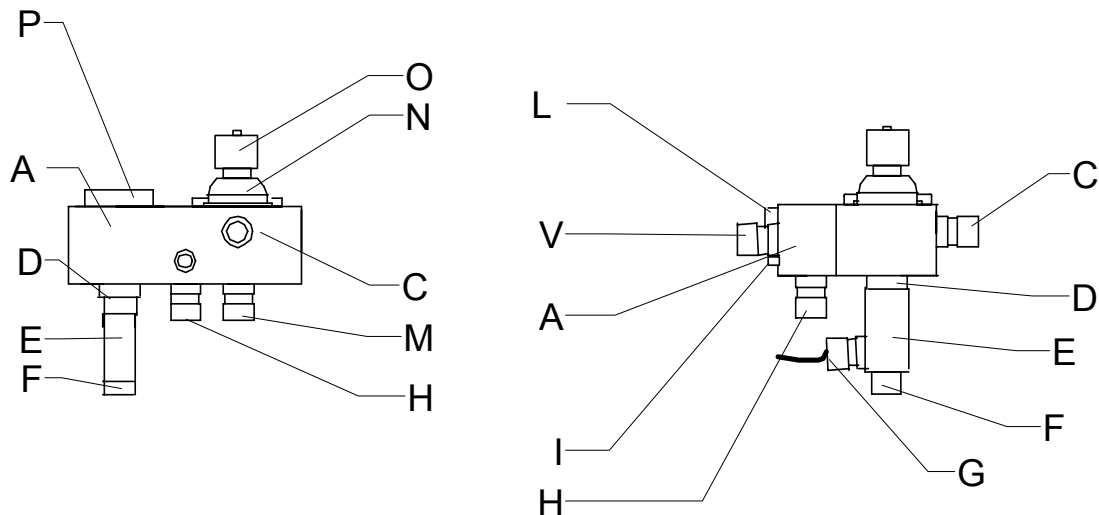



**During manual ventilation, the airway pressure can go over the limit set on the lung ventilator. The pressure limit depends on the regulation of the APL valve.**

- R mounting bracket of APL valve.
- S Soda lime canister, capacity 1.5 Kg.
- T Locking cap for closing and lifting the canister.
- U Connection for exit of used breathing gases ( to be connect to scavenging system).
- V REBREATHING or NON REBREATHING selector.

### 3.4.2. OPEN VERSION (NON REBREATHING)

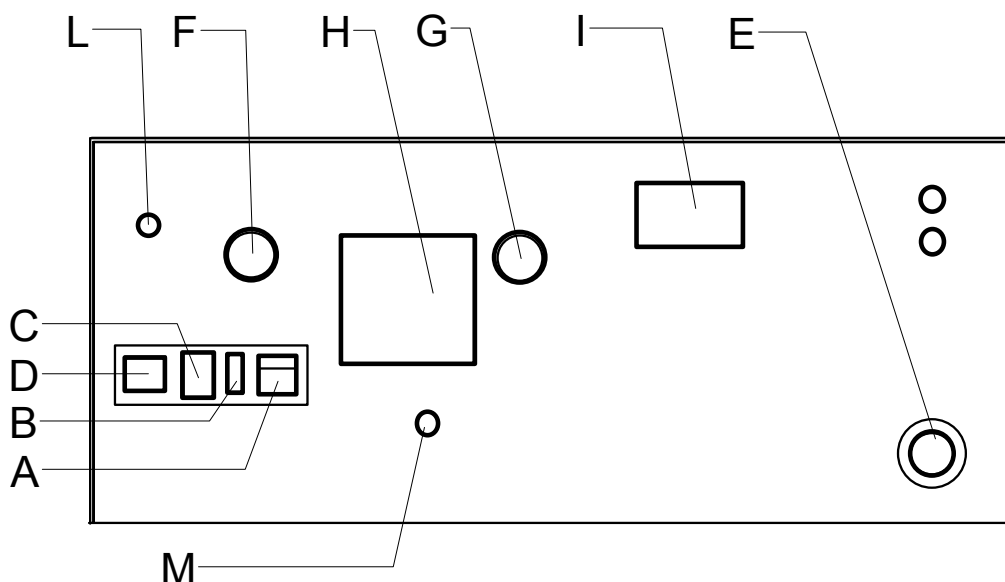
It is the device that takes fresh gases towards the patient and that collects the expired gases towards the disposal. The fresh gases from the AM5000 modules are also collected on the Breathing System. The manual ventilation is possible only with the TO AND FRO system.



- A Structure of the *Breathing System*.
- C Inspiratory line connection to the patient circuit.
- D Flow sensor connection to the expiratory line.
- E Expiratory flow sensor.
- F Expiratory line connection to the patient circuit
- G Mounting bracket for the flow sensor.
- H Reservoir balloon connection.
- I Connection for fresh gas input hose from AM 5000 anaesthesia module.
- L Ambient air aspiration valve. Opens automatically when the quantity of fresh gases in the breathing circuit is not enough to guarantee the set current volume.
- M Connection to lung ventilator.
- N Inspiratory valve plastic cover
- O Oxygen sensor. It measures the O<sub>2</sub> concentration of the inspiratory mix, therefore right before the mix reaches the patient.
- P Expiratory valve.
- V Connection for exit of used breathing gases ( to be connect to scavenging system).

### 3.5. VM 2000 lung ventilator

VM2000 lung ventilator is the device that mechanically controls the breathing activity of the patient when the patient is being automatically ventilated. Other than the regulations of the patient's ventilation mode, the VM2000 also enables checking the airway pressure and oxygen concentration of the patient's gas mixture.



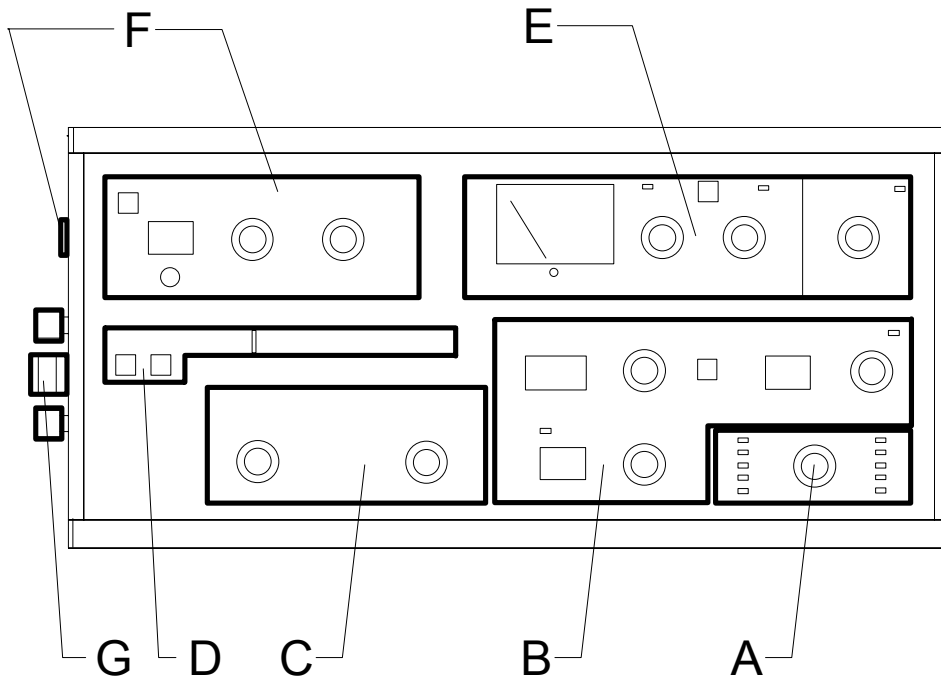
Back view

- A Main ON/OFF switch
- B Safety fuses



**ATTENTION!** The specification of the fuse to be used is indicated on the identification tag(I).  
Never use fuses with a different specification.

- C Inlet for main power cable.
- D Inlet for auxiliary power (MAX 6 Ampere).
- E Inlet for AIR - OXYGEN (3.5 Bar ± 0.75).
- F Outlet for power cable for RM3000 monitor.
- G Outlet for synchronizing cable for RM3000 monitor.
- H Cooling fan.
- I Identification tag.  
The following specifications are displayed:
  - MODEL
  - SERIAL NUMBER
  - POWER SUPPLY
  - POWER FREQUENCY
  - POWER CONSUMPTION
  - FUSE SPECIFICATION
- L Battery safety fuse (5A T).
- M equipotential connector.

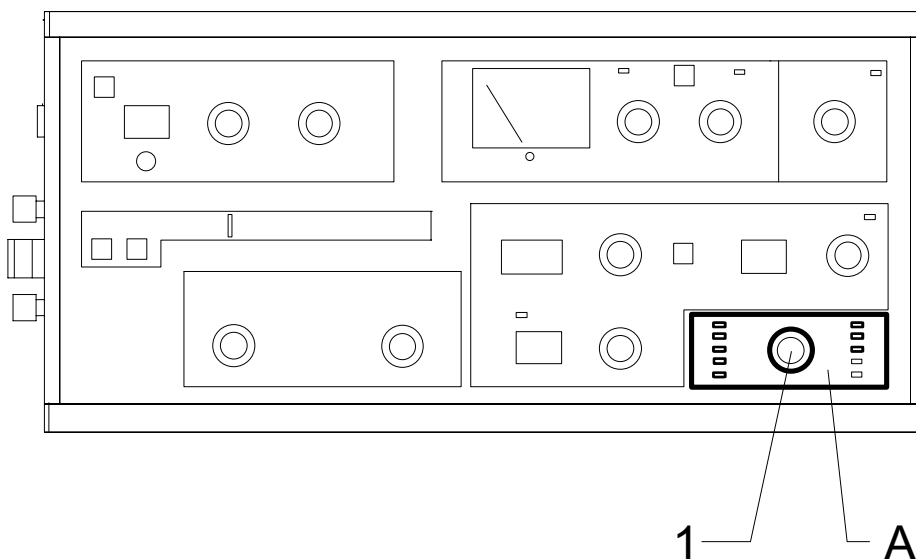


Front View

- A MODE section for setting ventilation modes of the lung ventilator
- B RATE section for setting breathing rate.
- C FLOW-PEEP section for setting inspiratory flow and the positive end expiratory pressure (PEEP).
- D TIDAL VOLUME section for setting tidal volume for the breathing act.
- E AIRWAY PRESSURE section for setting minimum and maximum alarm limit for the airway pressure, therefore check the maximum airway pressure, that the VM2000 can reach when in operation.
- F OXYMETER section for measurement and alarm for airway gas concentration.
- G BELLOW section



### 3.5.1. A) MODE Section

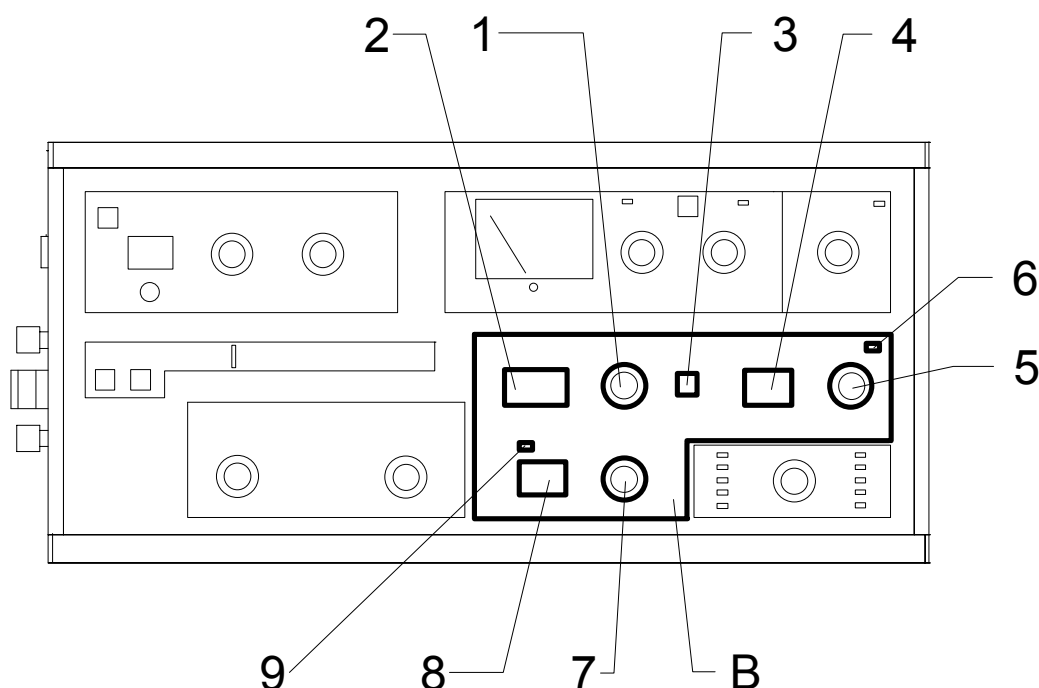


Operating modes of the lung ventilator can be selected by turning the knob of the MODE section (1). The selection of a operating mode is indicated when its corresponding LED turns ON.

OPERATING MODES:

POSITION	DESCRIPTION
OFF	Machine off displays the status of the power supply when one of the following operating modes are selected. With the main power supply the OFF led is on and it is green. When the unit is supplied by battery and the battery is charged, the led becomes orange. When the battery is low the led becomes red and the audible alarm comes on.
STAND-BY	Stand-by (pause) mode for setting parameters.
MANUAL - SPONT	Manual and spontaneous ventilation mode
CONTROL	Controlled ventilation mode
CONTROL + ASS	Controlled-Assisted ventilation mode
ASS	Assisted ventilation mode
SIMV	Synchronized intermittent mandatory ventilation mode
IMV	Non-synchronized intermittent mandatory ventilation mode

### 3.5.2. B) RATE Section



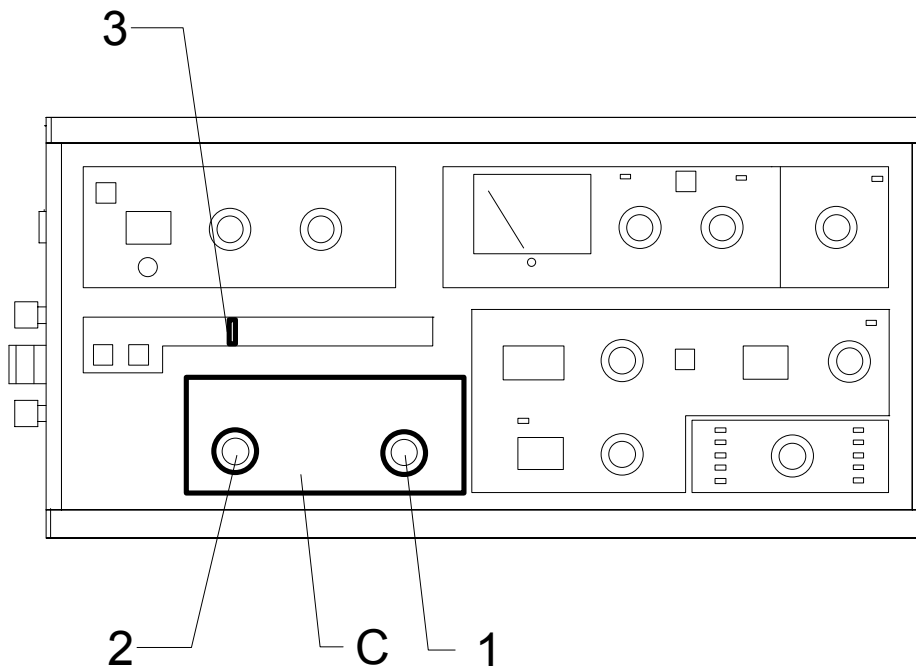
- 1 Breathing rate regulation knob (RATE) from 5 to 90 BPM (breaths per minute).  
When the machine is turned ON the preset breathing rate is 16 BPM.
- 2 Display for the set breathing rate (RATE).
- 3 Selection key for the Inspiration:Expiration ratio (I:E). When the machine is turned ON the I:E rate is reset at 1:2.  
In order to change the I:E ratio, this key (3) must be pressed and let go.  
The following I:E ratios can be selected: 1:2 > 1:3 > 1:4 > 2:1 > 3:1 > 4:1 > 1:1.
- 4 Display for the set I:E ratio.
- 5 Regulation knob for the sensor sensibility that recognizes the patient's spontaneous breathing (TRIGGER EFFORT) used to synchronize the ventilator.  
The sensibility can be adjusted from -10 to + 10 cmH<sub>2</sub>O.



**ATTENTION!** The sensibility has to be set at 2 or 3 cmH<sub>2</sub>O lower than the PEEP level.  
If the set sensibility is equal to or higher than the PEEP level, the trigger only activates at the end of each breathing cycle, hyperventilating the patient.

- 6 Yellow LED indicates trigger activation.
- 7 Regulation knob for SIMV rate (SIMV RATE).
- 8 Display for set SIMV rate (SIMV RATE).
- 9 LED for SIMV TIME. The length of time of the lit LED corresponds to the time period which the ventilator waits to synchronize the forced breath with a spontaneous breath.  
If at the end of this time period the patient has not breathed, the ventilator starts a forced breath (minimum rate guaranteed).

3.5.3. C) INSP FLOW - PEEP Section



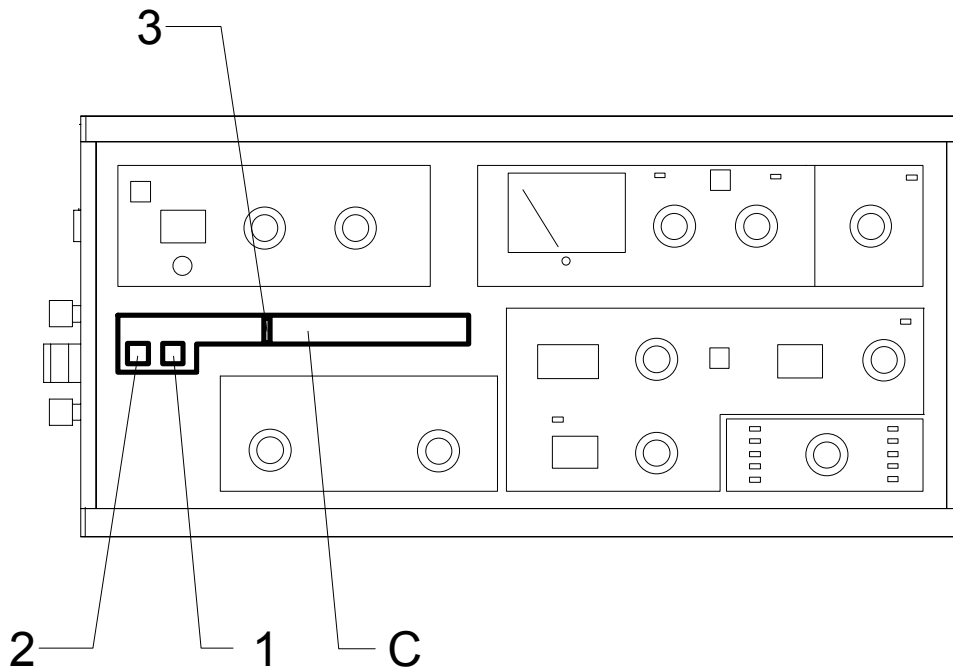
- 1 Positive end expiratory pressure (PEEP) regulation knob.



**ATTENTION!** Inserting PEEP during automatic ventilation requires care, because it determines the rise of the maximum and medium pressure of the airway pressure.  
The airway pressure alarms should always be set correctly.

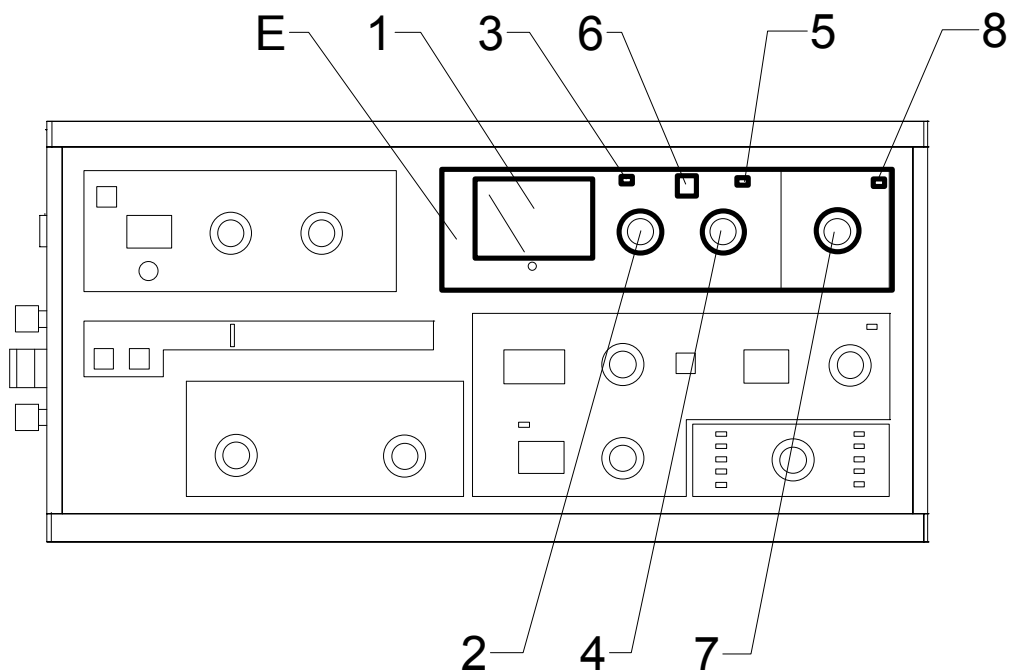
- 2 Inspiratory flow and pressure regulator.  
When ventilating with a high tidal volume or pressure the set tidal volume may not be completely administered ( the indicator of the tidal volume does not reach "0"). In this case the regulation knob (2) should be turned counter-clockwise (+) until the tidal volume indicator reaches "0".  
During normal ventilation conditions the selection knob should be completely turned clockwise (-).

3.5.4. D) TIDAL VOLUME Section



- 1 Selection key to increase tidal volume.
- 2 Selection key to decrease tidal volume.
- 3 LED for setting tidal volume with a scale from 0 to 1500 ml.  
 The indicator is connected with the bellow and therefore it will move towards the left (0 ml.) during the inspiratory cycle, and towards the right in the expiratory cycle.  
 The set tidal volume is indicated when the bellow is paused (all to the right = end of expiration).  
 It is recommended to regulate the tidal volume when the machine is on STAND-BY mode. It can also be set during ventilation, but the set tidal volume is displayed only when the bellow is at the end of its run, to the right.

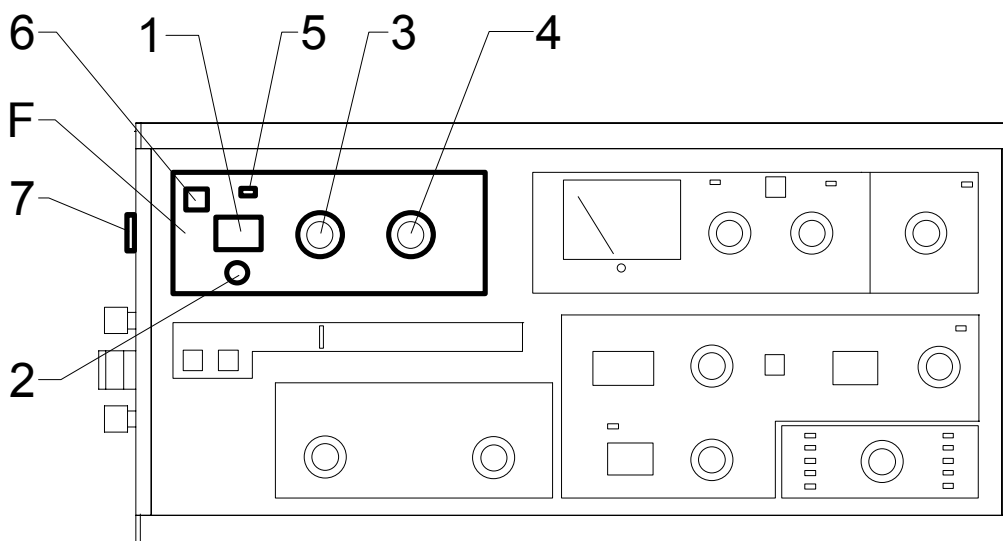
### 3.5.5. E) AIRWAY PRESSURE section



In this section the instantaneous airway pressure is measured and the following alarms are set:

- 1 Electronic airway pressure gauge. This analogic gauge enables the display of pressures from -10 to 100 cmH<sub>2</sub>O.
- 2 Regulation of low pressure alarm limit. Should be set lower than the measured (about 80%) so as to sense a decrease in pressure due to a leak or disconnection from the patient circuit.
- 3 Low pressure LED (visual) alarm. It is activated with the audible alarm when the pressure does not reach the set lower limit for at least 3 breathing cycles.
- 4 Regulation of high pressure alarm limit. Should be set higher than the measured so as to sense an increase in pressure due to, for example, an airway obstruction or an overdose of volume.
- 5 High pressure LED (visual) alarm. It is activated with the audible alarm when the pressure goes above the set upper limit. If this reoccurs for more than 5 breathing cycles the light becomes solid.
- 6 High and low pressure alarm reset. This key silences the pressure audible alarms for 30 seconds. After 30 seconds, if the alarm condition is still present, the alarm sounds again. If the alarm condition no longer exists, the alarm resets itself automatically.
- 7 Maximum pressure limit regulation. This regulation sets the maximum limit of the airway pressure. When this limit is reached the inspiratory phase stops and the expiratory phase starts (pressure limit operation). **When the pressure limit is activated, the set tidal volume is not completely administered.**
- 8 Pressure limit LED (visual) alarm. It is activated when the pressure limit is reached.

### 3.5.6. F) OXYMETER Section

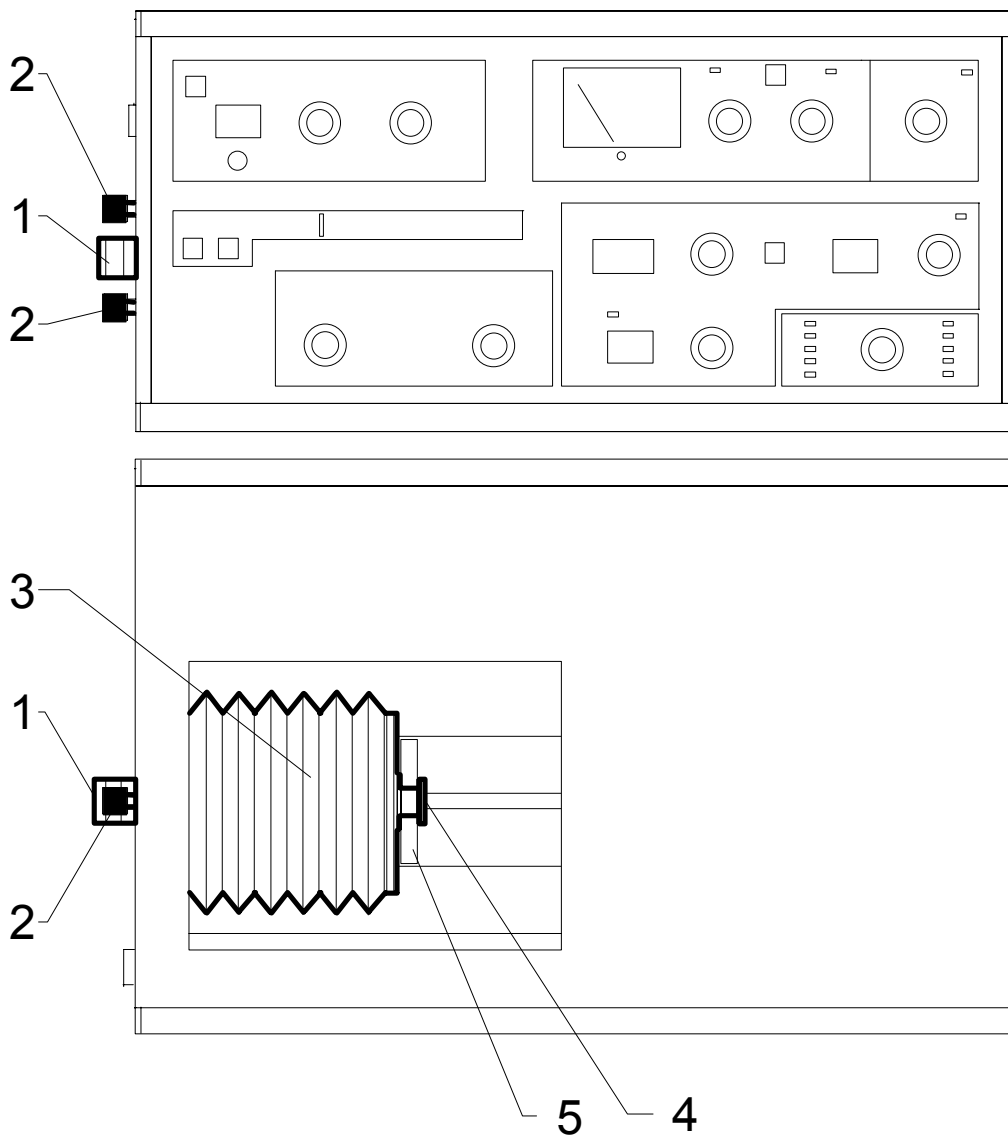


This device continuously measures the percentage of oxygen in the breathing mixture and checks that the concentration is within the set limits. The sensor is made of a galvanized cell mounted on the inspiratory valve of the Breathing System.

The oxymeter section is composed of:

- 1 Oxygen concentration display. The oxygen concentration value is displayed. If the sensor is not connected, two dashes (--) will appear on the display.
- 2 Calibration knob. Calibration enables the correction of the value read from the oxygen sensor by testing a mixture with a known oxygen concentration.  
The calibration procedure is described on section 5.3.
- 3 Minimum oxygen concentration alarm limit regulation. Should be regulated lower than the set concentration level so as to signal a decreases in the concentration of oxygen.
- 4 Maximum oxygen concentration alarm limit regulation. Should be regulated higher than the set concentration level so as to signal an increase in the concentration of oxygen.
- 5 Oxygen concentration LED (visual) alarm. The LED is always on when the high or low oxygen concentration alarm is activated.
- 6 Oxygen concentration audible alarm reset. This key silences the oxygen concentration audible alarms for 30 seconds. After 30 seconds, if the alarm condition is still present, the alarm sounds again. If the alarm condition no longer exists, the alarm resets itself automatically.
- 7 Inlet for oxygen concentration sensor.

3.5.7. G) BELLOW section



The primary circuit of the lung ventilator is composed of a rubber bellow moved by a pneumatic linear activator.

The bellow's run is regulated by an end-of-run guide which is positioned by a low voltage electric motor. The length of the run determines the tidal volume that will be administered.

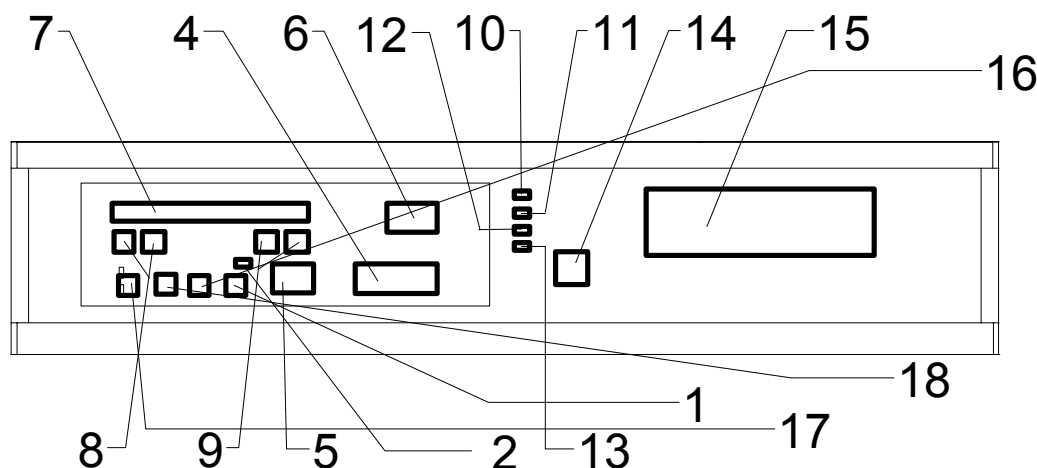
The bellow is accessible by raising the instrument shelf of the trolley.

- 1 Inlet to *Breathing System*.
- 2 Knobs for mounting the front of the bellow.
- 3 Rubber bellow.
- 4 Device for mounting the rear of the bellow.
- 5 Rear bellow support.

### 3.6. RM 3000 Breathing Monitor

The RM 3000 breathing monitor is a device that measures, displays, elaborates and controls the breathing parameters such as expiratory flow, airway pressure, tidal volume, the breathing rate (number of breaths per minute) and minute volume administered to the patient.

It warns the operator to alarm conditions when there is an apnea condition, high or low tidal or minute volume.



Front view

- 1 ON/OFF switch. The lung ventilator needs to be ON (main power switch in position "I") in order to turn ON the RM 3000 breathing monitor.
- 2 Power Stand-by LED.
- 4 Expired Tidal Volume display (EXP TIDAL VOLUME).
- 5 Measured breathing rate display (RATE).
- 6 Expired Minute Volume display (EXP. MINUTE VOLUME).
- 7 Expired volume LED indicator. Graphically displays the expired minute volume with the alarm limit marked by two blinking LEDs.
- 8 Low expired volume alarm limit regulation knob. (LOW MINUTE VOLUME).
- 9 High expired volume alarm limit regulation knob (HI MINUTE VOLUME).
- 10 APNEA alarm LED. The apnea alarm is activated when the monitor does not sense breathing activity.
- 11 HI MINUTE VOLUME alarm LED. The alarm is activated when the measured minute volume is higher than the set limit.
- 12 LOW MINUTE VOLUME alarm LED. The alarm is activated when the measured minute volume is lower than the set limit.
- 13 FAILURE. Technical failure. Indicates an operational problem in the monitor.
- 14 Reset of audible alarm.

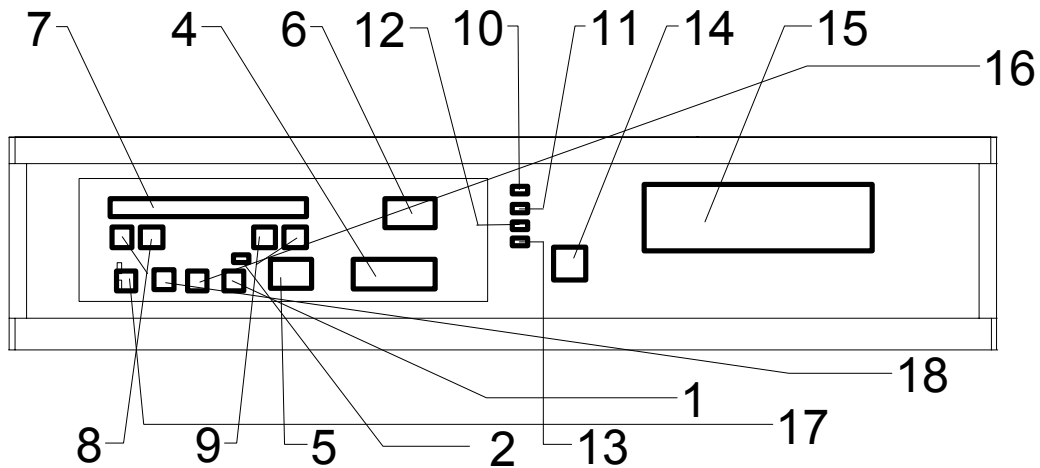
#### **ALARM LOGIC**

When there is an alarm condition, the relative LED is lit and audible alarm will sound.

After pressing the RESET key, if the alarm condition no longer exists, the LED is turned-off and the audible alarm is silenced. If the alarm condition is still present, the LED will blink and the audible alarm will be silenced for 30 seconds.

If the alarm condition stops within the 30 seconds after a RESET, both the visual and audible alarm will be automatically reset.





Front View

15 Back-lighted LCD display for monitoring the expiratory flow and pressure curves.

16 ENTER key. Enables choosing the required curve menu.

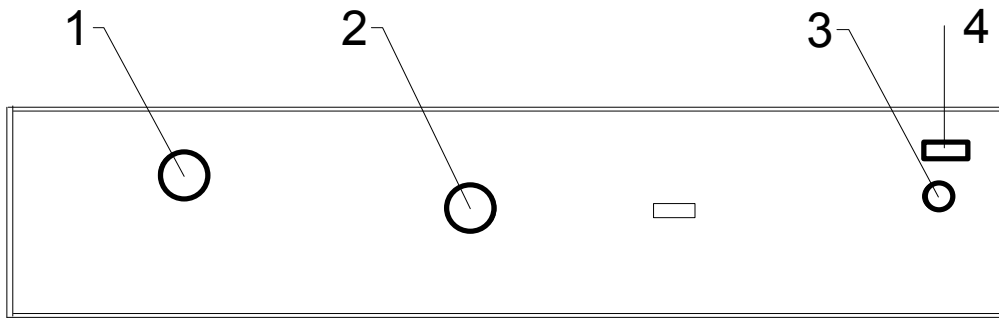
F1 Airway pressure  
F2 Expiratory flow

17 F1 key.

At the first menu page, enables the increase of contrast on the display.  
From the choice menu, enables the selection of the airway pressure curve.  
From the curve display, it enables changing the values of the Y-axis.

18 F2 key.

At the first menu page, enables the decrease of contrast on the display.  
From the choice menu, enables the selection of the expiratory flow curve.  
From the curve display, it enables changing the values of the X-axis.



Back View

- 1 Inlet for power cable (POWER).
- 2 Inlet for synchronization cable (LUNG VENTILATOR).
- 3 Inlet for flow sensor (FLOW SENSOR).
- 4 Serial Connector (SERIAL).

For the unit's connections to the workstation, please refer to section 4.1 of USER'S MANUAL.

### 3.7. Vaporizer

For use and maintenance instructions for the vaporizer, please refer to the VAPORIZER USER'S MANUAL.



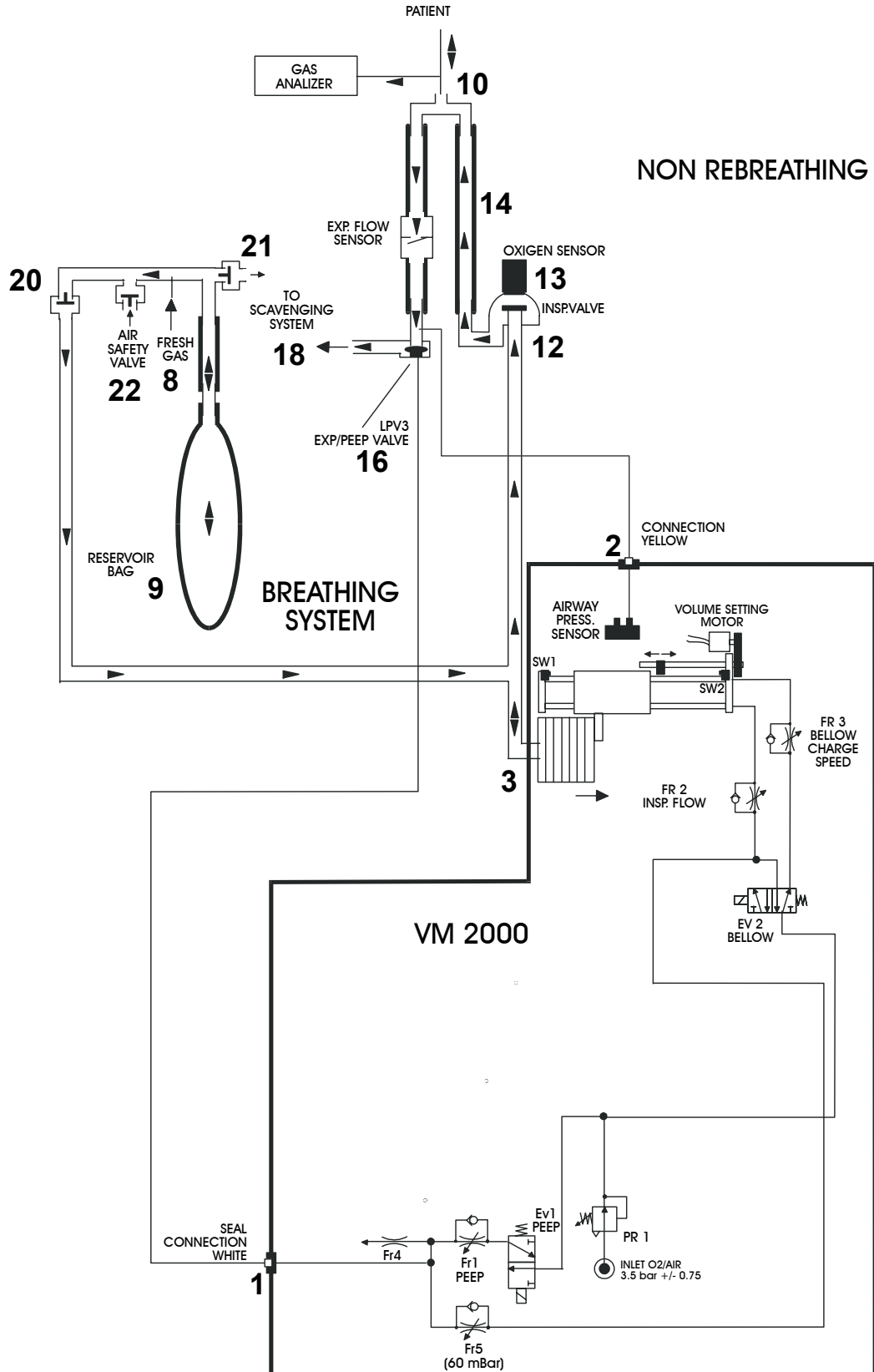
#### **PATIENT SAFETY NOTE**

**The anaesthesia vaporizer should be checked periodically and calibrated if needed (see user's manual)**

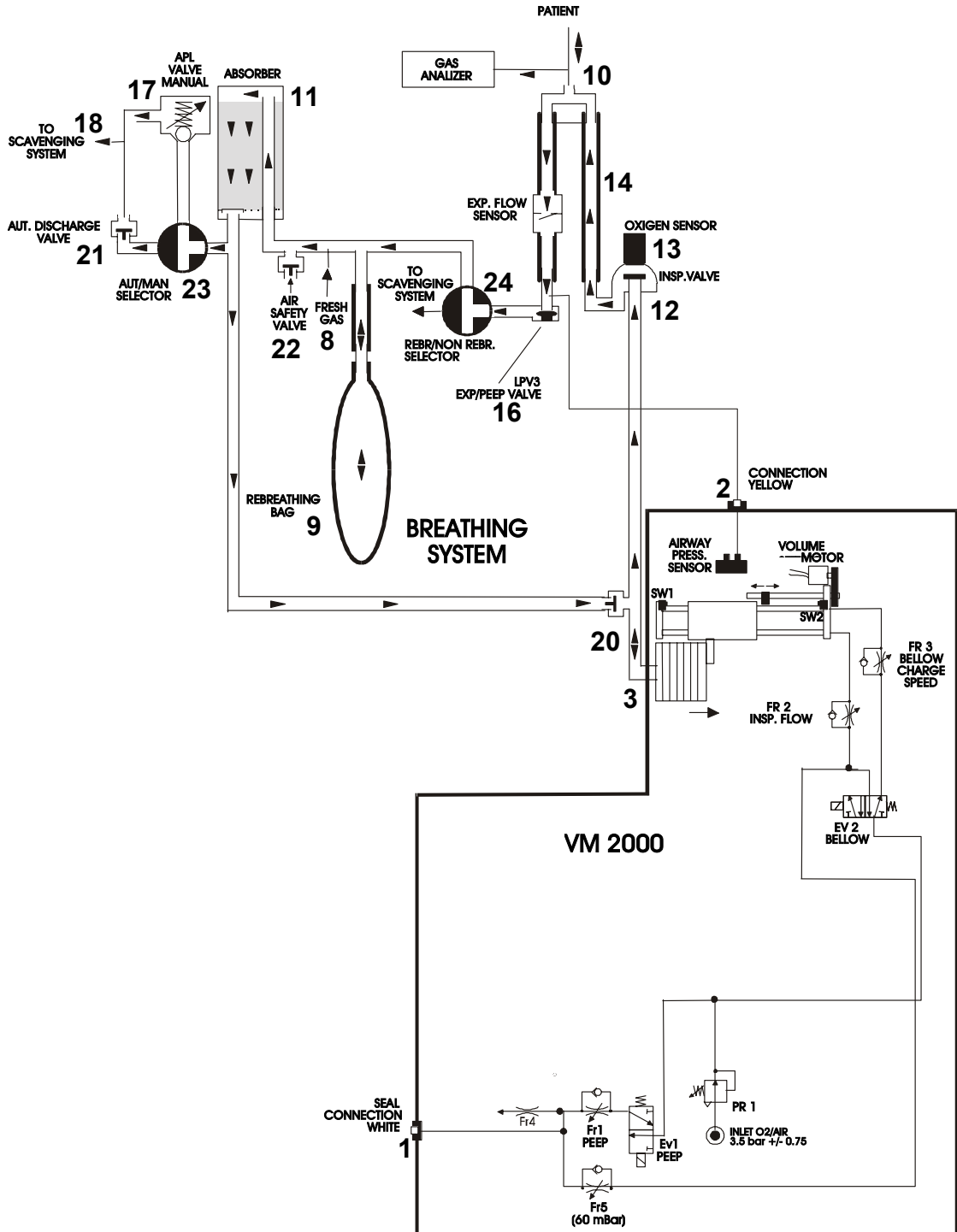
**This procedure should be done exclusively by SIARE authorized personnel or the vaporizer's manufacturer personnel.**

### 3.8 Operating Principal

The enclosed diagram is divided in two sections entitled VM 2000 and BREATHING SYSTEM. The VM 2000 sections contains its pneumatic diagram and a description of the diagram can be found in the VM 2000 technical manual. The BREATHING SYSTEM section contains the external breathing circuit pneumatic diagram. Between these sections it is indicated the connections between these two modules.



REBREATHING-NON REBREATHING



## CONNECTIONS BETWEEN THE BREATHING SYSTEM AND THE LUNG VENTILATOR:

Between the breathing system and the lung ventilator there are 2 pneumatic connections:

- The connection 1 feeds the pneumatic valve at low pressure denominated LPV3
- The connection 2 takes the pressure of the airway to sensor 6
- The connection 3 communicates the main breathing line with the bellow 7 of the ventilator.

The connections from 1, 2 are realized with flexible tubes o-rings. These connections are automatic when the operator assembles the group onto the trolley, and are not modifiable, while the connection 3 is realized with an ISO 22 mm corrugated tube that can be disassembled by the operator for ordinary maintenance (see PERSEO user's manual).

## FLOW OF THE BREATHING GAS IN SPONTANEOUS VENTILATION:

During spontaneous ventilation below 7 does not move, valve LPV3 is open.

The fresh gases that come from the AM5000 and go into the breathing system in position 8, filling the reservoir balloon number 9.

During the inspiratory phase, the patient is connected to point 10 and breathes the gases from this balloon. The flow of the gases in the inspiratory phase is as follows:

- reservoir balloon 9
- absorber 11. The absorber is a filter that is designed to absorb the CO<sub>2</sub> that can be present in the breathing mix.
- Inspiratory valve 12. The inspiratory valve is composed of a single-direction disc valve.
- Oxygen sensor 13. Measures the oxygen concentration in the inspiratory mix
- patient circuit in flexible corrugated tube 14.
- Mask or connector for tracheal tube 10
- patient

During the expiratory phase the patient expires only the first part of the expired gases on balloon 9, while the remaining part is disposed.

The flow of the gases in the expiratory phase is as follows

- patient
- RM3000 flow sensor
- LPV3 valve open - 16
- reservoir balloon 9
- when the reservoir balloon is full, the expired gas leave from drain 18 by manual regulation valve 17 (APL VALVE).

NOTE . the part of the fresh gases that is recycled depends from the type of flow of fresh gases that continuously arrive to reservoir 9. If at the beginning of the expiration, the reservoir 9 is already full of fresh gases, all the gases expired from the patient will exit by drain 18.

If instead (normal condition) the balloon will be only partly full, a small part of the expiratory mix will return to balloon 9, to be later filtered by the CO<sub>2</sub> absorber (11) and administered again to the patient.

## FLOW OF THE BREATHING GASES IN MANUAL VENTILATION

During the manual ventilation the configuration of the valves and the flow of the gases is the same as the spontaneous ventilation.

The spontaneous inspiratory phase of the patient is replaced by the manual squeezing of the reservoir balloon (9).

During this phase, the pressure of the airway increases up until the value set on the APL valve.

When it reaches this pressure value, the APL valve opens disposing of the excess gas in the circuit. This system enables to always maintain a balance between the fresh gases in the circuit and the expired gases disposed of.

### **FLOW OF THE BREATHING GASES IN AUTOMATIC VENTILATION**

During the AUTOMATIC ventilation, the breathing work of the patient is completely replaced by the lung ventilator that automatically delivers the breathing gas in the lungs of the patient generating a positive pressure.

During the inspiratory phase, the bellow 7 closes, forcing the gas towards the patient.

In this phase the single-direction valve (20) is closed in order to avoid that the gases go into balloon 9 and the LPV3 expiration valve is closed in order to avoid that the gases are driven out.

In this way the gases reach the lung of the patient.

During the expiratory phase, the bellow 7 opens aspirating the gas from reservoir balloon 9.

At the same time the patient expires freely on the reservoir balloon 9, followed by the opening of the expiratory valve LPV3.

When the balloon is full, the portion of the excess gas is disposed of through valve 21 that is tarred at 2 cmH<sub>2</sub>O.

The fresh gases from AM5000 module go into the breathing circuit in position 8 filling the balloon 9.

## **OPERATING PRINCIPALIN OPEN CIRCUIT VERSION (NON REBREATHING)**

The enclosed diagram is divided in two sections entitled VM 2000 and BREATHING SYSTEM. The VM 2000 sections contains its pneumatic diagram and a description of the diagram can be found in the VM 2000 technical manual.

The BREATHING SYSTEM section contains the external breathing circuit pneumatic diagram.

Between these sections it is indicated the connections between these two modules.

### **CONNECTIONS BETWEEN THE BREATHING SYSTEM AND THE LUNG VENTILATOR:**

Between the breathing system and the lung ventilator there are 2 pneumatic connections:

- The connection 1 feeds the pneumatic valve at low pressure denominated LPV3
- The connection 2 takes the pressure of the airway to sensor 6
- The connection 3 communicates the main breathing line with the bellow 7 of the ventilator.

The connections from 1, 2 are realized with flexible tubes o-rings. These connections are automatic when the operator assembles the group onto the trolley, and are not modifiable, while the connection 3 is realized with an ISO 22 mm corrugated tube that can be disassembled by the operator for ordinary maintenance (see PERSEO user's manual).

### **FLOW OF THE BREATHING GAS IN SPONTANEOUS VENTILATION:**

During spontaneous ventilation below 7 does not move, valve LPV3 is open.

The fresh gases that come from the AM5000 and go into the breathing system in position 8, filling the reservoir balloon number 9.

During the inspiratory phase, the patient is connected to point 10 and breathes the gases from this balloon. The flow of the gases in the inspiratory phase is as follows:

- reservoir balloon 9
- absorber 11. The absorber is a filter that is designed to absorb the CO<sub>2</sub> that can be present in the breathing mix.
- Inspiratory valve 12. The inspiratory valve is composed of a single-direction disc valve.
- Oxygen sensor 13. Measures the oxygen concentration in the inspiratory mix
- patient circuit in flexible corrugated tube 14.
- Mask or connector for tracheal tube 10
- patient

During the expiratory phase the patient expires only the first part of the expired gases on balloon 9, while the remaining part is disposed.

The flow of the gases in the expiratory phase is as follows

- patient
- RM3000 flow sensor
- LPV3 valve open – 16
- Drain 18

**NOTE** If the part of fresh gases that reach the balloon 9 is not enough to grant the ventilation the valve (22) opens automatically to allow entrance of ambient air.

### **FLOW OF THE BREATHING GASES IN AUTOMATIC VENTILATION**

During the AUTOMATIC ventilation, the breathing work of the patient is completely replaced by the lung ventilator that automatically delivers the breathing gas in the lungs of the patient generating a positive pressure.

During the inspiratory phase, the below 7 closes, forcing the gas towards the patient.

In this phase the single-direction valve (20) is closed in order to avoid that the gases go into balloon 9 and the LPV3 expiration valve is closed in order to avoid that the gases are driven out.

In this way the gases reach the lung of the patient.

During the expiratory phase, the bellow 7 opens aspirating the gas from reservoir balloon 9. At the same time the patient expires freely on the drain (18), followed by the opening of the expiratory valve LPV3.

The fresh gases from AM5000 module go into the breathing circuit in position 8 filling the balloon 9.

## **OTHER OPERATIVE MODES**

### **ASSISTED VENTILATION (see User's Manual)**

In the assisted ventilation the patient can control the start of a forced breath.

When the patient tries to breath, he creates a small depression inside the circuit that is detected by the pressure sensor 6, which immediately activates a forced act.

### **SIMV - IMV (see User's Manual)**

This mode alternates the SPONTANEOUS ventilation with AUTOMATIC or AUTOMATIC + ASSISTED.

### **PEEP**

Positive end of expiration pressure.

In normal conditions the patient expires at ambient pressure or at the maximum of the pressure of 2 cmH<sub>2</sub>O generated by the disposal valve (21).

It is possible by the LPV3 valve increase the pressure of the end of expiration up to 20 cm H<sub>2</sub>O.

In this way the patient's lungs do not empty completely but retain a residual operating capacity which is higher than that physiologic.

This function is useful in some pathologies i.e. of obstructive type.

For operating principles of VM 2000, RM3000, AM5000/3-AM5000/5 modules, check their Service Manual.



#### 4. ASSEMBLY OF VALVE GROUP (BREATHING SYSTEM)

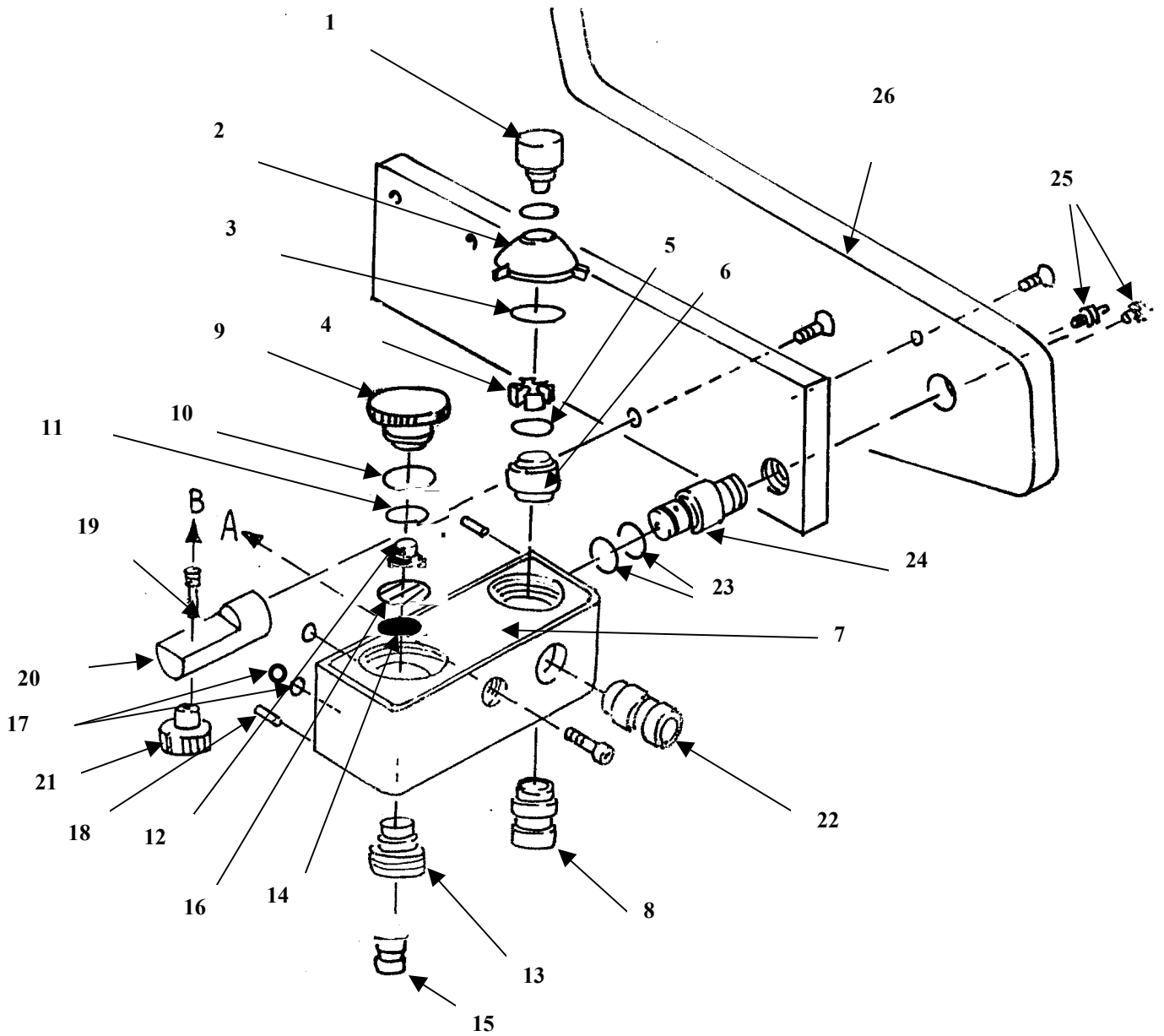
**Materials used:**

LOCTITE 573 sealer

Vaseline

RIF.	DESCRIPTION	COD.	QT.
1	POLAROGRAFIC TRANSD. O <sub>2</sub>	E75000004	1
2	INSP VALVE COVER	M52380119	1
3	OR 3166	M10003166	1
4	C S VALVE COVER	M52171909	1
5	INSP-EXP VALVE	M59171309	1
6	INSP VALVE SUPPORT	M50842509	1
7	BREATHING SYSTEM BODY	M52317419	1
8	CONNECTOR M22 for F15 X BREATHING SYSTEM	M57005519	1
9	EXP. VALVE SUPPORT	M58482319	1
10	OR 3166	M10003166	1
11	OR 2125	M10002125	1
12	EXP VALVE – BLACK RUBBER	P16000019	1
13	EXP LINE CONNECTOR	M57007219	1
14	EXP. UNIDIR.VALVE BODY	M52318109	1
15	CONNECTOR M22 for F15 X BREATHING SYSTEM	M57005519	1
16	UNIDIRECTIONAL VALVE MEMBRANE	M55110409	1
17	OR-2015	M10002015	2
18	CILINDRIC PLUG 4X14	M08000019	2
19	SCREW FOR KNOB B. SYSTEM	M59380809	1
20	B. SYSTEM SUPPORT	M58482419	1
21	FEMALE KNOB M6 D 24 CS	M26370099	1
22	CONNECTOR M22 for F15 X B. SYSTEM	M57005519	1
23	OR 2056	M10002056	2
24	B. SYSTEM CONNECTOR	M57007019	1
25	CONNECTOR M 5AU-6	P04000079	2
26	B. SYSTEM SUPPORT PLATE	M56092309	1

BREATHING SYSTEM AUT DIAGRAM: (cod G00050110).

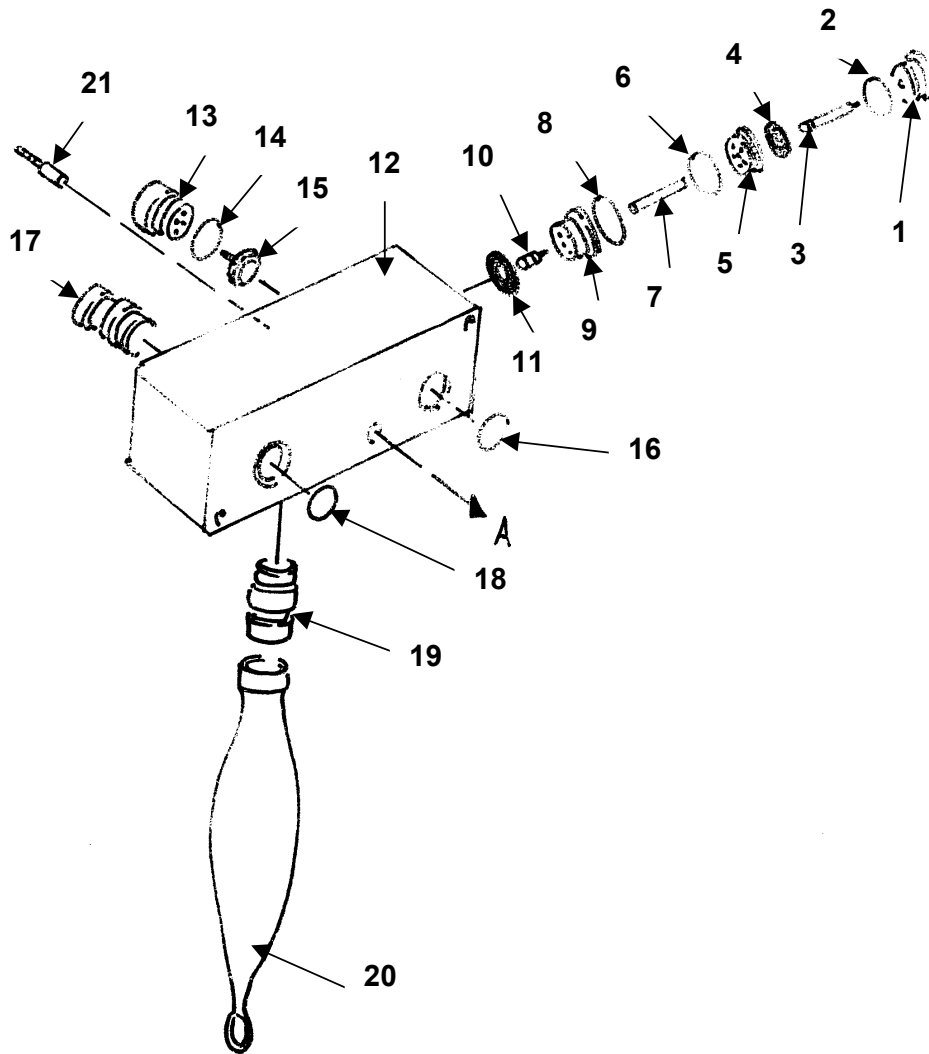


Components to complete the assembling of open BREATHING SYSTEM (cod. G00053110).

Proceed with the assembly as per the diagram and following this order:

Rif.	Description	Cod.	QT.
1	UNIDIRECTIONAL VALVE COVER	M52175519	1
2	OR 2100	M10002100	1
3	UNIDIR. VALVE PIN L=49	M55881309	1
4	UNIDIR. VALVE VIBRATING DIAPHRAGM	M55110409	1
5	UNIDIR VALVE BODY	M52317509	1
6	OR 2100	M10002100	1
7	UNIDIR. FEMALE PIN	M55881509	1
8	OR 2100	M10002100	1
9	UNIDIR VALVE BODY	M52317509	1
10	UNIDIR. VALVE PIN L=18	M55881409	1
11	UNIDIR. VALVE VIBRATING DIAPHRAGM	M55110409	1
12	OPEN CIRCUIT BODY	M50912419	1
13	AIR VALVE BODY	M52314619	1
14	OR 0128	M10000128	1
15	UNIDIR GREEN SILICONE VALVE	P16000009	1
16	OR 2075	M10002075	1
17	CONNECTOR M22 for F15 B.S.	M57005519	1
18	OR 2081	M10002081	1
19	CONNECTOR M22 for F15 B.S.	M57005519	1
20	ANAESTHESIA BAG 3 lt.	106151/3	1
21	CONNECTOR FOR RUBBER TUBE De=6.5 Di=5 L=19	P05000099	1

**BREATHING SYSTEM DIAGRAM TO COMPLETE OPEN CIRCUIT (cod. G00053110).**

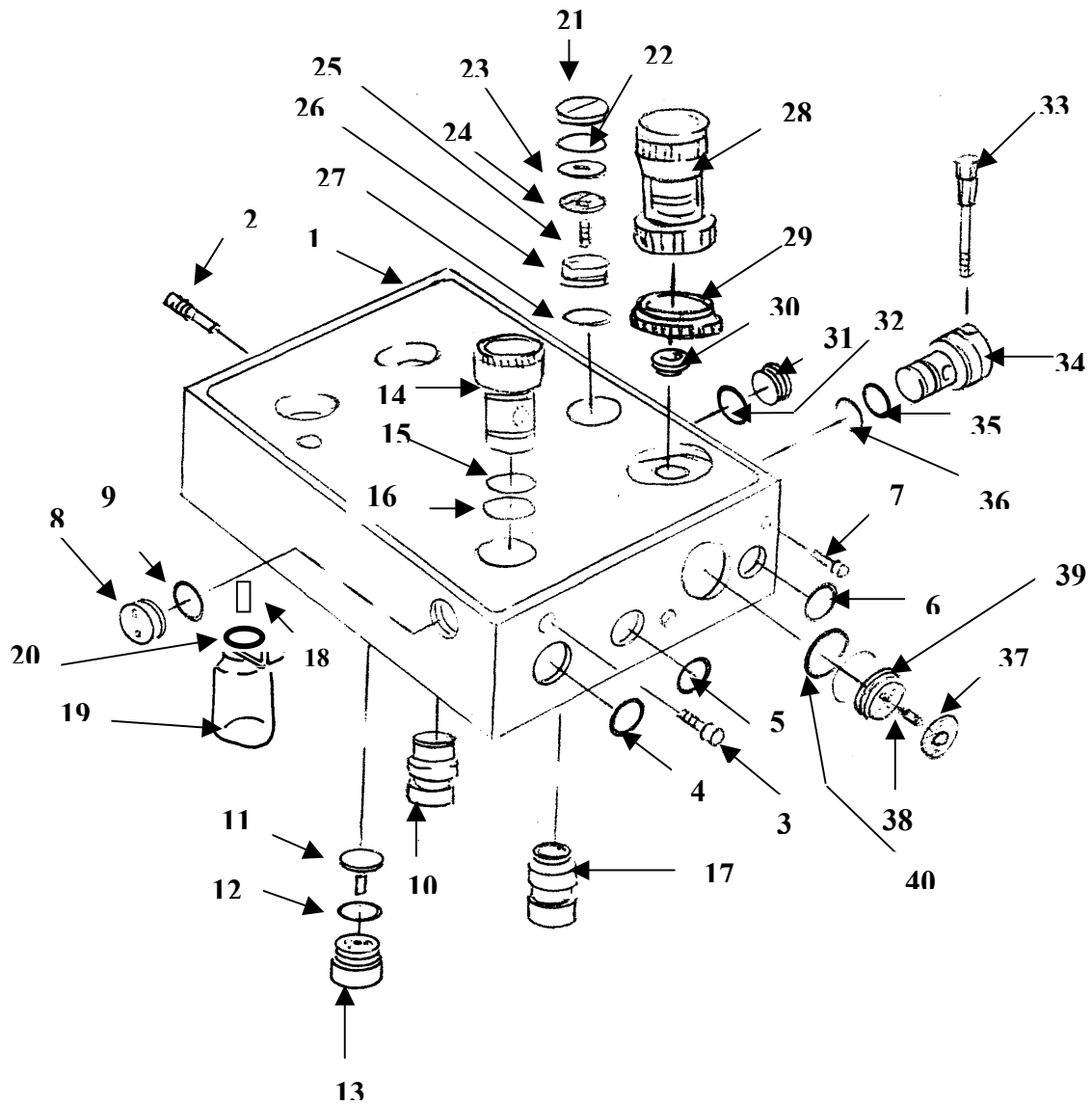


Components to complete BREATHING SYSTEM semi-closed circuit (cod. G00054110).

Proceed with the assembly as per the diagram and following this order:

Rif.	Descrizione	Codice	Quantità
1	SEMICLOSED CIRCUIT BODY	M50912529	1
2	CONNECTOR FOR RUBBER TUBE De=6.5 Di=5 L=19	P05000099	1
3	SCREW INOX TCEI M4X8	M00120029	1
4	OR 2062	M10002062	1
5	OR 2062	M10002062	1
6	OR 2050	M10002050	1
7	SCREW INOX TCEI M4X20	M00120079	1
8	B.S. COVER	M52175719	1
9	OR 108	M10000108	1
10	CONNECTOR M22 for F15 BS	M57005519	1
11	UNIDIR GREEN SILICONE VALVE	P16000009	1
12	OR 128	M10000128	1
13	AIR VALVE BODY	M52314619	1
14	SHACKLER VALVE D30	M59171219	1
15	OR 2100	M10002100	1
16	OR 2100	M10002100	1
17	CONNECTOR M22 for F15 BS	M57005519	1
18	WATER TRAP CONNECTOR	M57008609	1
19	WATER TRAP	M20280009	1
20	OR-3100	M10003100	1
21	UNIDIR VALVE COVER	M52175519	1
22	OR 2118	M10002118	1
23	PLANE BOLT INOX De=6.5 Di=5 L=19 Sp=2mm	M06120009	1
24	UNIDIR. VALVE VIBRATING DIAPHRAGM	M55110409	1
25	UNIDIR. VALVE PIN L=18	M55881409	1
26	UNIDIR. VALVE BODY	M52317509	1
27	OR 2112	M10002112	1
28	COMPLETE APL BREATHING SYSTEM VALVE	G60038110	1
29	FLANGE OF APL VALVE	M53361809	1
30	BUSH FOR APL BREATHING SYSTEM VALVE	M50980819	1
31	B.S. COVER	M52175719	1
32	OR 108	M10000108	1
33	ARMED LEVER SERIAL BL.366	M24620019	1
34	SHACKLER VALVE D22	M59171119	1
35	OR 2056	M10002056	1
36	OR 2056	M10002056	1
37	UNIDIR. VALVE VIBRATING DIAPHRAGM	M55110409	1
38	UNIDIR. VALVE PIN	M55881409	1
39	UNIDIR. VALVE BODY	M52317509	1
40	OR 2131	M10002131	1

**BREATHING SYSTEM SEMICLOSED DIAGRAM (cod. G00054110).**

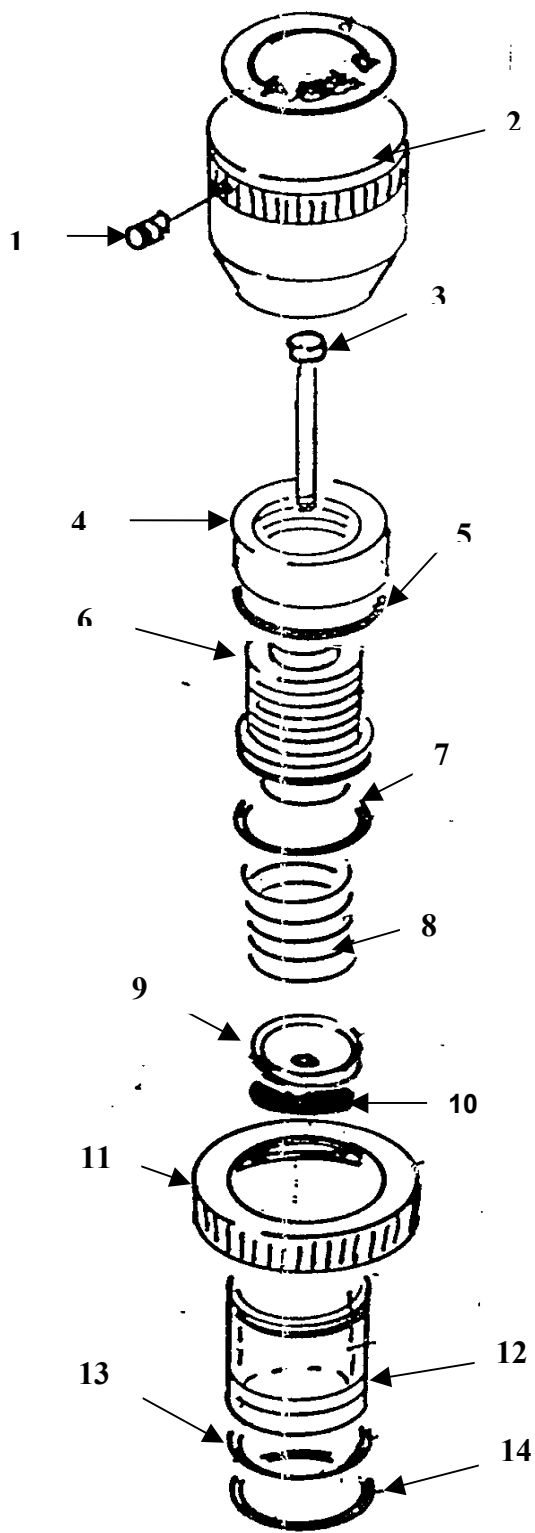


Components of complete APL VALVE FOR BREATHING SYSTEM (cod. G60038110).

Proceed with the assembly as per the diagram and following this order:

Rif.	Description	Cod.	QT.
1	GRUB SCREW (INOX) 4x6	M02220019	1
2	APL VALVE KNOB	M56370919	1
3	APL VALVE SHAFT	M50210809	1
4	APL VALVE COVER	M52174709	1
5	OR 2100	M10002100	1
6	AXIS SHAFT FOR APL VALVE	M50210909	1
7	OR 123	M10000123	1
8	SPRING FOR APL VALVE	M55251909	1
9	APL VALVE	M59170819	1
10	VIBRATING DIAPHRAGM	M55110009	1
11	APL VALVE BUSH	M53711919	1
12	APL VALVE BODY	M52316109	1
13	OR 3106	M10003106	1
14	OR 123	M10000123	1

COMPLETE APL VALVE FOR BREATHING SYSTEM DIAGRAM (cod. G60038110).



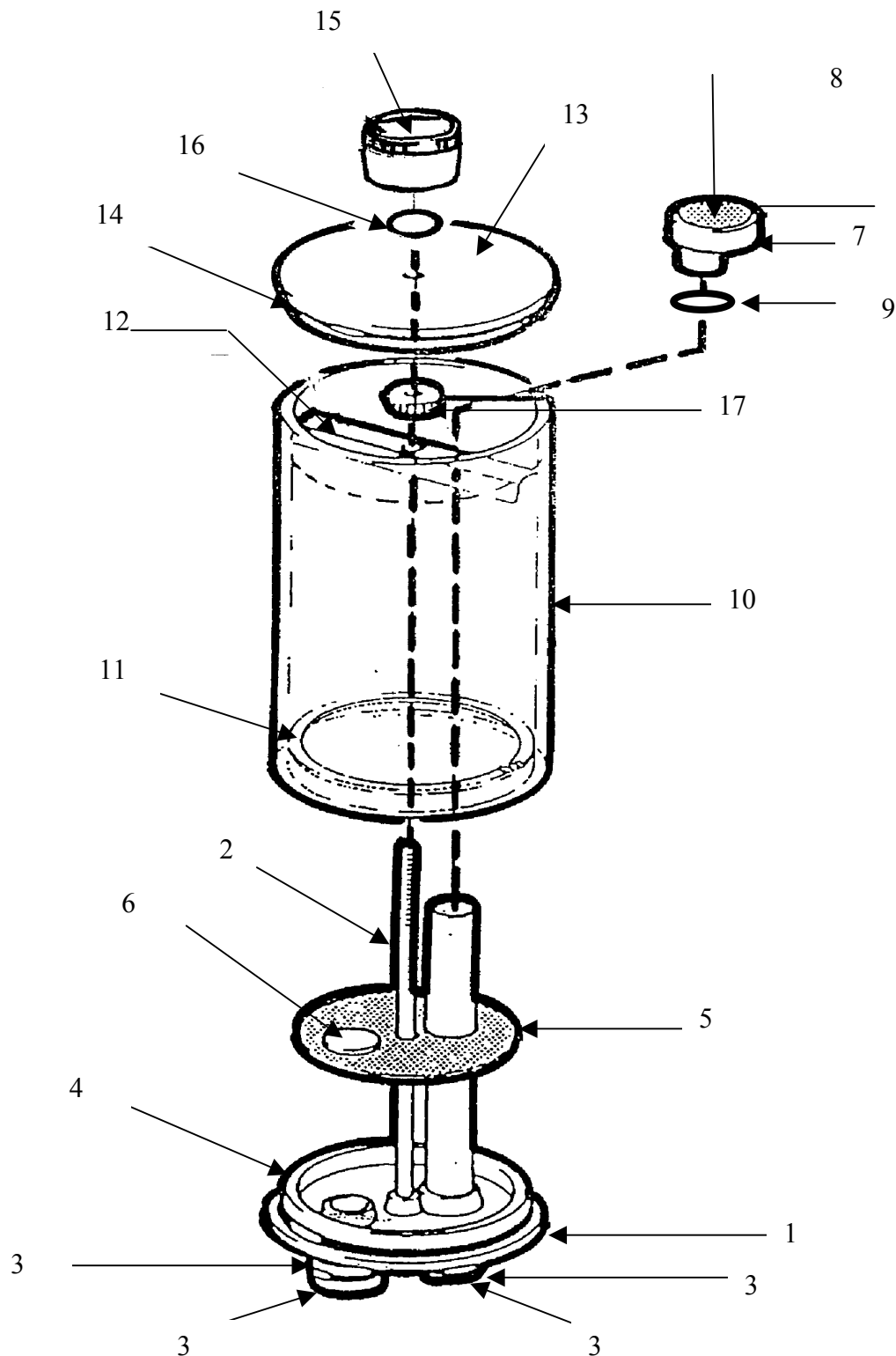


**COMPONENTS OF COMPLETE SODA LIME CANISTER (cod. G60034110).**

Proceed with the assembly as per the diagram and following this order:

<b>Rif.</b>	<b>Descrizione</b>	<b>Codice</b>	<b>Quantità</b>
1	SODA LIME BASE	M50840009	1
2	SODA LIME COLUMN	M51960019	1
3	OR 3112	M10003112	4
4	OR 6400	M10006400	1
5	SODA LIME LOWER GRILL SCREEN	M57140009	1
6	SODA LIME LOWER GRILL	M53920809	1
7	SODA LIME UPPER GRILL	M53920909	1
8	SODA LIME UPPER GRILL SCREEN	M57140109	1
9	OR 2056	M10002056	1
10	SODA LIME JAR	M59240119	1
11	SODA LIME ELASTIC BAND	M50140009	1
12	SODA LIME SUPPORT	M58960319	1
13	SODA LIME LID	M52172219	1
14	OR 6387	M10006387	1
15	SODA LIME HANDLE	M54970019	1
16	OR 3043	M10003043	1
17	SODA LIME	M56370019	1

**Complete soda lime canister (cod. G60034110).**



Fix semiclosed group to complete B.S. (cod. G00054110) or open group to complete B.S. (cod. G00053110) to common group B.S. aut. (cod. G00050110) with screw INOX TCEI M8X30 (cod. M00120039) as shown in the B.S. aut. diagram (cod. G00050110)

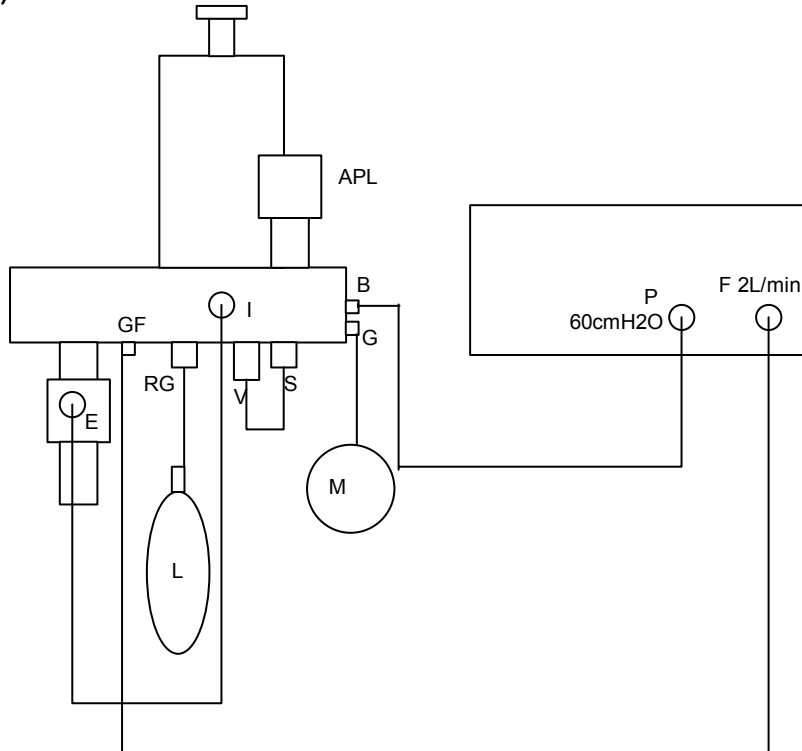
## 5. CALIBRATION AND TEST

### 5.1 Valve Group (Breathing System)

**PROCEDURE:**

Set the valve group selector on **MANUAL** and the rebreathing/non rebreathing selector on **REBREATHING**

1) **LEAK TEST**



where:

- M** Manometer (end of scale 100cmH<sub>2</sub>O)
- G** Yellow connector to ventilator
- B** White connector to ventilator
- E** Expiratory connector of the patient
- GF** Connector for inflow of fresh gases
- RG** Connector for balloon
- L** Balloon
- APL** Valve APL
- I** Inspiratory connector of patient
- V** Connector for connecting the ventilator
- S** Drainage of valve group
- P** Low pressure exit connector
- F** Low pressure exit connector

Completely close the APL valve.

Regulate the pressure **P** at around 60cmH2O.

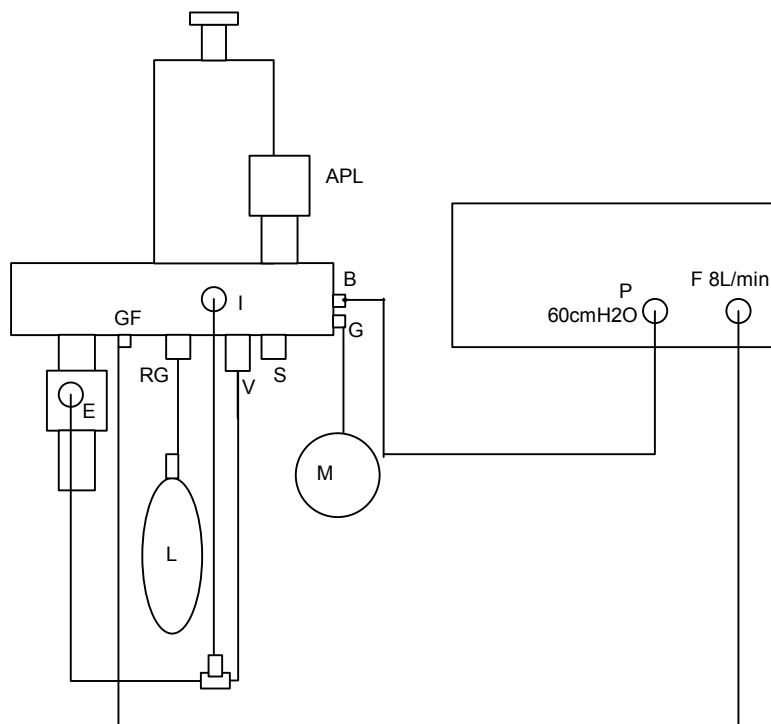
Regulate the flow **F** at around 2l/min.

Make the connections.

When on the manometer **M** the pressure of  $30 \pm 3$  cmH2O is reached, close the exit plug of the low pressure **P**.

After 30 seconds the pressure that is read on **M** should be  $> 20 \pm 2$ cmH2O.

## 2) APL VALVE TEST



WHERE:

- M** Manometer (end of scale 100cmH2O)
- G** Yellow connector to ventilator
- B** White connector to ventilator
- E** Expiratory connector of the patient
- GF** Connector for inflow of fresh gases
- RG** Connector for balloon
- APL** Valve APL
- L** Balloon
- I** Inspiratory connector of patient
- V** Connector for connecting the ventilator
- S** Drainage of valve group
- P** Low pressure exit connector
- F** Low pressure exit connector

Regulate the pressure **P** at around 60cmH2O.

Regulate the flow **F** at around 8l/min.

Make the connections

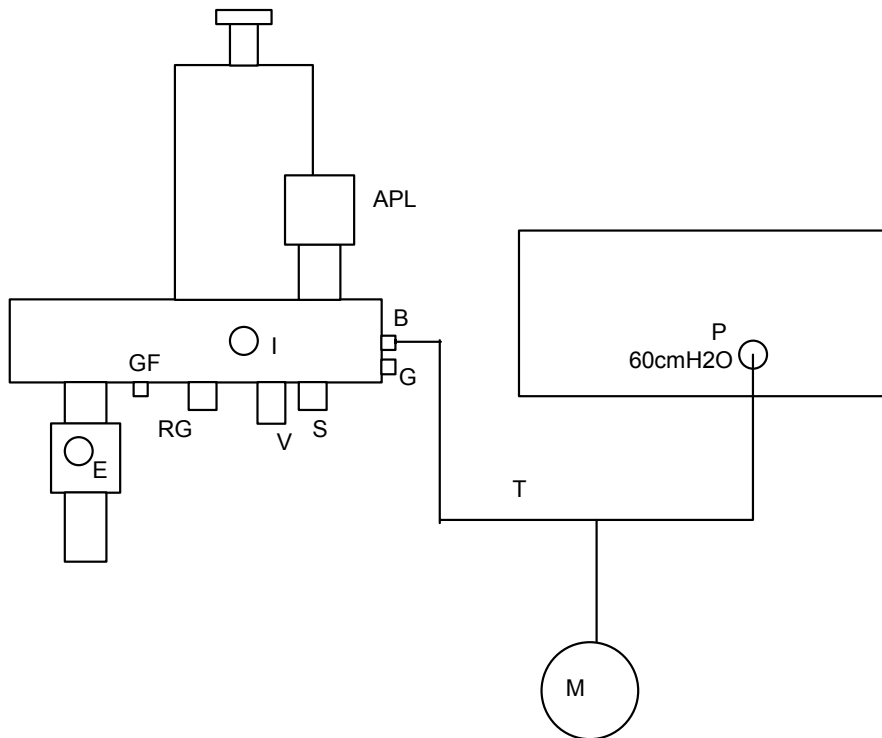
Open completely the APL valve.

On the manometer **M** the pressure should be  $2 \pm 1$ cmH2O.

Completely close the APL valve.

On manometer **M** the pressure should be  $30 \pm 3$ cmH2O.

3) TEST MUSHROOM VALVE



WHERE:

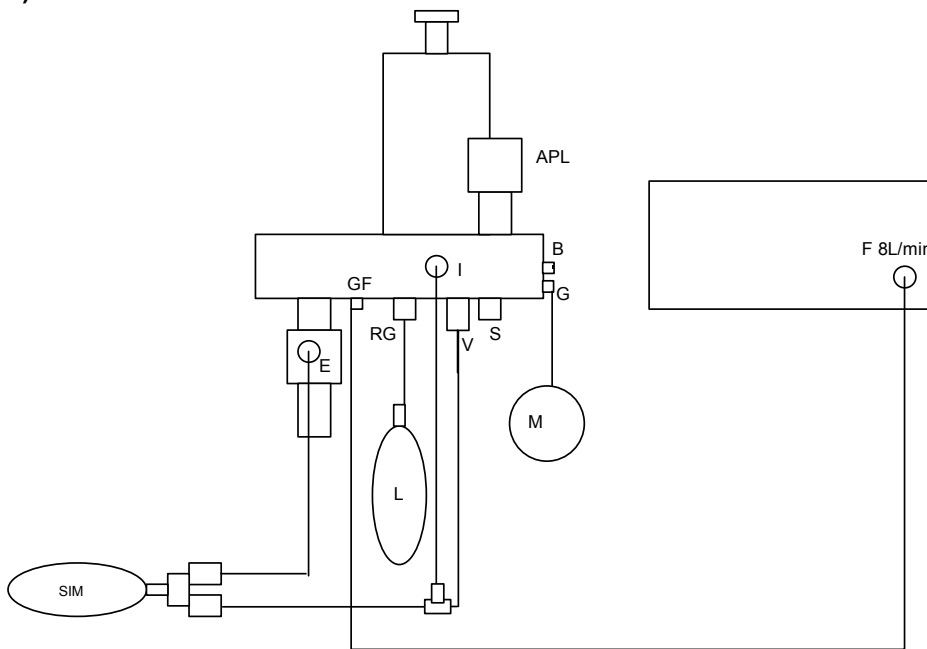
- M** Manometer (end of scale 100cmH20)
- G** Yellow connector to ventilator
- B** White connector to ventilator
- GF** Connector for inflow of fresh gases
- RG** Connector for balloon
- APL** Valve APL
- I** Inspiratory connector of patient
- V** Connector for connecting the ventilator
- S** Drainage of valve group
- P** Low pressure exit connector
- T** Connection tube

Regulate the pressure **P** at around 60cmH2O.

Make the connections.

On the manometer **M** the pressure after 30 sec. should be > 50cmH2O.

4) VENTILATION



WHERE:

- M** Manometer  $-20+100\text{cmH}_2\text{O}$
- G** Yellow connector to ventilator
- B** White connector to ventilator
- E** Expiratory connector of the patient
- GF** Connector for inflow of fresh gases
- RG** Connector for balloon
- APL** Valve APL
- L** Balloon
- SIM** simulator
- I** Inspiratory connector of patient
- V** Connector for connecting the ventilator
- S** Drainage of valve group
- P** Low pressure exit connector
- F** Low pressure exit connector

Regulate the flow **F** at about 8l/m.

Make the connections.

Try to make a manual ventilation of the simulator **SIM** by squeezing the balloon **L**.

Verify that the simulator goes into the corresponding pressure of the balloon **L** and that the inspiratory valve raises in the phase of pressure of balloon **L** and that it lowers in the phase of release.

## 5.2 Final Test

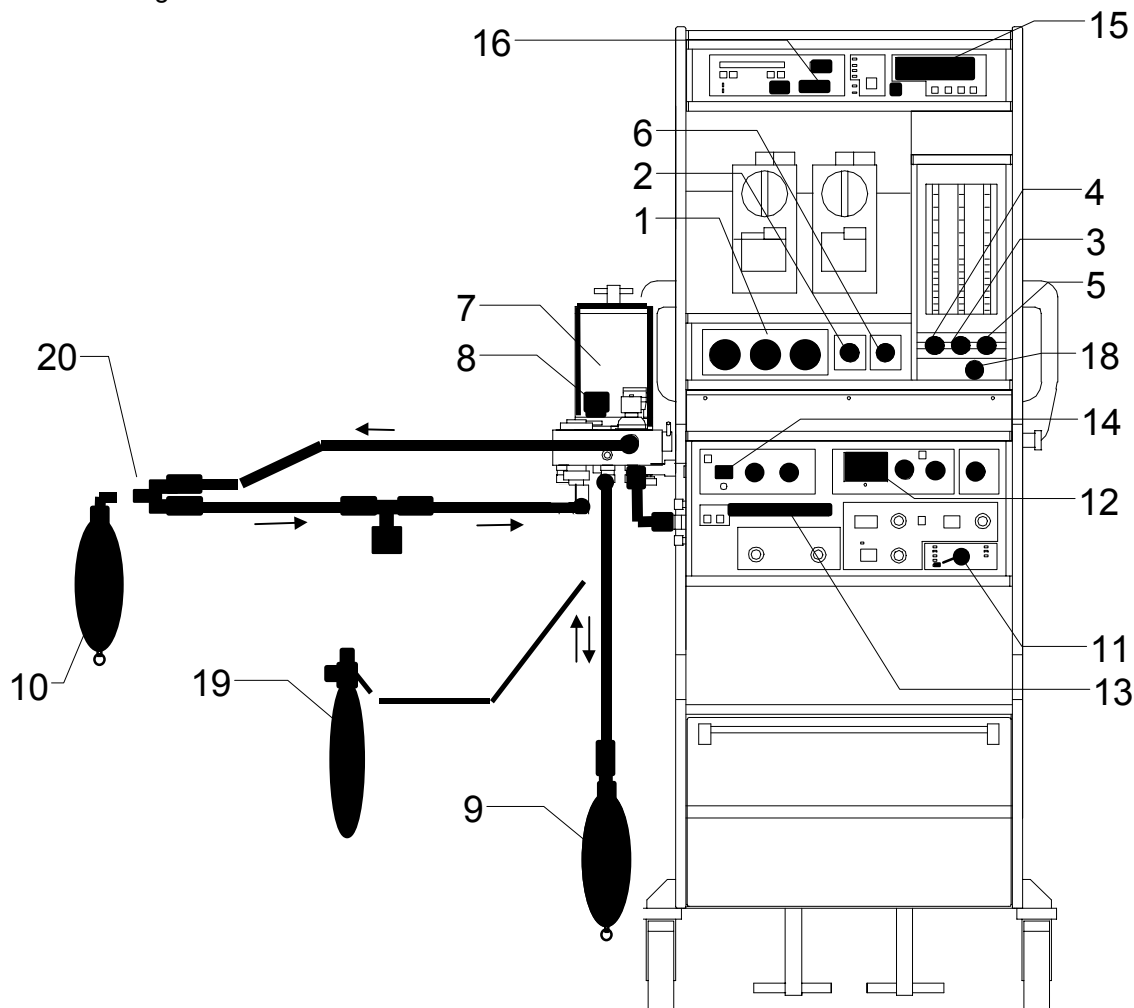
### PROCEDURE: INTERMEDIATE TESTS

Test the following components of the PERSEO workstation as specified in the relative service manuals:

A) Module AM5000/3 – AM5000/5

B) VM 2000 lung ventilator

C) RM 3000 breathing monitor



#### 2. GAS SUPPLY PRESSURE CHECK:

Check that the pressure of each of the medical gases is  $3,5 \text{ bar} \pm 0,75 \text{ bar}$ .

#### 3. MIX LIFE CHECK:

Place the selector (2) to N<sub>2</sub>O

Open the N<sub>2</sub>O regulator (3) to 6 l/min.

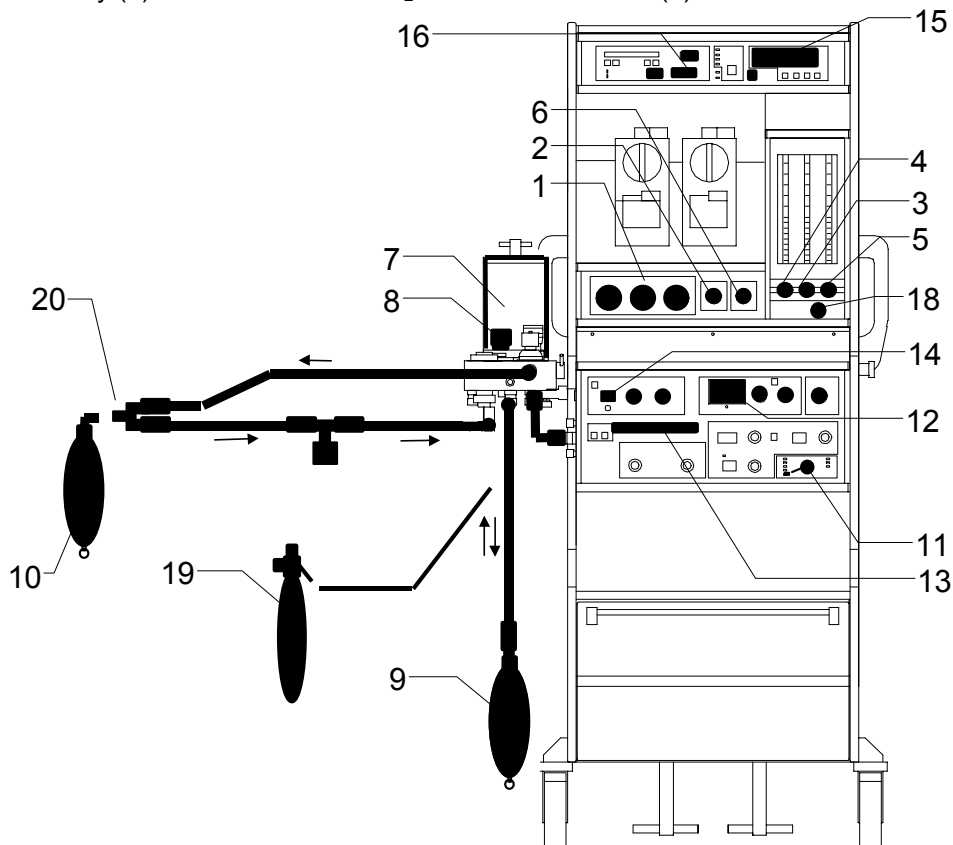
Check that the O<sub>2</sub> goes to 1.5 and 3 l/min. (MIX-LIFE).

#### 4. CUT OFF CHECK:

Disconnect the O<sub>2</sub> tube from the medical gas installation. The O<sub>2</sub> pressure gauge should immediately decrease and after a few seconds the N<sub>2</sub>O should shut-off automatically and the audible CUT-OFF alarm should sound.

**5. BY PASS TEST:**

Reconnect the O<sub>2</sub> tube and closed the N<sub>2</sub>O regulator (3).  
 Open the O<sub>2</sub> regulator (4) and close it.  
 Place the selector (2) on AIR.  
 Open the AIR regulator (5) and close it.  
 Press the BY-PASS key (6) and check that the O<sub>2</sub> reaches the balloon (9).



**6)HIGH PRESSURE ALARM TEST:**

Connect a testing balloon (10) or a normal anaesthesia balloon (2 liters) to connector (20) of the patient circuit..  
 Open the O<sub>2</sub> regulator (4) to 2 l/min.  
 Turn ON the lung ventilator by using the main switch located in the back panel and place the MODE selector knob(11) on CONTROL.  
 Bellow (13) should immediately start the inspiratory phase, thereby increasing the airway pressure on the airway pressure gauge (12).  
 Lower the airway pressure limit to a value lower than the measured value to make sure it is functioning properly.

**7)APNEA ALARM TEST:**

Disconnect testing balloon (10) and verify that the low airway pressure alarm comes on. Reconnect testing balloon (10).

**8) RM 3000 TEST:**

Turn on the breathing monitor (15) and select the pressure curve (ENTER + F1).  
 Check that the TIDAL VOLUME and RATE values are properly displayed and that the airway pressure curve displays the pressure changes due to ventilation.

**9) ELECTRICAL SAFETY TEST:**

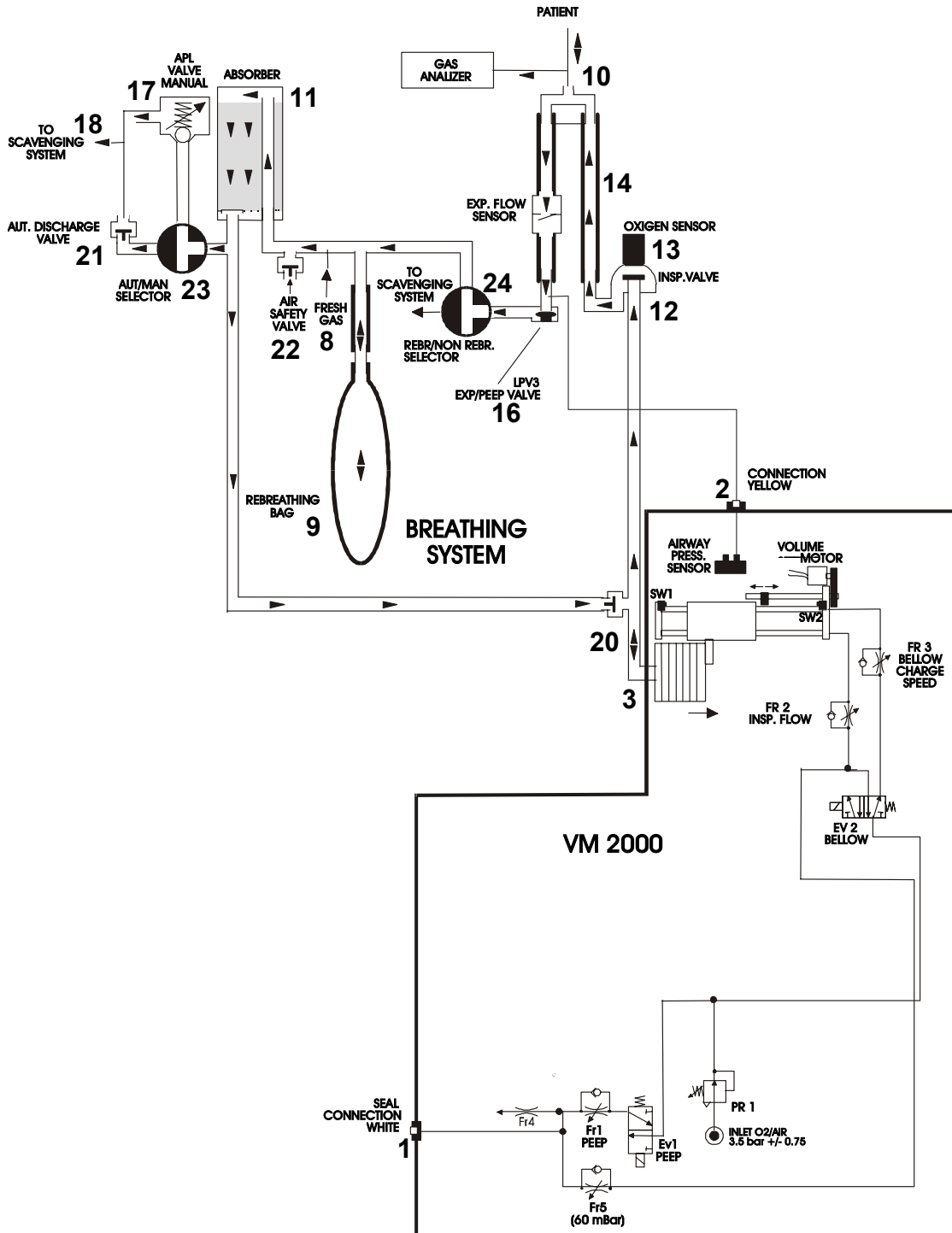
Perform the electrical safety tests as per the user manual of the safety tester.

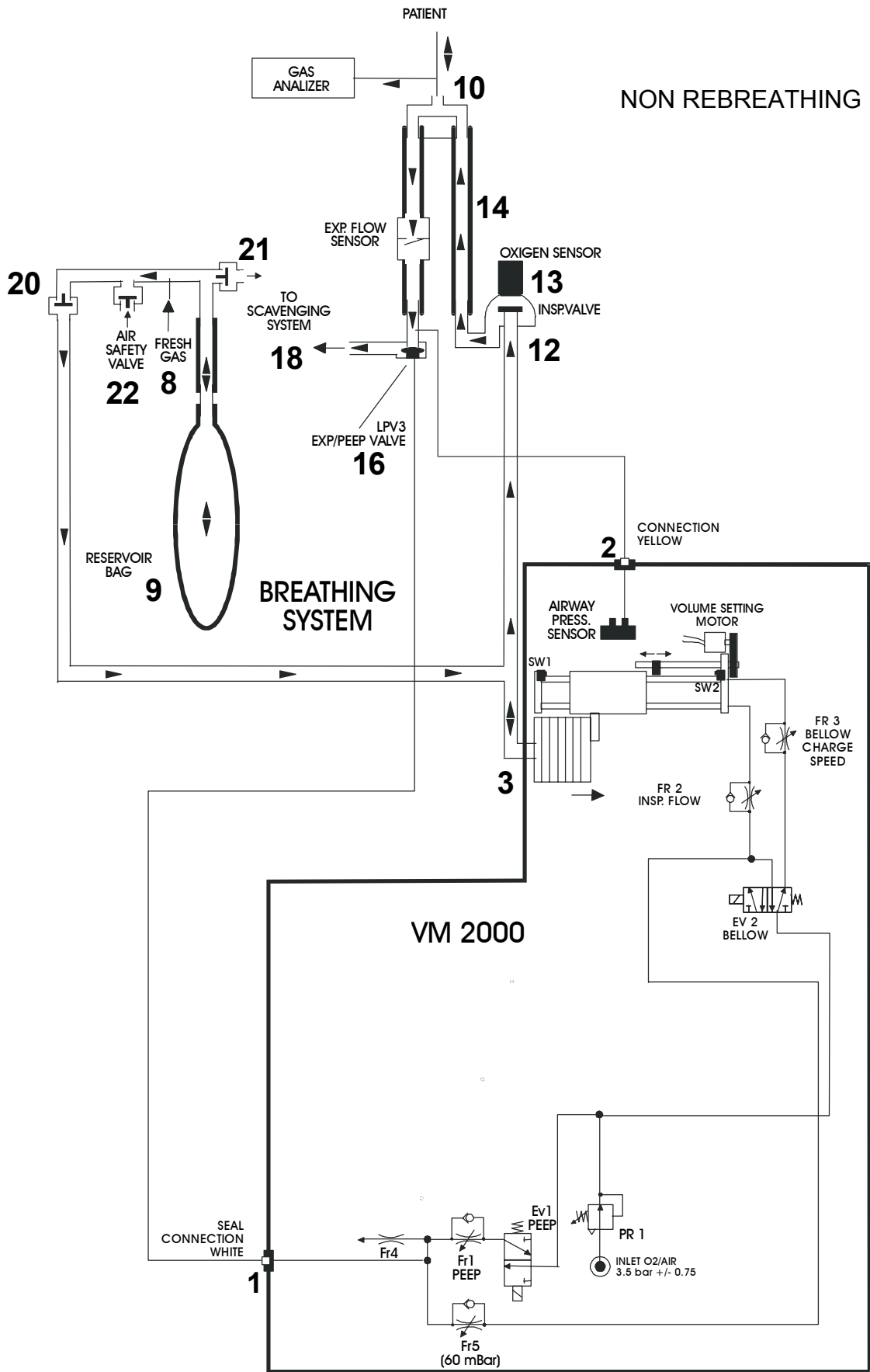


## 6. PNEUMATICS

### 6.1. Pneumatic Diagram Of Perseo

#### NON REBREATHING - REBREATHING





## **6.2 PNEUMATIC COMPONENTS**

### **REBREATHING and NON REBREATHING configuration**

	<b>QT.</b>	<b>Part name</b>	<b>Description</b>	<b>Code</b>
1	1	Volume setting motor	Motor reducer crouzet 12V 53 g/min	E93110001
2	2	SW1, SW2	Microswitch OMRON 0612RA1	E90960000
3	1	EV1	Electrov. 3/2 N.C. 12 Vdc	P11000019
4	1	Airway press. sensor	Press. Trans. diff. MPX-10DP	E72000000
5	1	EV2	Electrov. 5/2 12V	P11000089
6	2	FR1, FR2	Flow regulator DMRL 30/8 multi spin	P24000019
7	1	PR1	Press. Regulator AR 1000-M5	P20000039
8	2	FR3, FR4	Connector RG 6/8 RU	P24000079
9	1	FR5	Connector RG 6/8 RE	P24000059
10	1	OXYGEN SENSOR	Complete Polarogr. Transd. O <sub>2</sub> mod. C6	E75000004
11	1	REBREATHING BAG	Anaesthesia bag Lt. 3 SIARE	106151/3
12	1	INSP. VALVE	Green INSP valve CS	M59170209
13	1	LPV3	EXP valve – black rubber	P16000019
14	1	AIR SAFETY VALVE	Unidirectional green valve	P16000001
15	1	APL VALVE	Complete APL breathing system valve	G60038100
16	1	ABSORBER	complete soda lime canister	G60034100
17	1	EXP FLOW SENSOR	Complete flow transd. SIARE	G80029100
18	1	REBR/NON REBR SELECT	Shackler valve D30	M59171209
19	1	AUT/MAN SELECTOR	Shackler valve D22	M59171109
20	1	AUT DISCHARGE VALVE	unidir. valve vibrating diaphragm	M55110409

**BREATHING SYSTEM + VM2000**

**Configurazione NON REBREATHING**

	<b>Q.tà</b>	<b>Riferimento</b>	<b>Descrizione</b>	<b>Codice</b>
1	1	Volume setting motor	Motor reducer crouzet 12V 53 g/min	E93110001
2	2	SW1, SW2	Microswitch OMRON 0612RA1	E90960000
3	1	EV1	Electrov. 3/2 N.C. 12 Vdc	P11000019
4	1	Airway press. sensor	press Transd. diff. MPX-10DP	E72000000
5	1	EV2	Electrov. 5/2 12V	P11000089
6	2	FR1, FR2	Flow regulator DMRL 30/8 multi spin.	P24000019
7	1	PR1	Press regulator AR 1000-M5	P20000039
8	2	FR3, FR4	Connector RG 6/8 RU	P24000079
9	1	FR5	Connector RG 6/8 RE	P24000059
10	1	OXYGEN SENSOR	Complete Polarogr. Trans.O <sub>2</sub> mod. C6	E75000004
11	1	RESERVOIR BAG	Anaesthesia bag Lt. 3 SIARE	106151/3
12	1	INSP. VALVE	Green INSP valve CS	M59170209
13	1	LPV3	EXP valve – black rubber	P16000019
14	1	AIR SAFETY VALVE	Unidir. Green valve	P16000001
15	1	EXP FLOW SENSOR	Complete flow trans. SIARE	G80029100

### **6.3 Pneumatic Diagram VM 2000**

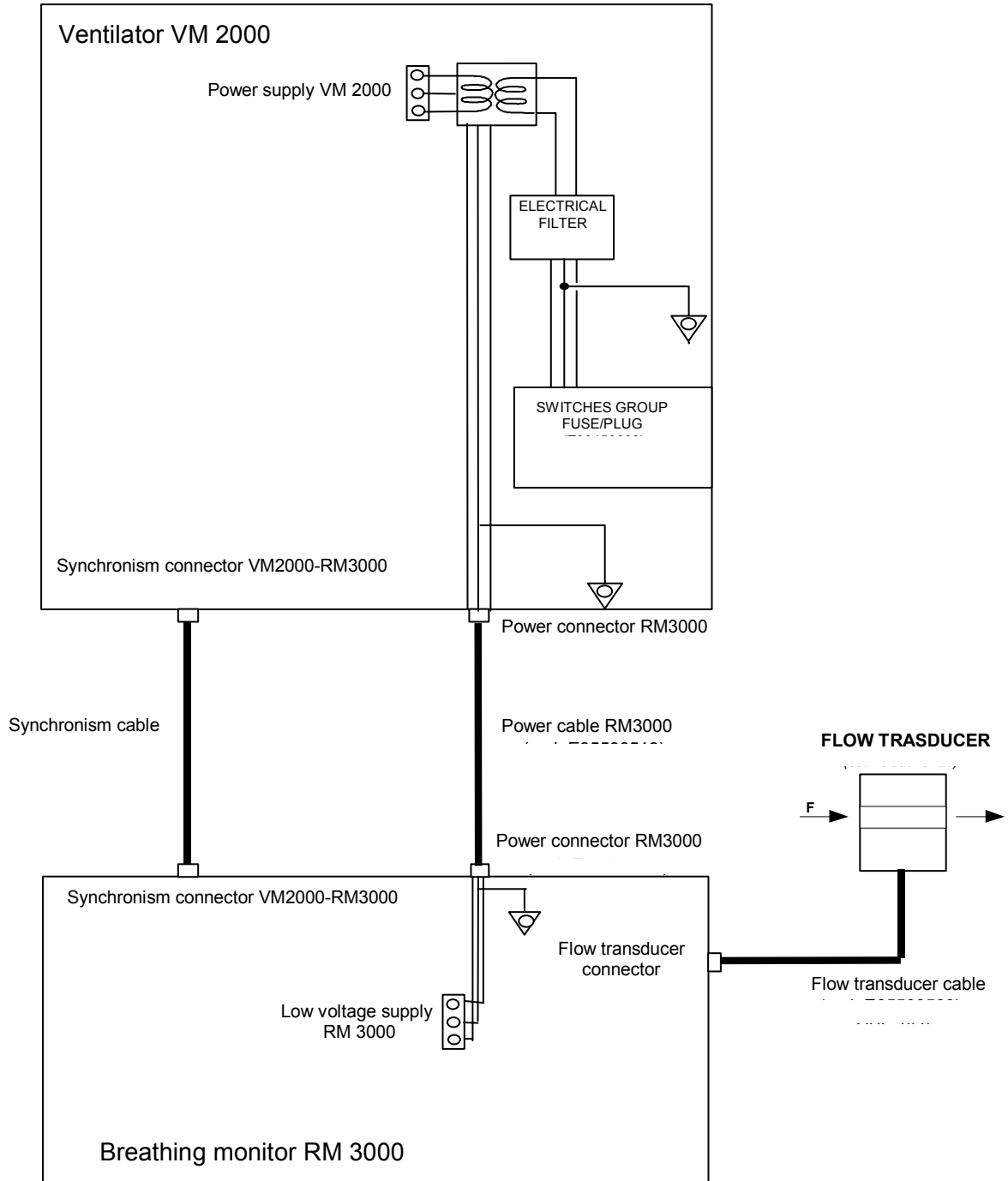
SEE SERVICE MANUAL OF VM 2000

### **6.4 PNEUMATIC DIAGRAM AM5000/3 – AM5000/5**

SEE SERVICE MANUAL OF AM5000/3 – AM5000/5

**7. ELECTRONICS**

**PERSEO**  
**Block diagram**  
**Electrical connections**



For the electronic components of the modules VM2000 and RM3000 see their relative service manuals.