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DrägerService®

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Technical Service Manual

Part Number: 4116029
Rev: C
Date: 11 December 2000
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Fabius®
Anesthesia System

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Fabius® Service Manual Table of Contents

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1.0 Introduction

Recommendations

Because of the sophisticated nature of North American Dräger. anesthesia equipment and its critical importance in the operating room setting, it is highly recommended that only appropriately trained and experienced professionals be permitted to service and maintain this equipment. Please contact DrägerService® at (800) 543-5047 for service of this equipment in North America. For service in Europe call 49 (451) 882-3781. For service in other countries call (215) 721-5402.

North American Dräger recommends that the Fabius be serviced at six month intervals. Periodic Manufacturer's Certification agreements are available for equipment manufactured by North American Dräger. Please contact us for further information concerning these agreements.

North American Dräger. products /material in need of factory repair shall be sent to:

For North America and other countries except Europe:

DrägerService®

3124 Commerce Drive
Telford, PA 18969 U.S.A.
(Include RMA Number)

For service in Europe:

Dräger Medizintechnik GmbH
Moislinger Allee 53-55
23542 Lübeck
Reparaturannahme
Germany

Guidelines

Troubleshooting the Fabius should always begin by communicating with those who observed or experienced a problem with the unit.

After performing any repair, replacement, calibration or adjustment, operation of the unit must be verified, accompanied by a Test Certificate.

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2.0 Function Description

1 General Information About Fabius

The Fabius basic unit consists of the following assemblies:

- control box
- gas box (on rear panel of Fabius)
- flowmeter block
- compact breathing system "Cosy"/circle absorption system "Circle System 9/Fabius"
- pneumatics
- ventilator (located in the swing-out part of Fabius)
- anesthetic vaporizer "Vapor 19.n"
- trolley

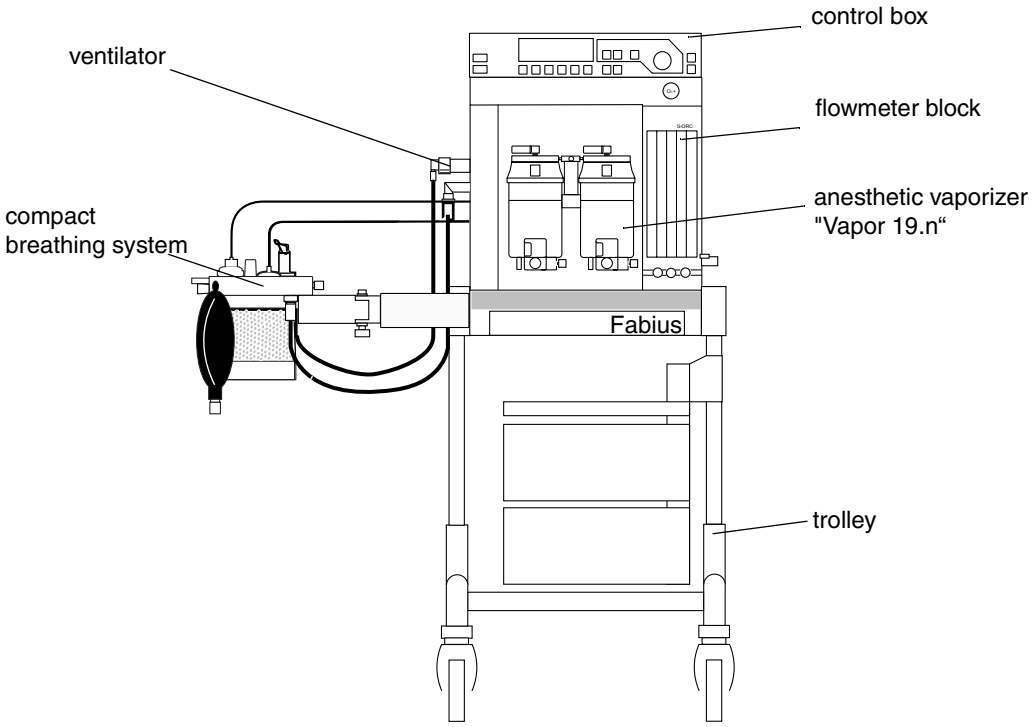

Fig. 1: Fabius equipped with a compact breathing system "Cosy"

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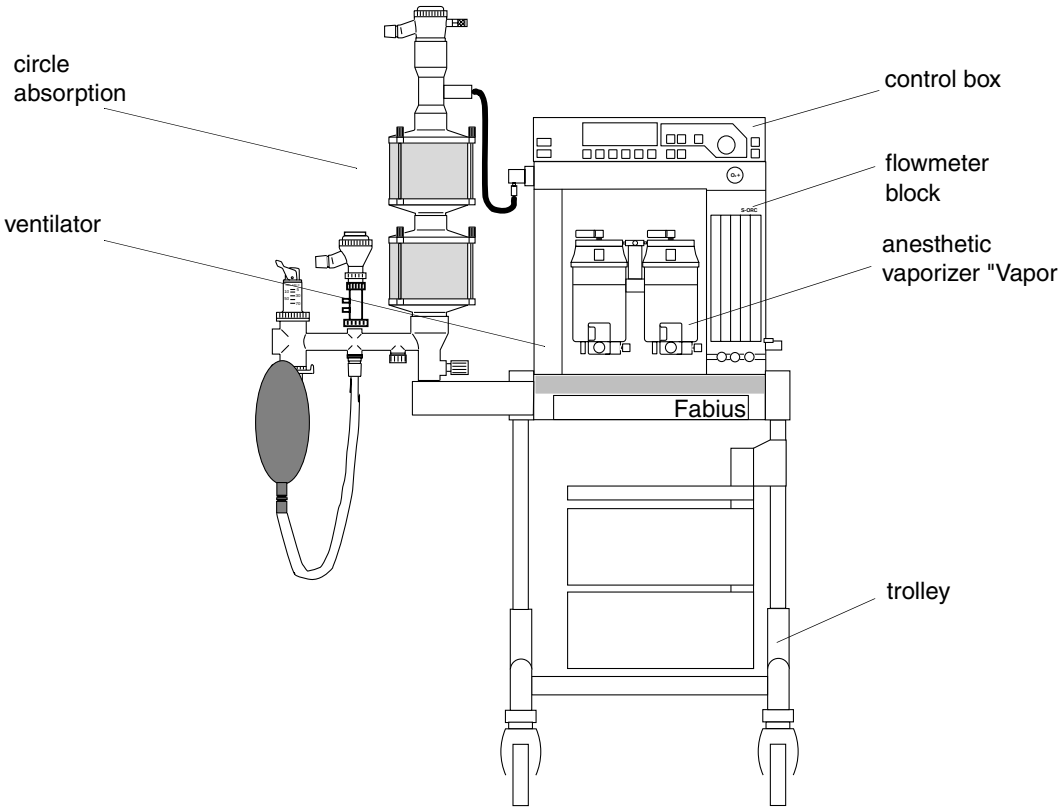

Fig. 2: Fabius equipped with a circle absorption system "Circle System 9 Fabius"

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Fabius provides connections for the following medical gas cylinders:

- O_2 cylinder
- N_2O cylinder

Fabius can be retrofitted with the following assemblies/functions:

- drawer assembly
- rechargeable batteries for uninterruptible power supply (UPS)
- additional gas (AIR)
- cylinder set mount

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2 Fabius Function Diagrams

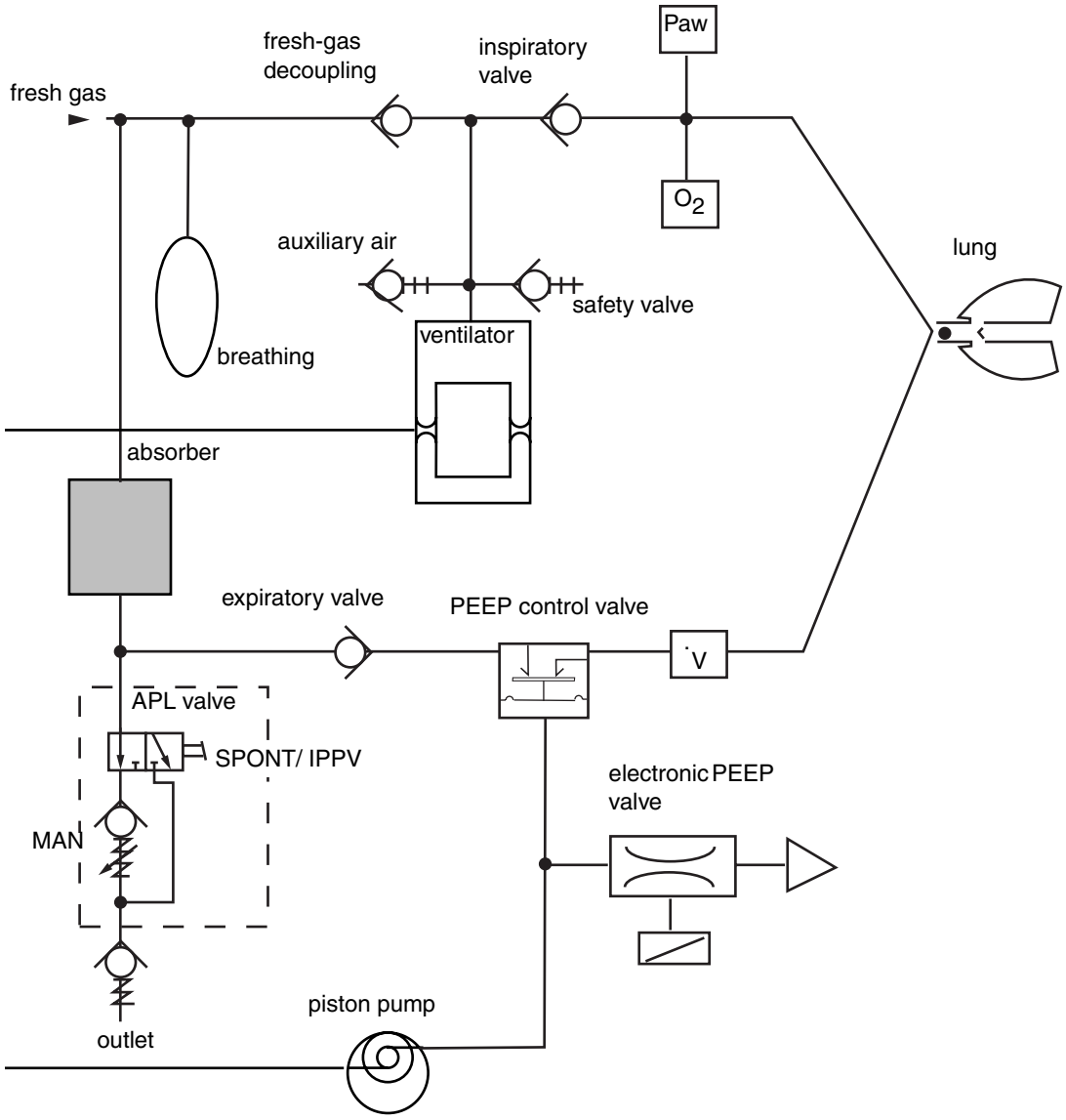

Fig. 3: Function diagram of Fabius with compact breathing system "Cosy"

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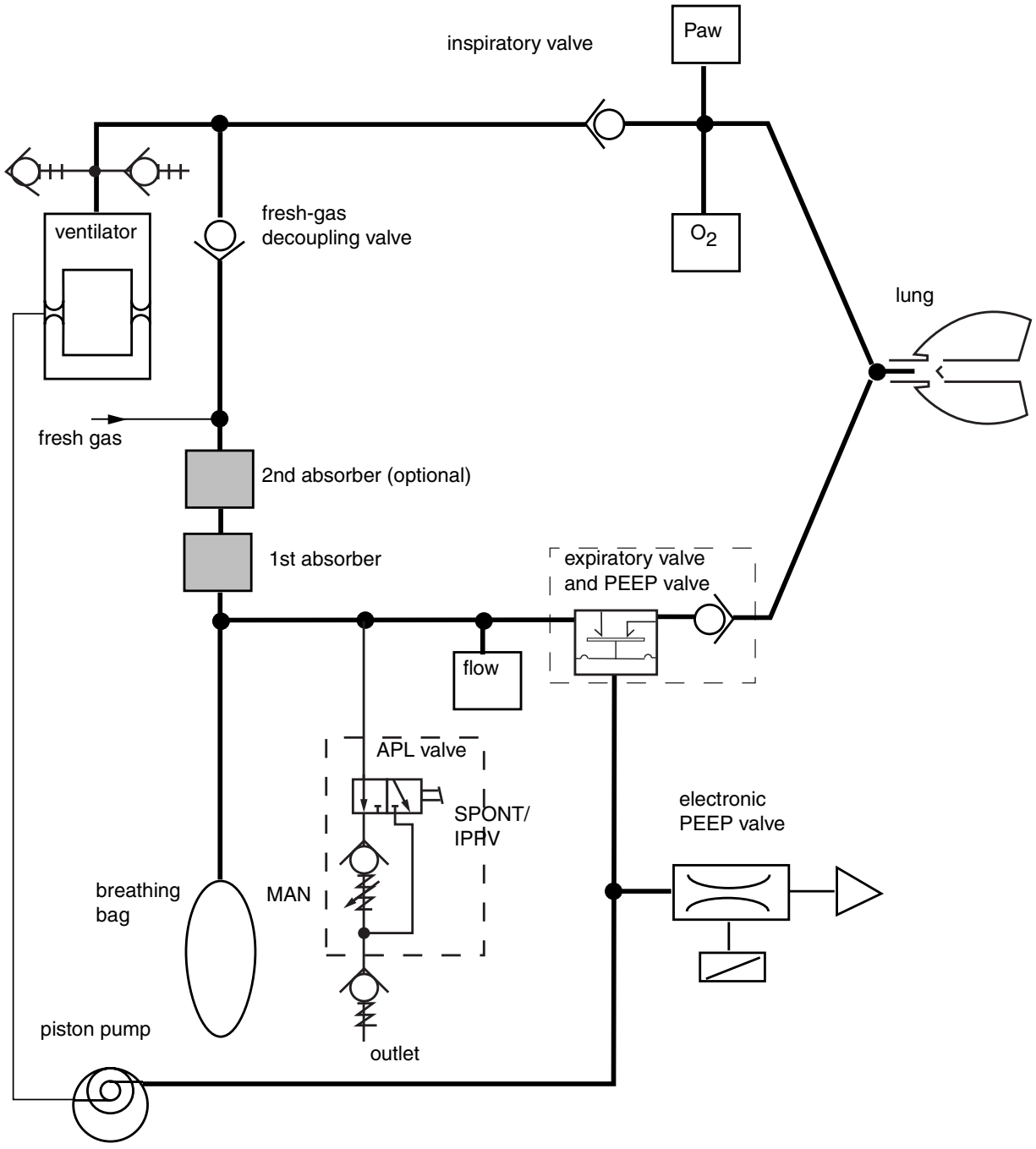

Fig. 4: Function diagram of Fabius with circle absorption system "Circle System 9 Fabius"

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2.1 Optional Uninterruptible Power Supply (UPS)

The uninterruptible power supply (UPS) consists of two rechargeable batteries. These rechargeable batteries are connected in series thus providing a total voltage of 24 V. The UPS is charged during the operation phases. In the event of a voltage drop or a complete power failure, the UPS can backup operation for approx. 90 minutes. The UPS is located in the gas box. Connection is made on the rear panel of the control box.

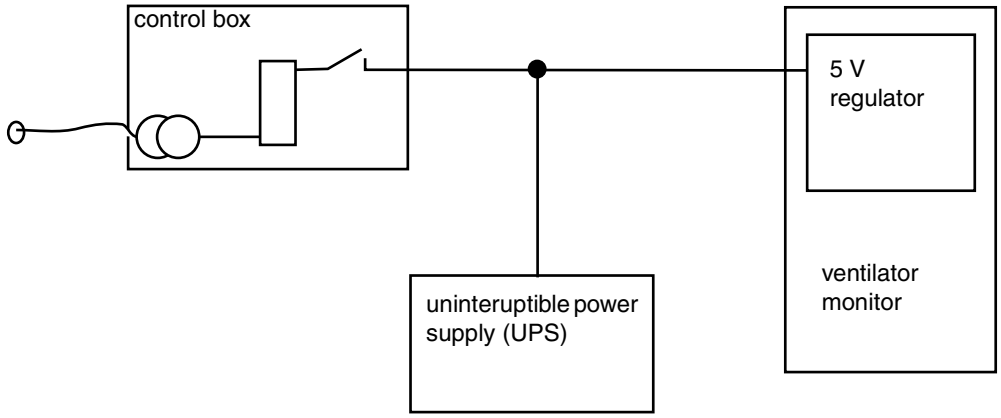

Fig. 5: Block diagram of Fabius' voltage supply

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3 Function Diagram (2-gas version)

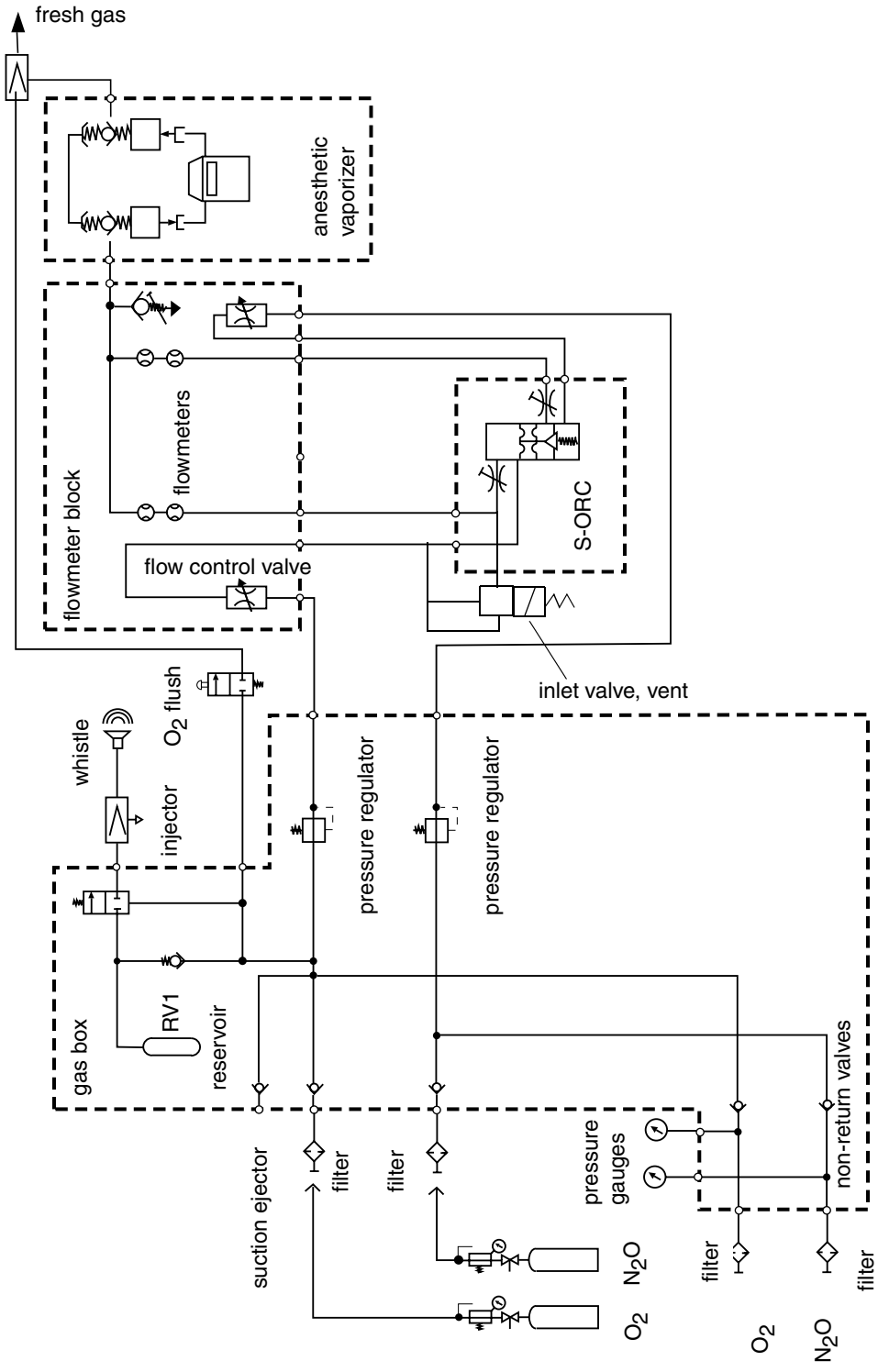

Fig. 6: Function Diagram (2-gas version)

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4 Function Diagram (3-gas version)

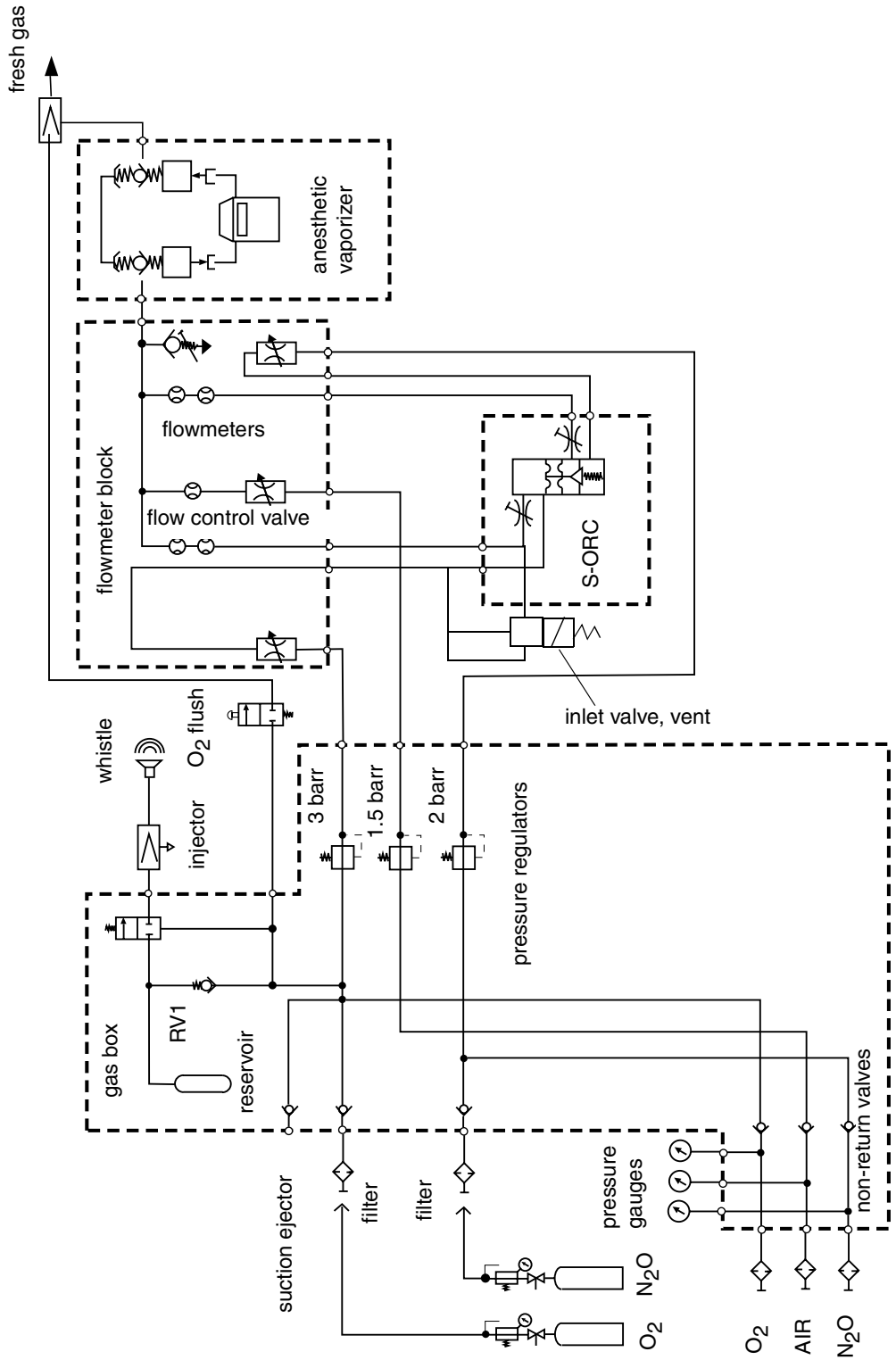

Fig. 7: Function Diagram of the Fabius (3-gas version)

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5 Function Description of the Gas Box

The supply gases flow through the built-in filters of the compressed-gas connections and are then available at the pressure gauges. The pressure gauges indicate the current pressure of the supply gases. The non-return valves prevent a reverse flow. The pressure of the supply gases is reduced by pressure regulators. The low-pressure supply gases then flow to the flowmeter block. As soon as the O_2 supply gas has reached a sufficient pressure, it flows through the spring-loaded non-return valve RV 1 and fills the reservoir.

If the O_2 supply fails or if the pressure of the O_2 supply gas decreases below a certain value, the 2-way valve switches over. The gas stored in the reservoir flows through the 2-way valve and the injector and activates the whistle (audible O_2-failure alarm).

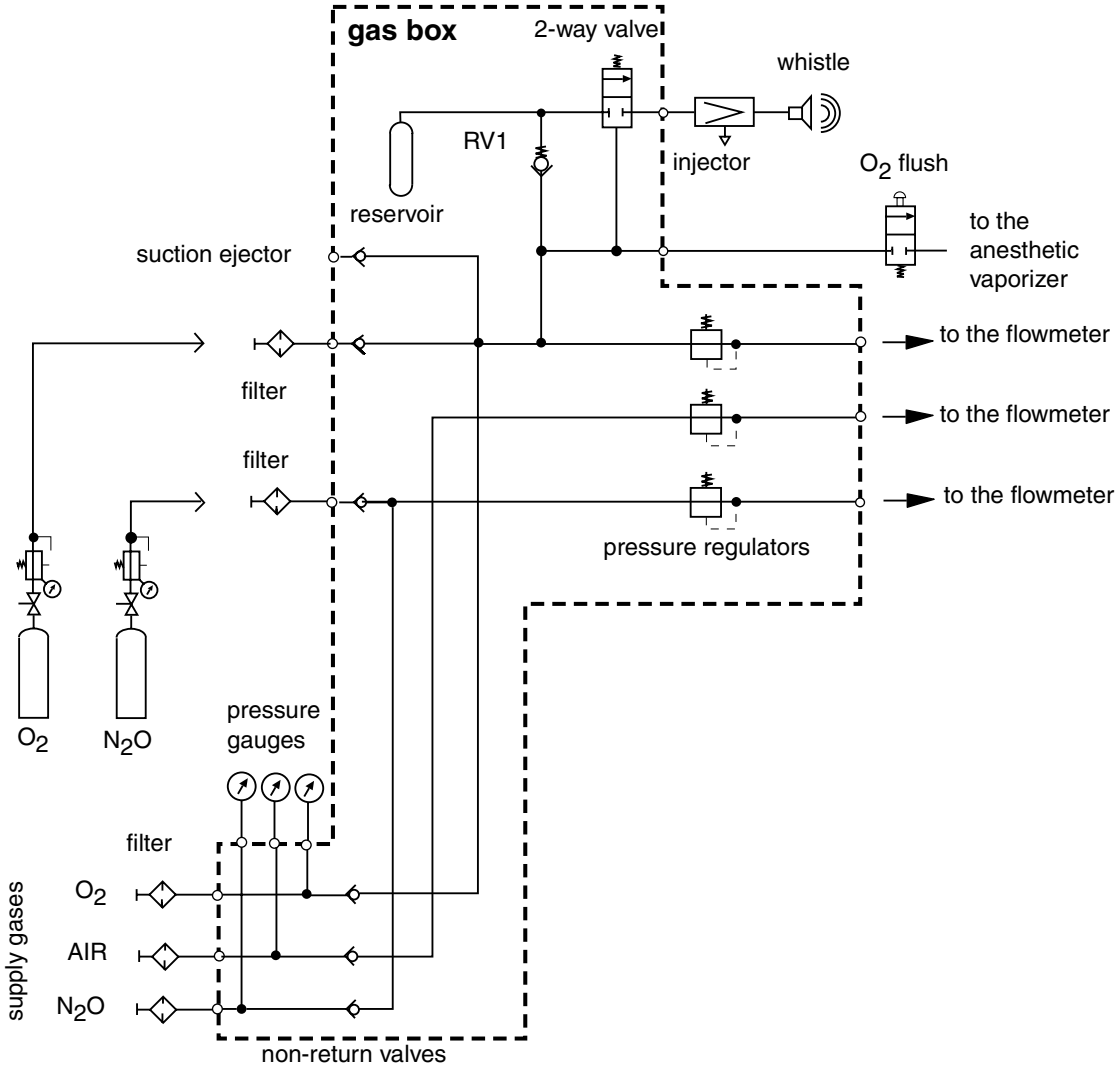

Fig. 8: Function diagram of the gas box (3-gas version), part 1

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If the O_2-flush button is pressed, the fresh-gas ejector prevents the fresh gas from flowing back into the anesthetic vaporizer. This avoids an increase in the anesthetic gas concentration.

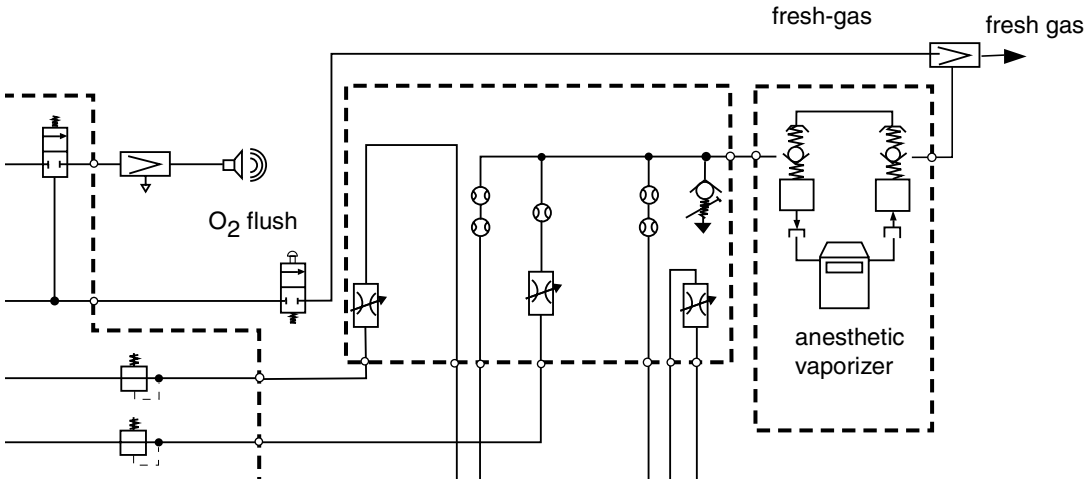

Fig. 9: Function diagram of the gas box (3-gas version), part 2

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5.1 S-ORC (Sensitive Oxygen Ratio Controller)

The S-ORC is a control element that functions like an N_2O shut-off device and ensures a vital O_2 concentration in the fresh gas. In the event of an O_2 shortage, the S-ORC limits the N_2O flow such that the O_2 concentration in the fresh gas does not decrease below 21 vol.%. For the S-ORC to function properly O_2 and N_2O must have different pressures.

If the O_2 flow control valve is closed or if the O_2 flow is lower than or equal to 200 mL/min, the S-ORC interrupts the N_2O flow.

N_2O can be added as of an O_2 flow of approx. 300 mL/min. In this case, the S-ORC also prevents O_2 concentrations below 21 vol.%.

The inlet valve vent allows O_2 to bypass the restrictor in the S-ORC when O_2 flows above 10 L/min. are needed.

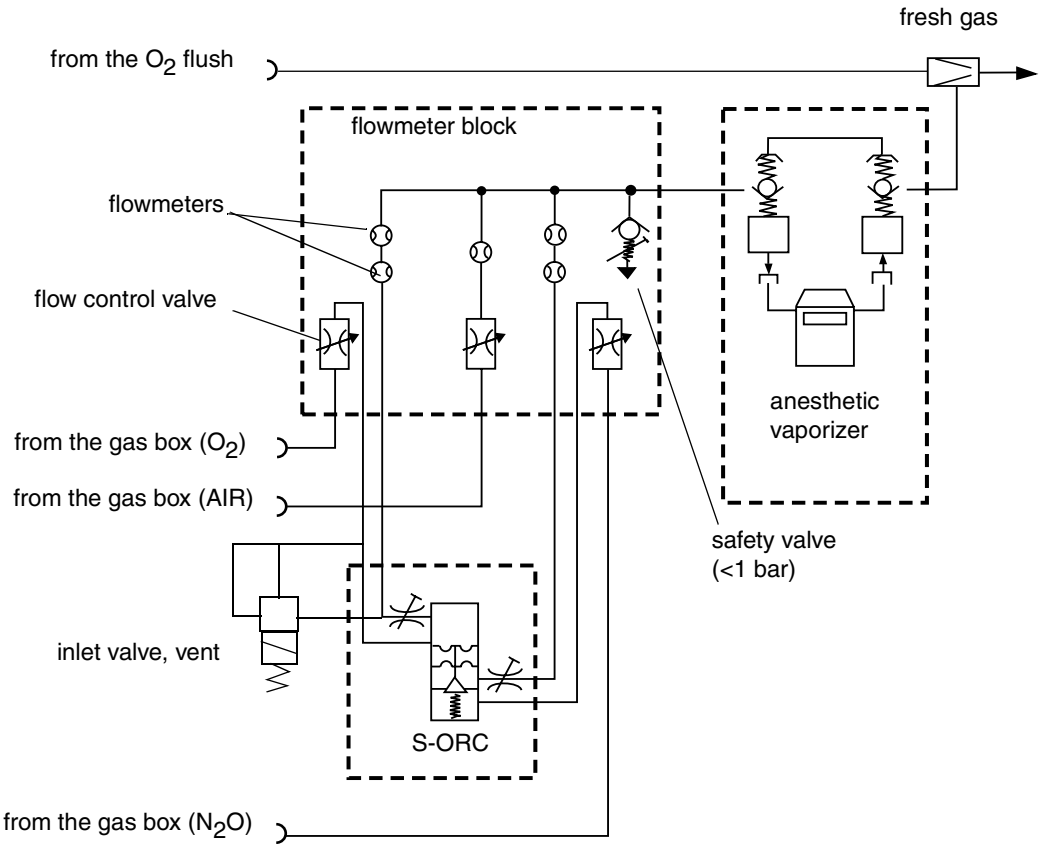

Fig. 10: S-ORC function diagram, part 1

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The flow control valves are used to adjust the O_2 and N_2O flows.

Restrictors located at the outlets of the S-ORC generate back-pressures. These back-pressures exert a force on the control diaphragms of the S-ORC. The O_2 back-pressure opens the S-ORC. The N_2O back-pressure closes the S-ORC. The pressure ratio at the control diaphragm affects the N_2O flow.

The restrictors and the spring tension are dimensioned such that a minimum concentration of 21 vol.% O_2 is always ensured. The maximum O_2 flow is approx. 9 L/min.

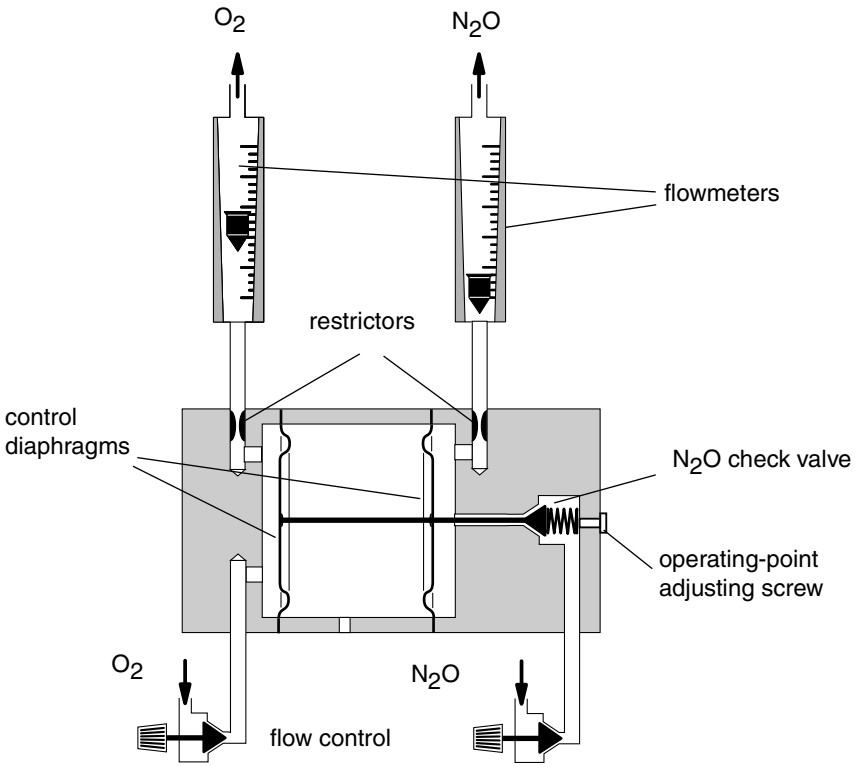

Fig. 11: S-ORC function diagram, part 2

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6 Compact Breathing System "Cosy" / Circle Absorption System "Circle System 9 Fabius"

Fabius is either equipped with a compact breathing system "Cosy" or with a circle absorption system "Circle System 9 Fabius". They have the same function.

6.1 Compact Breathing System "Cosy"

The compact breathing system "Cosy" allows three modes of patient ventilation: manual ventilation, spontaneous breathing, intermittent positive pressure ventilation (IPPV). The APL valve (adjustable pressure limiting valve) has a selector which can be used to toggle between "MAN" and "IPPV/SPONT".

In the "MAN" position, the compact breathing system is closed to atmosphere. This position is the default position for manual ventilation of the patient. The APL valve opening pressure can be adjusted from 5 to 70 hPa (mbar).

In the "IPPV/SPONT" position the APL valve is open to atmosphere. This position is the default position for intermittent positive pressure ventilation and spontaneous breathing.

The pressure limit (Pmax) can also be adjusted during IPPV from 20 hPa (mbar) to 70 hPa (mbar) using the control box.

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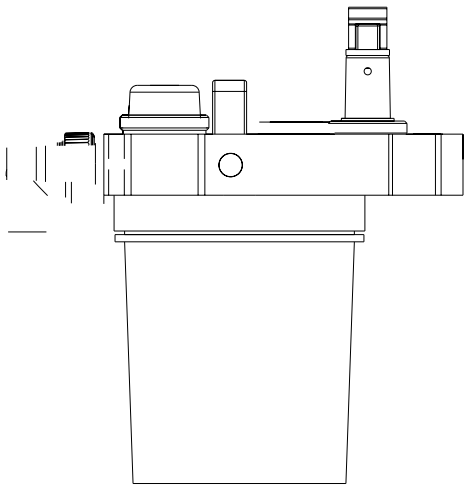

Fig. 12: Compact breathing system "Cosy"

Key

1	PEEP valve/PEEP control port	9	Expiratory valve
2	Clamping screw	10	Expiratory port
3	MAN/SPONT-IPPV selector (APL valve)	11	Flow sensor
		12	Fresh-gas port
4	Fresh-gas decoupling valve	13	Ventilator port
5	Breathing bag mount	14	Anesthetic gas scavenging port
6	Inspiratory port	15	Absorber
7	Inspiratory valve	16	Pressure sensor connector
8	Breathing bag terminal	17	Sample-gas return line port (optional)

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6.1.1 Function Description of the Compact Breathing System "Cosy"

Manual Ventilation: General

During manual ventilation, the APL valve is set to the "MAN" position. The patient system safety valve is activated. Only the warnings/alarms for the lower O_2 limit and for the upper airway pressure (Paw) are enabled. The piston of the ventilator is in the upper end position in order to reduce the dead space volume of the ventilator.

Manual Ventilation: Inspiration

During inspiration, expiratory valve **1** remains closed. When the clinician compresses the breathing bag **2** the gas mixture (expiratory gas and fresh gas) flows through the fresh-gas decoupling valve **3**, the inspiratory valve **4**, the O_2 sensor **5**, the inspiratory hose **6**, and the Y-piece into the patient's lung **7**. The pressure sensor **8** measures the airway pressure. The APL valve **9** limits the ventilation pressure. Any excess amount of the gas mixture flows through the APL valve **9** and the non-return valve **10** to the anesthetic gas scavenging system.

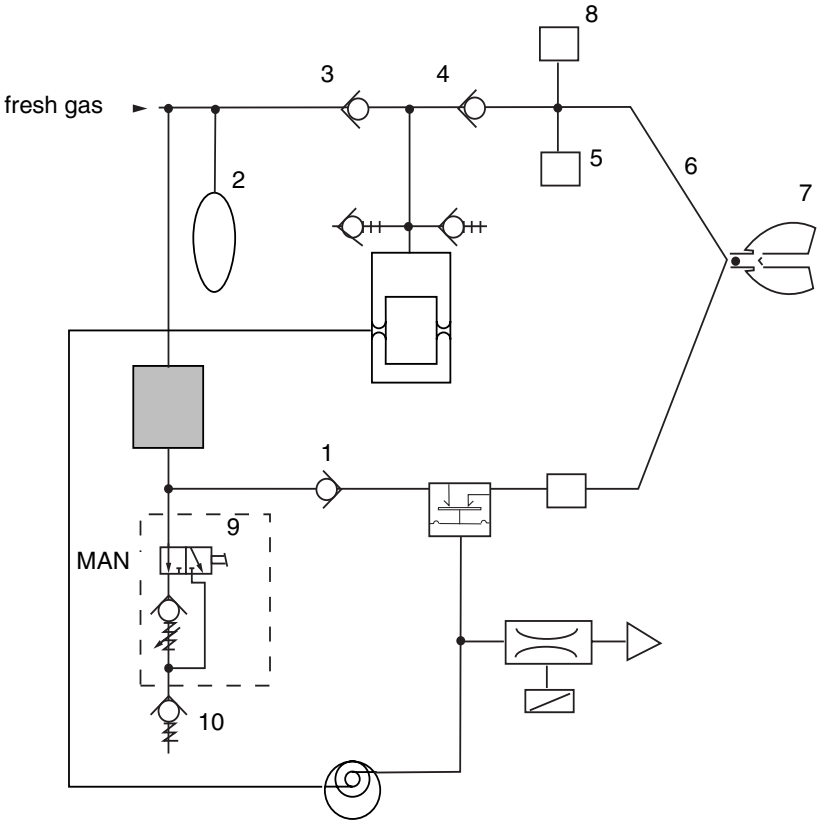

Fig. 13: Manual ventilation (inspiration)

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Manual Ventilation: Expiration

During expiration, the inspiratory valve **1** remains closed and thus prevents the expiratory gas from flowing back into the inspiratory branch.

After releasing the breathing bag **2**, the expiratory gas from the lung **3** flows through the expiratory hose **4**, the flow sensor **5**, the PEEP control valve **6**, the expiratory valve **7,** and through the absorber **8** into the breathing bag **2**. At the same time, new fresh gas flows into the breathing bag **2**.

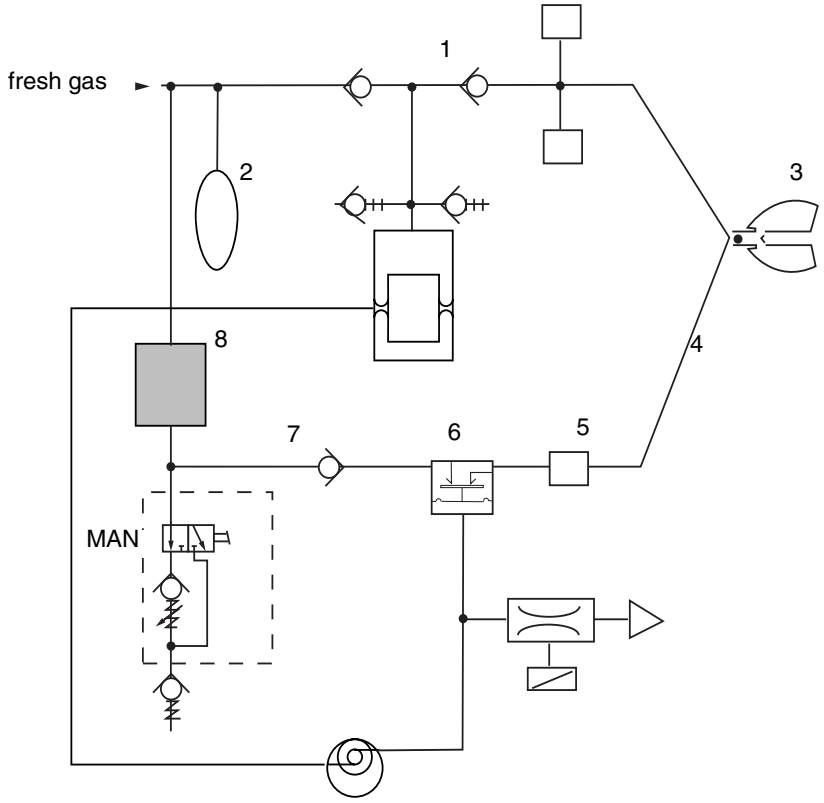

Fig. 14: Manual ventilation (expiration)

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Spontaneous Breathing: General

A prerequisite for spontaneous breathing is that the patient is supplied with a sufficient amount of fresh gas. The APL valve selector must be set to the "SPONT/IPPV" position. No pressure builds up in the compact breathing system. Only the warnings/alarms for the lower O_2 limit and for the upper airway pressure (Paw) are enabled.

Spontaneous Breathing: Inspiration

During inspiration, the expiratory valve **1** remains closed thus preventing rebreathing of expiratory gas containing CO_2.

The patient inhales the gas mixture (expiratory gas and fresh gas) from the breathing bag **2**. The gas mixture flows through the fresh-gas decoupling valve **3**, the inspiratory valve **4**, the O_2 sensor **5**, the inspiratory hose **6**, and through the Y-piece into the lung **7**. The pressure sensor **8** measures the airway pressure.

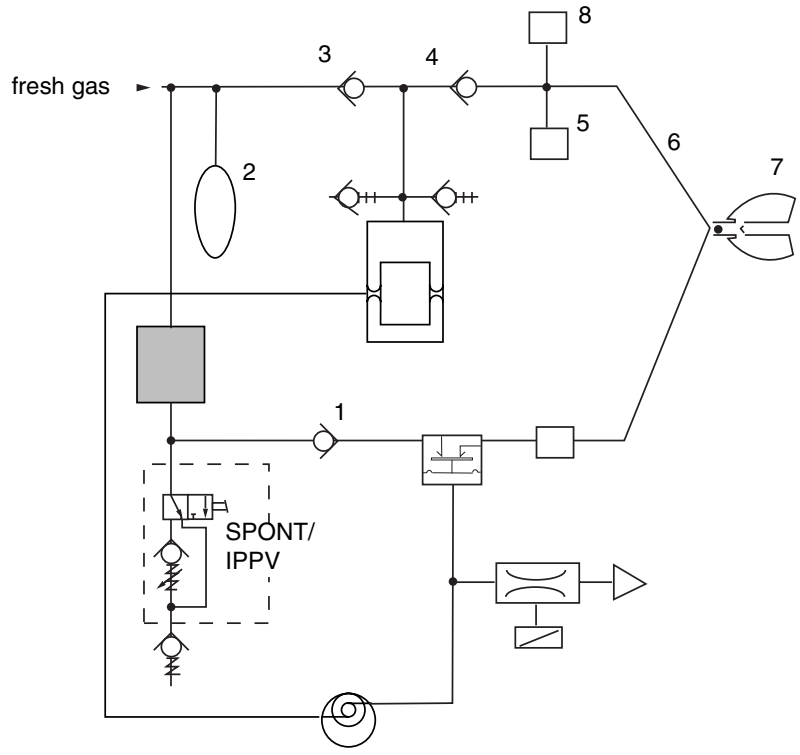

Fig. 15: Spontaneous breathing (inspiration)

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Spontaneous Breathing: Expiration

During expiration, the inspiratory valve **1** remains closed thus preventing the expiratory gas from flowing back into the inspiratory branch.

The APL valve **2** is open, irrespective of its pressure setting.

The expiratory gas flows from the lung **3** through the expiratory hose **4**, the flow sensor **5**, the PEEP control valve **6**, the expiratory valve **7**, and through the absorber **8** into the breathing bag **9**. At the same time, new fresh gas flows into the breathing bag.

When the breathing bag is full, any excess gas mixture flows through the non-return valve **10** into the anesthetic gas scavenging system.

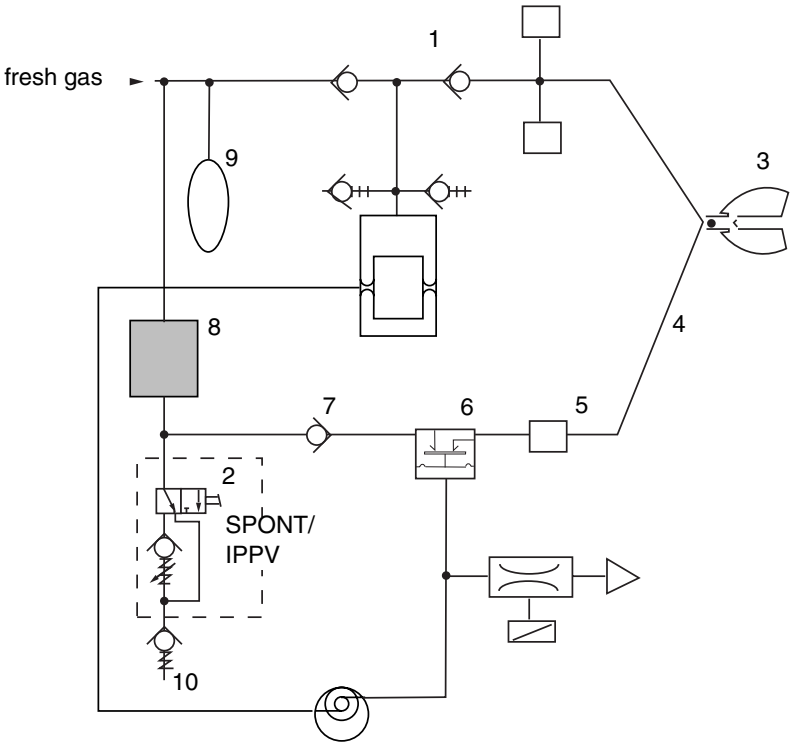

Fig. 16: Spontaneous breathing (expiration)

The CO_2 is scrubbed from the expiratory gas by the soda lime contained in the absorber **8**. The fresh gas replaces the anesthetic and oxygen taken up by the patient.

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Intermittent Positive Pressure Ventilation (IPPV): General

A prerequisite for IPPV is that the patient is supplied with a sufficient amount of fresh gas. The APL valve selector must be set to the "SPONT/IPPV" position.

If the APL valve selector is not set to the "SPONT/IPPV" position, the pressure in the breathing system will increase.

The safety valve of the patient system makes sure that no pressures greater than 80 hPa (mbar) build up in the system. The pressure limit (Pmax) can be adjusted on the control box.

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Intermittent Positive Pressure Ventilation (IPPV): Inspiration

During inspiration, the PEEP control valve **1** remains closed. The control pressure present at the PEEP control valve **1** varies with the set pressure limit (Pmax).

The pressure generated by the ventilator's piston closes the fresh-gas decoupling valve **2**. The gas mixture (expiratory gas and fresh gas) flows through the inspiratory valve **3**, the O_2 sensor **4**, the inspiratory hose **5**, and through the Y-piece into the lung **6**. The pressure sensor **7** measures the airway pressure. The ventilation pressure cannot exceed the pressure limit (Pmax) set on the control box because the PEEP control valve **1** opens. The fresh gas then fills the breathing bag **8**.

Any excess fresh gas flows through the open APL valve **9**, and through the non-return valve **10** into the anesthetic gas scavenging system.

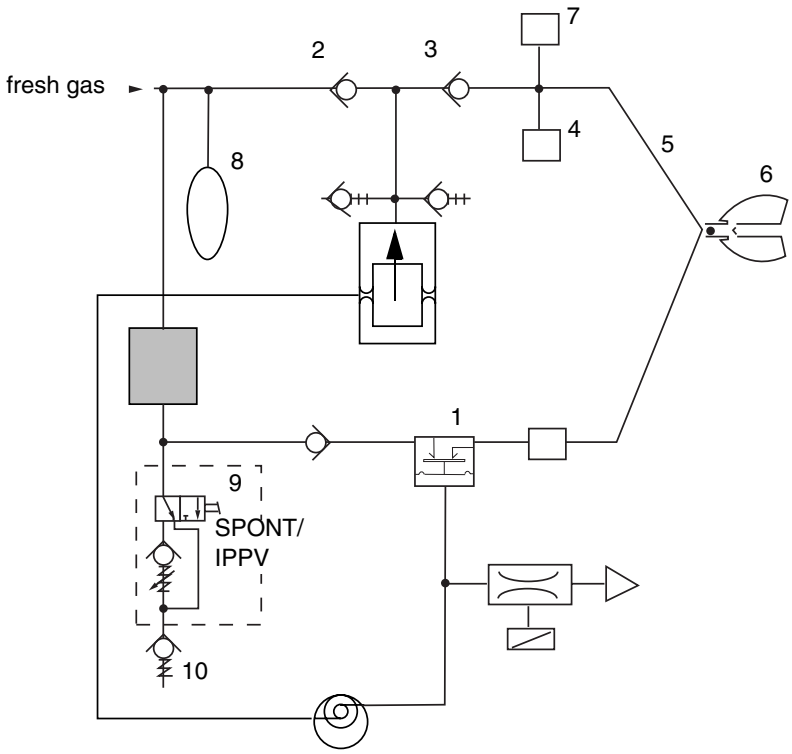

Fig. 17: Intermittent positive pressure ventilation (inspiration)

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Intermittent Positive Pressure Ventilation (IPPV): Expiration

During expiration, the inspiratory valve **1** remains closed thus preventing rebreathing into the inspiratory branch.

The expiratory gas from the lung **2** flows through the expiratory hose **3**, the flow sensor **4**, the PEEP control valve **5**, the expiratory valve **6**, and through the absorber **7** back into the breathing bag **8** mixing with fresh gas also flowing into the breathing bag.

The ventilator's piston moves back drawing the gas mixture needed for the next inspiration into the piston space.

Any excess fresh-gas flows through the APL valve **9**, and through the non-return valve **10** into the anesthetic gas scavenging system.

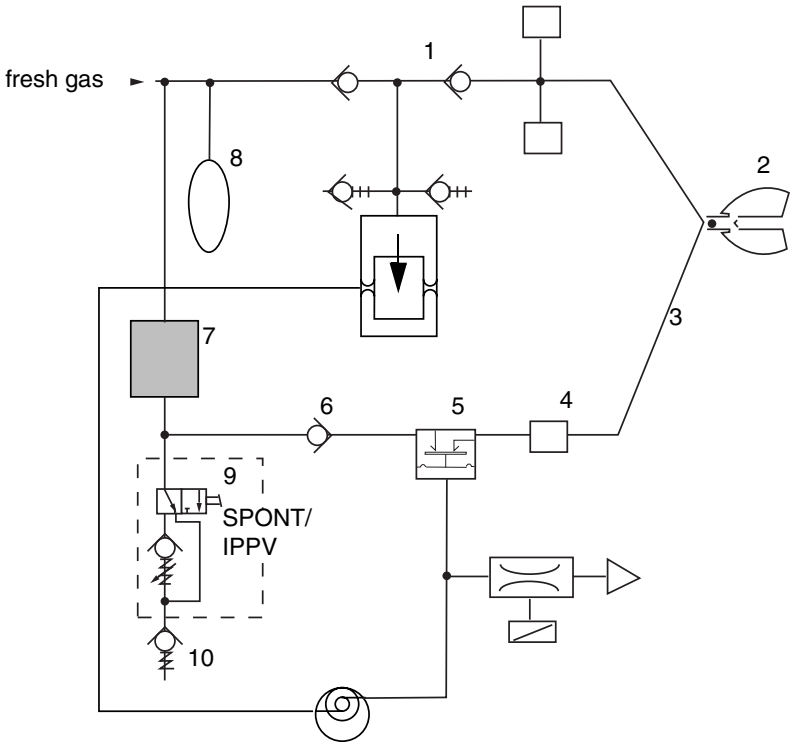

Fig. 18: Intermittent positive pressure ventilation (expiration)

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6.1.2 Cosy Absorber

The absorber is filled with fresh soda lime. The soda lime scrubs CO_2 from the respiratory gas and, because it is humidified, it prevents any absorption of anesthetics.

Expired soda lime changes its color. The soda lime must be replaced when two thirds of the soda lime in a canister are discolored.

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6.2 Circle Absorption System "Circle System 9 Fabius"

The circle absorption system "Circle System 9 Fabius" allows three modes of patient ventilation: manual ventilation, spontaneous breathing, intermittent positive pressure ventilation (IPPV). The APL valve (adjustable pressure limiting valve) has a selector which can be used to toggle between "MAN" and "IPPV/SPONT".

In the "MAN" position, the compact breathing system is closed to atmosphere. This position is the default position for manual ventilation of the patient. The APL valve opening pressure can be adjusted from 5 to 70 hPa (mbar).

In the "IPPV/SPONT" position the APL valve is open to atmosphere. This position is the default position for intermittent positive pressure ventilation and spontaneous breathing.

The pressure limit (Pmax) can also be adjusted during IPPV from 20 hPa (mbar) to 70 hPa (mbar) using the control box.

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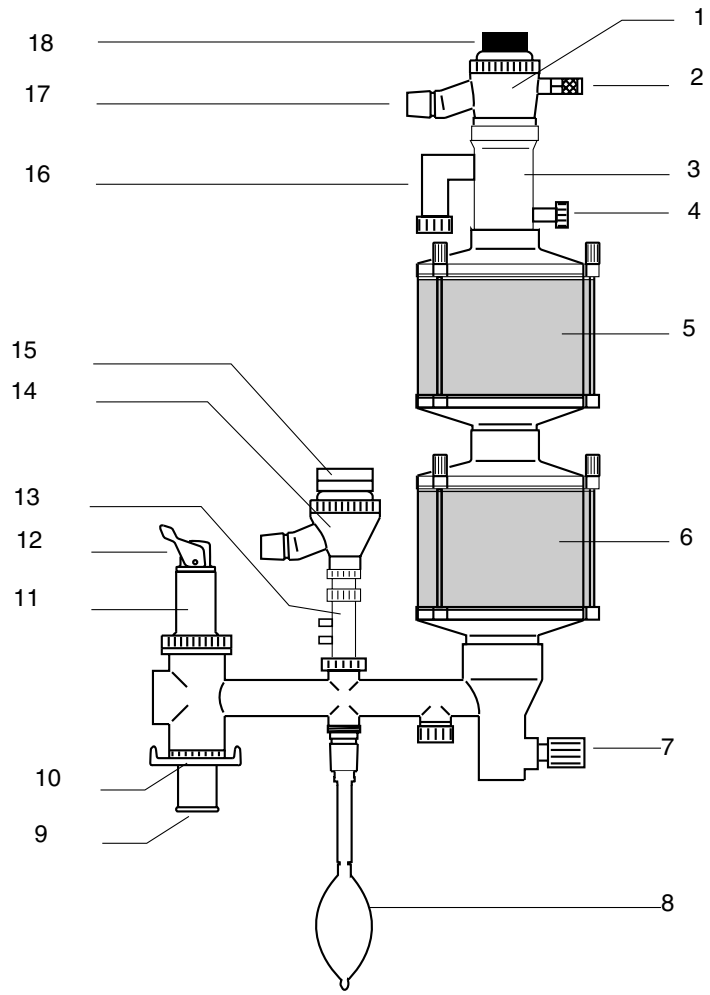

Fig. 19: Circle absorption system "Circle System 9 Fabius"

Key

1	Inspiratory valve	10	Non-return valve
2	Pressure-measuring port (Paw)	11	APL valve
3	Fresh-gas decoupling valve	12	MAN/SPONT-IPPV selector
4	Fresh-gas port	13	Flow sensor
5	First absorber	14	Expiratory valve
6	Second absorber (optional)	15	PEEP valve
7	Clamping screw	16	Ventilator port
8	Breathing bag	17	Inspiratory port
9	Anesthetic gas scavenging port	18	O_2 sensor

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6.2.1 Function Description of the Circle Absorption System

Manual Ventilation: General

During manual ventilation, the APL valve is set to the "MAN" position. The safety valve of the patient system is activated. Only the warnings/alarms for the lower O_2 limit and the upper airway pressure limit (Paw) are enabled.

Manual Ventilation: Inspiration

When the clinician compresses the breathing bag **1**, the gas mixture (expiratory and fresh gas) flows through the absorber **2**, the open fresh-gas decoupling valve **3**, the open inspiratory valve **4**, the inspiratory hose **5**, and through the Y-piece **6** into the lung **7**. The CO_2 contained in the gas mixture is scrubbed by the soda lime in the absorbers **2**. The ventilation pressure is limited by the APL valve **8**. The expiratory valve **9** remains closed. Any excess amount of the gas mixture flows through the APL valve **8**, and the non-return valve **10** into the anesthetic gas scavenging system **11**.

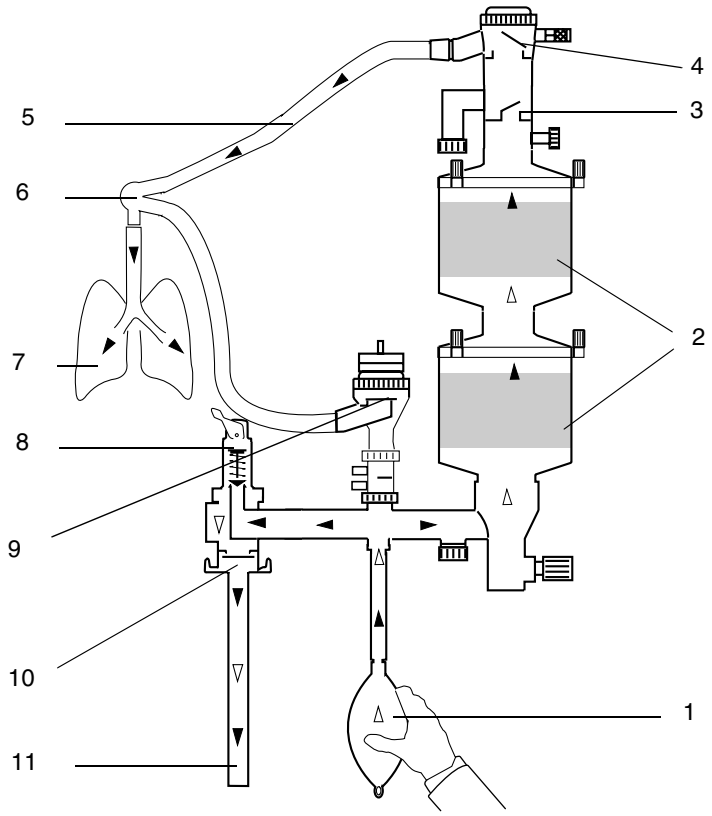

Fig. 20: Manual ventilation (inspiration)

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Manual Ventilation: Expiration

During expiration, the inspiratory valve **1** remains closed thus preventing the expiratory gas from flowing back into the inspiratory branch.

After releasing the breathing bag **2**, the expiratory gas flows through the open expiratory valve **3** and the flow sensor **4** into the breathing bag **2**. At the same time, fresh gas from the fresh-gas port **5** flows through the absorber(s) into the breathing bag **2**.

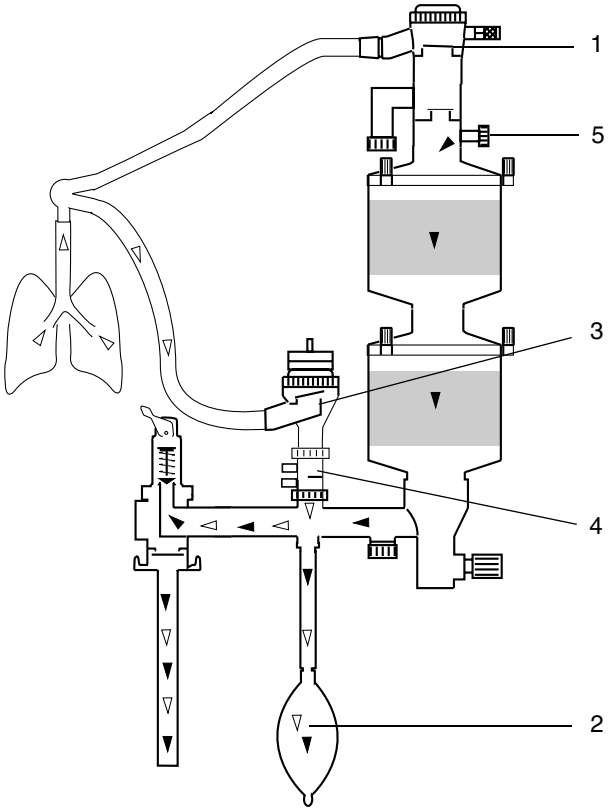

Fig. 21: Manual ventilation (expiration)

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Spontaneous Breathing: General

A prerequisite for spontaneous breathing is that the patient is supplied with a sufficient amount of fresh gas. The APL valve selector must be set to the "IPPV/SPONT" position. No pressure builds up in the circle absorption system. Only the warnings/alarms for the lower O_2 limit and the upper airway pressure limit (Paw) are enabled.

Spontaneous Breathing: Inspiration

During inspiration, the expiratory valve **1** remains closed and prevents rebreathing of expiratory gas containing CO_2.

The patient inhales the gas mixture from the breathing bag **2.** The gas mixture flows through the absorber(s) **3**, the open inspiratory valve **4**, the inspiratory hose **5**, and the Y-piece **6**. Additional fresh gas is supplied to the patient through the fresh-gas port **7**.

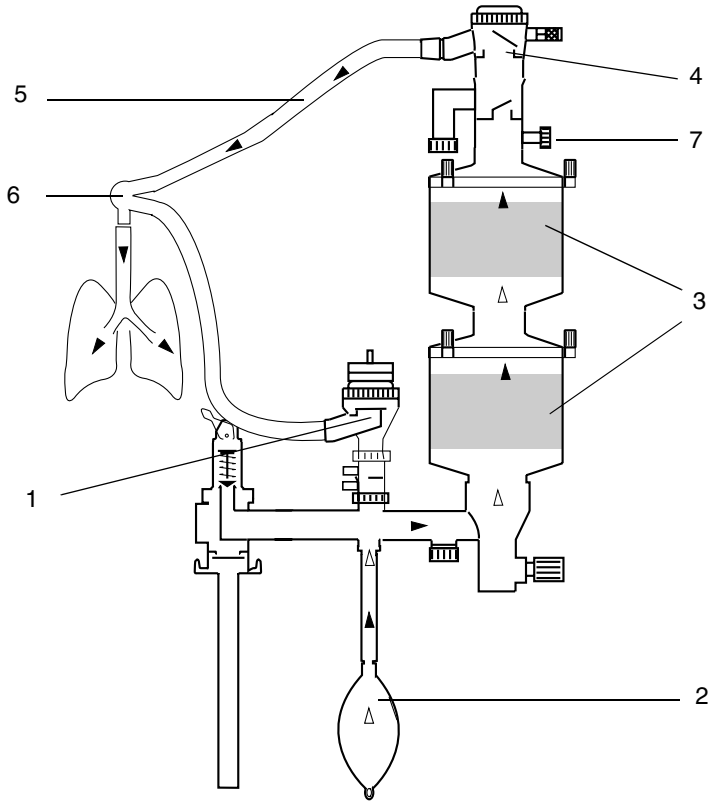

Fig. 22: Spontaneous Breathing (inspiration phase)

The CO_2 is scrubbed from the expiratory gas by the soda lime contained in the absorber(s) **3**. The fresh gas replaces the anesthetic and the oxygen taken up by the patient.

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Spontaneous Breathing: Expiration

During expiration, the inspiratory valve **1** remains closed thus preventing the expiratory gas from flowing back into the inspiratory branch.

The APL valve **2** is open, irrespective of the current pressure setting.

The expiratory gas flows through the expiratory hose **3**, the open expiratory valve **4**, the flow sensor **5**, into the breathing bag **6**. At the same time, fresh gas from the fresh-gas port **7** flows through the absorber(s) **8** into the breathing bag **6**.

When the breathing bag **6** is full, any excess gas mixture flows through the non-return valve **9** into the anesthetic gas scavenging system **10**.

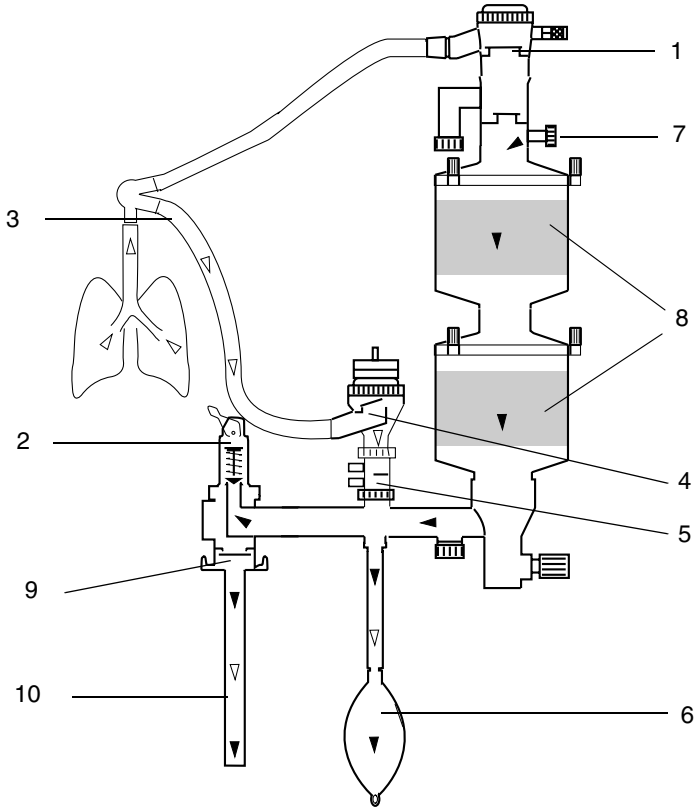

Fig. 23: Spontaneous breathing (expiration)

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Intermittent Positive Pressure Ventilation (IPPV): General

A prerequisite for IPPV is that the patient is supplied with a sufficient amount of fresh gas. The APL valve selector must be set to the "IPPV/SPONT" position.

If the APL valve selector is not set to the "IPPV/SPONT" position, the pressure in the breathing system will increase.

The safety valve of the patient system limits the pressure to 80 hPa (mbar). The desired pressure limit (Pmax) can be adjusted on the control box.

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Intermittent Positive Pressure Ventilation (IPPV): Inspiration

During inspiration, the inspiratory valve **1** remains open. The PEEP valve closes the expiratory valve **2**. A control pressure, which varies with the pressure limit (Pmax) set on the control box, is applied to the PEEP valve.

The gas mixture (expiratory and fresh gas) from the ventilator **3** flows through the hose **4**, the inspiratory valve **1**, the inspiratory hose **5**, and through the Y-piece **6** into the lung **7**. The ventilation pressure cannot exceed the pressure limit (Pmax) set on the control box. The fresh gas flows through the absorbers and fills the breathing bag.

Any excess amount of fresh gas flows through the APL valve **8** and the non-return valve **9** into the anesthetic gas scavenging system **10**.

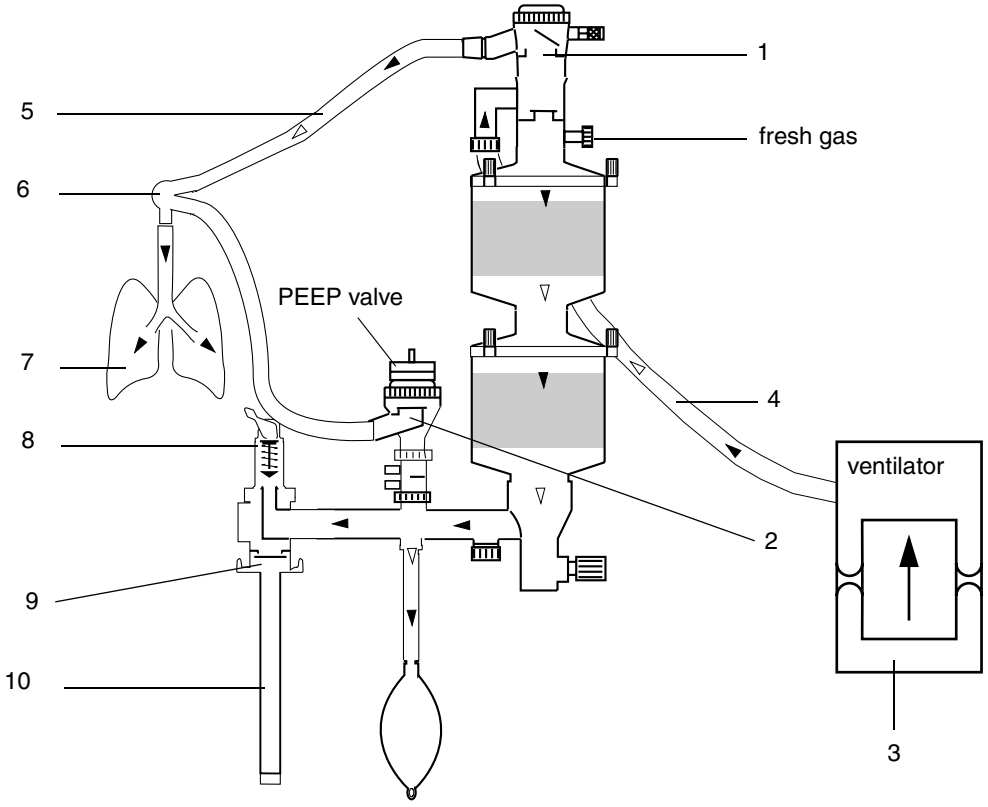

Fig. 24: Intermittent positive pressure ventilation (inspiration)

If the inspiratory pressure exceeds the set pressure limit (Pmax), the PEEP valve opens. Any excess gas flows through the PEEP valve, and the flow sensor into the circle absorption system.

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Intermittent Positive Pressure Ventilation: Expiration

During expiration, the inspiratory valve **1** remains closed thus preventing rebreathing into the inspiratory branch.

The expiratory gas flows through the expiratory valve **2**, the flow sensor **3**, back into the breathing bag **4** and, at the same time, mixes with the fresh-gas from the fresh gas port **5**.

The ventilator piston moves back drawing the gas mixture needed for the next inspiration into the piston space.

The excess fresh gas flows through the APL valve **6**, and through the non-return valve **7 in**to the anesthetic gas scavenging system **8**.

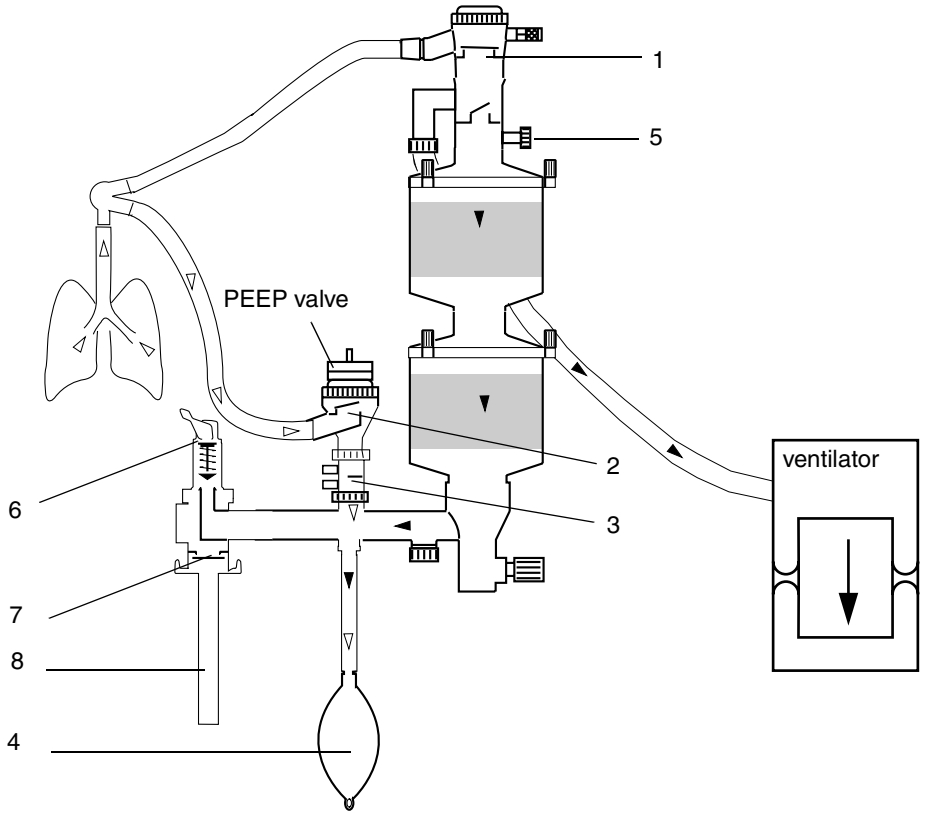

Fig. 25: Intermittent positive pressure ventilation (expiration)

Intermittent Positive Pressure Ventilation: Expiration with PEEP

A PEEP value is adjusted on the control box. The corresponding PEEP control pressure is applied to the diaphragm of the PEEP valve. The diaphragm plate of the PEEP valve pushes the mica disc of the expiratory valve which closes the crater. If the pressure of the expiratory gas exceeds the set PEEP value, the expiratory valve **2** opens.

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6.2.2 Absorber

The absorber is filled with fresh soda lime. The soda lime scrubs the CO_2 from the respiratory gas and, because it is humidified, it prevents any absorption of anesthetics.

Expired soda lime changes its color. The soda lime must be replaced when two thirds of the soda lime in a canister are discolored.

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7 Ventilation Unit

The ventilation unit consists of the ventilator and the pneumatics.

The ventilation unit is powered with DC voltage from the control box or, in the event of mains power failure, from the uninterruptible power supply (UPS). The ventilator delivers the fresh gas (at a given volume, pressure, and frequency) which comes from the flowmeter block and from the breathing bag to the patient. During expiration, the bag-type rolling seal of the ventilator fills with the expiratory gas from the patient and with the fresh gas stored in the breathing bag.

During inspiration, a specific amount of this gas mixture is delivered to the patient. A safety valve limits the ventilation pressure.

If the fresh gas in the machine is not sufficient, the ventilator draws in ambient air through the auxiliary air valve located in the patient system.

7.1 Ventilator

The ventilator is mounted into the swivel-out compartment of Fabius. The cover of the ventilator has a connection for the respiratory hose of the circle absorption system or compact breathing system, respectively. The ventilator is powered electrically. Its control system and keypad are located in/on the control box. The control box also contains the basic monitoring system. A sight window on the swivel out compartment allows the clinician to watch the movement of the rolling seals.

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7.1.1 Function Principle of the Ventilator

The ventilator consists of a piston and a cylinder. The recirculating ball screw driven by the motor moves the piston. When the piston moves back it slides completely over the motor. The incremental encoder determines the number of motor rotations and transmits the corresponding signal to the microprocessor. The rolling seal is attached to the piston. The bag-type rolling seal encloses the inspiratory volume.

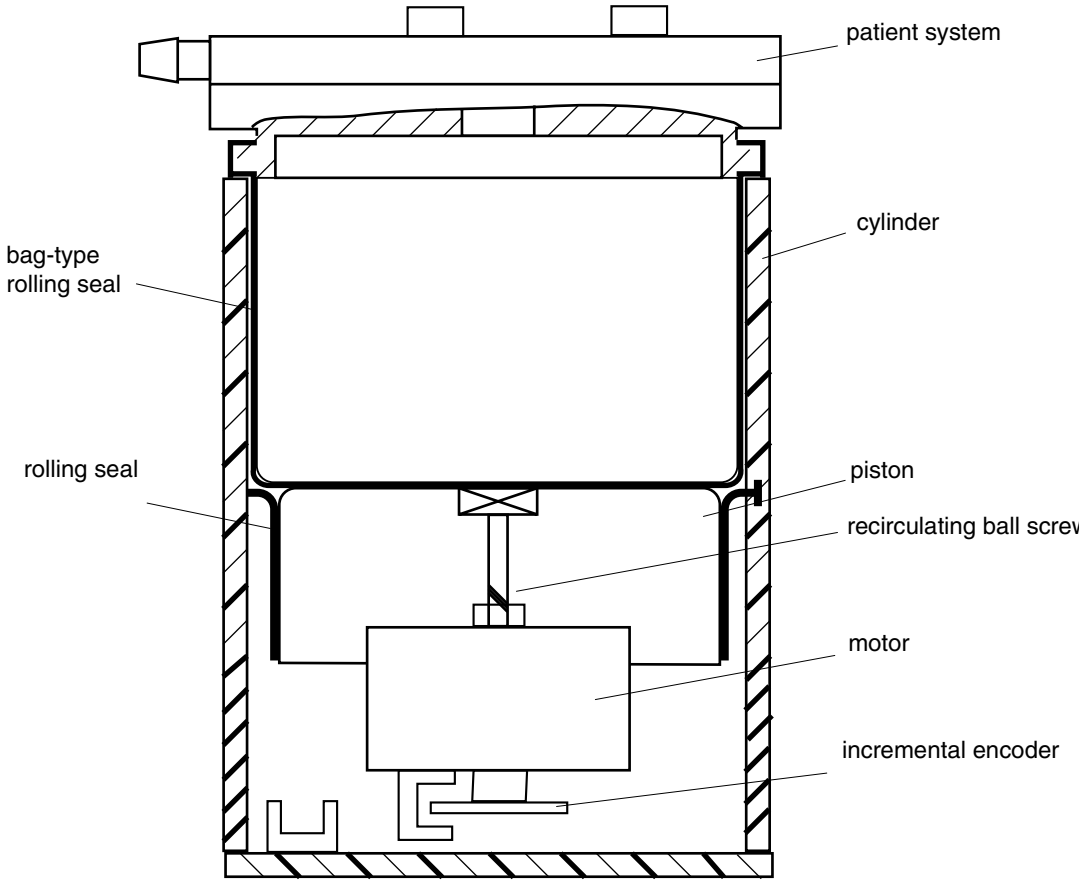

Fig. 26: Sectional view of the ventilator

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7.2 Pneumatics

The pneumatics comprises the following subassemblies:

- electronic PEEP valve
- Pneumatic Control PCB
- piston pump
- pressure sensor

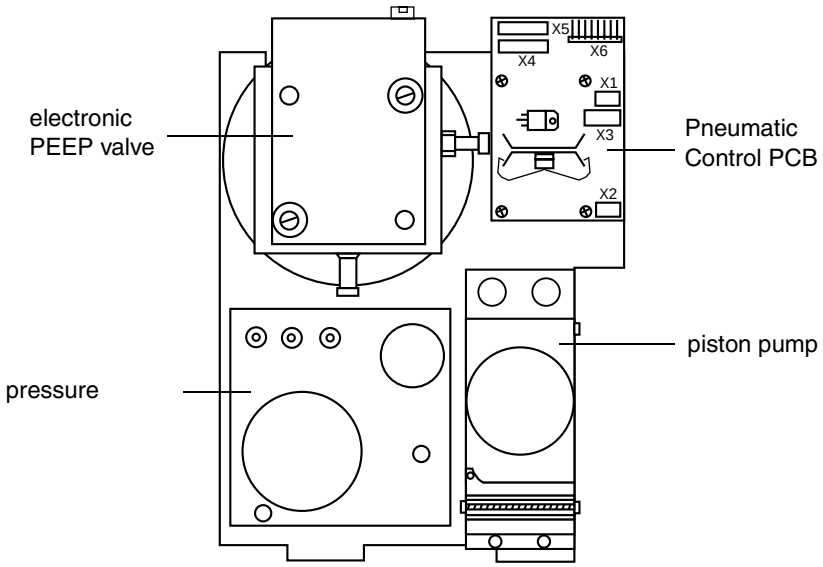

Fig. 27: Top view of the pneumatics

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7.2.1 Function Principle of the Pneumatic Control of the Ventilator

The piston pump generates a vacuum required for the bag-type rolling seal and the rolling seal of the ventilator as well as the control pressure for the PEEP valve. The spring-loaded non-return valve limits the vacuum to –200 hPa (mbar). A pressure sensor measures the current pressure and converts the pressure value into a corresponding electrical signal. This signal is transmitted to the microprocessor. The reservoir V1 "smooths" the flow to the electronic PEEP valve. The combination of filter and reservoir V2 dampen the noise.

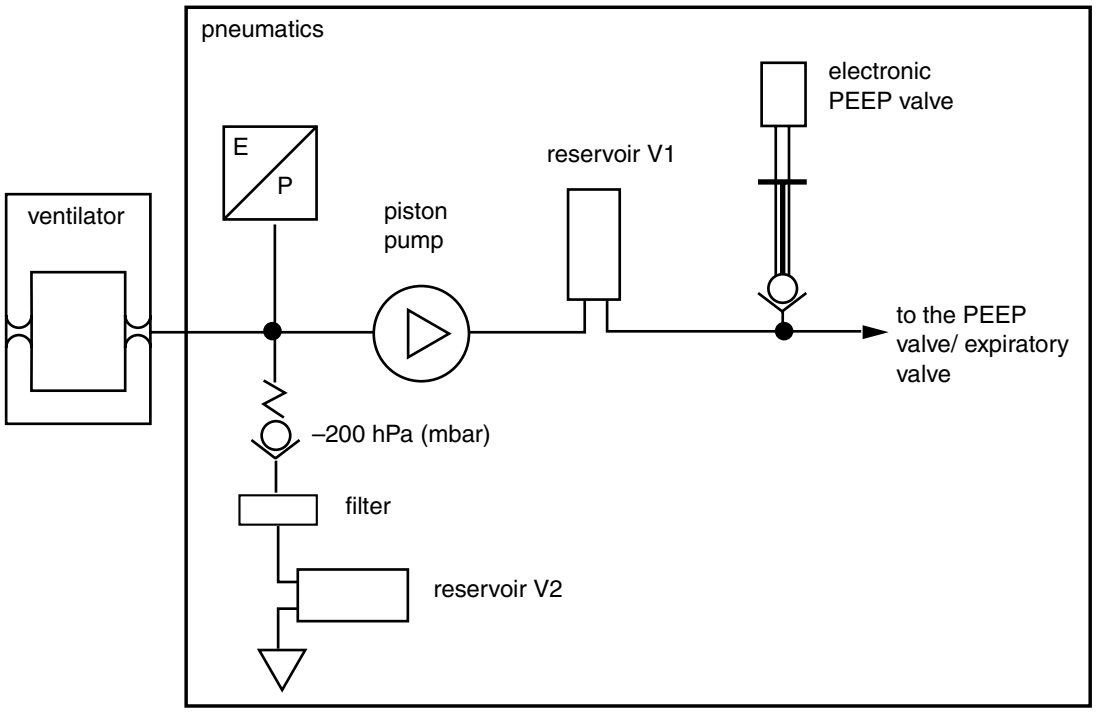

Fig. 28: Function diagram of the pneumatic control of the ventilator

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7.3 Function Description of the Electronic PEEP Valve

7.3.1 Expiration

The piston pump generates a gas flow. This gas flow is directed to the electronic PEEP valve.

If an endexpiratory PEEP value has been set on the control box, this value corresponds to a specific electrical current. The current flows across the coil of the electronic PEEP valve. The diaphragm closes the crater. The electronic PEEP valve generates a control pressure. This control pressure is applied to the mechanical PEEP valve. The patient can only exhale up to the set PEEP value.

7.3.2 Inspiration

During inspiration, the electronic PEEP valve generates a control pressure which corresponds to the set pressure limit (Pmax).

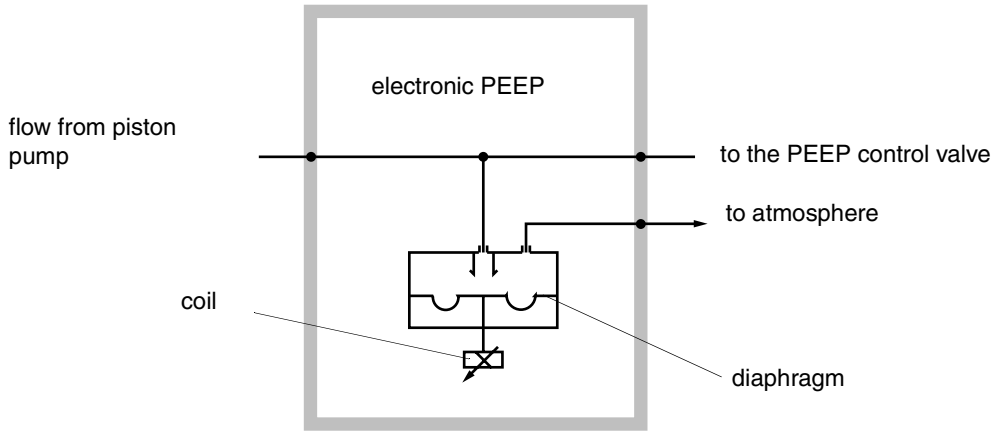

Fig. 29: Function diagram of the electronic PEEP valve

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8 Patient System

The patient system provides the connection between Fabius and the patient.

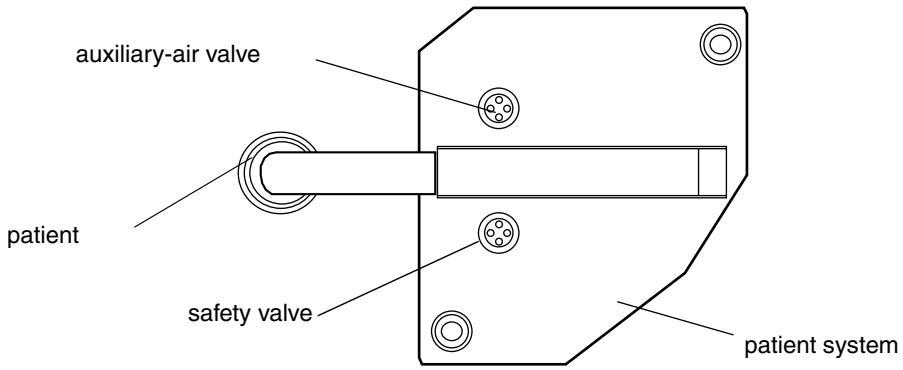

Fig. 30: Top view of the patient system

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8.1 Safety Valve of the Patient System

If the pressure limit (Pmax) is exceeded considerably, or if the pressure limit control fails, the patient system safety valve limits the gas pressure. This safety valve is permanently set to a working pressure of 60 hPa (mbar) to 80 hPa (mbar).

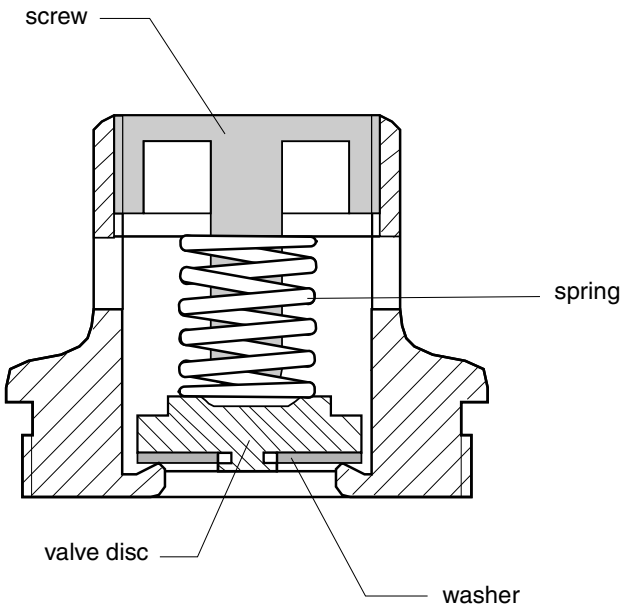

Fig. 31: Sectional view of the safety valve

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8.2 Auxiliary Air Valve of the Patient System

The auxiliary air valve allows the patient to spontaneously breathe ambient air should the medical gas supply and/or Fabius fail. The opening pressure of the auxiliary air valve is 0 to –5 hPa (mbar).

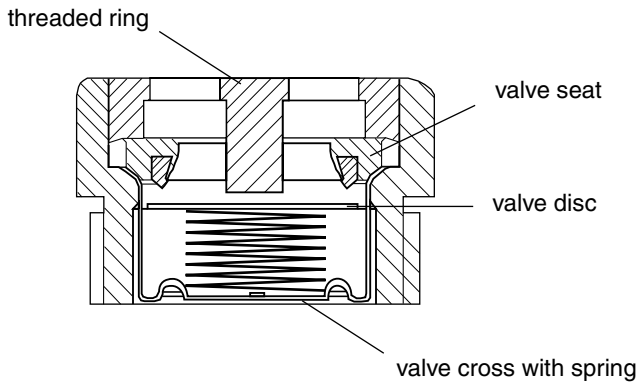

Fig. 32: Sectional view of the auxiliary air valve

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9 Electronics Block Diagram

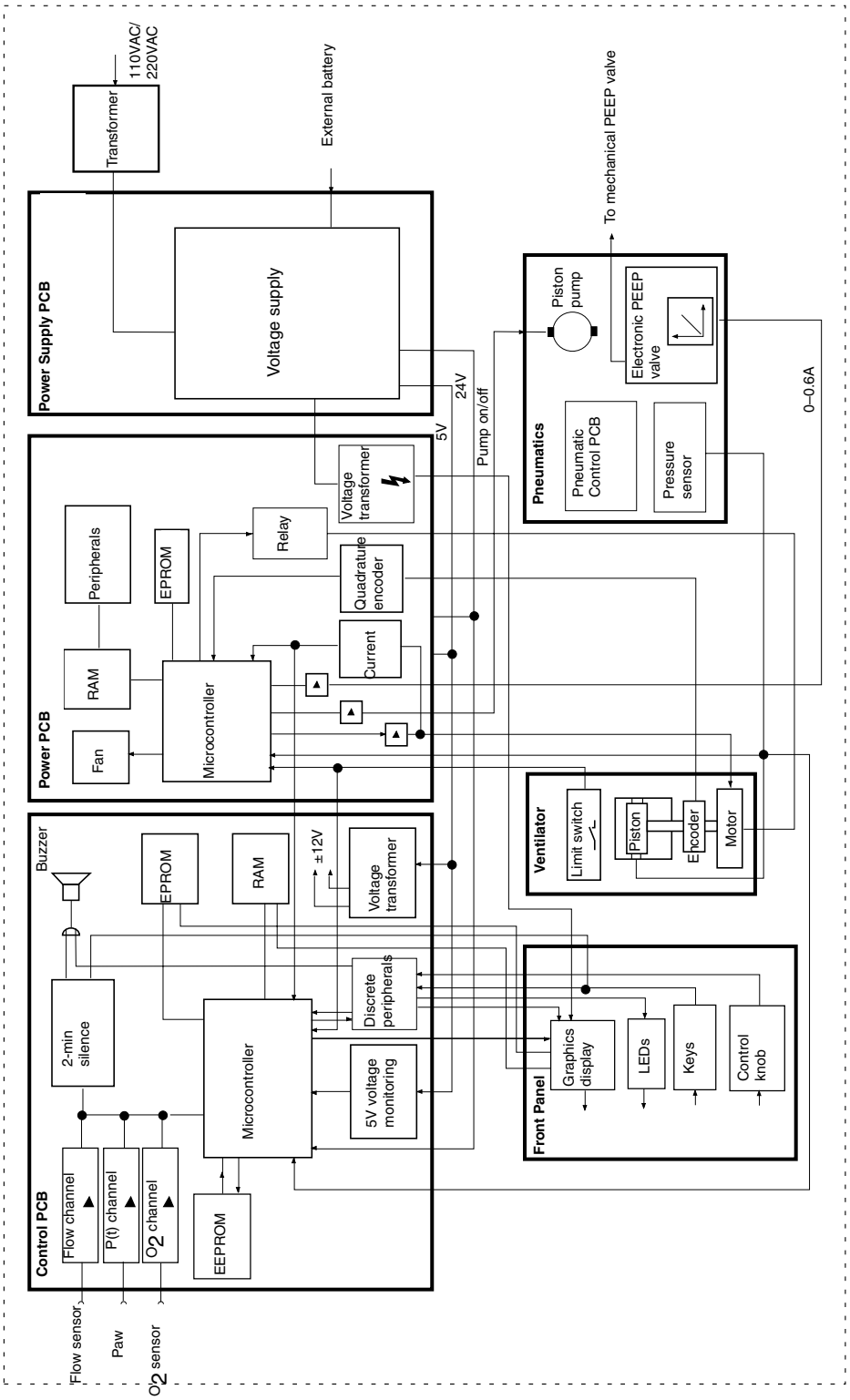

Fig. 33: Electronics block diagram

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10 Control Box

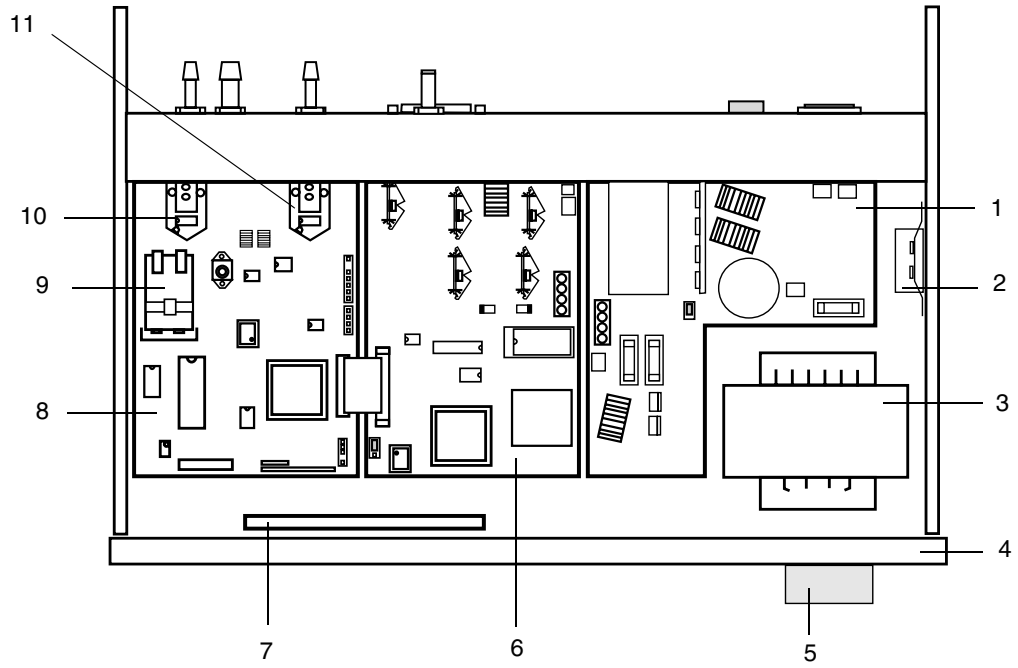

Fig. 34: Top view of the control box

Key

1	Power Supply PCB
2	Mains filter
3	Mains transformer
4	Front panel (front frame and membrane keypad)
5	Control knob
6	Power PCB
7	Graphics display and backlighting lamp
8	Control PCB
9	Rechargeable battery or Goldcap capacitor
10	Differential pressure sensor (flow)
11	Airway pressure sensor (Paw)

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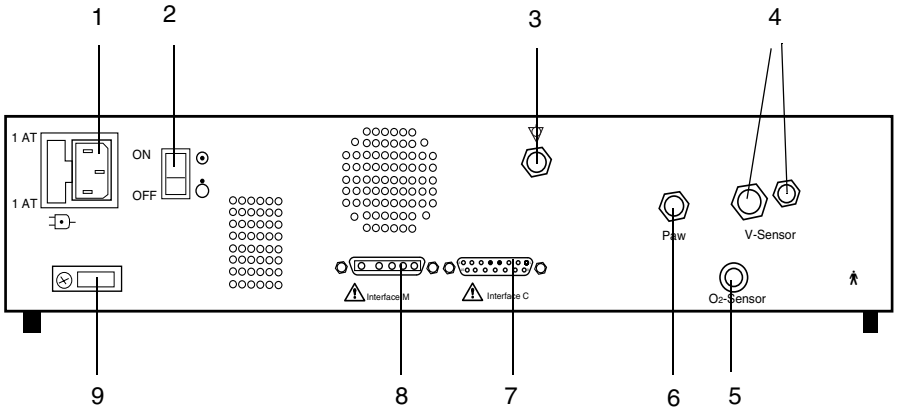

Fig. 35: Rear View of the Control Box

Key

1 Mains supply receptacle with mains fuses

2 ON/OFF switch

3 Equipotential bonding pin

4 Flow sensor port

5 O_2 sensor port

6 Pressure sensor port (Paw)

7 Pneumatics connector

8 Motor and Battery connector

9 Power cord clamp

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10.1 Power Supply Unit

The power supply unit consists of the Power Supply PCB, the mains supply receptacle, the ON/OFF switch, the fuses, the mains filter, and the mains transformer.

The power supply unit powers Fabius with the following voltages:

- +24 VDC
- +5 VDC

10.1.1 Power Supply PCB

The Power Supply PCB uses the voltage regulator L4960 to generate the +5 V operating voltage.

Two voltage regulators LT1074 connected in parallel generate the supply voltage (28 V) and the rechargeable battery charging voltage.

The resistor S1 (the conductor is designed as sense resistor) is used to measure the charging current of the rechargeable battery. An integrated circuit transmits the signal to the microcontroller.

The signals A and B are fed back to the 24 V voltage regulators and function as charging current limitation.

The Power Supply PCB monitors the rechargeable battery voltage, generates the battery symbol control on the display and the power failure alarm.

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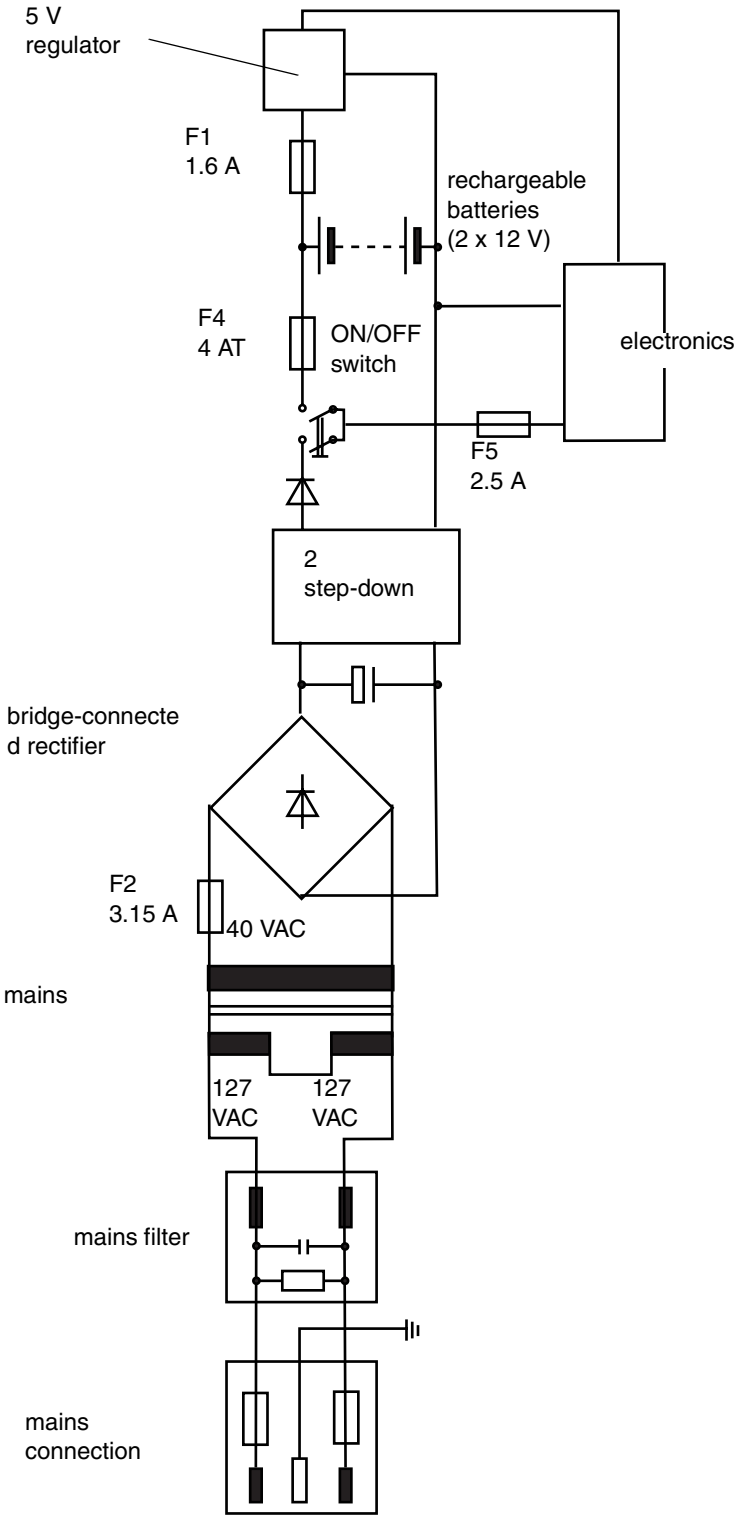

Fig. 36: Block diagram of the control box power supply unit

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10.2 Control PCB

The Control PCB measures and monitors all measuring and status signals. If an error occurs, the Control PCB switches off the solenoids, and activates the buzzer. The Control PCB is then reset.

The Control PCB is equipped with the pressure sensors for the airway pressure (Paw) and the flow (ΔP).

The Control PCB comprises the following components:

- microcontroller
- quartz oscillator
- EPROM
- EEPROM
- RAM
- latch
- 9 V rechargeable battery or Goldcap capacitor

The Control PCB provides the following functions:

- measurement of oxygen concentration, flow, and pressure
- voltage monitoring and power-on
- LED control
- 2-min silence timer
- buzzer and buzzer control
- contrast control
- membrane keypad scanning
- control knob scanning
- motor current monitoring
- membrane pressure
- charging voltage monitoring
- display control
- ±12 V generation

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10.3 Control PCB Block Diagram

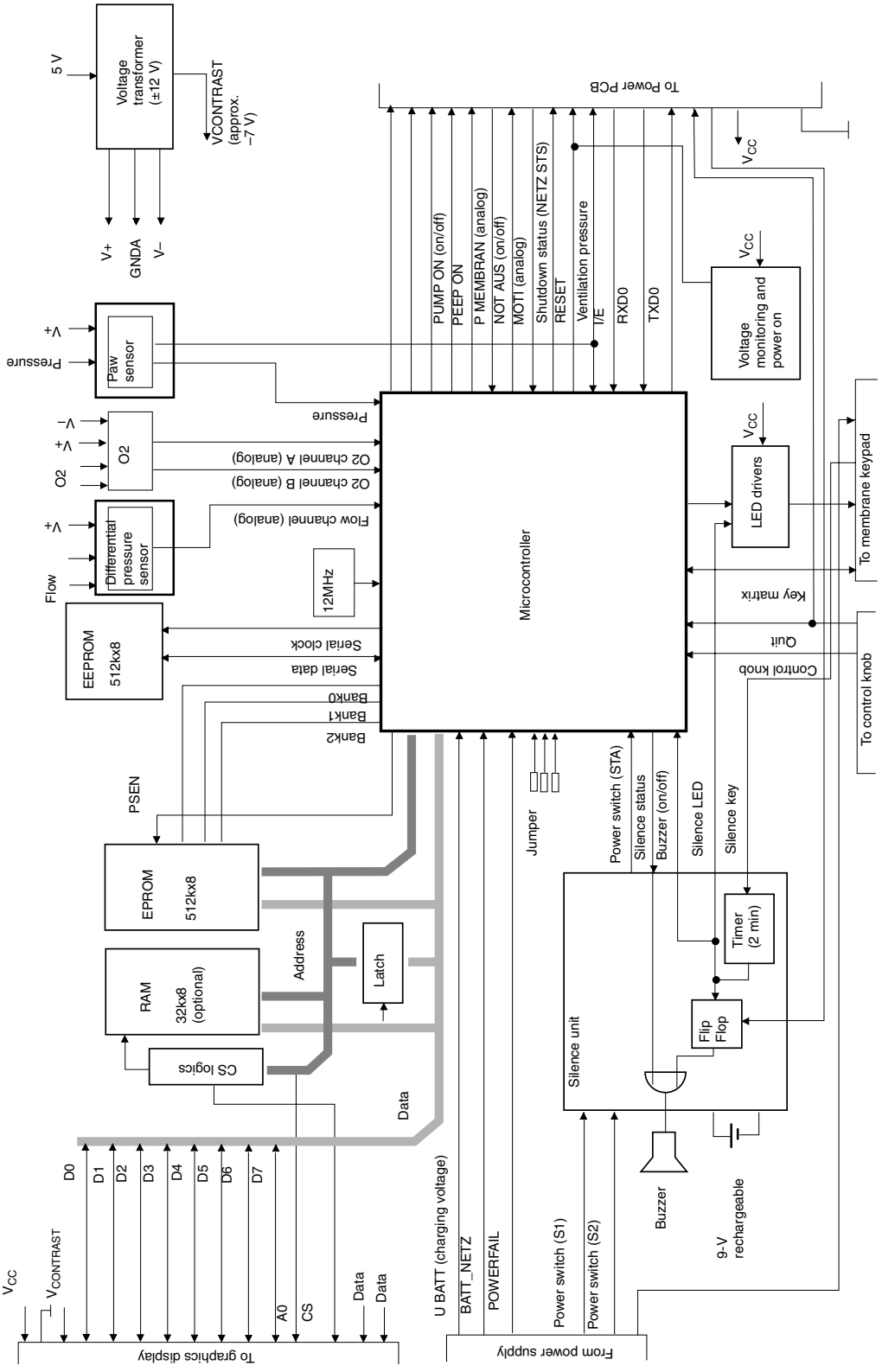

Fig. 37: Control PCB block diagram

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10.3.1 Microcontroller

The microcontroller 80C517A controls the functions of the control box.

10.3.2 Quartz Oscillator

The quartz oscillator QOS12Mhz clocks the microcontroller 80C517A with 12 MHz.

10.3.3 EPROM

The EPROM M27C4001 is used to store the program for the control box. It has a programmable area of 512 kbytes.

10.3.4 EEPROM

The EEPROM X24C04 is a memory chip used to write and read serial data. It contains the set customer parameters and the zero values of flow, pressure, and O_2.

10.3.5 RAM

The 32 Kx8 RAM contains the current patient parameters and stores data which the microcontroller needs to buffer.

10.3.6 Latch

Latch HC373 is a driver block.

10.3.7 Voltage Transformer

The voltage transformer transforms the 5 V input voltage into the ±12 V output voltage.

10.3.8 Oxygen Concentration Evaluation

The operational amplifier OP07 evaluates the voltage of the O_2 sensor.

10.3.9 Voltage Monitoring Circuit/Voltage Monitor

The IC 7665 monitors the output voltage (+5 V) of the control box. If the voltage is higher or lower than the specified voltage, the IC 7665 generates a RESET signal. This RESET signal resets the microcontroller. The IC makes sure that the microcontroller only initializes when the operating voltage has reached an adequate level.

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10.3.10 LED Control

The LEDs (LED_MAN, LED_IPV, LED_SBY, LED_SIL, LED_WAR and LED_ALA) are triggered by the transistors BCX17.

10.3.11 2-Min Silence Timer

The 2-min silence timer has a timer IC (74HC4060). The timer IC enables suppression of the audible alarm for two minutes.

10.3.12 Buzzer and Buzzer Control

During operation, the buzzer is powered with 24 V. If a power failure occurs, the built-in 9 V rechargeable battery on the Control PCB powers the buzzer. (Later models have a Goldcap capacitor instead of a battery.) In the event of a failure, the buzzer is triggered by the microcontroller.

10.3.13 Contrast Control

The operational amplifier TL072D generates the contrast voltage for the graphics display. The contrast voltage is approximately –7 VDC to –8 VDC.

10.3.14 9V Rechargeable Battery or Goldcap Capacitor

In the event of a power failure, the 9 V rechargeable battery supplies the operating voltage for the buzzer. The 24 V operating voltage supplies a charging circuit which charges the rechargeable battery during normal operation.

Later models have a Goldcap capacitor instead of a battery.

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10.4 Power PCB

The Power PCB controls the piston pump, the electronic PEEP valve, the fan, the ventilator motor, and the backlighting of the graphics display.

The Power PCB comprises the following components:

- microcontroller
- quartz oscillator
- EPROM
- latch
- MOSFET amplifier for the motor
- voltage transformer for the backlighting lamp
- PEEP valve control
- light barrier evaluation of the motor (limit switch)
- system temperature monitoring and fan control
- quadrature encoder
- safety relay

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10.5 Power PCB Block Diagram

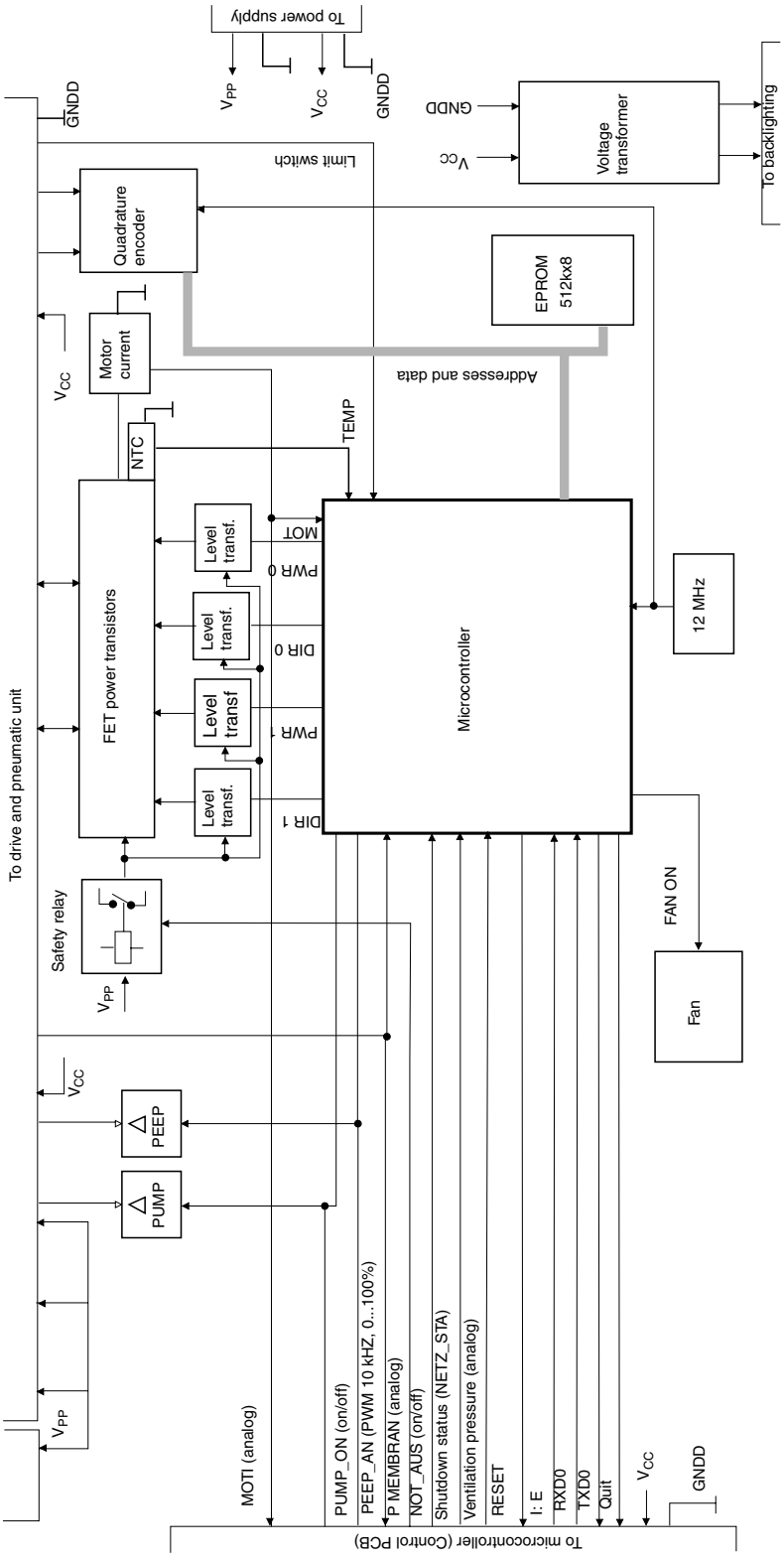

Fig. 38: Power PCB block diagram

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10.5.1 Microcontroller

The microcontroller 80C517A controls the functions of the Power PCB.

10.5.2 Quartz Oscillator

The quartz oscillator of the Control PCB clocks the microcontroller 80C517A with 12 MHz.

10.5.3 EPROM

The EPROM has a programmable area of 512 kbytes.

10.5.4 Latch

The latch HC373 is a driver block.

10.5.5 MOSFET Amplifier

The MOSFET amplifier controls the motor of the ventilator.

10.5.6 Voltage Transformer for the Backlighting Lamp

The voltage transformer E1241 transforms the input voltage into a corresponding output voltage for the lamp of the backlighting.

Risk of damage to the voltage transformer.

The voltage transformer will be damaged if used at no load. **Do not operate the voltage transformer without the lamp of the backlighting**.

10.5.7 PEEP Valve Control

The power field-effect transistor BUZ20 and the operational amplifier LM324 control the PEEP valve.

10.5.8 Light Barrier Evaluation of the Motor

The IC 74HC14 evaluates the final position and the movement of the motor (END-SCH, PHASE0, and PHASE1).

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10.5.9 System Temperature Monitoring

The system temperature sensor is located on the MOSFET output module. It is an NTC (negative temperature coefficient) thermistor. The microcontroller uses the system temperature sensor to measure the system temperature.

10.5.10 Quadrature Encoder

The quadrature encoder CF32007NT picks up the number of rotations of the motor and transmits this data to the microcontroller.

10.5.11 Safety Relay

In the event of a malfunction, the microcontroller switches off the safety relay using the NOT_AUS (emergency off) signal. As a result, the motor, the electronic PEEP valve, the piston pump, and the fan can no longer be activated.

10.5.12 Fan Control

If the system temperature inside the control box increases (to approx. 60 °C), the microcontroller activates the fan.

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10.6 Graphics Display

The graphics display consists of the LCD, the LCD drivers, the LCD controller, the display RAM (8 kbytes), and the fluorescent display (backlighting.

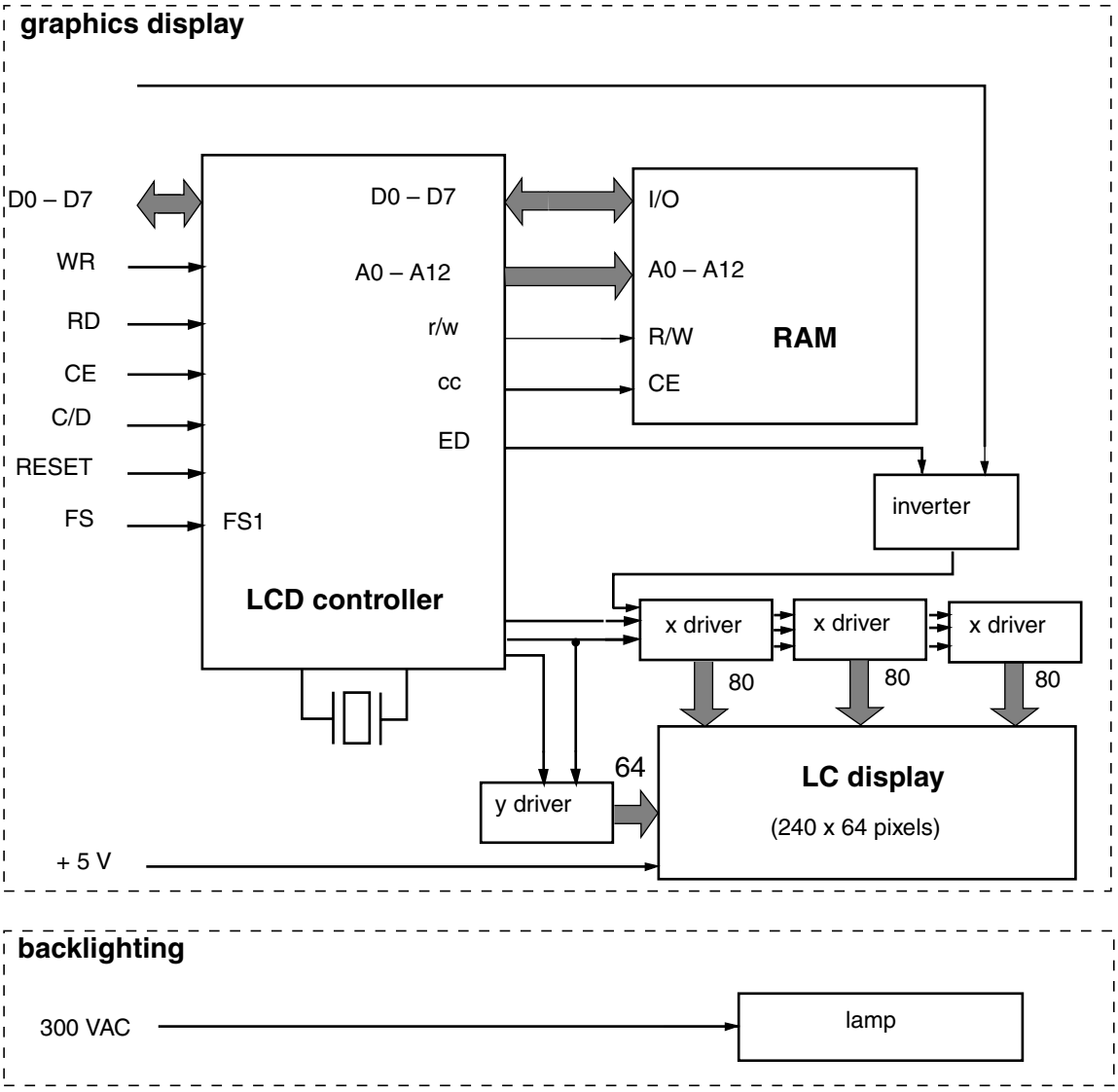

Fig. 39: Block diagram of the graphics display

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10.7 Front Panel

The front panel consists of the front frame and the membrane keypad.

10.7.1 Membrane Keypad

The membrane keypad has 15 keys (man/spont, IPPV, Pmax, VT, f_{IPPV}, T_I:T_E, T_{IP}:T_I, PEEP, upper and lower limit value setting, flow calibration, silence, standby, and 3 softkeys). The Control PCB scans the key operations.

10.7.2 Man/Spont Key

Fabius can be set to manual ventilation or spontaneous breathing by pressing the Man/Spont key.

10.7.3 IPPV Key

Fabius can be set to intermittent positive pressure ventilation by pressing the IPPV key.

10.7.4 Pmax Key

The inspiratory pressure limit can be set in a range of 10 hPa (mbar) to 70 hPa (mbar) by pressing the Pmax key. A pressure higher than 40 hPa (mbar) must be confirmed by pressing the Reset/Check key (a message is shown on the display).

10.7.5 V_T Key

After pressing the V_T key, the tidal volume can be set in a range of 50 mL to 1400 mL.

10.7.6 T_I:T_E Key

After pressing the T_I:T_E key, the inspiratory/expiratory time ratio can be set in a range of 1:3 to 2:1. The set value becomes effective at the end of the current respiratory cycle.

10.7.7 T_{IP}:T_I Key

After pressing the T_{ip}:T_i key, the inspiratory pause time to inspiratory time can be set in a range of 5% to 50%. The set value becomes effective at the end of the current respiratory cycle.

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10.7.8 PEEP Key

After pressing the PEEP key, the positive end-expiratory pressure may be set in a range of 1 hPa (mbar) to 15 hPa (mbar). The set value has immediate effect.

10.7.9 Limit Values Key

The limit values key is used to set the upper and the lower limit values within a certain range.

10.7.10 Calibration Key (–0–)

After pressing the calibration key (–0–), the differential pressure sensor and the O_2 sensor are calibrated. The O_2 sensor is calibrated to 21 vol.% or 100 vol.%.

10.7.11 2-Min Silence Key

After pressing the 2-min silence key, the audible alarm is silenced for 2 minutes. This status is indicated by the yellow LED in the silence key. Pressing the silence key again during the alarm silence time will reset the audible alarm.

10.7.12 Standby Key

After pressing the standby key, the control box switches over to standby mode.

10.7.13 Menu Key

After pressing the menu key, it is possible to configure Fabius.

10.7.14 Screen Page Key

After pressing the screen page key, it possible to select different screen pages.

10.7.15 Control Knob

The control knob is used to change patient parameters (for example, PEEP, V_T, or P_{max}) by turning (selection of data) and pressing (confirmation of selected data).

10.8 Interface

The interface is use to transmit the analog voltages to the pneumatics.

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11 FiO_2 Measurement

The O_2 sensor measures the fraction of inspired O_2 (FiO_2) in the respiratory gas.

The O_2 sensor contains an alkaline electrolyte, a lead anode, two gold cathodes, and a plastic membrane. The spatial separation of the two gold cathodes allows to carry out a voltage comparison.

The O_2 sensor is an electrochemical cell which generates a voltage from the ion current.

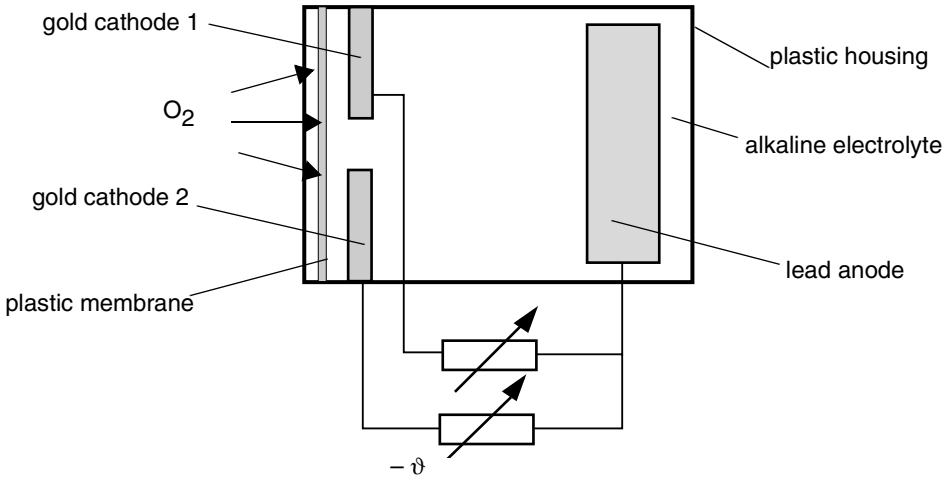

Fig. 40: O_2 sensor

The O_2 to be measured diffuses through the plastic membrane, reacts at the gold cathodes (negative polarity) and forms lead oxide and water at the lead anode (positive polarity). During this chemical process, an electrical voltage is generated which is proportional to the O_2 partial pressure.

The internal resistance is determined by the surface of the gold cathodes, the O_2 diffusion velocity, and the distance between the gold cathodes and the lead anode. The resistance is approximately 700 ohms.

This chemical process is temperature-sensitive. Therefore temperature-sensitive resistors are connected in parallel to the O_2 sensor. These resistors and the internal resistance of the O_2 sensor correct the measuring voltage. Due to the two gold cathodes used in the O_2 sensor cell, two different measuring voltages are generated. These measuring voltages are compared with each other.

If the O_2 sensor fails, the control box will indicate an error on the graphics display.

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12 Flow Measurement

A moving screen (moving vane) measures the expiratory flow of the patient. A flow-dependent pressure builds up at the moving vane. This pressure is picked up at the differential pressure sensor (ΔP). The differential pressure sensor converts the pressure into an electronic signal and transmits this signal to the microcontroller.

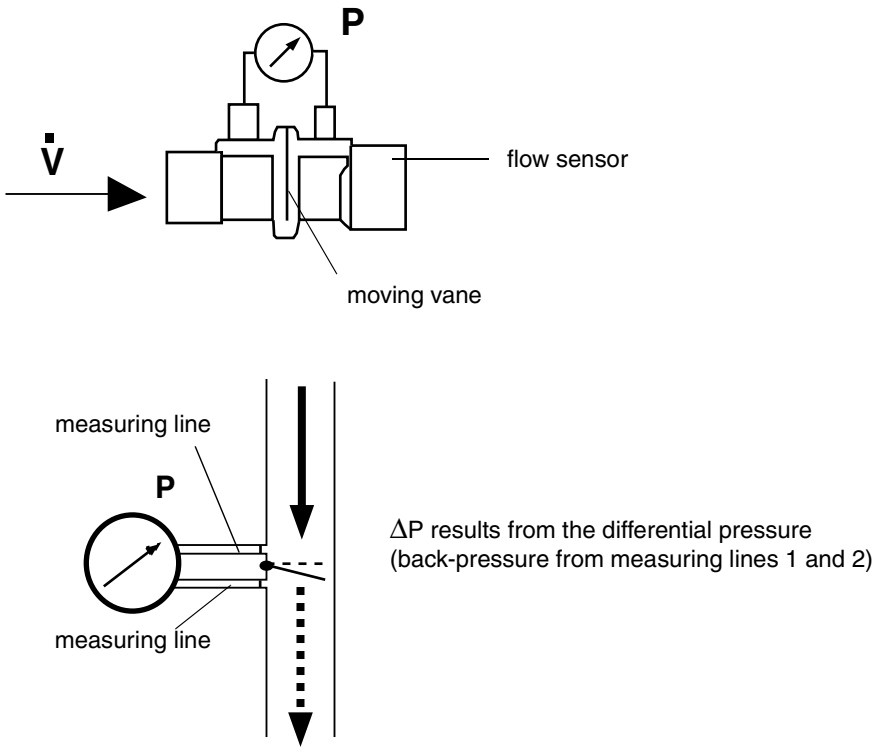

Fig. 41: Flow measurement principle

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13 Anesthetic Vaporizer "Vapor 19.n"

Refer to separate technical documentation of the anesthetic vaporizer "Vapor 19.n".

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RETURN TO CD-ROM TABLE OF CONTENTS

3.0 Repair Instructions

1 Service Strategy for Fabius

Table 1: Service Strategy

Where	Test Documentation	Procedure
Inspection in the field	– Test Certificate – Service Manual, CD-ROM	– Checking actual condition of machine – Performing minor repairs – Replacing wear and tear parts
Safety check in the field	– Safety check of machine (record) – Instructions for Use, CD-ROM	– Machine safety check
Repair in the field	Test Certificate Spare parts list Service Manual Section 5 Repair information Service Bulletins (IDMs/TSBs) Conversion instructions Function diagrams, CD-ROM	– Replacing electrical, electronic, and mechanical assemblies – Repairing assemblies – Calibrating, adjusting – Performing minor conversions
Workshop at the subsidiary, region	Test Certificate Spare parts list Service Manual Section 5 Repair information Service Bulletins (IDMs/TSBs) Conversion instructions Function diagrams, CD-ROM	– Replacing electrical, electronic, and mechanical assemblies – Repairing assemblies – Calibrating, adjusting – Performing major conversions
Workshop in Lübeck and Telford	Test Certificate Spare parts list Service Manual Section 5 Repair information Service Bulletins (IDMs/TSBs) Conversion instructions Process and testing instructions Circuit diagrams Function diagrams, CD-ROM	– Replacing and repairing all mechanical and electrical assemblies – Calibrating, adjusting – Performing major conversions
Customer, owner, operator	– Instructions for Use – Check list, as applicable	– Recording actual condition of machine – Decontamination of machine

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2 Fabius Versions

Fabius is available in several versions.

2.1 Fabius (China Version)

The first machines were built for the Chinese market. The China version runs with two gas types: N_20 and O_2. Separate connections (battery/motor) are available on the rear panel of the control box.

Risk of malfunction.

Optional features intended for the CE version might cause problems if used in the China version (e.g. cylinder bank). Specific printed circuit boards are used in the China version which are not identical with those used in the CE version. The China version printed circuit boards are available in China only.

The China version of Fabius comprises the following assemblies:

- control box
- ventilator
- circle absorption system "Fabius"
- flowmeter block
- fixed-installed anesthetic vaporizer "Vapor 19.n"
- H-ORC
- gas box
- trolley

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2.2 Fabius (CE Version)

The CE version of Fabius is manufactured for all other countries except the USA. It is available with two gas types (N_2O and O_2), or three gas types (N_2O, O_2 and AIR).

The CE version of Fabius comprises the following assemblies:

- control box
- ventilator
- compact breathing system ("Cosy")/circle absorption system 9 Fabius
- flowmeter block
- adaptable anesthetic vaporizer "Vapor 19.n"
- S-ORC
- gas box
- trolley

2.3 Fabius (US Version)

The US version of Fabius comes with three gas types (N_2O, O_2 and AIR). The flowmeters in the flowmeter block are arranged differently than those of the Fabius CE version and have also a different color coding.

The US version of Fabius comprises the following assemblies:

- control box
- ventilator
- compact breathing system ("Cosy")/circle absorption system 9 Fabius
- flowmeter block
- adaptable anesthetic vaporizer "Vapor 19.n"
- S-ORC
- gas box
- trolley

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3 Fabius Assemblies

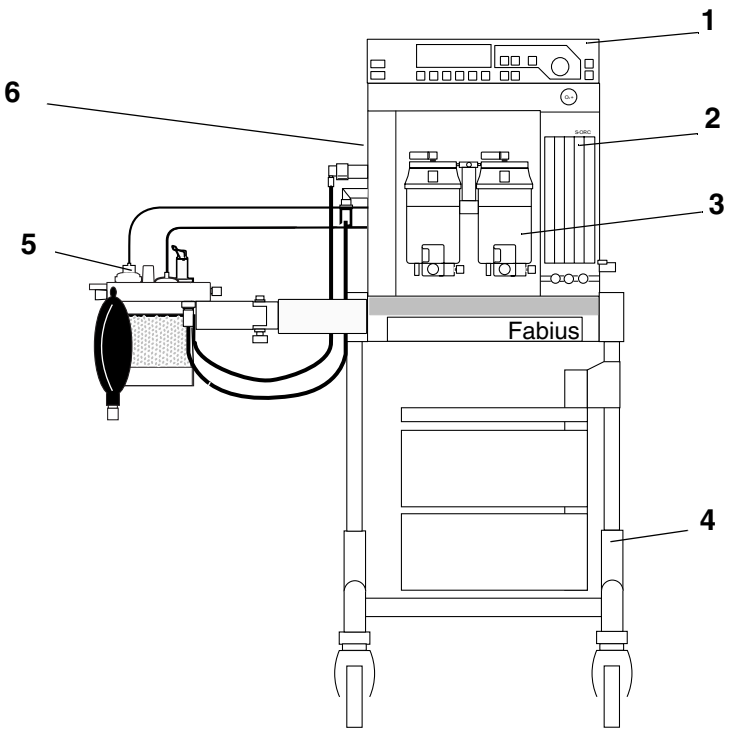

Fig. 1: Front view of Fabius with compact breathing system "Cosy"

Key

1 Control box
2 Flowmeter block
3 Anesthetic vaporizer(s) Vapor 19.n
4 Trolley
5 Compact breathing system "Cosy"
6 Ventilator

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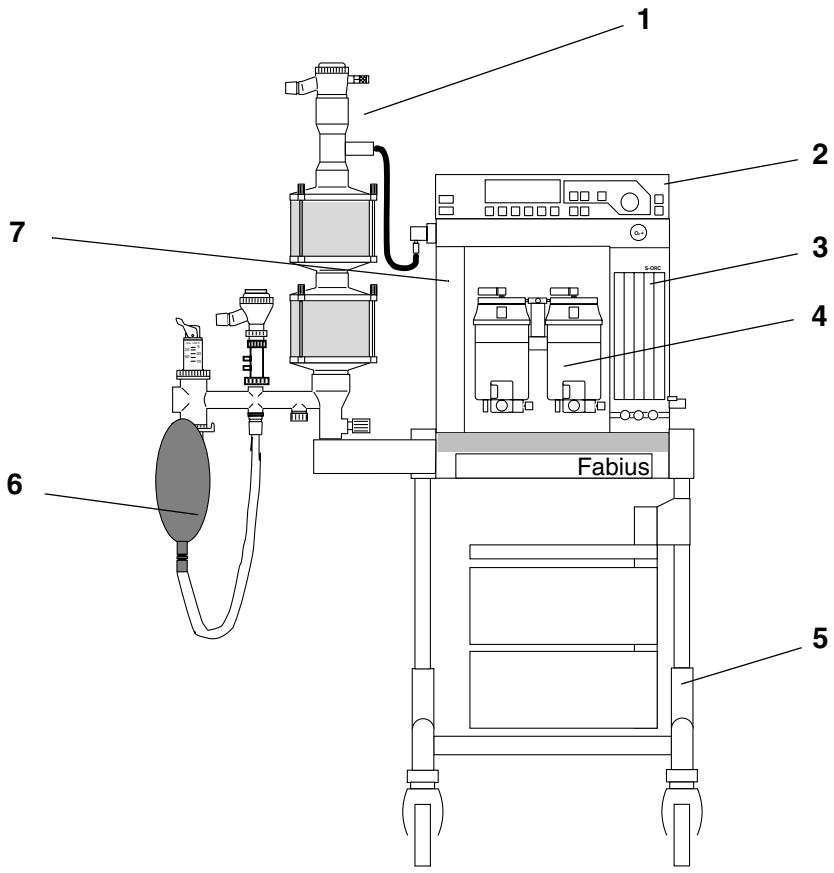

Fig. 2: Front view of Fabius with circle absorption system 9 Fabius

Key

1 Circle absorption system 9 Fabius
2 Control box
3 Flowmeter block
4 Anesthetic vaporizer(s) Vapor 19.n
5 Trolley
6 Breathing bag
7 Ventilator

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4 Fabius Assemblies (rear view)

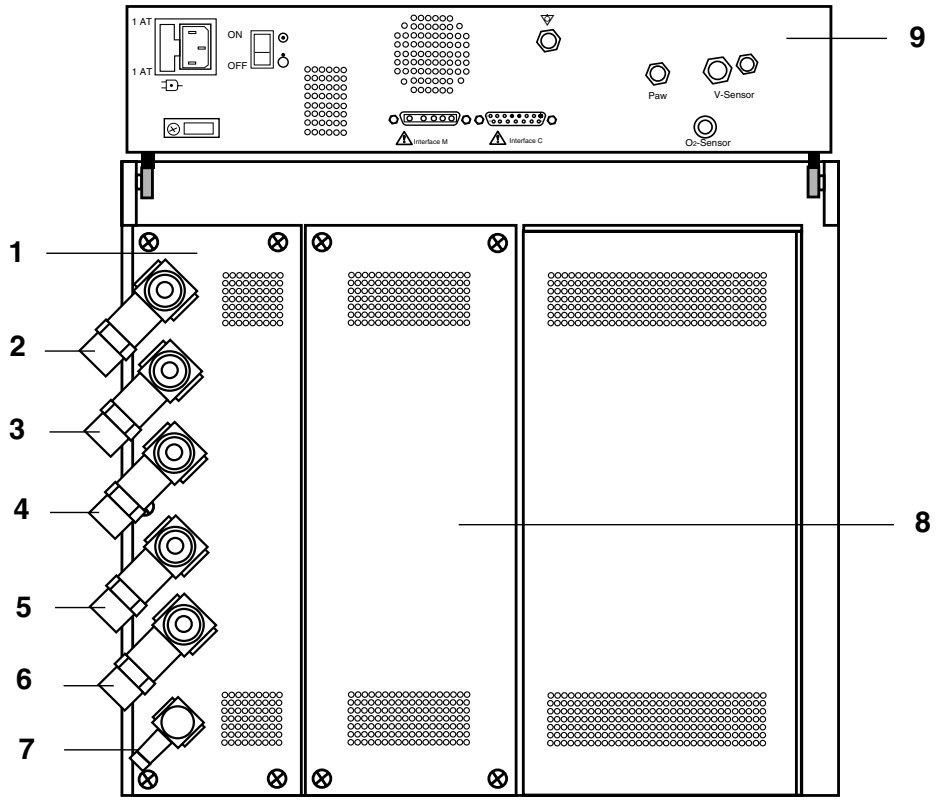

Fig. 3: Fabius assemblies (rear view)

Key

1	Gas box cover
2	O_2 input port
3	N_2O input port
4	AIR input port
5	O_2 cylinder input port
6	N_2O cylinder input port
7	O_2 output port (ejector)
8	Cover plate of pneumatics and (optional) rechargeable battery
9	Control box

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5 Removing Assemblies from Gas Box

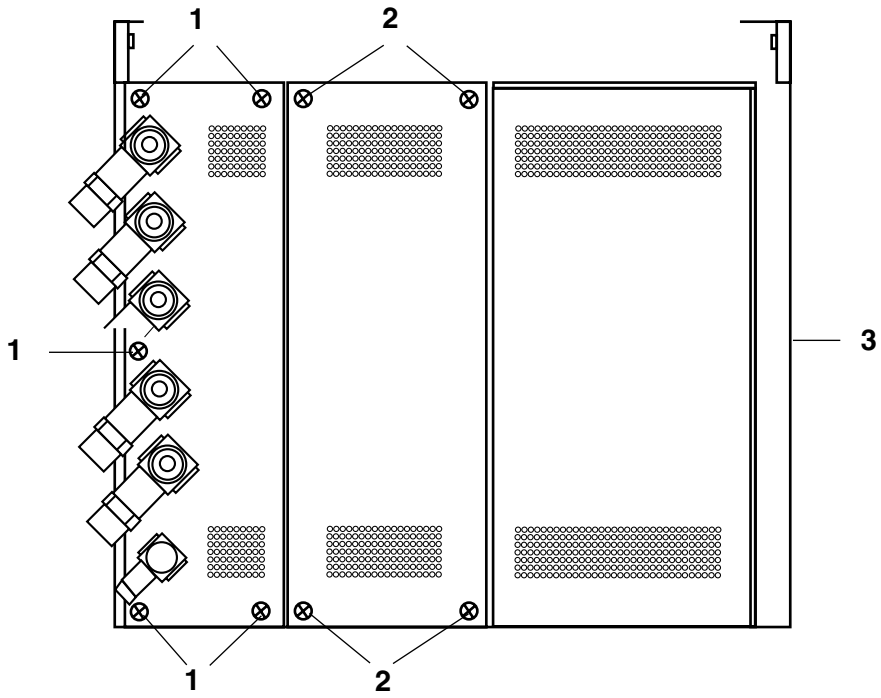

Fig. 4: Cover plates on rear panel of Fabius

Table 2: Assembly Removal Steps

Assembly	Remove screws	Swivel out door
Pneumatics (Pneumatics Control PCB, pump, PEEP valve, pressure sensor)	2	
Gas box	1	
Ventilator		3

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6 Debug Mode (software 1.00)

The following information is displayed in the debug mode during normal operation of Fabius: system data, measured values, error log. One debug mode page is available. System data cannot be changed.

6.1 Accessing the Debug Mode (software 1.00)

The debug mode can be accessed from any operating mode.

- Press the “Menu” key.
- Select “keycode” by turning rotary knob.
- Confirm selection by pressing rotary knob.

The selected numeric code is displayed on black background.

- Select keycode “1” by turning rotary knob one position clockwise.
- Confirm selection by pressing rotary knob.
- Press rotary knob again.

An additional screen page is displayed. Fabius remains in the normal mode and can be operated as desired.

6.2 Exiting the Debug Mode (software 1.00)

- Press the “Menu” key.
- Select “keycode” by turning rotary knob.
- Confirm selection by pressing rotary knob.

The selected numeric code is displayed on black background.

- Select keycode “0” by turning rotary knob one position counter-clockwise.
- Confirm selection by pressing rotary knob.
- Press rotary knob again.

Fabius is now in the normal operating mode.

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6.3 Debug Mode Table (software 1.00)

Table 3: Debug Mode (software 1.00)

Pressure sensor value (Paw) in mbar (default) **P XXX (0 to 738)**	Plateau pressure in mbar **Plat XXX (varies with system settings)**
Flow sensor A/D converter value (default) **FL XXX (0 L/min 512)**	Supply voltage (approx. 27 V) in volts **U_24 XX.X (22.5 – 35.0)**
Oxygen sensor channel 1 in mV **O2_1 XXX (9 – 20)**	Supply voltage (+12 V) in volts **U+12 XX.X (12.0 ±2.0)**
Oxygen sensor channel 2 in mV **O2_2 XXX (9 – 20)**	Supply voltage (–12 V) in volts **U–12 XX.X (12.0 ± 2.0)**
Expiratory Vt during inspiration (mL) **Vtix XXX (varies with system settings, ideally 0)**	EEPROM error code **EEPR XXXX**
Pressure sensor calibration value **CalP XXX (704 – 768)**	Battery charging current in amperes **LADI X.X (approx. 0.0 – 2.0)**
Flow sensor calibration value **CalF XXX (482 – 542)**	Motor current in amperes **MOTI X.X (0.0 – 2.5)**
Oxygen sensor calibration value (21% O2) **CalO XX (39 – 113)**	Pressure between rolling seals in mbar **PMEM XXX (200 ±50)**
Monitoring error code **MONI XXXX**	Ventilation error **VENT XXXX**
Calculation from controller data (set values): Tidal volume (mL) frequency (1/min) **V: XXXX F: XX**	System temperature in °C **T XX (max. 60°C)**
Error log (most recent error entry on extreme left) **LOG** **XX XX XX XX XX XX XX XX XX**	

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7 Debug Mode (software 2.00)

The following information is displayed in the debug mode during normal operation of Fabius: system data, measured values, error log. Two pages are available in this debug mode. System data cannot be changed.

7.1 Accessing the Debug Mode (software 2.00)

The debug mode can be accessed from any operating mode.

- Press the “Menu” key.
- Select “keycode” by turning rotary knob.
- Confirm selection by pressing rotary knob.

The selected numeric code is displayed on black background.

- Select keycode “1” (debug mode) or “2” (flow curve) by turning rotary knob one position clockwise.
- Confirm selection by pressing rotary knob.
- Press rotary knob again.

An additional screen page is displayed. Fabius remains in the normal operating mode and can be operated as desired.

7.2 Exiting the Debug Mode (software 2.00)

- Press the “Menu” key.
- Select “keycode” by turning rotary knob.
- Confirm selection by pressing rotary knob.

The selected numeric code is displayed on black background.

- Select keycode “0” by turning rotary knob one position counter-clockwise.
- Confirm selection by pressing rotary knob.
- Press rotary knob again.

Fabius is now in the normal operating mode.

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7.3 Debug Mode Table (software 2.00)

7.3.1 Debug Mode (software 2.00), Page 1 (keycode "1")

Error log (most recent error entry on extreme left) **LOG XX XX XX XX XX XX XX XX XX XX XX XX XX XX**	
A/D pressure sensor value in mbar/ calibration value (default) in mbar **P XXX (650 to 825) / XXX (738 = 0hPa)**	Motor current in amperes (normal operating range 0 to 1.5 A) **Imot X.XX**
Flow sensor A/D converter value / calibration value (default) **F1 XXX** (482 to 542) / **XXX** (0 L/min = 512)	Pressure between the rolling seals in hPa (normal operating range 120 to 250 hPa) **Pvac XXX**
Oxygen sensor channel 1 in mV Oxygen sensor channel 2 in mV (normal operating range 5mV to 105 mV) **O2_ XXX / XXX**	System temperature in °C (normal operating range 10 to 70 °C) **Tem XX**
Oxygen sensor calibration status Oxygen sensor calibration value (21% O2) (Calibration value in mV **CAL nnnn (XXX) /**	Frequency: calculated from piston movement (1/min) (normal operating range 6 to 60 1/min) **f_v: XX**
Elapsed time meter (full hours displayed) **h XXXXXXXXX**	Tidal volume calculated from piston movement (normal operating range 50 to 1400 mL) **V_v: XXXX**
Supply voltage (approx. 27 V) in volts (normal operating range 23.0 V to 35.0 V) **U+24 XX.X**	Motor type, jumper position: Power PCB (motor type: JC = Mavillor, J8 = GEC) **XXRXX JC**
Supply voltage (+12 V) in volts (normal operating range 10.8 V to 13.2 V) **U+12 XX.X (12.0 V ±2.0 V)**	Monitoring error code **MON XXXX**
Supply voltage (–12 V) in volts (normal operating range –10.8 V to –13.2 V) **U–12 XX.X**	Ventilator error code **VEN XXXX**
Battery charging current in amperes (normal operating range –2 to 3 A) **Ibat X.X**	EEPROM error code **EEP XXXX**
	Control PCB software version **XXMXX J6**

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7.3.2 Flow Curve (software 2.00), Page 2 (Keycode “2”)

Flow curve (Quit key: toggles between 1:1 and 1:6 resolution)	Measured tidal volume in mL (normal operating range: 0 to 9999 mL) **Vte XXXX mL**
	Expiratory VT during inspiration (in mL, ideally: 0) (normal operating range: 0 to 9999 mL) **Vtix XXXX mL**
	Expiratory peak flow in L/min (normal operating range: 0 to 150 L/min) **Flep XXX L/min**
	Tidal volume corresponding to ventilator’s I/E phase (in mL) (normal operating range: 0 to 9999 mL) **Vtev XXXX mL**
	Plateau pressure in hPa (normal operating range 0 to 99 hPa) **Plat XX hPa**

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8 "Ventilator" (VEN) Display Field

Overview: VEN

0000 ==> no errors
0001 – 0008 ==> motor errors
0040 and 0080 ==> pump errors
0100 ==> temperature error
1000 and 2000 ==> communication errors
4000 ==> current error (motor current is too high)

Error	Error Description	Possible Cause
0001	No incrementing.	Motor open or not connected. Incremental encoder not connected.or needs replacement
0002	End position switch activated continuously.	Light barrier not connected.or needs replaced
0004	End position switch not detected.	External light interference, or light barrier needs replaced.
0008	Motor direction incorrect (use only upon power-on of Fabius).	Motor conductors reversed. Phase conductors of incremental encoder reversed.
0010	24 V supply not available.	Controller relay (Power PCB) switched off. Fuse F4 on Power Supply PCB open.
0020		
0040	Diaphragm pressure too low.	Ventilator cover open. Vacuum hose not connected. Diaphragm pump needs replaced
0080	Diaphragm pressure too high.	Diaphragm pressure sensor connector not connected.
0100	Temperature too high.	NTC error on Power PCB. Fan not running
0200	I/E signal from controller (Power PCB) not in expected range.	Ventilation frequency or inspiratory time out of tolerance. Motor and/or motor control error.
0400	Ventilator piston does not work in IPPV mode.	Motor open or not connected. Power PCB needs replaced
0800	Data error (gain, offset, from PEEP valve)	EEPROM or RAM error. New PEEP valve calibration.

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1000	Communication error from Control PCB to Power PCB.	Line interruption in ribbon cable, bent connector.
2000	Communication error from Power PCB to Control PCB.	Line interruption. Power PCB does not work (see error 1000).
4000	Motor current temporarily too high.	Incremental encoder lost increments. Contamination, scratches, light barrier needs replaced
8000	Motor current continuously too high.	Power amplifier needs replaced. Motor open.

9 "Monitor" (MON) Display Field

Overview: MON

0000 ==> no errors
00XX ==> O_2 sensor error
0X00 ==> pressure sensor error
X000 ==> flow sensor error

Error	Error Description	Possible Cause
0001	FiO_2 sensor voltage too low.	O_2 sensor needs replaced. O_2 sensor calibrated incorrectly.
0002	FiO_2 sensor voltage too high.	O_2 sensor needs replaced. O_2 sensor calibrated incorrectly.
0004	FiO_2 measured values outside permissible range.	O_2 sensor needs replaced
0008	FiO_2 time-out during calibration.	O_2 sensor needs replaced. Sensor not yet stabilized. Calibration of O_2 sensor at changing O_2 concentration or O_2 concentration not corresponding to calibration mode (21%/100%).
0010	FiO_2/relative error between FiO_2 sensor channels > 25%.	O_2 sensor needs replaced.
0020	FiO_2 calibration constant from EEPROM incorrect.	O_2 sensor not yet calibrated. Data loss in the EEPROM.
0040	FiO_2/coding for calibration.	Current error occurred during calibration.

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0080	One calibration value lost during operation (pressure sensor, flow sensor, FiO_2 sensor calibration values).	RAM error. Electromagnetic interference.
0100	Pressure above maximum value for more than 5 seconds.	Pressure sensor needs replaced. Continuously high pressure.
0200	Pressure below minimum value for more than 5 seconds.	Pressure sensor needs replaced. Continuously low pressure.
0400	Pressure/calibration error.	Pressure sensor needs replaced. Pressure during calibration higher than or lower than 0 mbar.
0800	Pressure/plausibility error during respiratory phase.	Software error.
1000	Flow above maximum value for more than 5 seconds (<150 L).	Flow sensor or differential pressure sensor (flow) needs replaced Continuously high expiratory flow.
2000	Flow below minimum value for more than 5 seconds.	Flow sensor or differential pressure sensor (flow) needs replaced. Continuously high expiratory flow.
4000	Flow/calibration error.	Flow sensor or differential pressure sensor (flow)needs replaced. Flow at flow sensor during calibration higher than or lower than 0 L/min.
8000	Flow/plausibility error during respiratory phase.	Respiratory phase detection software error.

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10 "EEPROM" (EEP) Display Field

Overview: EEP

0000 ==> no error
XX00 ==> write error
00XX ==> read error

Error	Error Description	Possible Cause
0001	Read error. System configuration (device configuration)	Data error. EEPROM needs replaced.
0002	Read error. System data (values stored in the event of a power failure)	Data error. EEPROM needs replaced. Data stored incorrectly in the event of a power failure.
0004	Read error. User configuration (user settings)	Data error. EEPROM needs replaced.
0008	Read error. Settings of ventilation (last setting in the event of a power failure)	Data error. EEPROM needs replaced. Data stored incorrectly in the event of a power failure.
0010	Read error. Monitoring limit values (last setting in the event of a power failure)	Data error. EEPROM needs replaced. Data stored incorrectly in the event of a power failure.
0020	Read error. Monitoring calibration values. Ventilation calibration values.	Data error. EEPROM needs replaced.
0040	Read error. Error log.	Data error. EEPROM needs replaced.
0080	For internal use.	Data error. EEPROM needs replaced.
0100	Write error. System configuration (device configuration)	Data error. EEPROM needs replaced.
0200	Write error. System data (values stored in the event of a power failure)	Data error. EEPROM needs replaced. Data stored incorrectly in the event of a power failure.
0400	Write error. User configuration (user settings)	Data error. EEPROM needs replaced.

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0800	Write error. Ventilation settings (last setting in the event of a power failure)	Data error. EEPROM needs replaced. Data stored incorrectly in the event of a power failure.
1000	Write error. Monitoring limit values (last setting in the event of a power failure)	Data error. EEPROM needs replaced. Data stored incorrectly in the event of a power failure.
2000	Write error. Monitoring calibration values. Ventilation calibration values.	Data error. EEPROM needs replaced.
4000	Error log write error	Data error. EEPROM needs replaced.
8000	For internal use.	Data error. EEPROM needs replaced.

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11 Error Log

Error	Error Description	Possible Cause
0	No error	
11	Reset; cause unknown	Hardware error. Electromagnetic interference. EEPROM needs replaced
14	RAM (Control PCB)	RAM needs replaced.
15	EPROM (Control PCB)	EPROM needs replaced.
16	Watchdog reset (Control PCB)	Hardware error. Software error. Watchdog time exceeded.
17	A/D converter	Error during A/D conversion.
18	Graphics display	Graphics display or connector needs replaced.
21	Battery	Wrong battery installed or installed battery flat.
22	Analog voltage	Error in ±12 V voltage supply. Control PCB needs replaced.
23	Supply voltage	Battery exhausted during power supply from battery.
31	EEPROM*	Read/write error during system start-up. EEPROM needs replaced. Data error.
32	EEPROM* write error	Error during EEPROM writing. EEPROM needs replaced. Data error.
33	EEPROM* read error	Error during EEPROM reading. EEPROM needs replaced. Data error.
34	RAM backup error	Error while reading internal RAM data during system start-up.
35	Data check error/system reset occurs	Checksum of settings or operating mode incorrect.
36	Communication error	RAM locations inverted or needs replaced.
37	Calibration value check error (O_2 sensor, pressure sensor, flow sensor, PEEP valve)	EEPROM error. RAM error. Standard values are being used. **Calibration required.**

* Later models do not have an EEPROM and require board replacement.

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41	Motor error	Ventilator drive error: no incrementing possible. End position switch activated continuously. End position switch not detected. For current code and error description, see display field “VEN”. **Error may also occur if Fabius is operated while ventilator is not connected.**
42	24 V operating voltage	Relay of Power PCB switched off. Open fuse F4 on Power Supply PCB.
43	End position of actuator exceeded.	Incremental encoder lost increments.
44	Diaphragm pressure too low.	Ventilator cover open. Vacuum hose disconnected. Diaphragm pump needs replaced.
45	Diaphragm pressure too high.	Diaphragm pressure sensor connector disconnected. Diaphragm pressure sensor needs replaced. **Error may also occur if Fabius is operated while ventilator is not connected.**
46	System temperature too high.	Error occurred on Power PCB.
47	Time-out in IPPV/ventilation not OK.	Motor open or disconnected. Power PCB needs replaced. **Error may also occur if Fabius is operated while ventilator is not connected.**
48	SIO error	There is an interruption of the communication line. The controller (Power PCB) does not function.
49	Motor current too high.	Power amplifier needs replaced. Motor open.

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51	Ventilation frequency or inspiratory time out of tolerance.	Motor does not meet specifications. Ventilator needs replaced. **Error may also occur if Fabius is operated while ventilator is not connected.**
81	RAM (Power PCB)	RAM needs replaced.
82	EPROM (Power PCB)	EPROM needs replaced.
83	Watchdog reset (Power PCB)	Software error. Duration exceeded.

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12 DrägerService Mode (software 1.00)

The DrägerService Mode is used to calibrate critical components (Paw sensor, PEEP valve). The DrägerService Mode should only be used by qualified and authorized DrägerService technicians.

DrägerService Mode allows the following actions:

- calibrating the pressure sensor (Paw)
- deleting error log entries
- reading out/resetting elapsed hours meter
- selecting the function (monitor or ventilator or monitor and ventilator)
- initializing Fabius (calibration values, elapsed hours, etc.)

12.1 Accessing the DrägerService Mode (software 1.00)

The DrägerService Mode can only be accessed while Fabius is in the standby mode.

- Press the “Menu” key.
- Select “keycode” by turning rotary knob.
- Confirm by pressing rotary knob.

The respective number is displayed on black background.

- Select keycode “112” by turning rotary knob clockwise.
- Confirm by pressing rotary knob.

An additional screen page is displayed.

12.2 Exiting the DrägerService Mode (software 1.00)

- Switch the control box off.

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12.3 DrägerService Mode (software 1.00) Screen Display

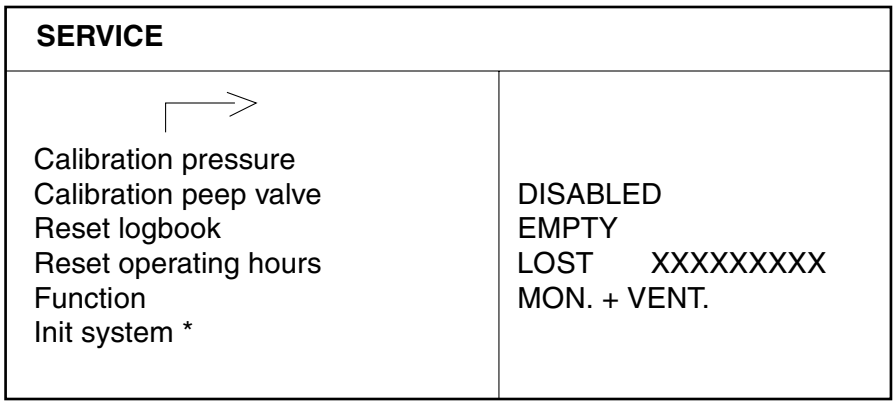

Fig. 5: DrägerService Mode screen display (software 1.00)

*** Initialization of Fabius**

Risk of loss of calibration data when selecting menu item "Init system". Select menu item “Init system” only if you want to store new calibration data or if you have replaced the Control PCB.

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13 DrägerService Mode (software 2.00)

The DrägerService Mode is used to calibrate critical components (Paw sensor, PEEP valve). The DrägerService Mode should only be used by qualified and authorized DrägerService technicians.

DrägerService Mode allows the following actions:

- calibrating the pressure sensor (Paw)
- calibrating the PEEP valve
- deleting error log entries
- reading out/resetting elapsed hours meter
- selecting the function (monitor or ventilator or monitor and ventilator)
- initializing Fabius (calibration values, elapsed hours, etc.)

13.1 Accessing the DrägerService Mode (software 2.00)

The DrägerService Mode can only be accessed while Fabius is in the standby mode.

- Press the “Menu” key.
- Select “keycode” by turning rotary knob.
- Confirm by pressing rotary knob.

The respective number is displayed on black background.

- Select keycode “112” by turning rotary knob clockwise.
- Confirm by pressing rotary knob.

An additional screen page is displayed.

13.2 Exiting the DrägerService Mode (software 2.00)

- Switch the control box off.

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13.3 DrägerService Mode (software 2.00) Screen Display

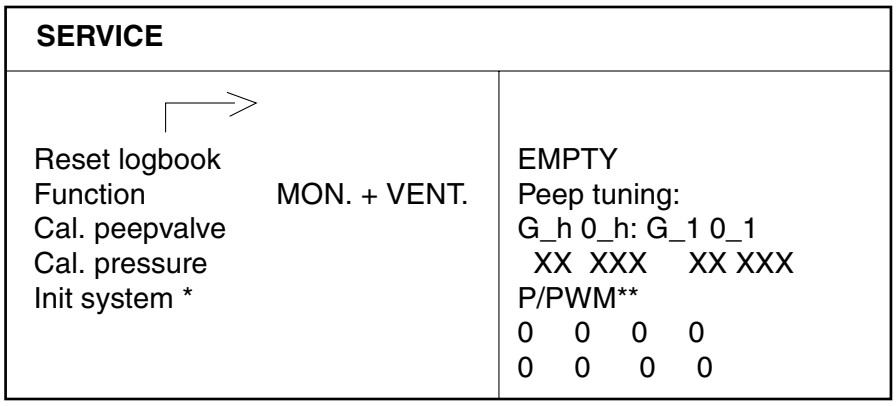

Fig. 6: DrägerService Mode screen display (software 2.00)

*** Initialization of Fabius**
**** P (pressure) corresponds to PWM (pulse width modulation) ratio**

Risk of loss of calibration data when selecting menu item "Init system". Select menu item “Init system” only if you want to store new calibration data or if you have replaced the Control PCB.

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14 General Information About the Control Box

Any of the following assemblies must be replaced completely in case of malfunctioning:

- power cable
- mains filter
- ON/OFF switch
- fuses
- power transformer
- Power Supply PCB
- Power PCB
- Control PCB
- differential pressure sensor (flow)
- pressure sensor (Paw)
- Display PCB
- backlighting lamp
- rotary knob
- rechargeable battery

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14.1 Removing the Control Box from the Gas Box

- Switch control box off using ON/OFF switch (ON/OFF switch is located on rear panel of control box).
- Disconnect cable and hose connections **1** to **7** (see figure below) and remove control box.
- Loosen screw of cable clamp **8** and thread power cord out of cable clamp.

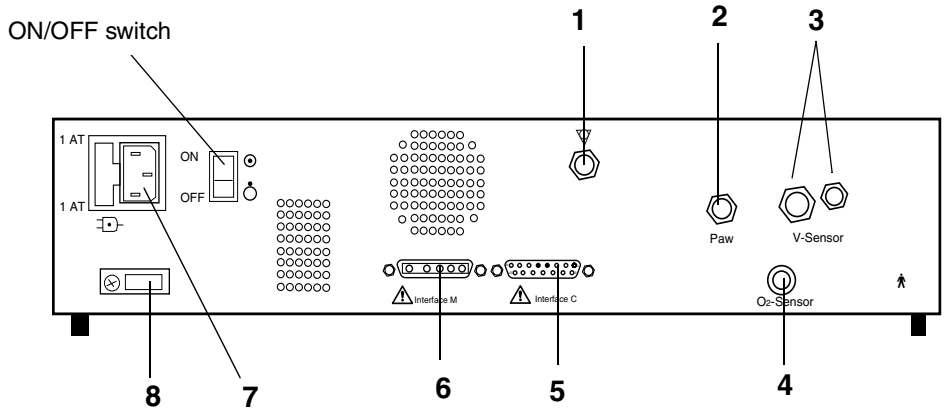

Fig. 7: Rear view of the control box, disconnecting cable and hose connections

- Loosen knurled screws **9**.

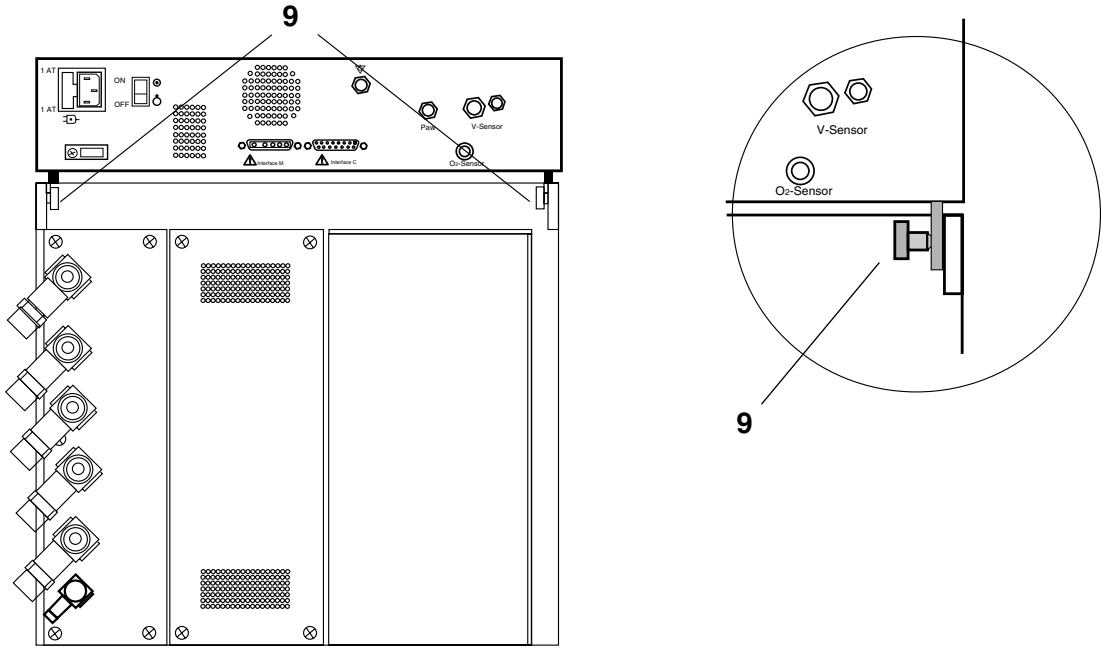

Fig. 8: Rear view of Fabius, loosening knurled screws

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- Lift control box **1** at rear and remove control box **1** from front mount.

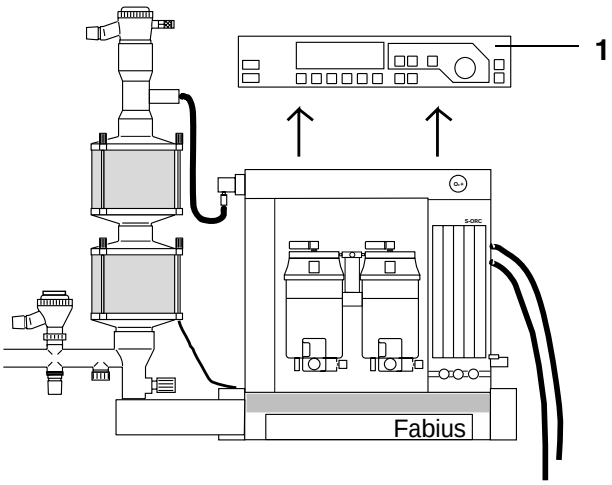

Fig. 9: Front view of Fabius, removing control box from front

- Place control box **1** on a stable surface.

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14.2 Removing the Top Cover from the Control Box

Electrostatic discharge can damage electrostatic sensitive devices. Use a static-dissipative mat and a wrist strap when handling electrostatic sensitive devices.

- Remove lateral screws **1** from control box **2** and lift top cover **3** in direction of **A** and away from control box **2**.
- Place top cover **3** of control box **2** aside.

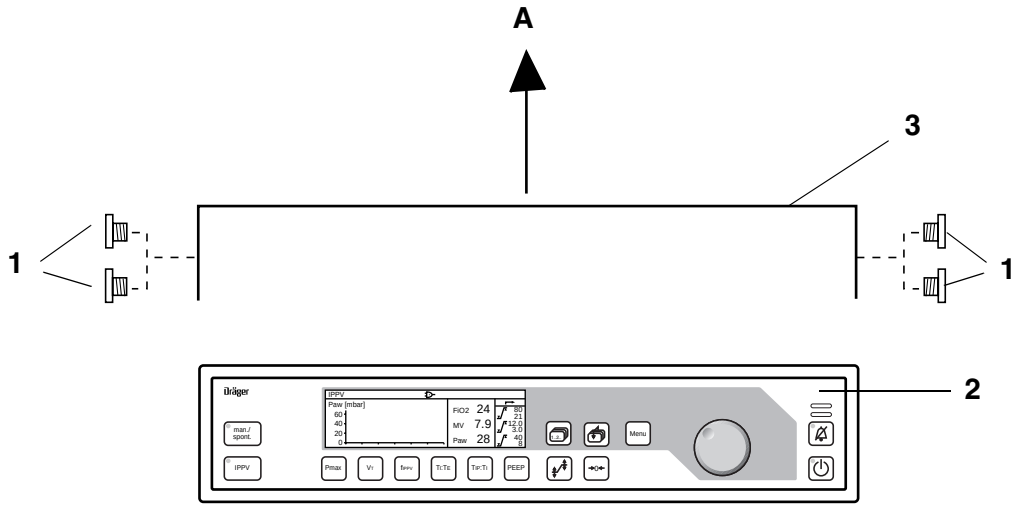

Fig. 10: Removing top cover of control box

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14.3 Control Box Assemblies

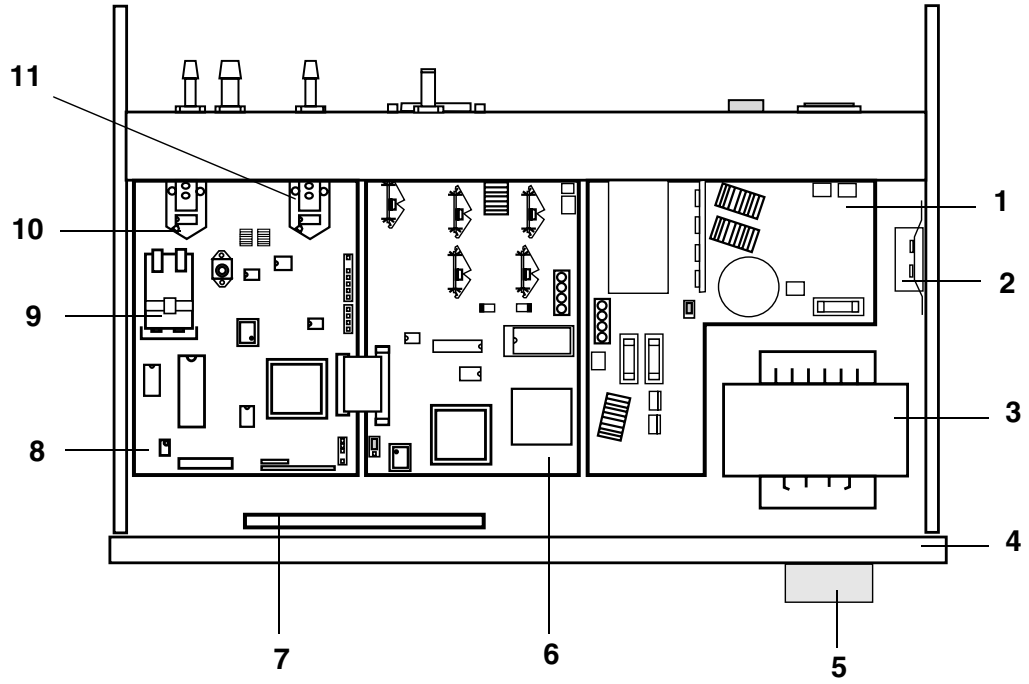

Fig. 11: Top view of the control box (top cover removed)

Key

1	Power Supply PCB
2	Mains filter
3	Power transformer
4	Front (front frame and membrane keypad)
5	Rotary knob
6	Power PCB
7	Display PCB/backlighting lamp
8	Control PCB
9	Rechargeable battery
10	Differential pressure sensor (flow measurement)
11	Pressure sensor (airway pressure "Paw")

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14.4 Control Box (Rear Panel)

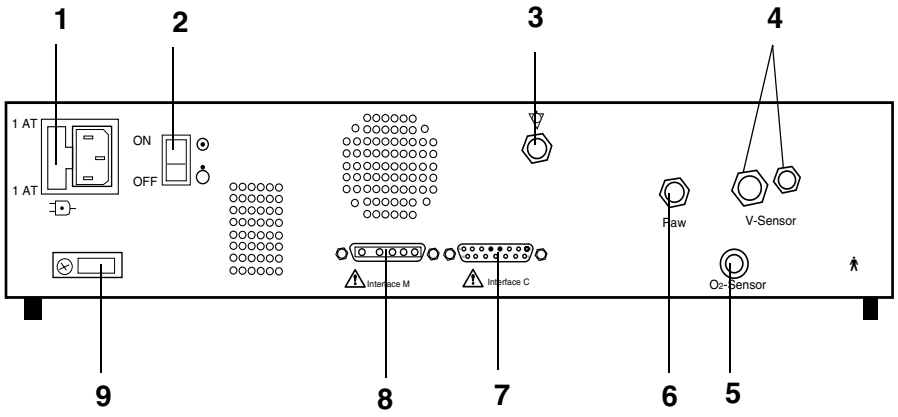

Fig. 12: Rear view of the control box

Key

1 Power receptacle with mains fuses

2 ON/OFF switch

3 Equipotential bonding pin (ground)

4 Flow sensor port

5 Oxygen sensor port

6 Pressure sensor port (Paw)

7 Pneumatics interface

8 Motor control interface

9 Power-cord cable clamp

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14.5 Power Transformer

In case of repair, replace the complete power transformer.

14.5.1 Testing the Power Transformer Output Voltage

- Switch control box off using ON/OFF switch (ON/OFF switch is located on rear panel of control box).
- Unplug power cord from AC outlet.
- Check mains fuses of the control box (mains fuses are located on rear panel of control box).
- If mains fuses are OK, proceed as follows:

Electrostatic discharge can damage electrostatic sensitive devices. Use a static-dissipative mat and a wrist strap when handling electrostatic sensitive devices.

- Remove control box from trolley (see control box chapter "Removing the Control Box from the Gas Box").
- Remove lateral screws **1** from control box **2** and lift top cover **3** in direction of **A** and away from control box **2**.
- Place top cover **3** of control box **2** aside.

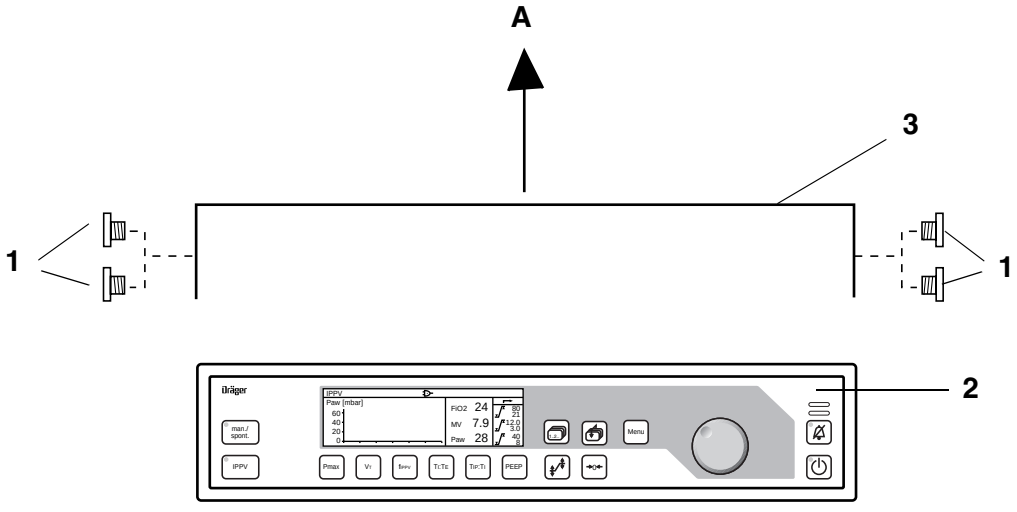

Fig. 13: Removing top cover of the control box

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- Plug power cord into AC outlet.
- Switch control box on.
- Using a multimeter, measure the power transformer output voltage (it should be approx. 40 VAC).
- If the power transformer output voltage is not approx. 40 VAC, check fuses, if fuses are OK, replace power transformer (see "Dismounting/Replacing the Power Transformer").

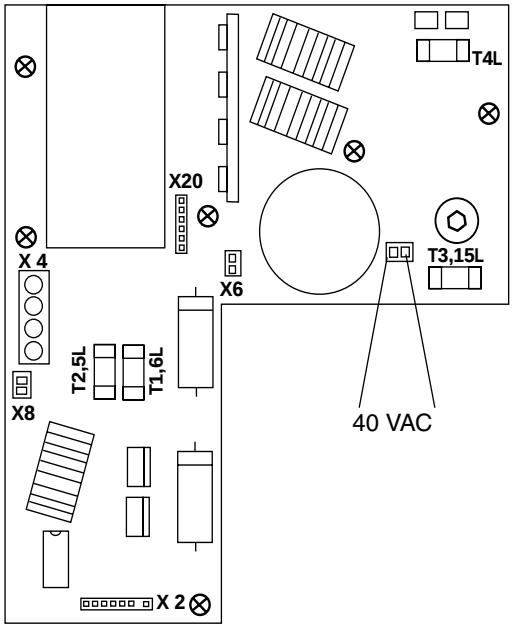

Fig. 14: Power Supply PCB, measuring the power transformer output voltage

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14.5.2 Dismounting/Replacing the Power Transformer

- Switch control box off using ON/OFF switch (ON/OFF switch is located on rear panel of control box).
- Unplug power cord from AC outlet.

Electrostatic discharge can damage electrostatic sensitive devices. Use a static-dissipative mat and a wrist strap when handling electrostatic sensitive devices.

- Remove control box from trolley (see "Removing the Control Box from the Gas Box").
- Remove lateral screws **1** from control box **2** and lift top cover **3** in direction of **A** and away from control box **2**.
- Place top cover **3** of control box **2** aside.

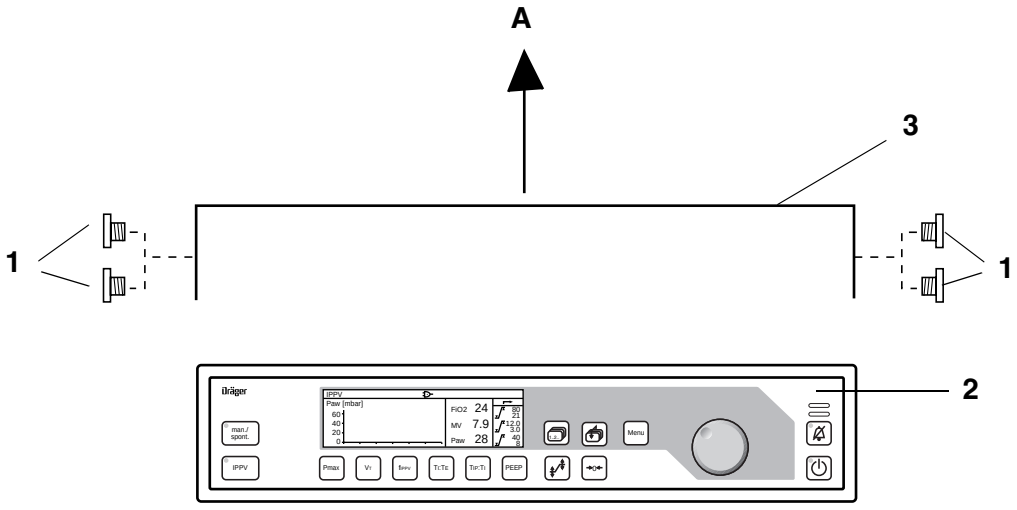

Fig. 15: Removing top cover of the control box

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- Disconnect cable connector **1** of power transformer from the Power Supply PCB.

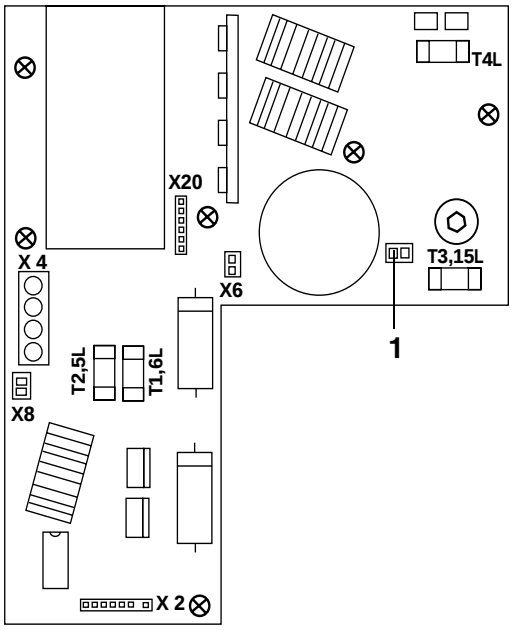

Fig. 16: View of the Power Supply PCB, disconnecting the cable connector

- Disconnect both power transformer cable lugs **2** from connectors of mains filter.

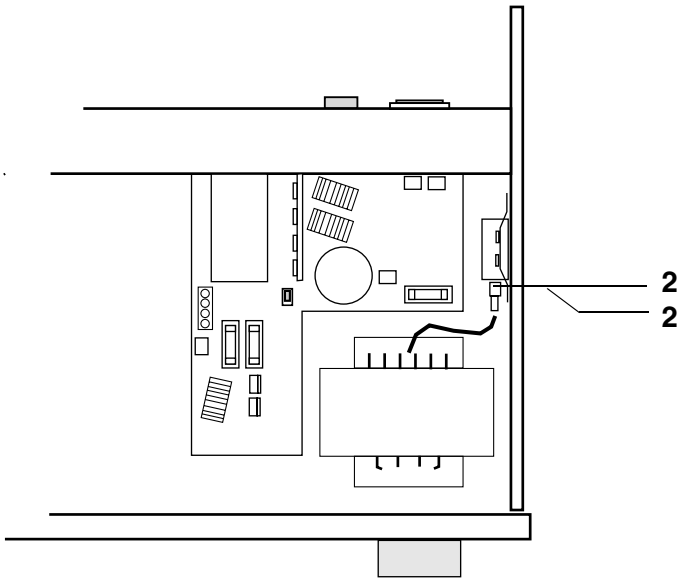

Fig. 17: Disconnecting cable lugs from connectors of mains filter

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- Remove screws **1** and place device mounting plates **2** aside.

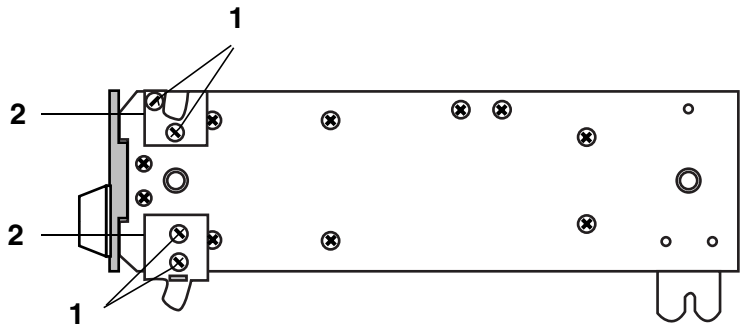

Fig. 18: Right hand side of control box, removing device mounting plates

- Remove screws **3**.

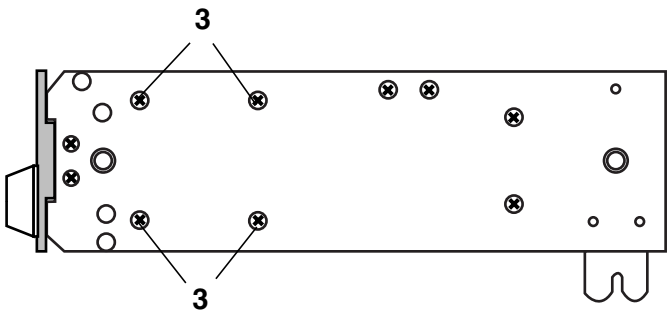

Fig. 19: Right hand side of control box, removing fixing screws of power transformer

- Replace the power transformer with a new one and secure new power transformer to control box using screws **3**.
- Mount device mounting plates **2** to control box (see Figure "Right hand side of control box, removing device mounting plates."
- Connect both cable lugs of power transformer to connectors of mains filter.

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Check that new power transformer is wired according to country-specific requirements. Adjust voltage range if necessary (see Figure "Adjusting voltage range on power transformer"**.**

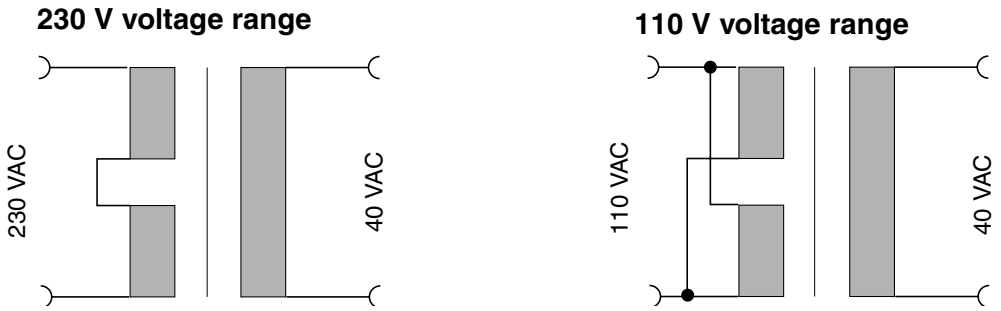

Fig. 20: Adjusting voltage range on power transformer

Make sure to use the correct fuses for 110 V or 230 V supply: 100 V = 2 AT, 230 V = 1 AT

- Connect power transformer cable connector to connection **1** of Power Supply PCB.

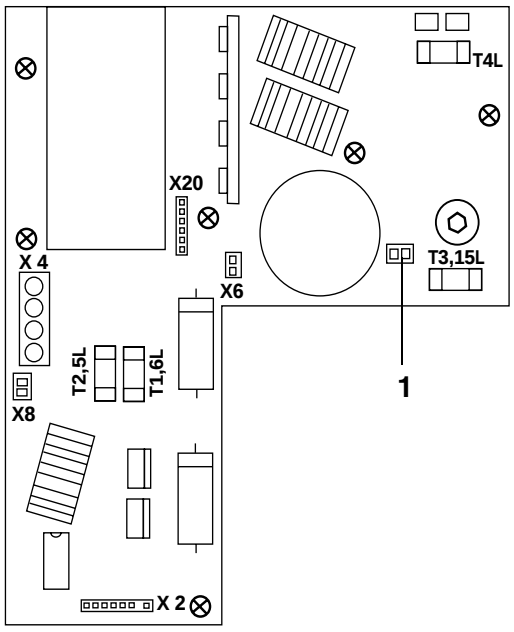

Fig. 21: Power Supply PCB; connecting power transformer cable connector

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- Mount top cover to control box.
- Mount control box to Fabius trolley.
- Connect hoses and cables to control box.
- Check control box function according to Test Certificate.

14.6 Power Supply PCB

14.6.1 General Information About the Power Supply PCB

In case of malfunctioning, replace mains fuses (located in the power receptacle assembly), fuses F1, F2, F4, and F5 (located on Power Supply PCB), or complete Power Supply PCB.

14.6.2 Testing the Power Supply PCB in the Debug Mode

- Check voltages of Power Supply PCB in the debug mode:
  U +24 = +24 V (23.0 V through 35.0 V)
  U +12 = +12 V (10.8 V through 13.2 V)
  U –12 = –12 V (–10.8 V through –13.2 V)

14.6.3 Testing the Power Supply PCB

- Switch control box off using ON/OFF switch (ON/OFF switch is located on rear panel of control box).
- Remove control box from trolley (see "Removing the Control Box from the Gas Box").

Electrostatic discharge can damage electrostatic sensitive devices. Use a static-dissipative mat and a wrist strap when handling electrostatic sensitive devices.

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- Remove lateral screws **1** from control box **2** and lift top cover **3** in direction of **A** and away from control box **2**.
- Place top cover **3** of control box **2** aside.

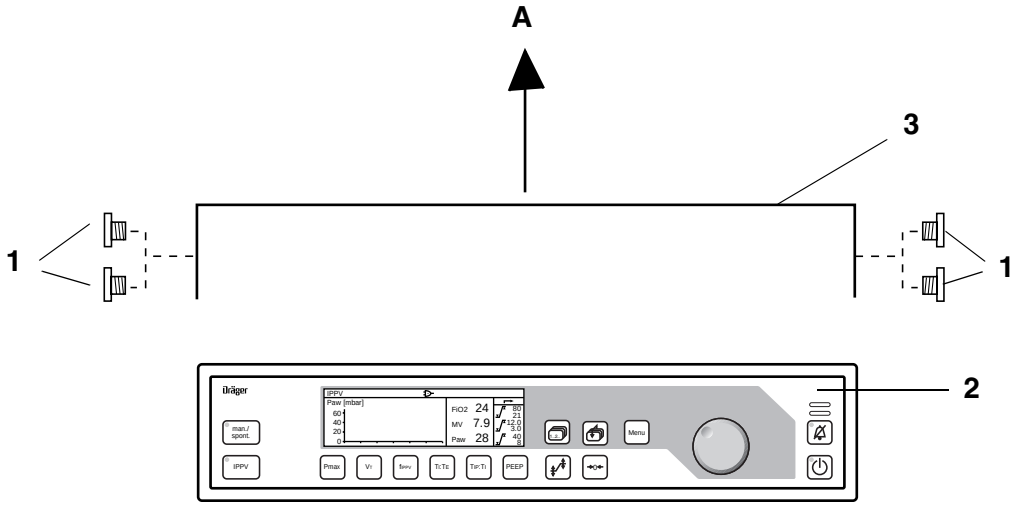

Fig. 22: Front view of control box, removing top cover

- Check that fuses on Power Supply PCB are OK.

If fuses on Power Supply PCB are not OK, proceed as follows:

- Plug control box power cord into AC outlet.
- Switch control box on.

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- Measure the following voltages: approx. 27 VDC, 5 VDC, and approx. 40 VAC (see Figure "Test points on Power Supply PCB, measuring output voltages".

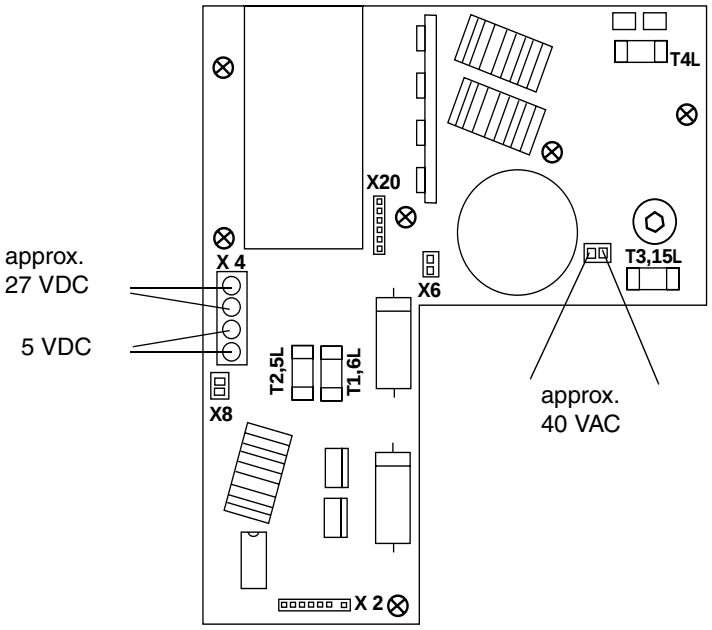

Fig. 23: Test points on Power Supply PCB, measuring output voltages

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14.7 Plug Connector X20 (free)

Table 4: Voltage Regulator

Pin	Designation	Value
1	GND	
2	FB	approx. +2 V during AC supply
3	+28V_1	+28 V
4	+28V_2	+28 V
5	FB	approx. +2 V during AC supply
6	GND	

14.8 Rechargeable Battery Connector X11

The following voltages should be measured according to the current operating mode (battery-powered, AC-powered, or ON/OFF switch set to OFF): on-load voltage, charging voltage, off-load voltage.

14.9 Voltage Supply to 5V Voltage Regulator X8

This connector creates the connection between the +24 V voltage supply and the 5V voltage regulator and motor.

14.10 Status Signals X2

Table 5: Status Signals

Pin	Designation	Value
1		
2	Netz_S1	OFF = 8.7 V ON = 0 V to 3
3	Netz_S2	
4	NETZ/BATT	NETZ (AC) = 4.8 V BATT = 0.6 V to GND
5	NMI/POWERFAIL	
6		not used

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14.10.1 Dismounting/Replacing the Power Supply PCB

- Switch control box off using ON/OFF switch (ON/OFF switch is located on rear panel of control box).
- Remove control box from trolley (see "Removing the Control Box from the Gas Box").

Electrostatic discharge can damage electrostatic sensitive devices. Use a static-dissipative mat and a wrist strap when handling electrostatic sensitive devices.

- Remove lateral screws **1** from control box **2** and lift top cover **3** in direction of **A** and away from control box **2**.
- Place top cover **3** of control box **2** aside.

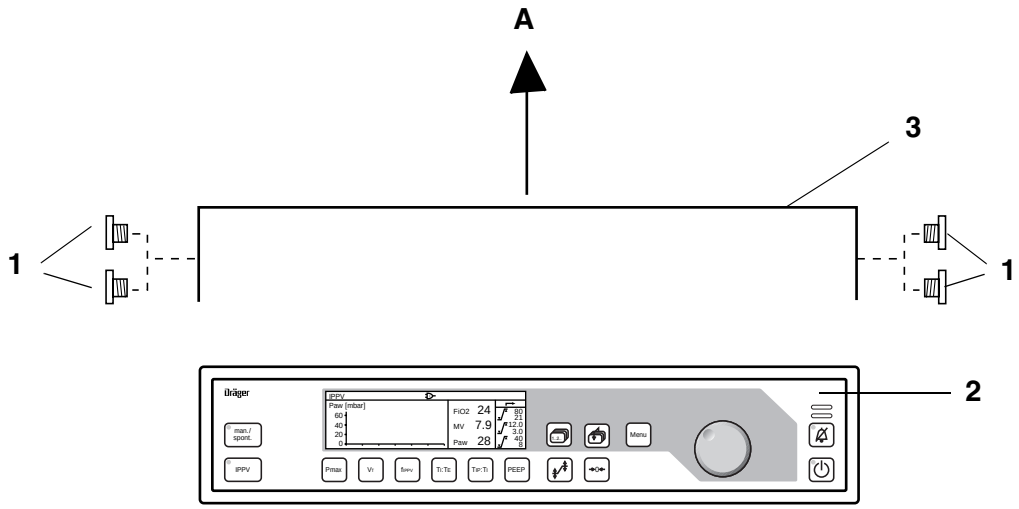

Fig. 24: Front view of control box, removing top cover

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- Disconnect connectors from connections **1**.

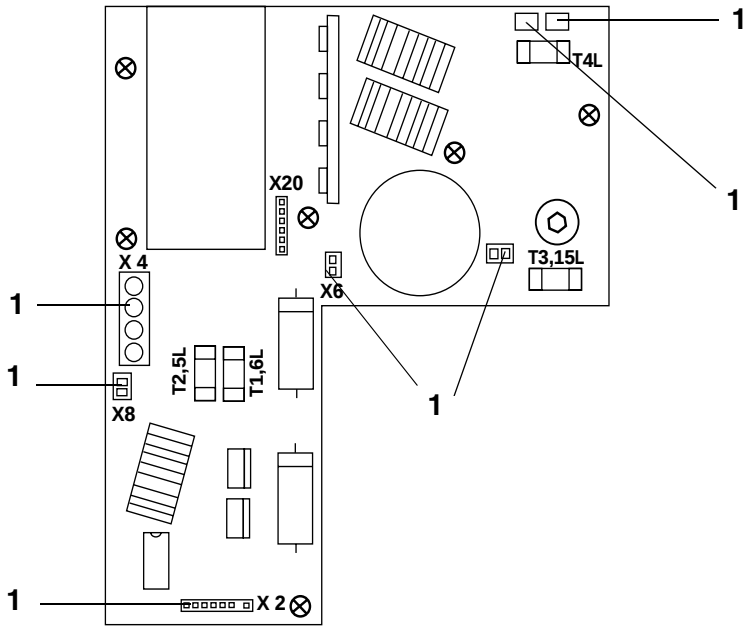

Fig. 25: Power Supply PCB, disconnecting connectors

- Remove nut and washer **2** of rectifier mount.

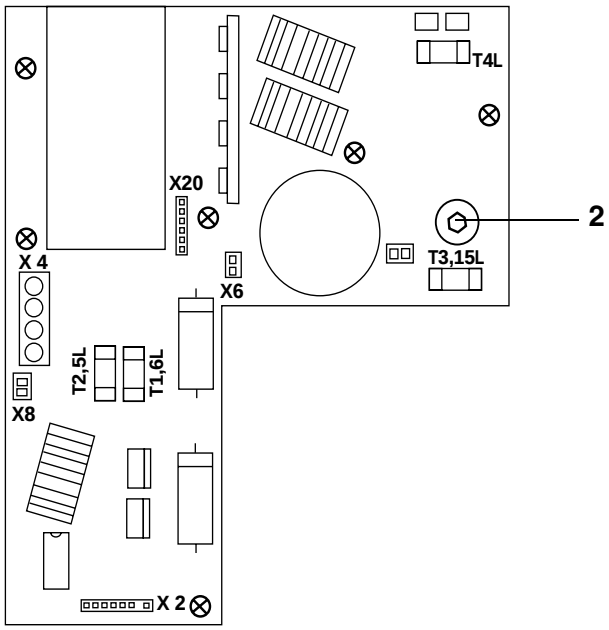

Fig. 26: Power Supply PCB, removing nut and washer

- Remove fixing screws **1**.

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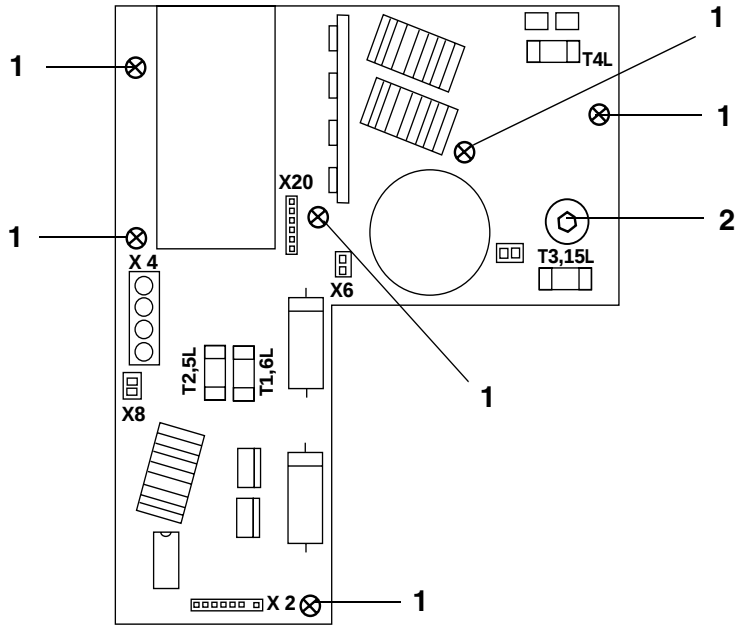

Fig. 27: Power Supply PCB, removing fixing screws

- Replace the Power Supply PCB with a new one.
- Secure new Power Supply PCB using fixing screws **1**.
- Secure rectifier using nut and washer **2** (see Figure "Power Supply PCB, removing fixing screws").
- Install new Power Supply PCB into control box using reverse method of that used for removal.

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- Reconnect connectors to respective connections **1** on Power Supply PCB.

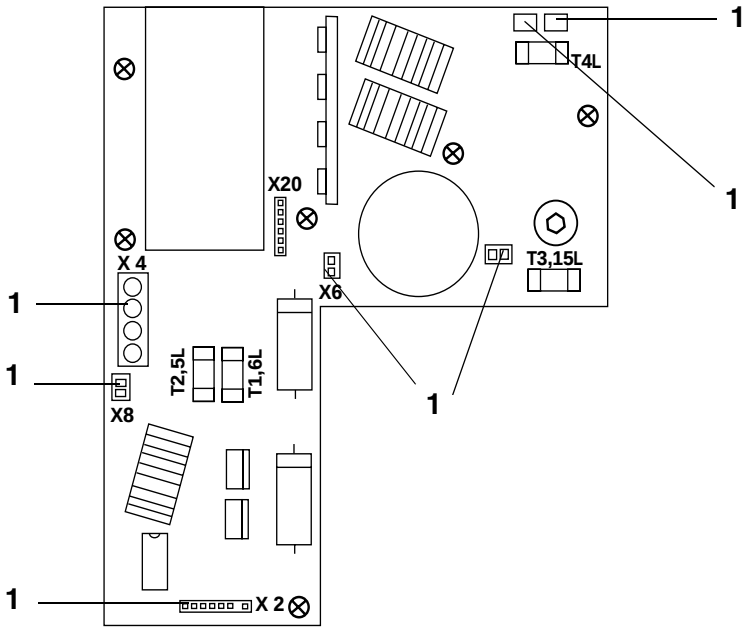

Fig. 28: Power Supply PCB, reconnecting connectors

- Assemble control box using reverse method of that used for disassembly.
- Mount control box to Fabius trolley.
- Check control box function according to Test Certificate.

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14.11 Control PCB

14.11.1 General Information About the Control PCB

In case of malfunctioning, replace the complete Control PCB.

After replacing the Control PCB, carry out "Init System" and calibrate the pressure sensor, the flow sensor, and the PEEP valve.

- Replace the rechargeable battery at 3-year intervals.

As of the first quarter of 1998, new Control PCBs have been equipped with a Supercap capacitor as standard backup for alarm sound generation. In this case it is not necessary to remove the rechargeable battery from the old Control PCB and to install it on the new one.

Resistor R40 has been set at the factory. Do not change settings of resistor R40.

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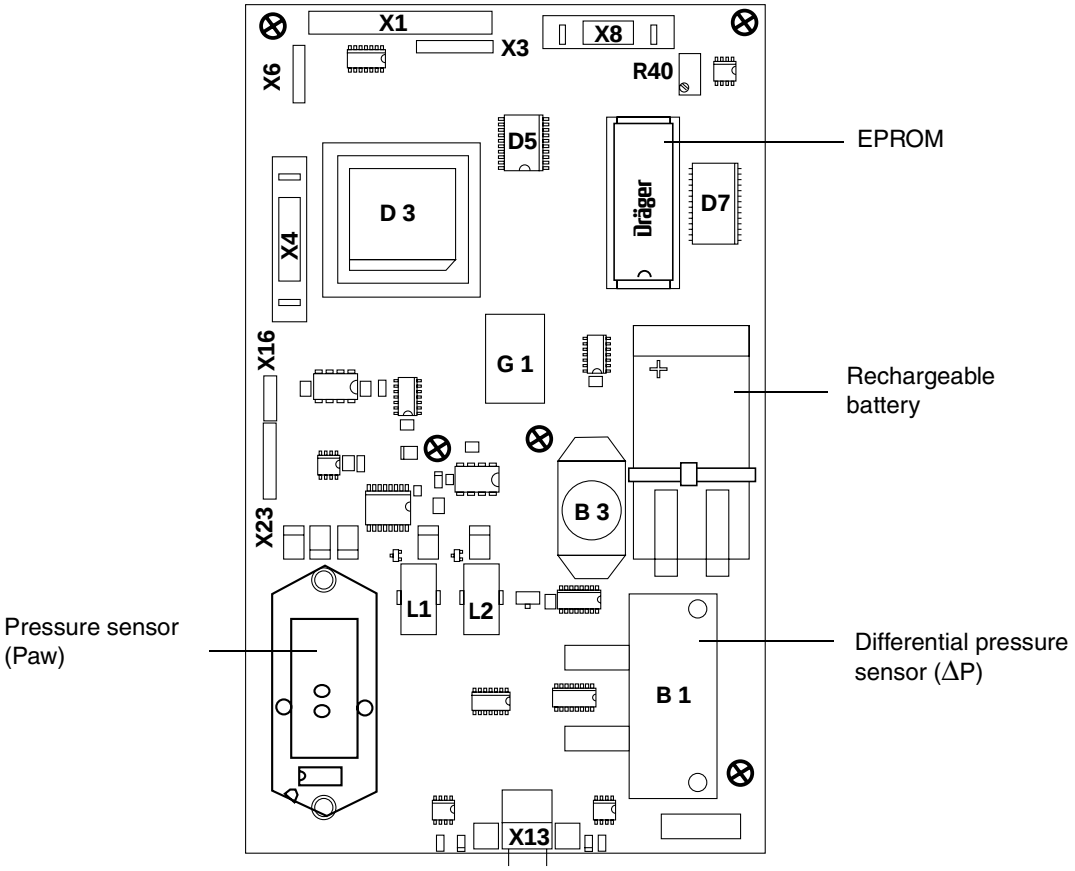

Fig. 29: Control PCB

14.11.2 Testing the Control PCB

- Check Control PCB in the Debug Mode: (the following will be displayed if the Control PCB is OK: MON 0000, EEP 0000)

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14.12 Control PCB Connections

14.12.1 Connector X23

See X2 Power Supply PCB

14.12.2 Connector X4

See X7 Power PCB

14.12.3 Connector X1 (Membrane Keypad)

Table 6: Membrane Keypad

Pin	Designation	Value
1	Line0	
2	Line1	
3	Line2	
4	Line3	
5	Column0	
6	Column1	
7	Column2	
8	Column3	
9	L_MAN	LED
10	L_IPPV	
11	L_SBY	
12	L_SIL	
13	L_WAR	
14	L_ALA	

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14.12.4 Connector X3 (Rotary Knob)

Table 7: Rotary Knob

Pin	Designation	Value
1	GNDD	
2	Column2	Key
3	Line3	Key
4	FPL_CLCK	
5		
6	FPL_PULS	
7	VCC	+5 V

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14.13 Dismounting/Replacing the Control PCB

- Write down the control box configuration data.
- Switch control box off using ON/OFF switch (ON/OFF switch is located on rear panel of control box).
- Remove control box from Gas Box (see "Removing the Control Box from the Gas Box").

Electrostatic discharge can damage electrostatic sensitive devices. Use a static-dissipative mat and a wrist strap when handling electrostatic sensitive devices.

- Remove lateral screws **1** from control box **2** and lift top cover **3** in direction of **A** and away from control box **2**.
- Place top cover **3** of control box **2** aside.

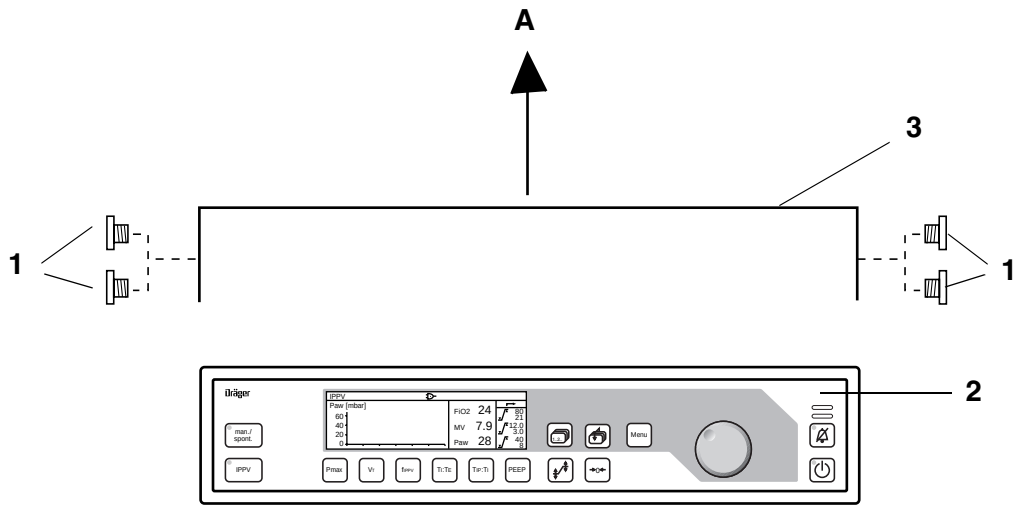

Fig. 30: Front view of control box, removing top cover

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- Disconnect connectors from sockets **1**.
- Disconnect connector of cable connection **2** from Display PCB.
- Undo latches and disconnect connector of cable connection **3** from Power PCB.

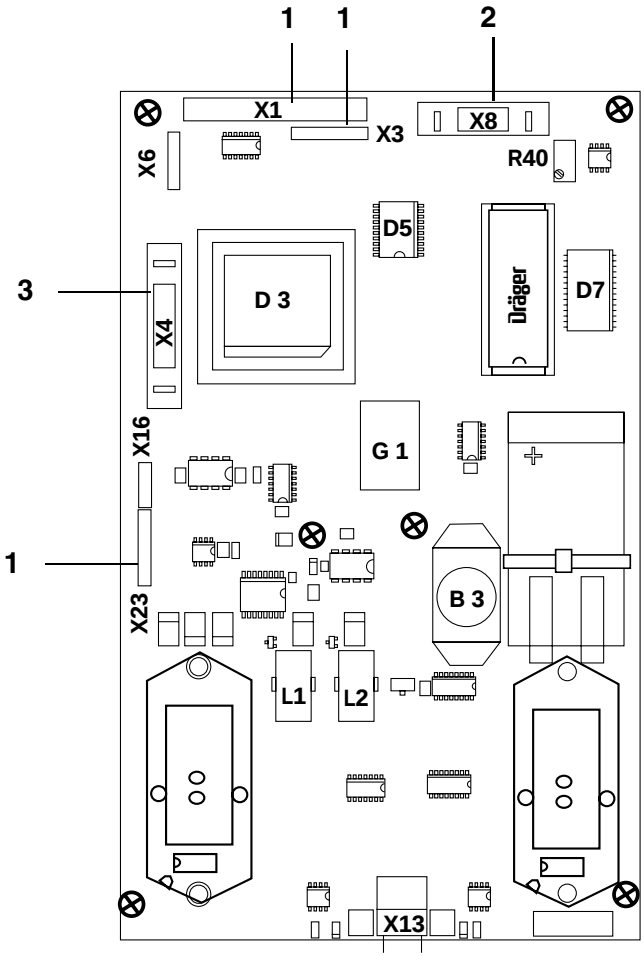

Fig. 31: Control PCB, disconnecting connectors

- Remove nut **4** from O_2 sensor port.

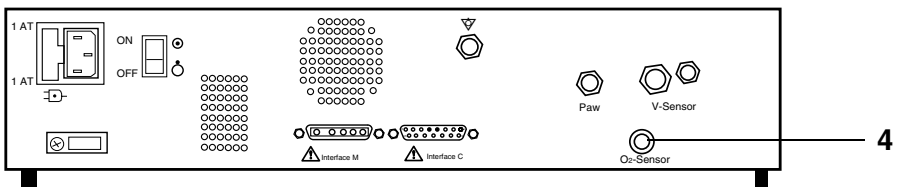

Fig. 32: Rear view of control box, removing nut of O_2 sensor port

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- Remove hose **1** from pressure sensor (Paw).
- Remove fixing screws and washers **2** of pressure sensor (Paw).
- Carefully remove pressure sensor and mount it to new Control PCB.
- Remove EPROM **3** from old Control PCB and mount it to new Control PCB (**make sure to mount EPROM correctly (direction) into EPROM mount)**.
- Cut cable tie **4** which holds rechargeable battery in place.
- Remove rechargeable battery and mount it to new Control PCB using a new cable tie (**make sure to mount rechargeable battery correctly (direction)**.
- To avoid wrong connections, mark hoses **5** of flow sensor.
- Disconnect hoses **5** from flow sensor.

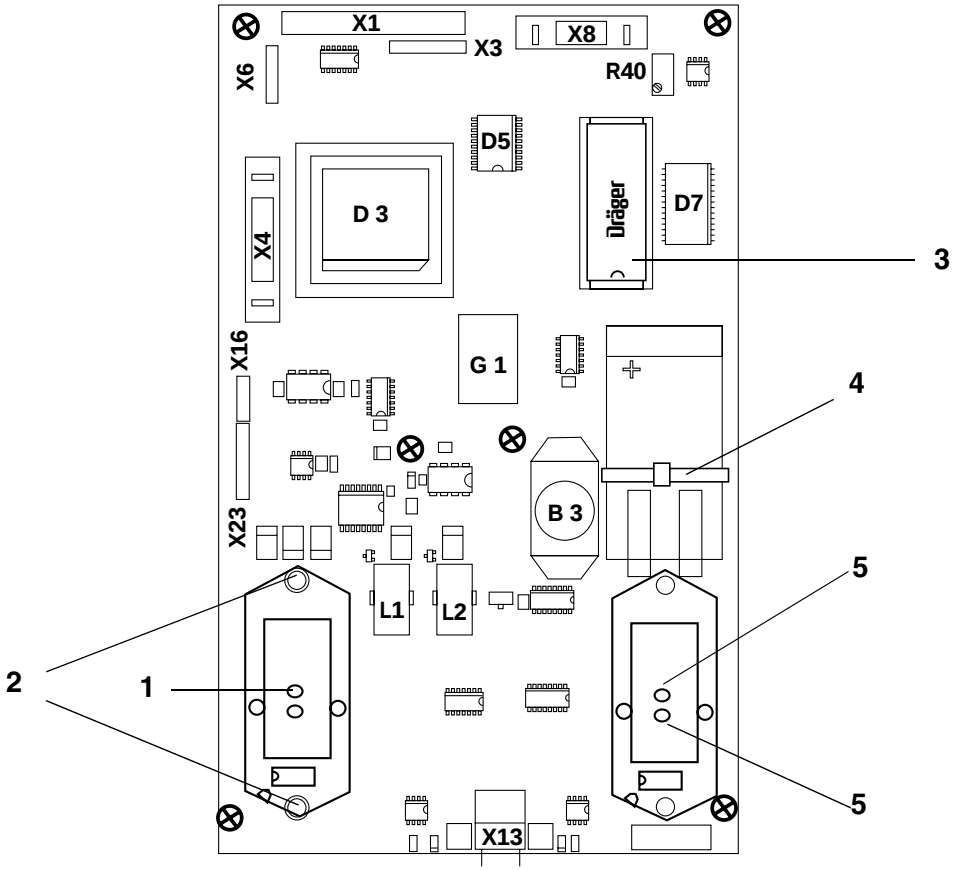

Fig. 33: Removing pressure sensor (Paw), differential pressure sensor, rechargeable battery and EPROM

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- Remove fixing screws **1**.

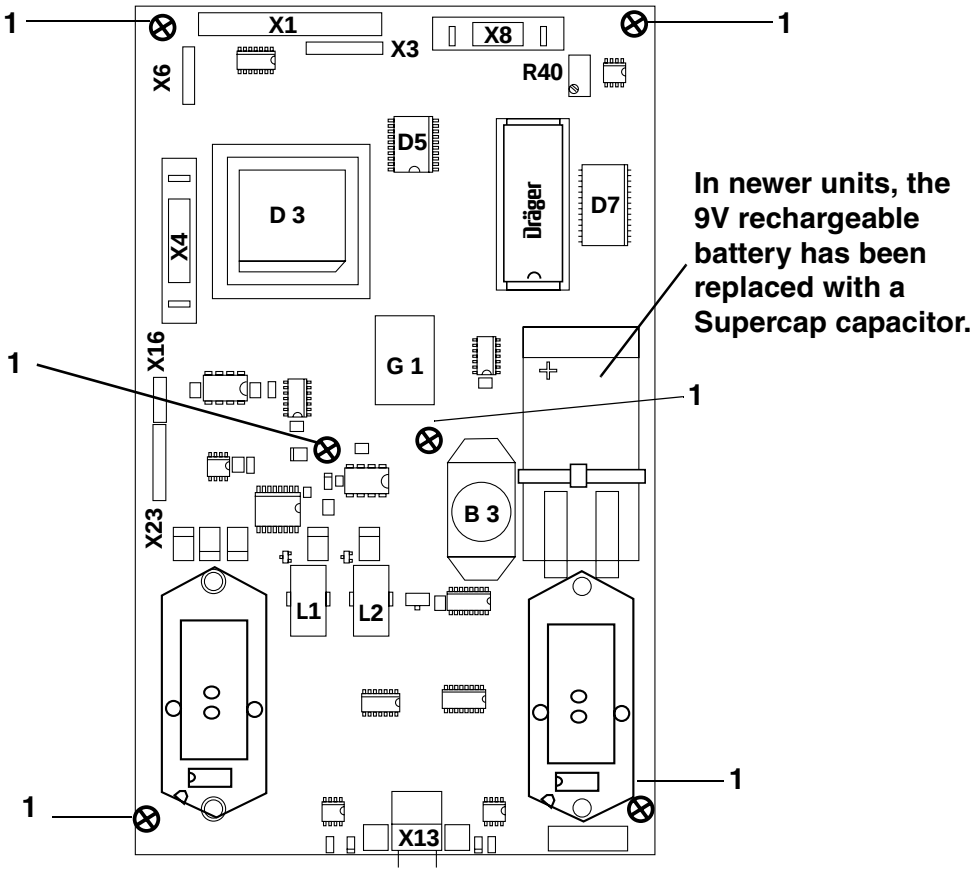

Fig. 34: Control PCB, removing fixing screws

- Replace Control PCB with a new one.
- Secure new Control PCB to control box using fixing screws **1**.
- Connect hoses to flow sensor of new Control PCB **(make sure to connect hoses as marked previously)**.
- Connect connectors.
- Secure O_2 sensor port using nut (**do not forget washer on inside of O_2 sensor port)**.
- Mount top cover to control box.
- Mount control box to Fabius trolley.
- Connect cables and hoses to control box (see markings).
- Carry out a system initialization (system init, keycode 112).
- Enter previously recorded menu settings.

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- Calibrate pressure sensor (Paw) in the DrägerService Mode.
- Calibrate flow sensor in the debug mode.
- Re-calibrate PEEP valve.
- Calibrate oxygen concentration in the debug mode.
- Check Control PCB function according to Test Certificate.

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14.14 Pressure Sensor (Paw) on Control PCB

In case of failure, replace the complete pressure sensor (Paw) on the Control PCB. After replacement, calibrate the pressure sensor (Paw) in the DrägerService Mode.

14.14.1 Testing the Pressure Sensor (Paw)

- Test pressure sensor (Paw) in the debug mode: “P” and “Plat”.

14.14.2 Dismounting/Replacing the Pressure Sensor (Paw)

- Switch control box off using ON/OFF switch (ON/OFF switch is located on rear panel of control box).
- Remove control box from Gas Box (see "Removing the Control Box from the Gas Box").

Electrostatic discharge can damage electrostatic sensitive devices. Use a static-dissipative mat and a wrist strap when handling electrostatic sensitive devices.

- Remove lateral screws **1** from control box **2** and lift top cover **3** in direction of **A** and away from control box **2**.
- Place top cover **3** of control box **2** aside.

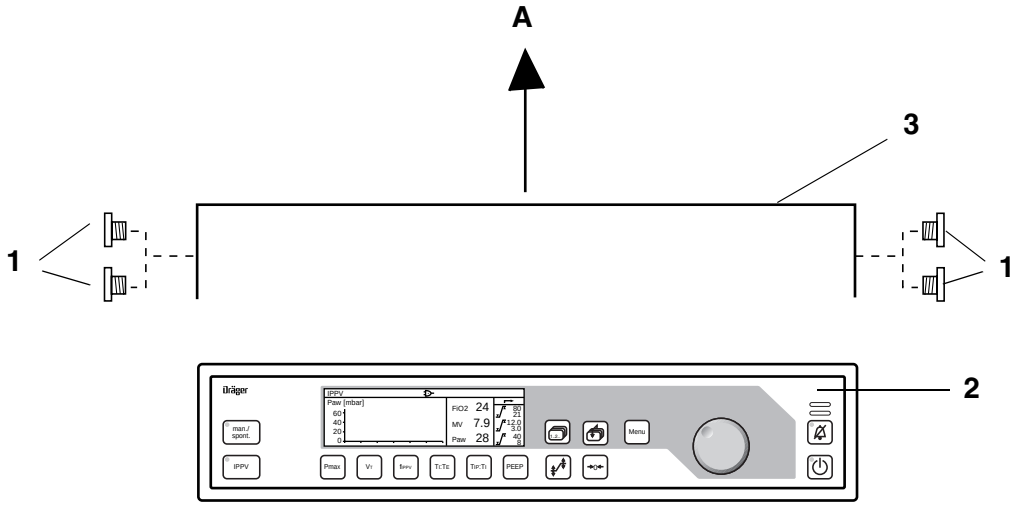

Fig. 35: Front view of control box, removing top cover

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- Disconnect silicone hose **1** from pressure sensor (Paw).
- Remove fixing screws and washers **2** from pressure sensor (Paw).

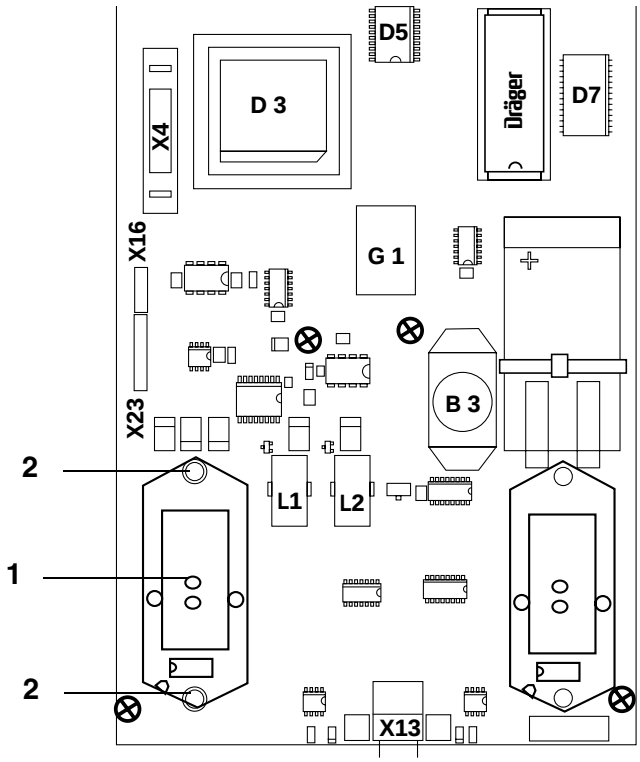

Fig. 36: Control PCB, removing pressure sensor (Paw)

- Carefully disconnect pressure sensor (Paw) from terminal strip.
- Replace pressure sensor (Paw) with a new one.
- Secure new pressure sensor (Paw) to Control PCB using fixing screws and washers **2**.
- Connect silicone hose to port **1** of new pressure sensor (Paw) (see Figure "Control PCB, removing pressure sensor (Paw)").
- Mount top cover to control box.
- Mount control box to Gas Box.
- Connect cables and hoses to control box.
- Calibrate pressure sensor (Paw) in the DrägerService Mode.
- Check pressure sensor (Paw) function according to Test Certificate.

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14.14.3 Dismounting/Replacing the Pressure Sensor (Flow)

Two different types of differential pressure sensors for flow measurement may exist in the field. Fabius CE printed circuit boards are designed for either type. However, we recommend using the type manufactured by Data Instruments.

- Switch control box off using ON/OFF switch (ON/OFF switch is located on rear panel of control box).
- Remove control box from Gas Box (see "Removing the Control Box from the Gas Box").

Electrostatic discharge can damage electrostatic sensitive devices. Use a static-dissipative mat and a wrist strap when handling electrostatic sensitive devices.

- Remove lateral screws **1** from control box **2** and lift top cover **3** in direction of **A** and away from control box **2**.
- Place top cover **3** of control box **2** aside.

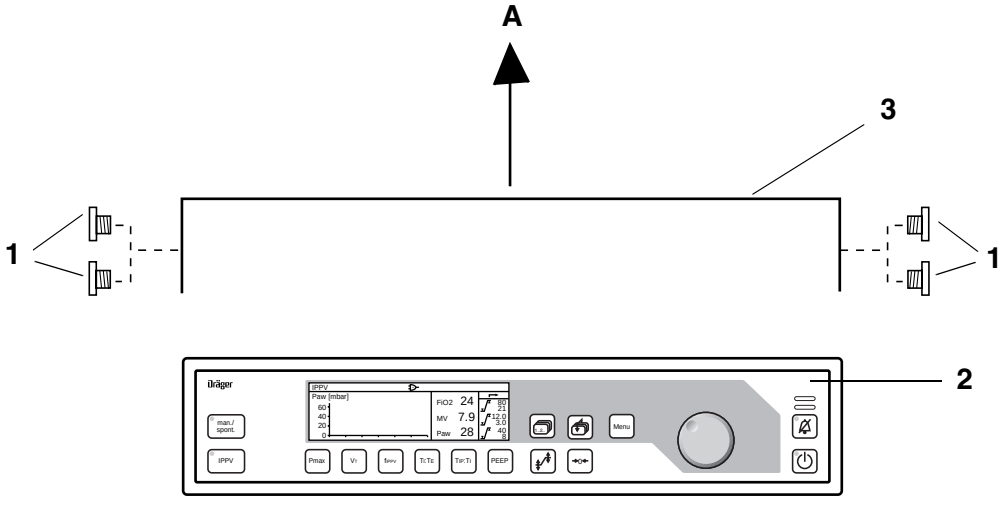

Fig. 37: Front view of control box, removing top cover

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- Mark silicone hoses for later reassembly and disconnect them from pressure sensor (flow).
- Remove fixing screws and washers from pressure sensor (flow) **2**.

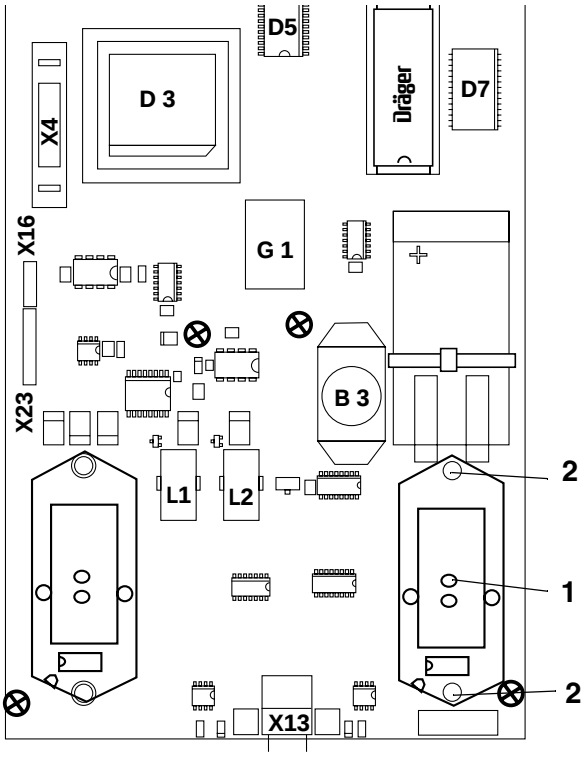

Fig. 38: Removing pressure sensor (flow) from Control PCB

- Carefully disconnect the existing pressure sensor (Flow) from terminal strip **1**.
- Replace the old pressure sensor (flow) with a new one.
- Secure new pressure sensor (flow) to Control PCB using fixing screws and washers **2**.
- Connect silicone hoses to new pressure sensor.
- Mount top cover to control box.
- Mount control box to Gas Box.
- Connect cables and hoses to control box.
- Calibrate pressure sensor (flow) in the standby mode.
- Check pressure sensor (flow) function according to Test Certificate.

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14.15 Power PCB

In case of failure, replace the complete Power PCB. The EPROM is not included in the new Power PCB. It must be removed from the old Power PCB and mounted to the new one.

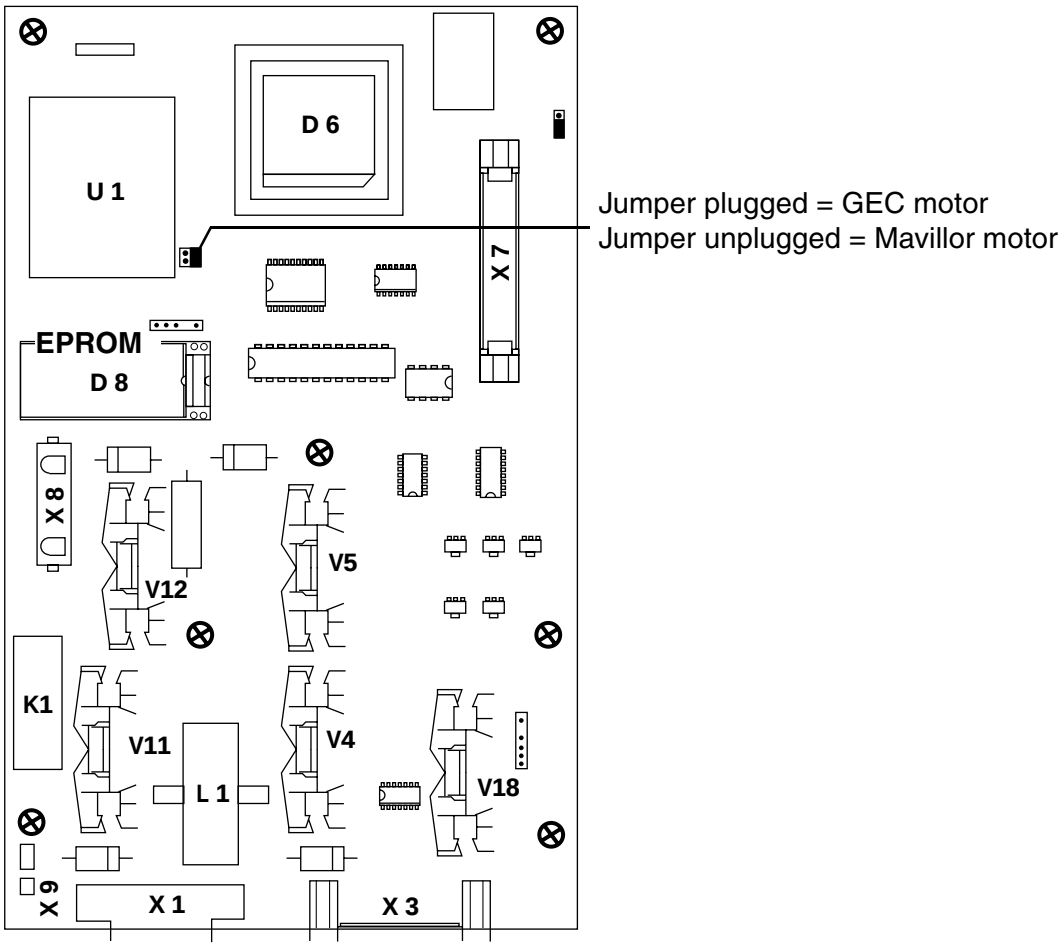

Fig. 39: Power PCB, location of EPROM

Remove EPROM from Power PCB and mount EPROM onto new Power PCB.

Make sure to mount EPROM correctly (direction) into EPROM mount.

14.15.1 Testing the Power PCB

- Test Power PCB in the debug mode: (the following is displayed if Power PCB is OK: VEN 0000, no temperature error).

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14.16 Power PCB Connections

14.16.1 Interface M (X1)

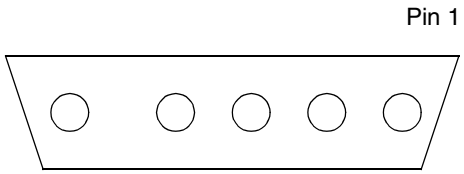

Fig. 40: Location of pin 1 on interface M (X1)

Table 8: Pin Assignment

Pin	Designation	Value During Operation, Connector Disconnected
1	AKKU+	+27 V to 5
2	MOTOR1	+27V to 4
3	GEHÄUSE GND	
4	MOTOR2	
5	AKKU-	

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14.16.2 Interface C (X3)

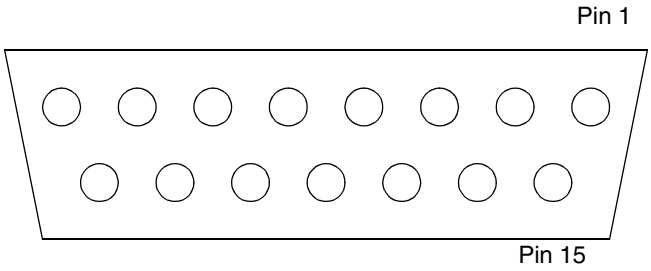

Fig. 41: Location of pin 1 and pin 15 on interface C (X3)

Table 9: Pin Assignment of Pneumatics Interface C (X3)

Pin	Designation	Value During Operation, Connector Disconnected
1	PEEP	
2	Index	+5V to GNDD
3	PUMPE	
4	MV2	not used
5	P_MEMBRAN	+5V to GNDD
6	VCC	+5V to GNDD
7	Phase1	+5V to GNDD
8	GNDD	
9	VCC	+5V to GNDD
10	End_Sch	+5V to GNDD
11	VPP_SAVE	+27V to GNDD
12	MV1	not used
13	VPP_SAVE	+27 V to GNDD
14	GNDD	
15	Phase0	+5V to GND

14.16.3 Connector X9 (Fan)

This connector is supplied with 27 VDC when the fan is activated.

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14.16.4 Rechargeable Battery Connector X11

The following voltages should be measured according to the current operating mode (battery-powered, AC-powered, or ON/OFF switch off): on-load voltage, charging voltage, off-load voltage.

14.16.5 Display Backlighting Connector X4

Approximately 1000 VAC are applied at off-load, approximately 280 V AC are present during operation.

Voltage dips slightly during measurement.

14.16.6 Connector X8 (connection to Power Supply PCB)

During operation, +5 V are measured across red (+5V) and black wire (GND), and approx. +27 V across black (GND) and blue wire (motor).

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14.16.7 Connector to Control PCB X7

Table 10: Connector Pin Assignment of Connector X7

Pin	Designation	Value
1	VCC	+5V to GNDD
2	VCC	
3	VCC	
4	VCC	
5	MV1_AN	not used
6	MV2_AN	not used
7	PEEP_AN	
8		
9	TXD0	
10	RXD0	
11	I_ZU_E	
12	RESET	
13	Quit_0	
14	MOTI	
15	Horn_Reg	
16	Pressure	
17	GNDD	
18	MV3_AN	not used
19	FLOW	
20	P_MEMBRA	
21	OFF_ON	
22	Shutdown_Status	
23	GNDD	
24	GNDD	
25	GNDD	
26	GNDD	

14.16.8 Jumper X10, EPROM Size

Plugged between pin 1 and 2

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14.16.9 Jumper X13, Motor

Jumper plugged with GEC motor, unplugged with Mavillor motor.

14.16.10 Jumper X12, not used

14.17 Dismounting/Replacing the Power PCB

- Switch control box off using ON/OFF switch (ON/OFF switch is located on rear panel of control box).
- Remove control box from Gas Box (see "Removing the Control Box from the Flowmeter Chasis").

Electrostatic discharge can damage electrostatic sensitive devices. Use a static-dissipative mat and a wrist strap when handling electrostatic sensitive devices.

- Remove lateral screws **1** from control box **2** and lift top cover **3** in direction of **A** and away from control box **2**.
- Place top cover **3** of control box **2** aside.

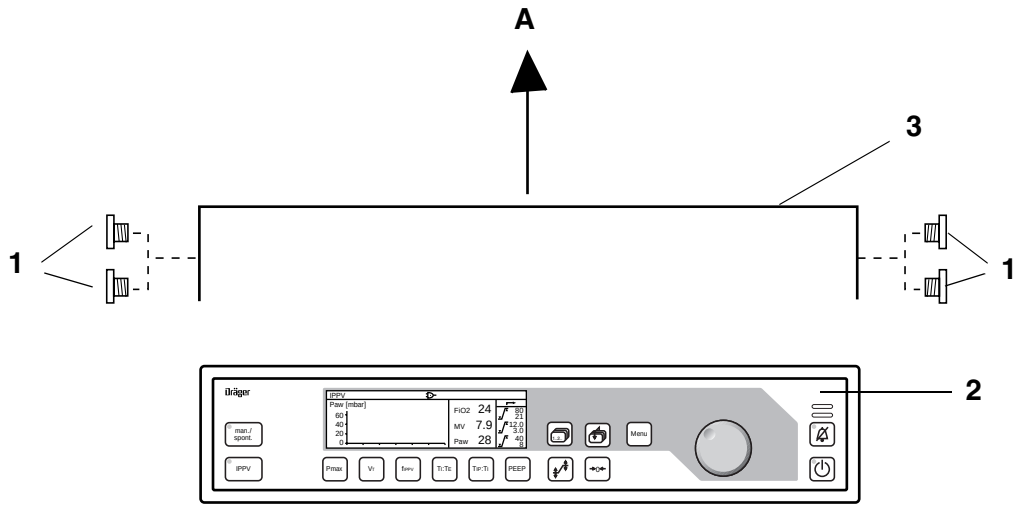

Fig. 42: Front view of control box, removing top cover

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- Remove EPROM **1** from old Power PCB and mount it to new Power PCB (**make sure to mount EPROM correctly (direction) into EPROM mount)**.

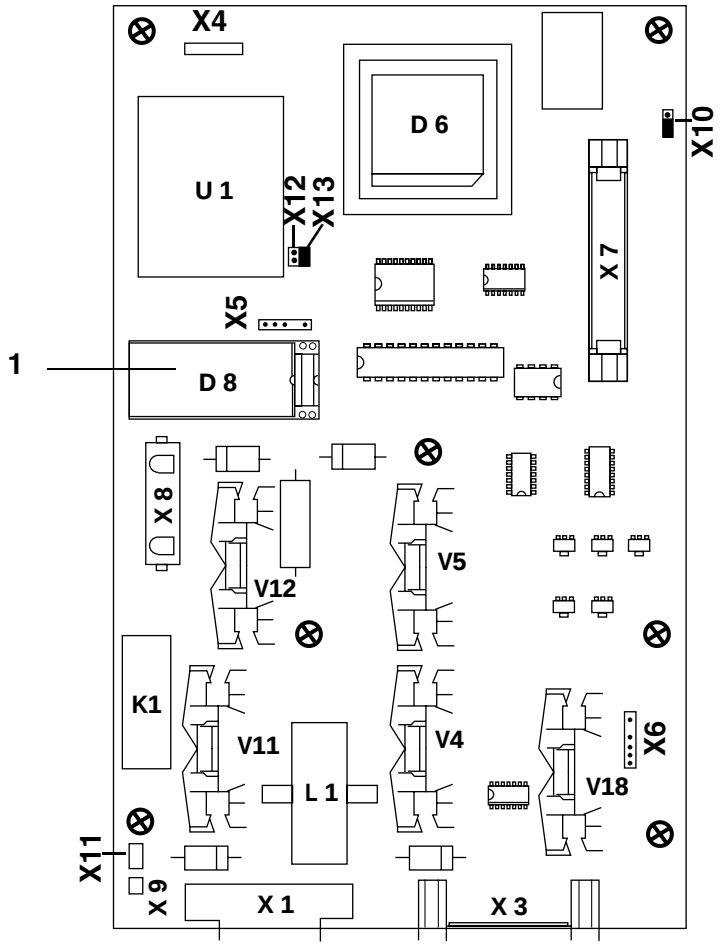

Fig. 43: Power PCB, installing EPROM on new Power PCB

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- Disconnect connectors from sockets **1**.
- Remove nuts and washers (located on rear panel of control box) from interface **2**.
- Remove nuts and washers (located on rear panel of control box) from interface **3**.

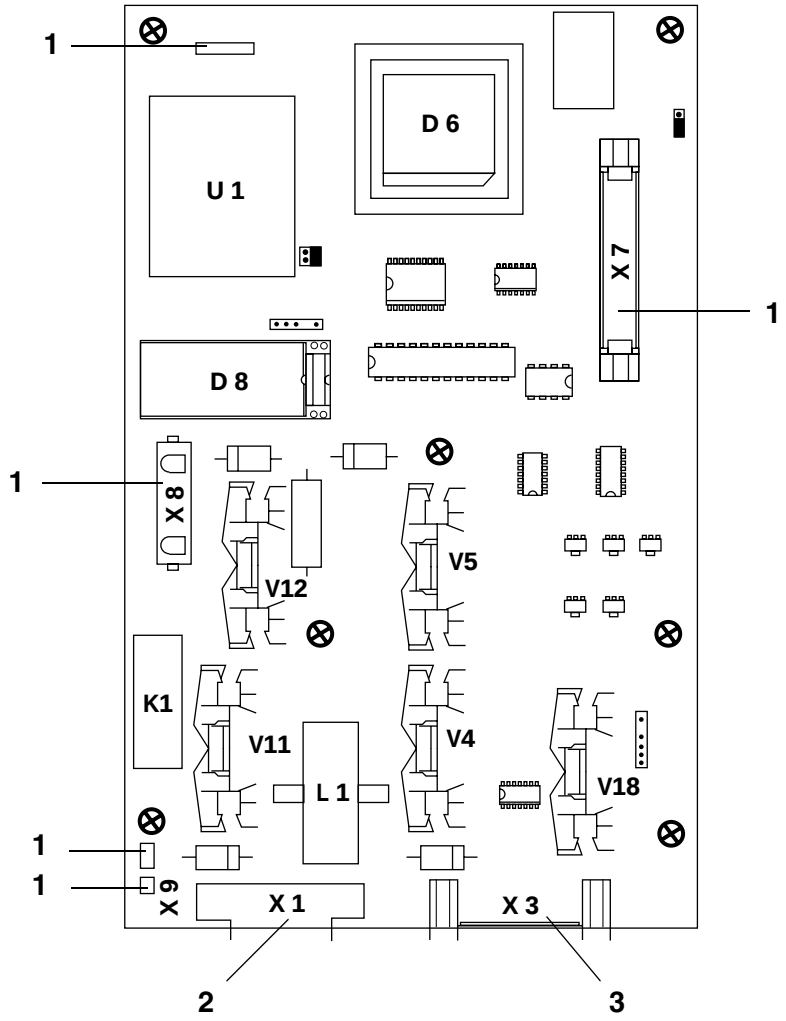

Fig. 44: Power PCB, disconnecting connectors

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- Remove fixing screws **1** from Power PCB.

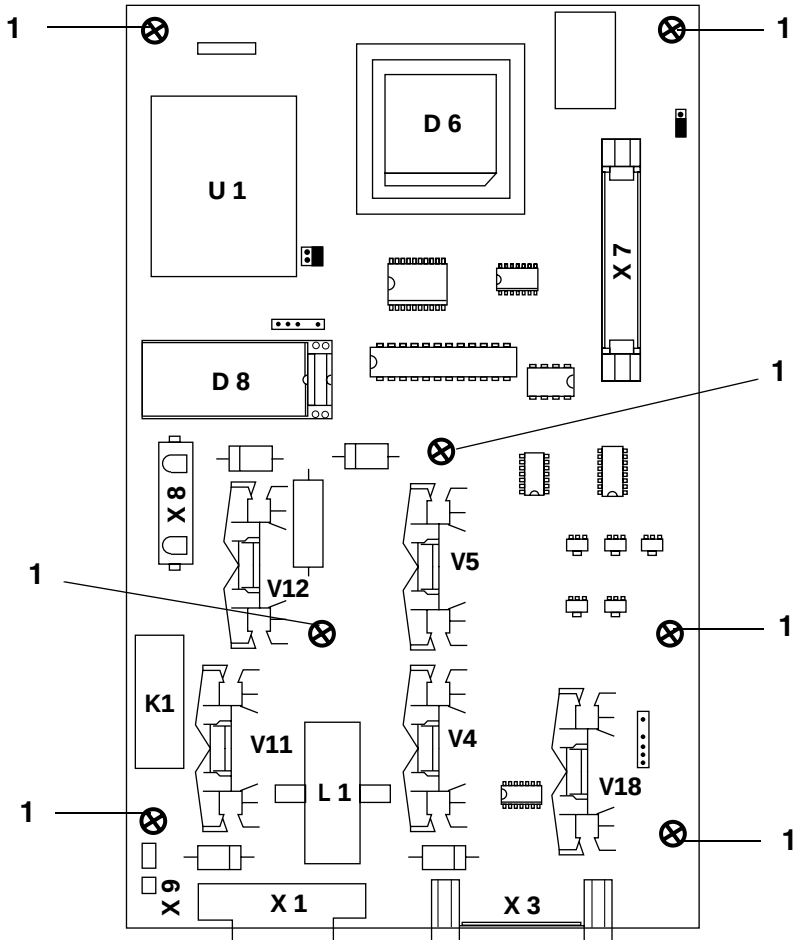

Fig. 45: Power PCB, removing fixing screws

- Replace Power PCB with new Power PCB.
- Secure new Power PCB to control box using fixing screws **1**.
- Connect connectors to respective sockets.

The fan connector is not coded. It can be connected on either ends.

- Secure pneumatics interface socket to rear panel of control box.
- Secure ventilator interface socket to rear panel of control box.
- Mount top cover to control box.

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- Mount control box to Fabius trolley.
- Connect cables/hoses to control box.
- Calibrate pressure sensor in the DrägerService Mode.
- Calibrate flow sensor in the debug mode.
- Calibrate oxygen concentration in the debug mode.
- Check Power PCB function according to Test Certificate.

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14.18 Front Panel (complete)

The front panel comprises the front frame, membrane keypad, rotary knob and display PCB. In case of failure, the complete front panel, rotary knob or display can also be replaced separately.

14.18.1 Testing the Membrane Keypad Elements

- Press control box keys and check response (LEDs on respective key should come on when key is pressed).

14.18.2 Dismounting/Replacing the Front Panel

- Switch control box off using ON/OFF switch (ON/OFF switch is located on rear panel of control box).
- Remove control box from Gas Box (see "Removing the Control Box from the Gas Box").

Electrostatic discharge can damage electrostatic sensitive devices. Use a static-dissipative mat and a wrist strap when handling electrostatic sensitive devices.

- Remove lateral screws **1** from control box **2** and lift top cover **3** in direction of **A** and away from control box **2**.
- Place top cover **3** of control box **2** aside.

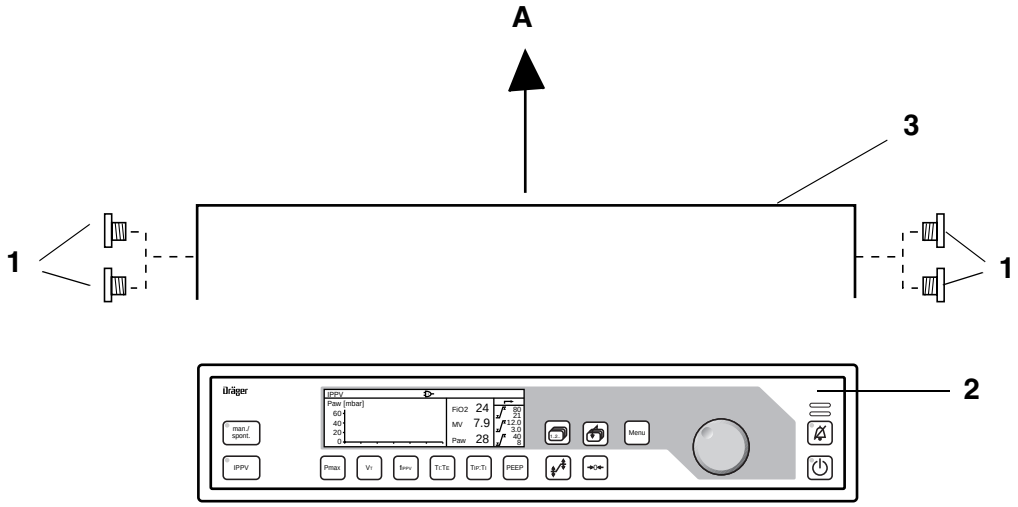

Fig. 46: Front view of control box, removing top cover

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- Disconnect connector **1**.
- Disconnect connector **2**.
- Disconnect connector **3**.
- Disconnect connector **4**.

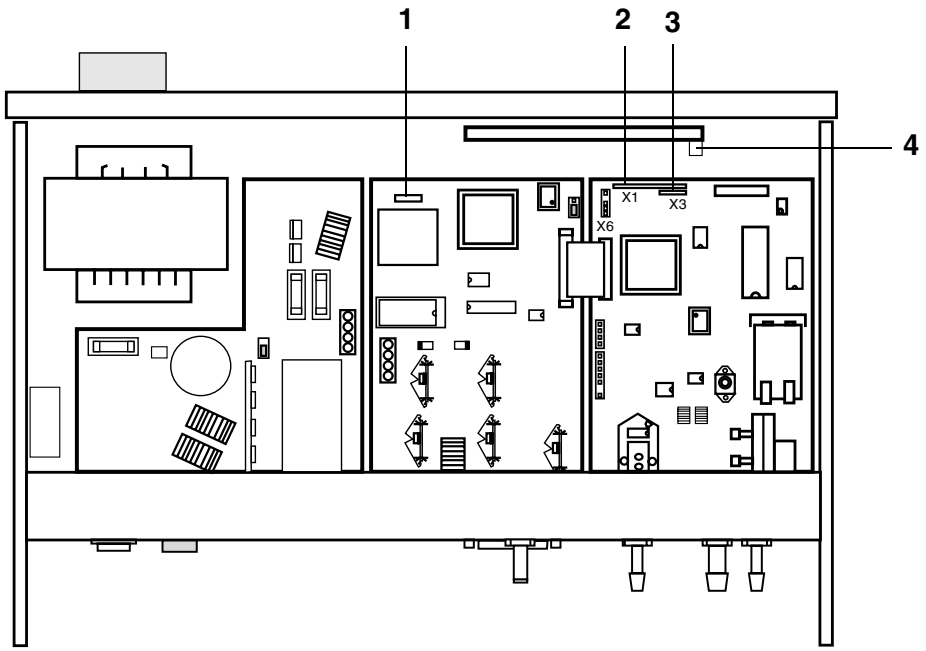

Fig. 47: Top view of control box (cover removed), disconnecting connectors

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- Remove rotary knob cap **1**.

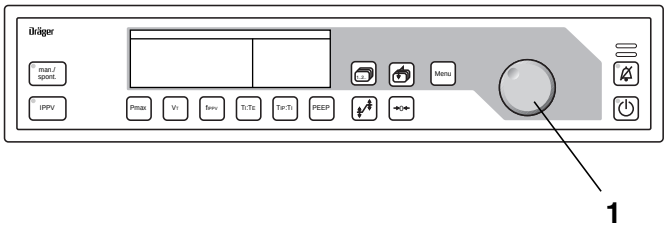

Fig. 48: Front view of control box, removing rotary knob cap

- Remove hexagon nut **2**.

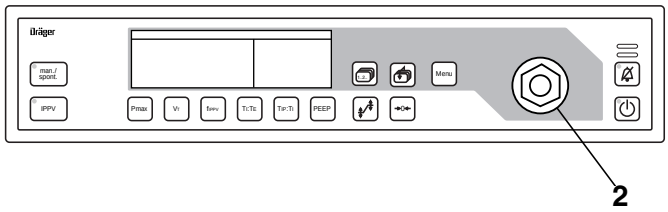

Fig. 49: Front view of control box, removing hexagon nut

- Remove fixing screws **3**.

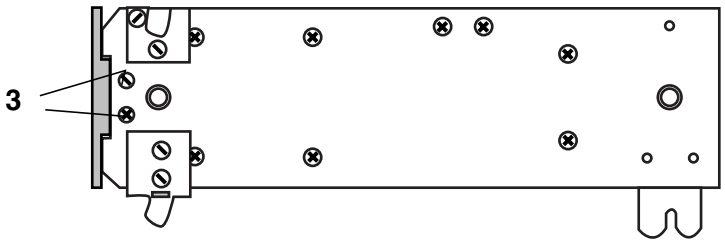

Fig. 50: Right-hand view of control box, removing fixing screws

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- Remove fixing screws **1**.

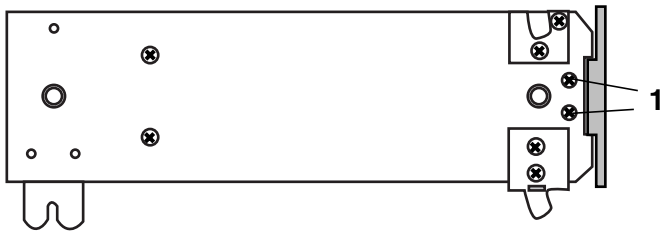

Fig. 51: Left-hand view of control box, removing fixing screws

- Pull front panel slightly away from control box.
- Remove screw and washer **2** from front panel.
- Disconnect all necessary cables and wire harnesses from front panel to control box to allow removal.

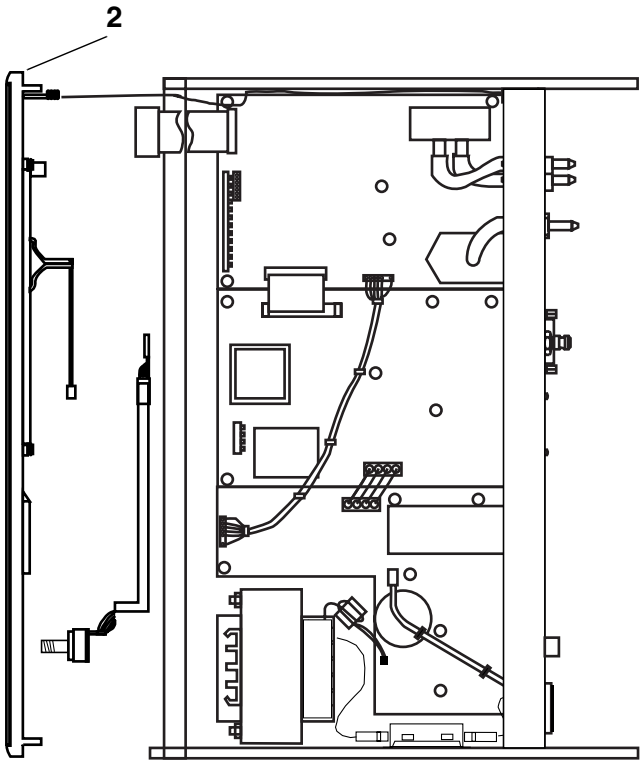

Fig. 52: Top view control box (top cover removed), removing screw and washer

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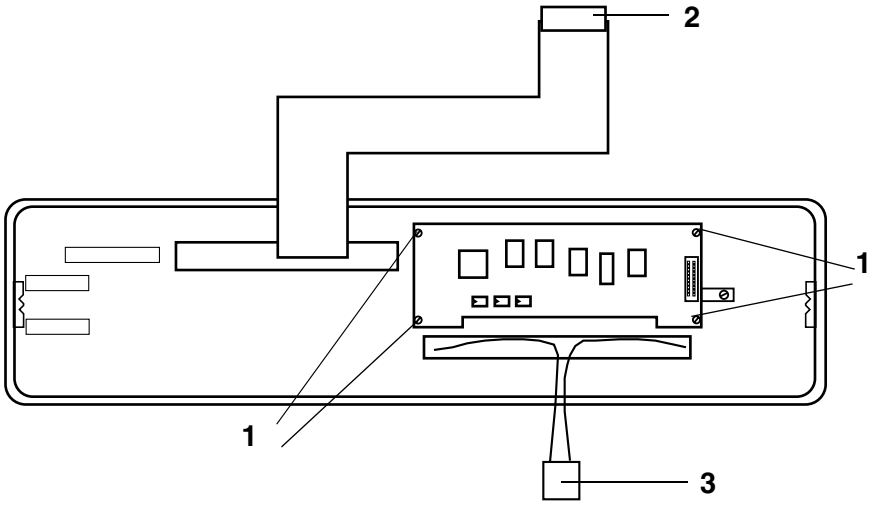

Fig. 53: Rear view of front panel, removing Display PCB

- Secure Display PCB to new front panel using fixing screws and washers **1**.
- Connect ground to new front panel.
- Secure new front panel to control box.
- Connect connector **2** to Control PCB and connector **3** to Power PCB.
- Connect graphics display cable from Control PCB to display.
- Mount rotary knob assembly to front panel.
- Push rotary knob cap onto rotary knob.
- Connect rotary knob connector to Control PCB.
- Mount top cover to control box.
- Mount control box to Gas Box.
- Connect cables and hoses to control box.
- Check function of membrane keypad, backlighting, and display during operation.

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14.19 Display PCB

In case of failure, replace the complete Display PCB.

14.19.1 Testing the Display PCB

- Check display function during operation.

14.19.2 Dismounting/Replacing the Display PCB

- Switch control box off using ON/OFF switch (ON/OFF switch is located on rear panel of control box).
- Remove control box from Gas Box (see "Removing the Control Box from the Gas Box").

Electrostatic discharge can damage electrostatic sensitive devices. Use a static-dissipative mat and a wrist strap when handling electrostatic sensitive devices.

- Remove lateral screws **1** from control box **2** and lift top cover **3** in direction of **A** and away from control box **2**.
- Place top cover **3** of control box **2** aside.

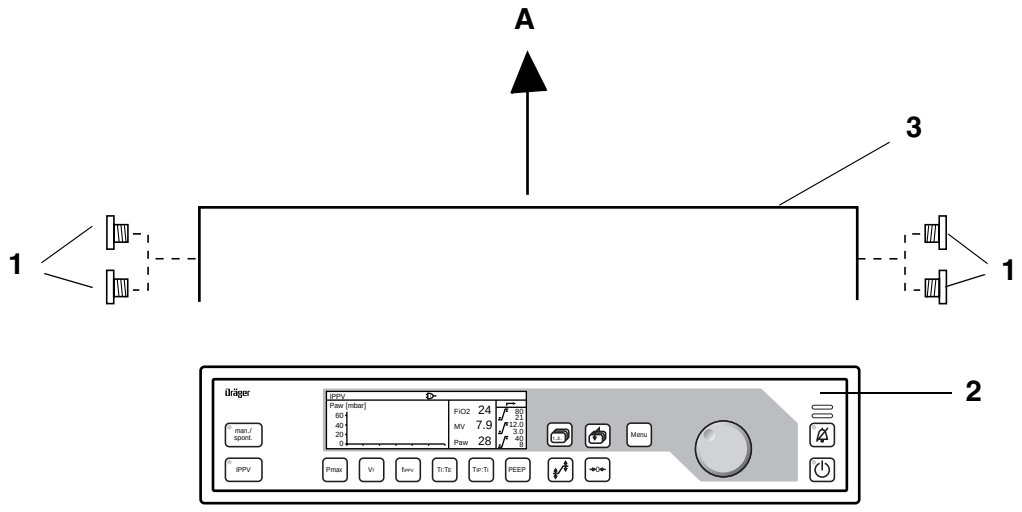

Fig. 54: Front view of control box, removing top cover

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- Disconnect connector **1**.
- Disconnect connector **2**.
- Disconnect connector **3**.
- Disconnect connector **4**.

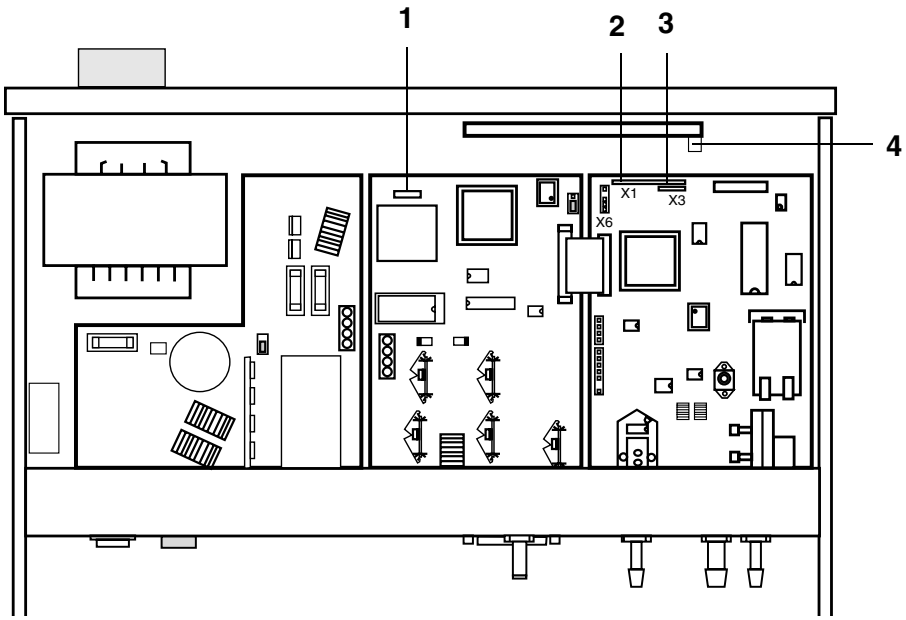

Fig. 55: Top view of control box (top cover removed), disconnecting connectors

- Remove fixing screws **5**.

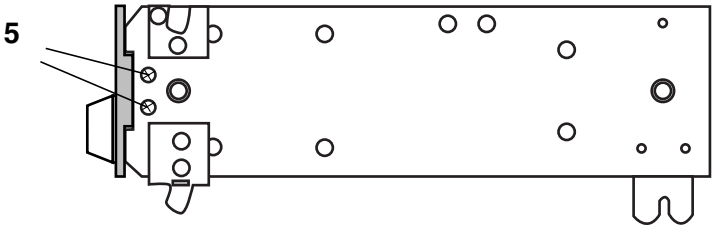

Fig. 56: Right-hand view of control box, removing fixing screws

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- Remove fixing screws **1**.

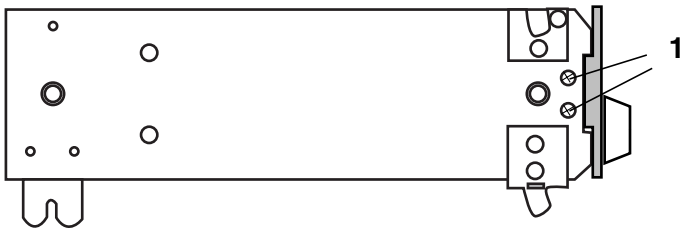

Fig. 57: Left-hand view of control box, removing fixing screws

- Pull front panel **2** slightly away from control box.
- Remove fixing screws and washers **3** of Display PCB.

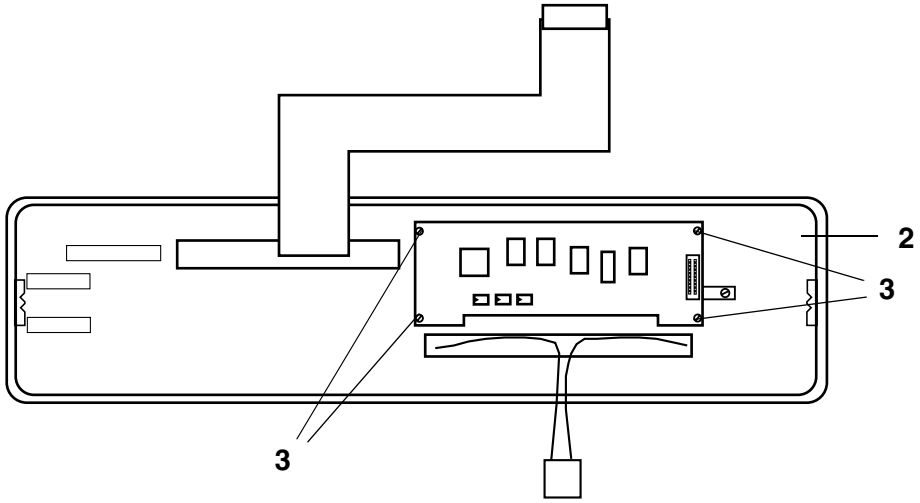

Fig. 58: Rear view of front panel, removing fixing screws and washers

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- Remove label **1**.
- Remove fixing screws **2**.

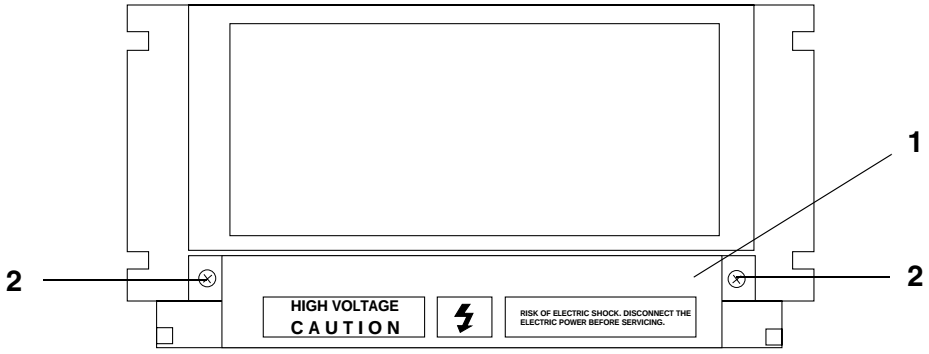

Fig. 59: View of dismounted display

- Mount backlighting lamp to new Display PCB.
- Secure new Display PCB to front panel using fixing screws and washers.
- Mount front panel to frame of control box.
- Connect connectors to respective sockets.
- Mount top cover to control box.
- Mount control box to Gas Box.
- Check function of membrane keypad, backlighting, and display during operation.

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14.19.3 Dismounting/Replacing the Backlighting Lamp

- Switch control box off using ON/OFF switch (ON/OFF switch is located on rear panel of control box).
- Remove control box from Gas Box (see "Removing the Control Box from the Gas Box").

Electrostatic discharge can damage electrostatic sensitive devices. Use a static-dissipative mat and a wrist strap when handling electrostatic sensitive devices.

- Remove lateral screws **1** from control box **2** and lift top cover **3** in direction of **A** and away from control box **2**.
- Place top cover **3** of control box **2** aside.

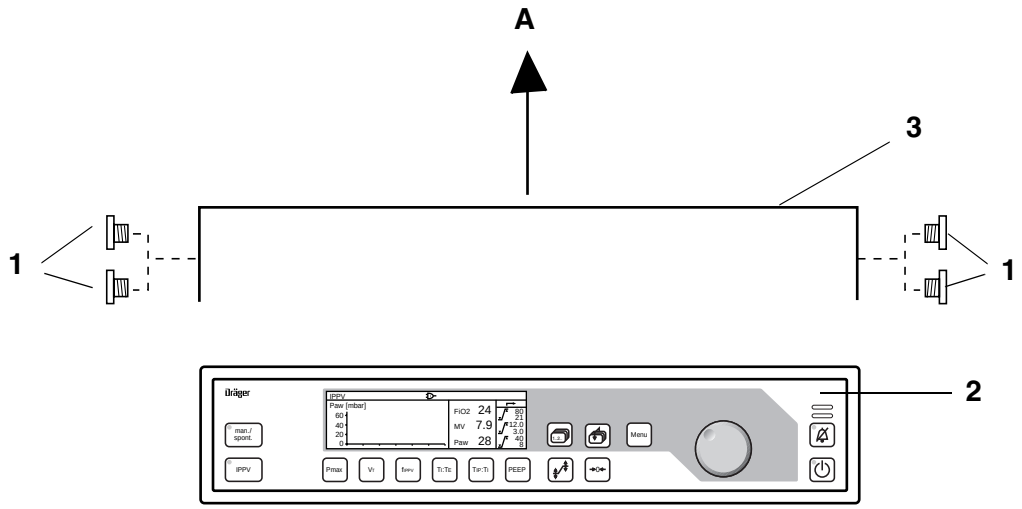

Fig. 60: Front view of control box, removing top cover

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- Disconnect connector **1**.
- Disconnect connector **2**.
- Disconnect connector **3**.
- Disconnect connector **4**.

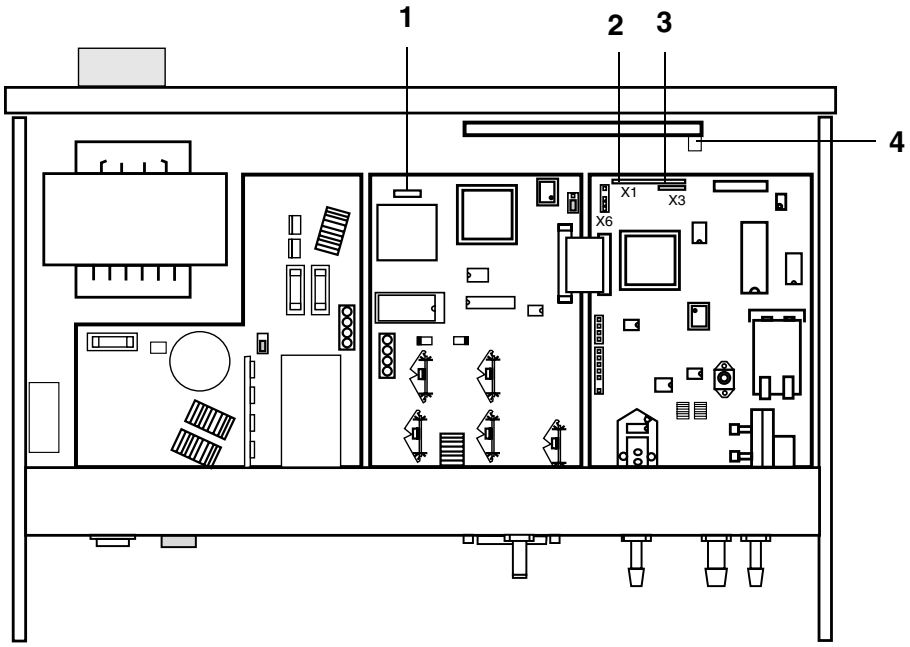

Fig. 61: Top view of control box (top cover removed), disconnecting connectors

- Remove fixing screws **5**.

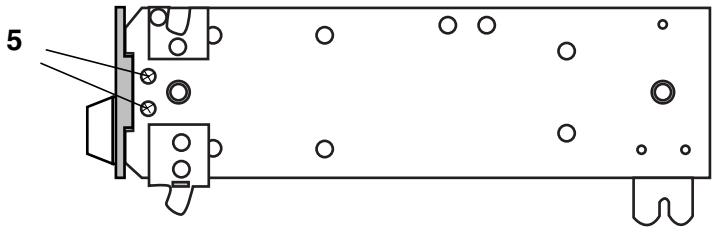

Fig. 62: Right-hand view of control box, removing fixing screws

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- Remove fixing screws **1**.

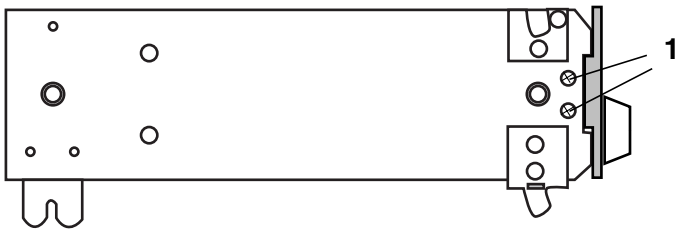

Fig. 63: Left-hand view of control box, removing fixing screws

- Pull front panel **2** slightly away from control box.
- Carefully cut cable tie which fastens all front panel cables together.
- Remove fixing screws and washers **3**.

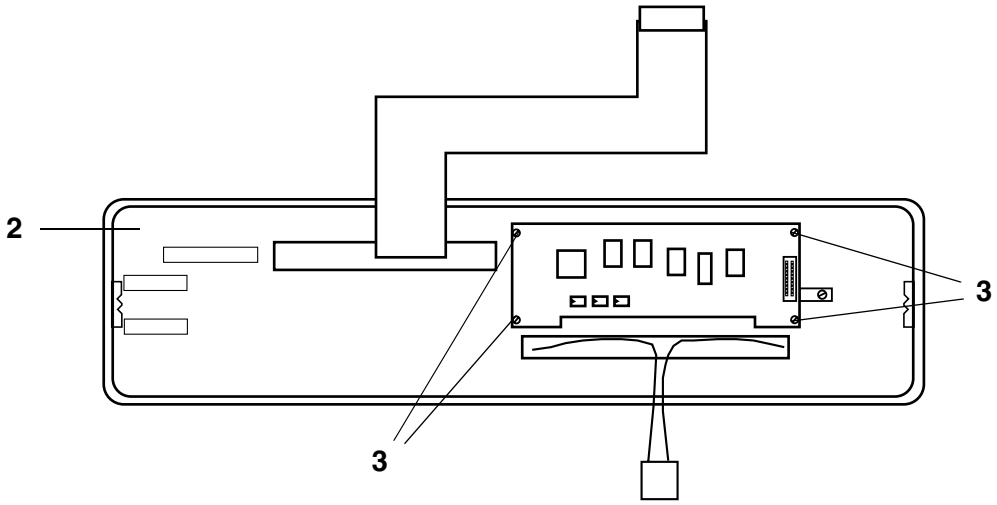

Fig. 64: Rear view of front panel, removing fixing screws and washers

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- Turn Display PCB such that display screen is up.
- Remove label **1**.
- Remove fixing screws **2**.

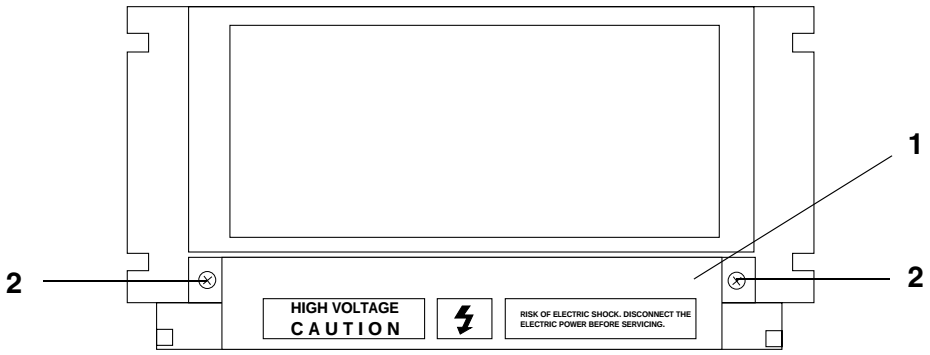

Fig. 65: View of dismounted display assembly

- Replace the backlighting lamp with a new one.
- Attach new label below display.
- Mount display to front panel.
- Mount front panel to frame of control box.
- Connect connectors to respective sockets.
- Mount top cover to control box.
- Mount control box to Gas Box.
- Check backlighting lamp function during operation.

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15 Gas Box

15.1 Gas Box Components (left-hand side)

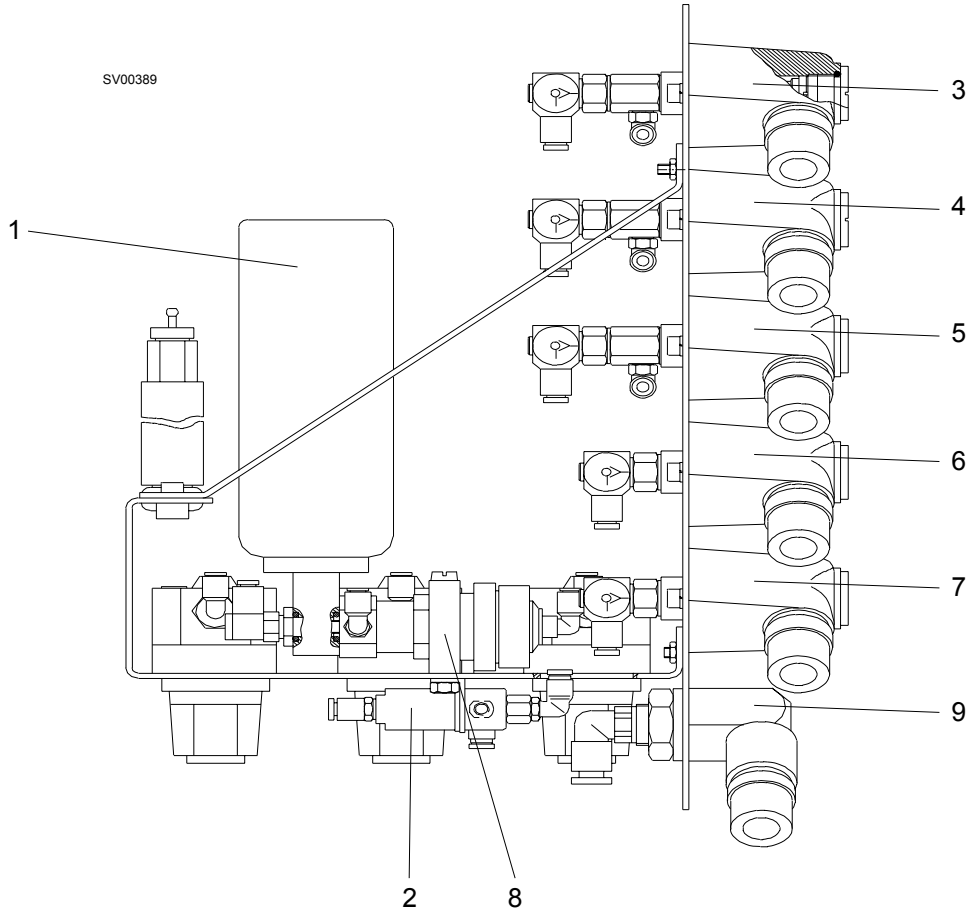

Fig. 66: Left-hand view of gas box

Key

1	Container	**6**	O_2 cylinder connection
2	Input valve, vent	**7**	N_2O cylinder connection
3	O_2 connection	**8**	Gas failure alarm
4	N_2O connection	**9**	O_2 outlet port (ejector)
5	AIR connection		

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15.2 Gas Box Components (right-hand side)

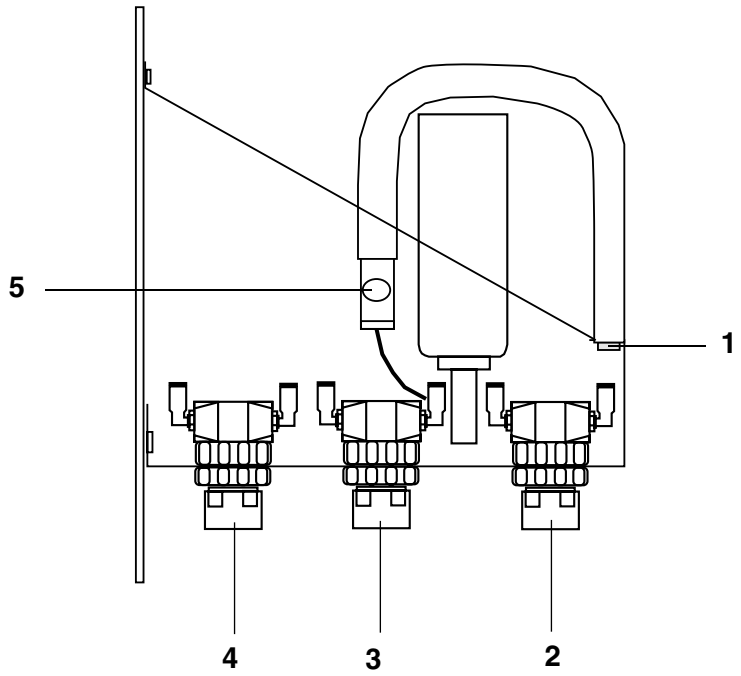

Fig. 67: Right-hand view of gas box

Key

1	Alarm whistle
2	DR2 (N_2O pressure regulator)
3	DR3 (AIR pressure regulator)
4	DR1 (O_2 pressure regulator)
5	Ejector

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15.3 Removing the Gas Box

- Switch control box off using ON/OFF switch (ON/OFF switch is located on rear panel of control box).
- Disconnect power plug from AC outlet.
- Disconnect gas supply hoses from pipeline system.
- Remove fixing screws **1** from cover **2** and pull cover **2** slightly out.

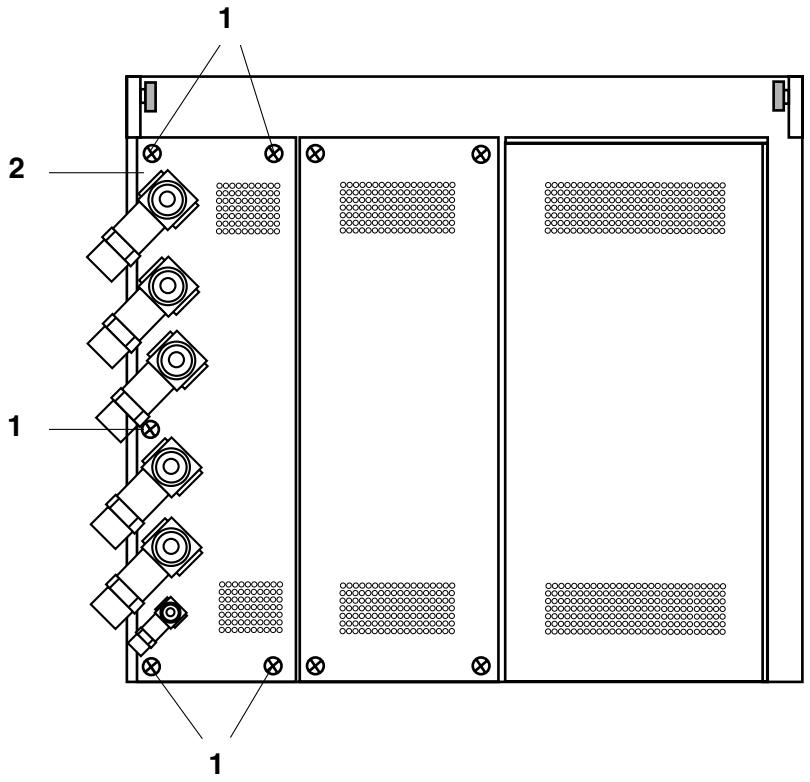

Fig. 68: Rear view of Fabius, removing gas box

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15.4 Pressure Regulators

Replace pressure regulators after six years of service or install “Pressure Regulator” spare parts set. See replacement interval matrix on Page 4.5 of the Test Certificate.

15.4.1 Testing the Pressure Regulators

- Check pressure regulators according to Test Certificate.

15.4.2 Mounting the "Pressure Regulator" Spare Parts Set

- Switch control box off using ON/OFF switch (ON/OFF switch is located on rear panel of control box).
- Disconnect power plug from AC outlet.
- Disconnect gas supply hoses from pipeline system.
- Remove gas box (see "Removing the Gas Box").
- Mark hoses of respective pressure regulator for later reassembly, for example, **1** for outlet, **2** for inlet, in order to avoid interchanging of inlet and outlet of pressure regulator **(note the arrow marking on pressure regulator)**.

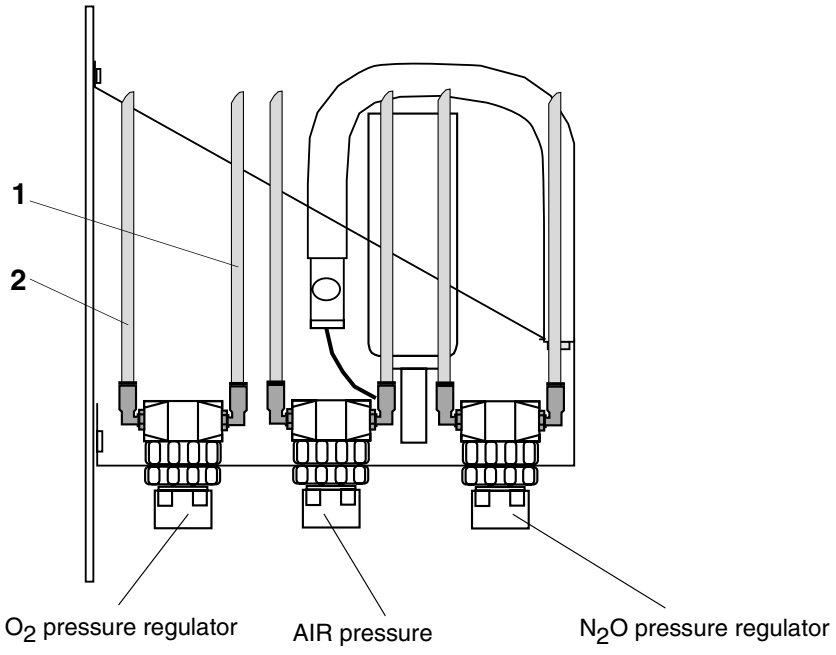

Fig. 69: Marking pressure regulator hoses

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- Remove hoses **1** of respective pressure regulator (O_2/AIR/N_2O) by pushing in retaining rings **2** and pulling out hoses simultaneously.
- Remove fixing screw **3** and remove pressure regulator.

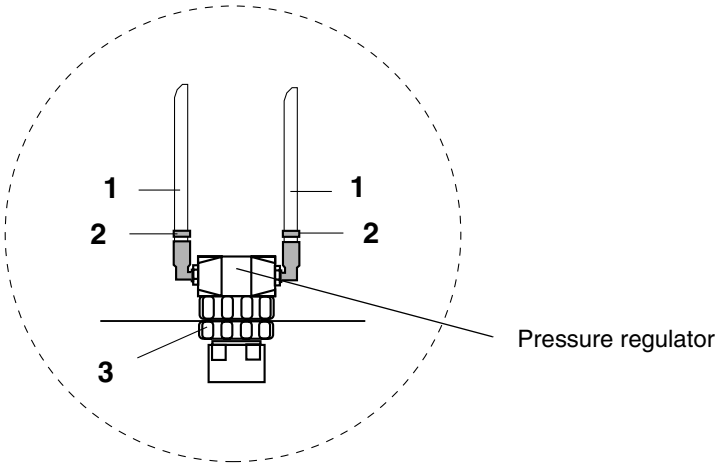

Fig. 70: Disconnecting hoses from pressure regulator

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Before installing the “Pressure Regulator” spare parts set, the pressure regulator must be closed (depressurized) as follows:

- Unlock adjusting ring **1** (pull in direction of **A**).
- Turn adjusting ring **1** counterclockwise in direction of **B** as far as it will go.
- Remove nut **2**.
- Mount new “Pressure Regulator” spare parts set (sealing ring, diaphragm, and locking bolt) to dismounted pressure regulator.
- Mount pressure regulator.

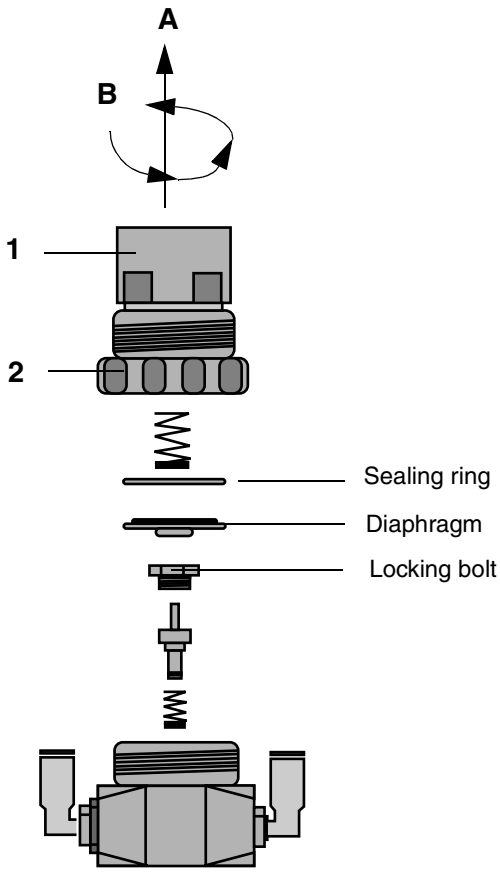

Fig. 71: Pressure regulator components

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- Secure respective pressure regulator to gas box using locknut **1**.

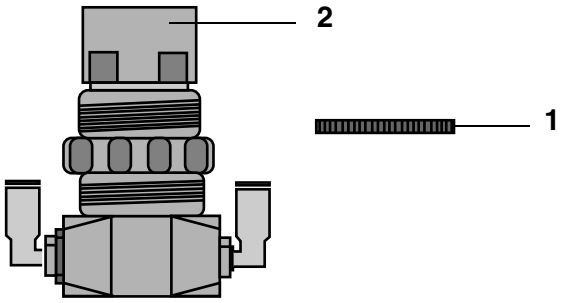

Fig. 72: Adjusting/securing pressure regulator

15.4.3 Adjusting the Pressure Regulator

- Use a T-piece to connect a separate pressure gauge (range: 0 to 6 bar) to outlet of pressure regulator to be adjusted.
- Reconnect hoses (according to previously applied markings).
- Adjust a flow of 1 L/min and set O_2 pressure regulator to 3.0 bar ±0.2 bar using adjusting ring **2** (see Figure "Adjusting/securing pressure regulator"). (Pressure regulator can be opened by turning adjusting ring clockwise).
- Adjust a flow of 1 L/min and set N_2O pressure regulator to 2.0 bar ±0.2 bar using adjusting ring **2** (see Figure "Adjusting/securing pressure regulator"). (Pressure regulator can be opened by turning adjusting ring clockwise).
- Adjust a flow of 1 L/min and set AIR pressure regulator to 1.5 bar ±0.2 bar using adjusting ring **2** (see Figure "Adjusting/securing pressure regulator"). (Pressure regulator can be opened by turning adjusting ring clockwise).
- Push adjusting ring **2** downward in order to fix set value.
- Remove T-piece and separate pressure gauge from gas box.
- Check that hose system is free of leaks (for example by using leak detector spray).
- Reassemble Fabius using the reverse method of that used for disassembly.
- Check pressure regulator function according to Test Certificate.

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16 Cosy Compact Breathing System Components

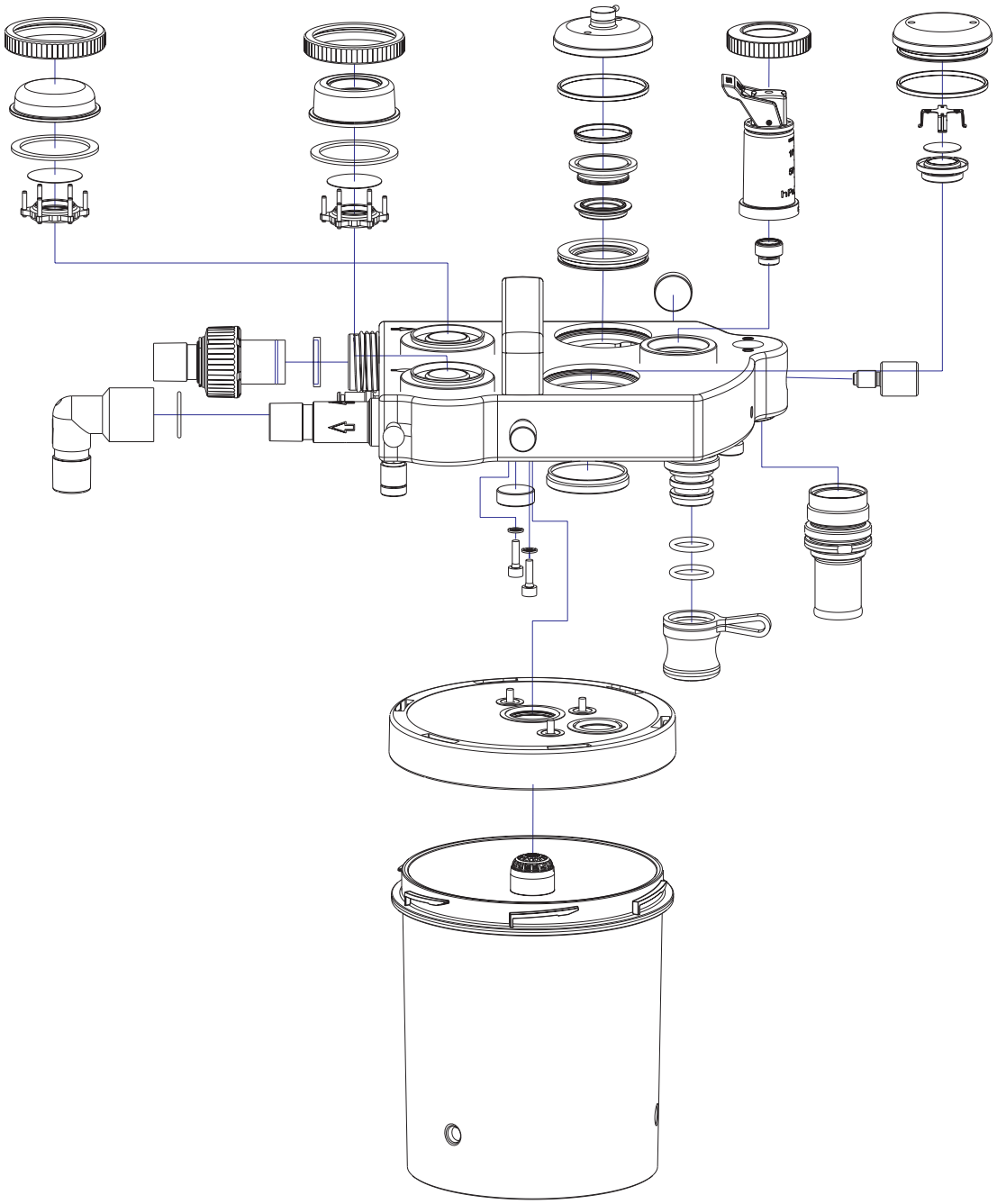

Fig. 73: Exploded view of the compact breathing system "Cosy"

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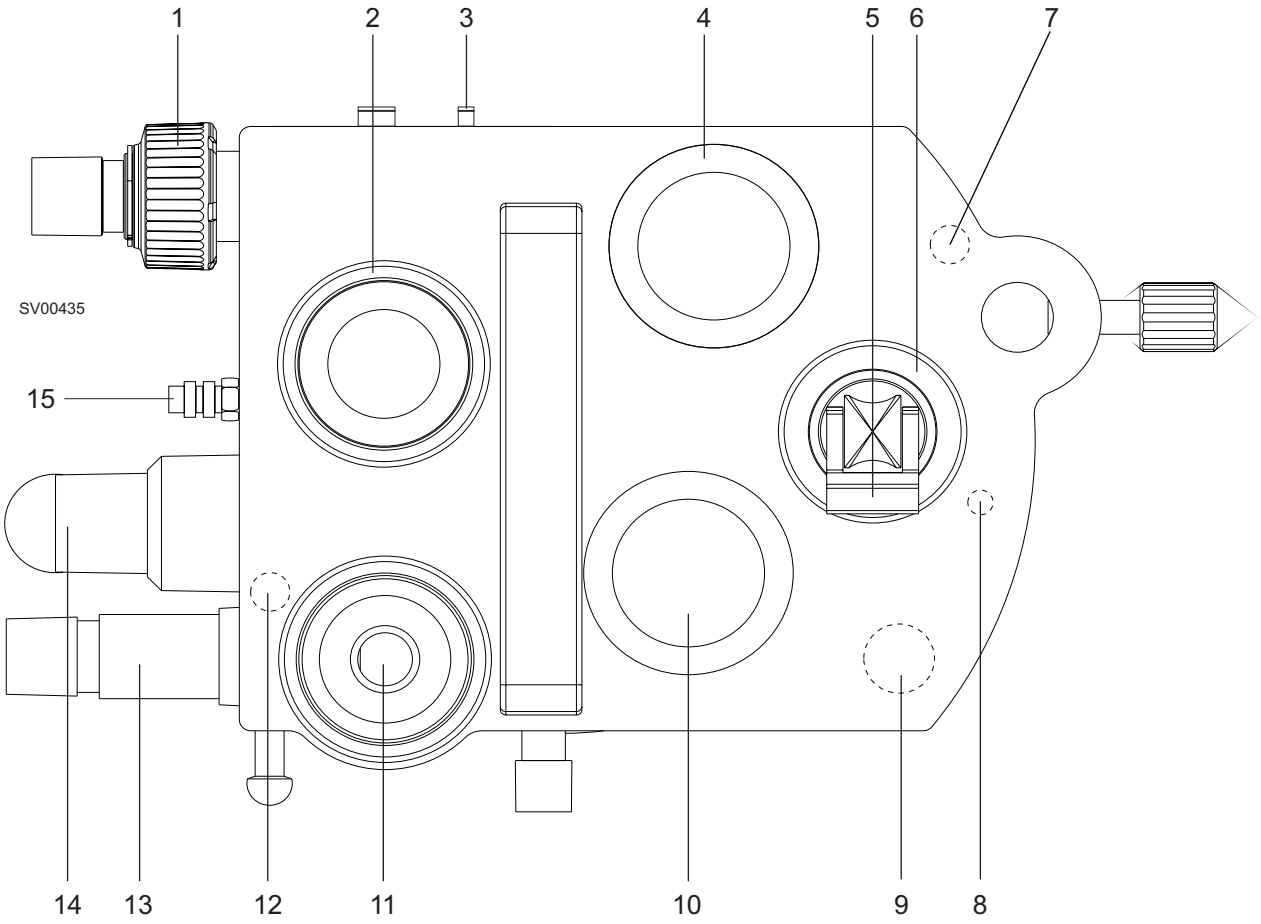

Fig. 74: Ghost view of the compact breathing system "Cosy"

Key

1	Expiratory port	8	Fresh-gas port
2	Expiratory valve	9	Ventilator port
3	Flow sensor	10	Fresh-gas decoupling valve
4	PEEP valve	11	Inspiratory valve
5	MAN/SPONT-IPPV selector	12	Pressure measuring port
6	APL valve	13	Inspiratory port
7	Anesthetic gas scavenging port	14	Breathing bag terminal
		15	Sample-gas return line port

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16.1 Fresh-Gas Decoupling Valve

In case of repair, replace the valve disc, the valve seat, or the sealing rings. Carefully glue valve seat into place using silicone glue.

16.1.1 Fresh-Gas Decoupling Valve Components

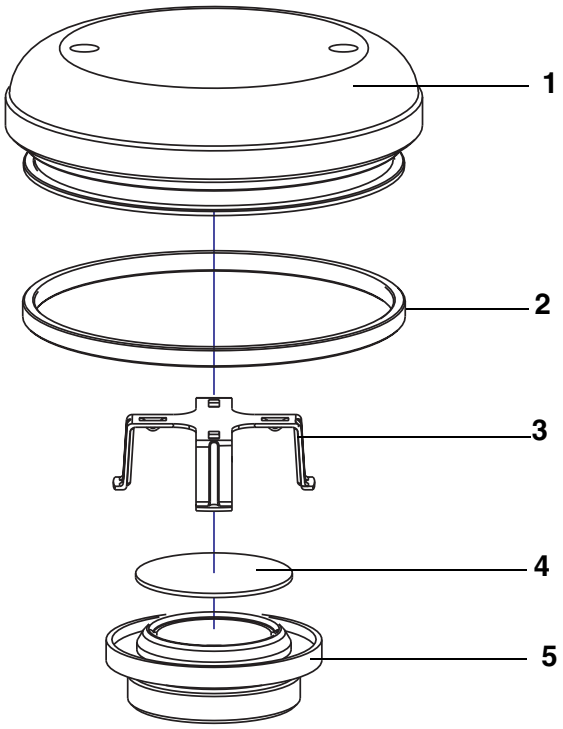

Fig. 75: Fresh-gas decoupling valve components

Key

1	Screw plug
2	O-ring seal
3	Spring cross
4	Valve disc
5	Valve seat

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16.2 Inspiratory Valve

In case of repair, replace the gasket, the valve disc, and the valve seat, or the complete inspiratory valve. Carefully glue valve seat into place using silicone glue.

16.2.1 Inspiratory Valve Components

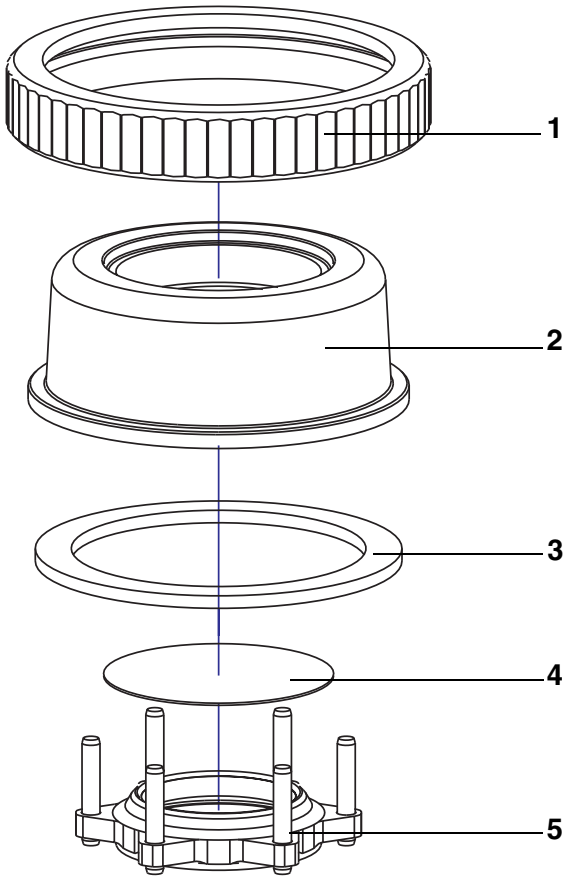

Fig. 76: Inspiratory valve components

Key

1	Ring nut
2	Cap
3	Gasket
4	Valve disc
5	Valve seat

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16.3 Expiratory Valve

In case of repair, replace the gasket, the valve disc, the valve seat, or the complete expiratory valve. Carefully glue valve seat into place using silicone glue.

16.3.1 Expiratory Valve Components

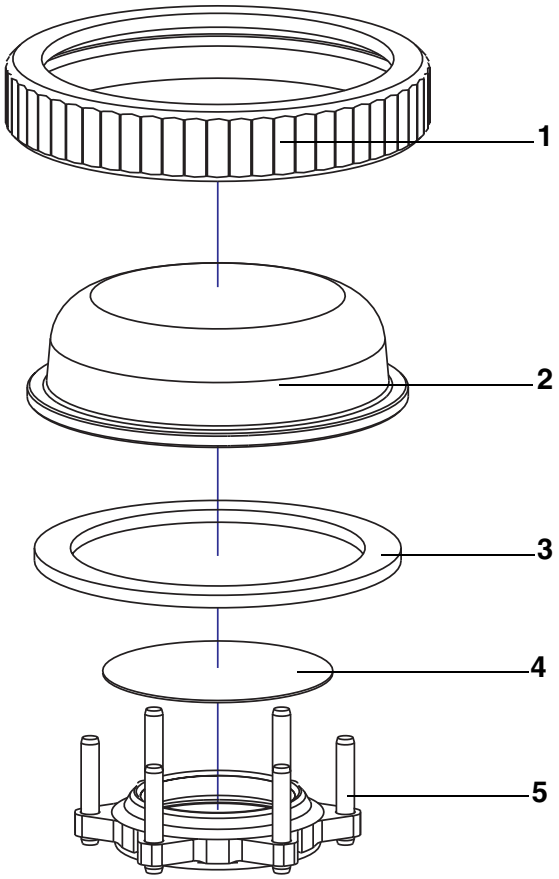

Fig. 77: Expiratory valve components

Key

1	Ring nut
2	Inspection cap
3	Gasket
4	Valve disk
5	Valve crater

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16.4 PEEP Valve

In case of repair, replace the O-ring, the socket, the diaphragm, the valve seat, the sealing ring, or the complete PEEP valve. Carefully glue valve seat into place using silicone glue.

16.4.1 PEEP Valve Components

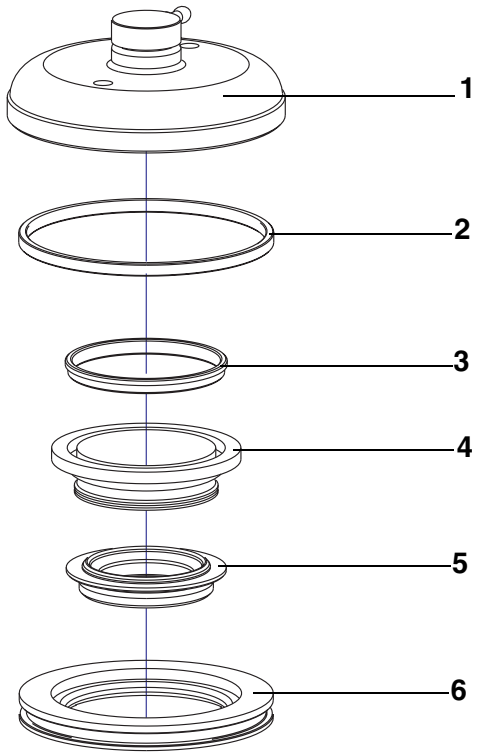

Fig. 78: PEEP valve components

Key

1	Screw plug with nozzle
2	O-ring
3	Socket
4	Diaphragm
5	Valve seat
6	Sealing ring

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16.5 APL Valve

In case of repair, replace the complete APL valve.

16.5.1 APL Valve Components

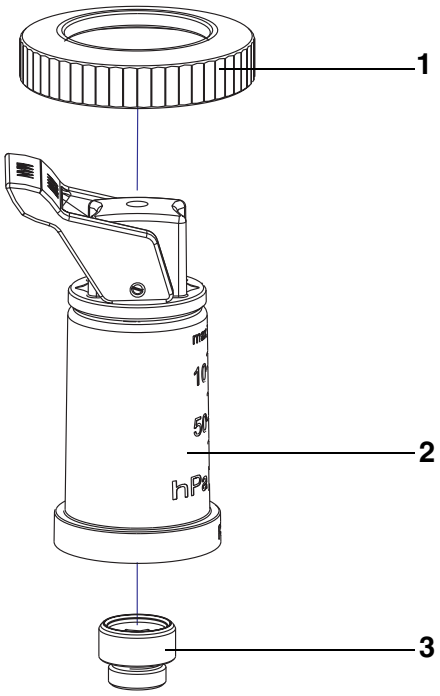

Fig. 79: APL valve components

Key

1	APL valve ring nut
2	Cosy APL valve
3	Crater screw

16.5.2 Replacing the APL Valve

- Remove the APL valve ring nut from the old APL valve.
- Mount the APL valve ring nut to the new APL valve.
- Mount the new APL valve to the Cosy compact breathing system mount.
- Perform a function check on Fabius.

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16.6 Cosy Absorber

In case of repair, replace individual absorber components or the complete absorber.

16.6.1 Cosy Absorber Components

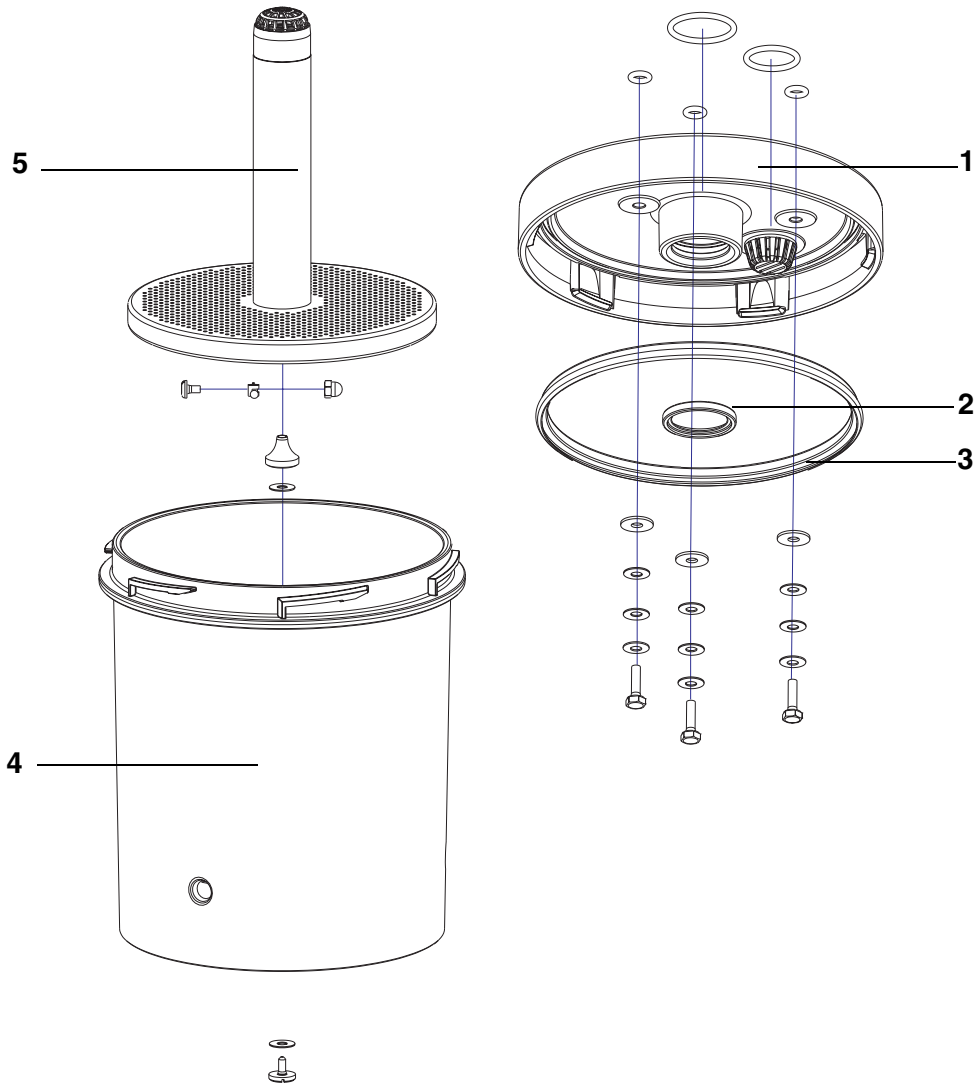

Fig. 80: Exploded view of the Cosy absorber

Key

1	Absorber cover	4	Absorber canister
2	O-ring	5	Absorber insert
3	Lip seal		

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17 Circle Absorption System Components

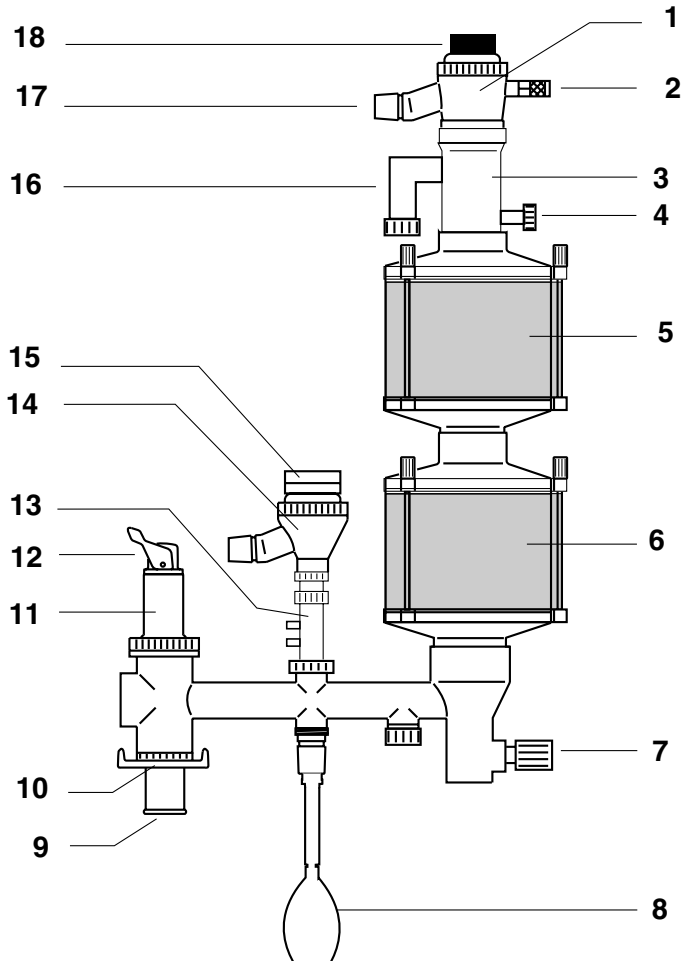

Fig. 81: Circle absorption system components

Key

1	Inspiratory valve	**10**	Check valve
2	Pressure measuring port	**11**	APL valve
3	Fresh-gas decoupling valve	**12**	MAN/SPONT-IPPV selector
4	Fresh-gas port	**13**	Flow sensor
5	Absorber no. 1	**14**	Expiratory valve
6	Absorber no. 2 (optional)	**15**	PEEP valve
7	Clamping screw	**16**	Ventilator port
8	Breathing bag	**17**	Inspiratory port
9	Anesthetic gas scavenging port	**18**	O_2 sensor

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17.1 Fresh-Gas Decoupling Valve

In case of repair, replace (as applicable) the valve disc, the screen element, the valve seat, the sealing rings, or the complete fresh-gas decoupling valve.

17.1.1 Fresh-Gas Decoupling Valve Components

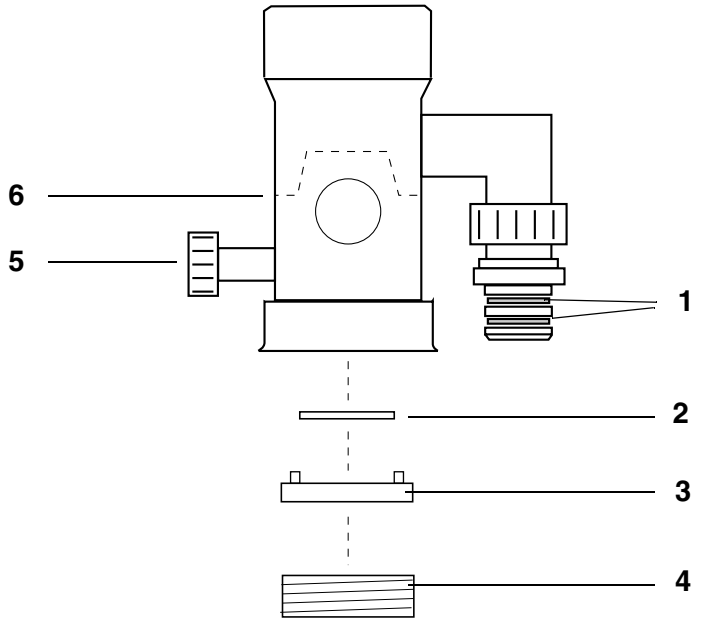

Fig. 82: Fresh-gas decoupling valve components

Key

1	Sealing rings
2	Valve disc
3	Valve seat
4	Threaded ring
5	Fresh-gas port
6	Spring cross

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17.2 Inspiratory Valve

In case of repair, replace (as applicable) the sealing rings, the valve disc, the valve seat, the screen element, the clamp ring, or the complete inspiratory valve assembly.

17.2.1 Inspiratory Valve Components

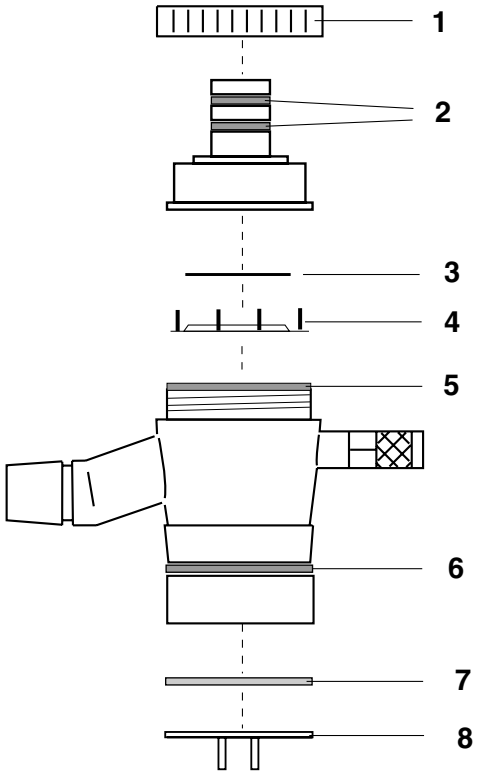

Fig. 83: Inspiratory valve components

Key

1	Ring nut
2	Sealing rings
3	Valve disc
4	Valve seat
5	Sealing ring
6	Sealing ring
7	Screen element
8	Clamp ring

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17.3 Expiratory Valve

In case of repair, replace (as applicable) the sealing ring, the valve disc, the valve seat, the spring ring, or the complete expiratory valve.

17.3.1 Expiratory Valve Components

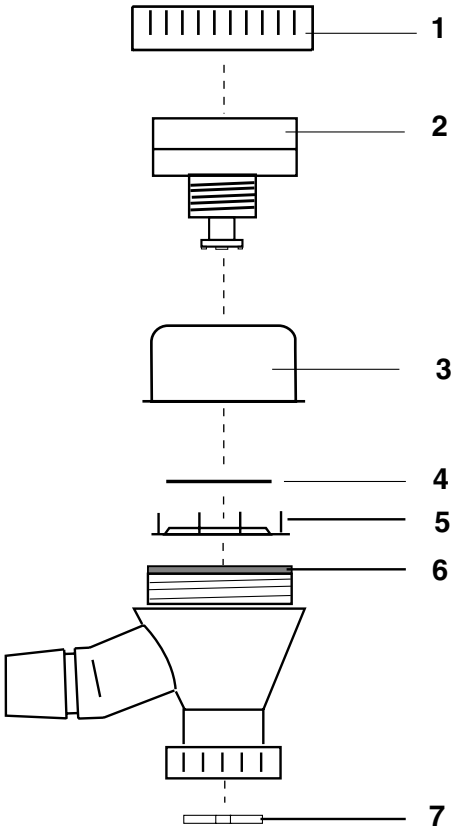

Fig. 84: Expiratory valve components

Key

1	Ring nut
2	PEEP valve
3	Upper part of the expiratory valve
4	Valve disc
5	Valve seat
6	Sealing ring
7	Spring ring

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17.4 PEEP Valve

In case of repair, replace (as applicable) the diaphragm, the spacer, the top part of the PEEP valve, or the complete PEEP valve.

17.4.1 PEEP Valve Components

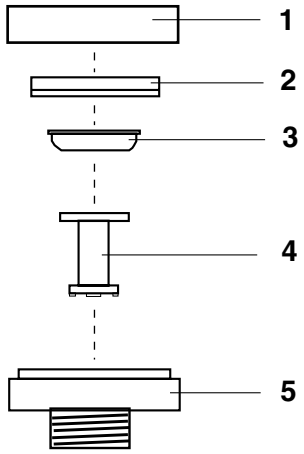

Fig. 85: Components of the PEEP valve

Key

1	Top part of the PEEP valve
2	Spacer
3	Diaphragm
4	Diaphragm plate
5	Lower part of the PEEP valve

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17.5 Absorber

In case of repair, replace (as applicable) the screen diaphragm, the sealing ring, the plexiglass cover, or the complete absorber.

17.5.1 Absorber Components

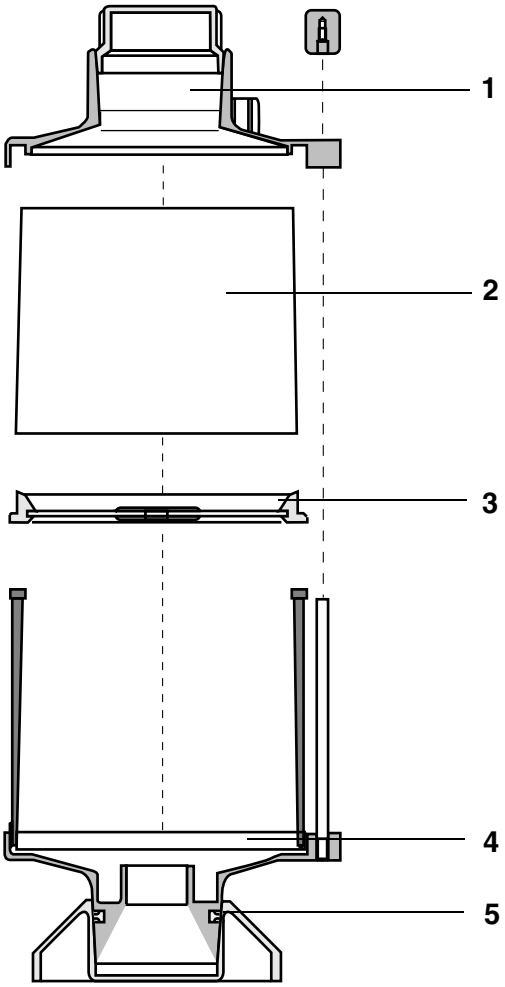

Fig. 86: Sectional view of the absorber

Key

1	Upper part of the absorber	**4**	Lower part of the absorber
2	Plexiglass cover	**5**	Sealing ring
3	Screen diaphragm		

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17.6 APL Valve

In case of repair, replace the complete APL valve.

17.6.1 Replacing the APL Valve

- Remove the APL valve ring nut from the old APL valve.
- Mount the APL valve ring nut to the new APL valve.
- Mount the new APL valve to the Cosy compact breathing system mount.
- Perform a function check on Fabius.

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18 General Information About the Flowmeter Block

The flowmeter block is available in several versions. Depending on the drive gases used, it comes with four flowmeter tubes (2 x N_20, 2 x O_2) or five flowmeter tubes (2 x N_2O, 2 x O_2, and 1 x AIR).

In case of repair, replace (as applicable) the shield, the flow control valves, the pressure gauges, the rotary knobs, the rotary knob caps, the flowmeter tubes, or the complete flowmeter block.

18.1 Flowmeter Block Components

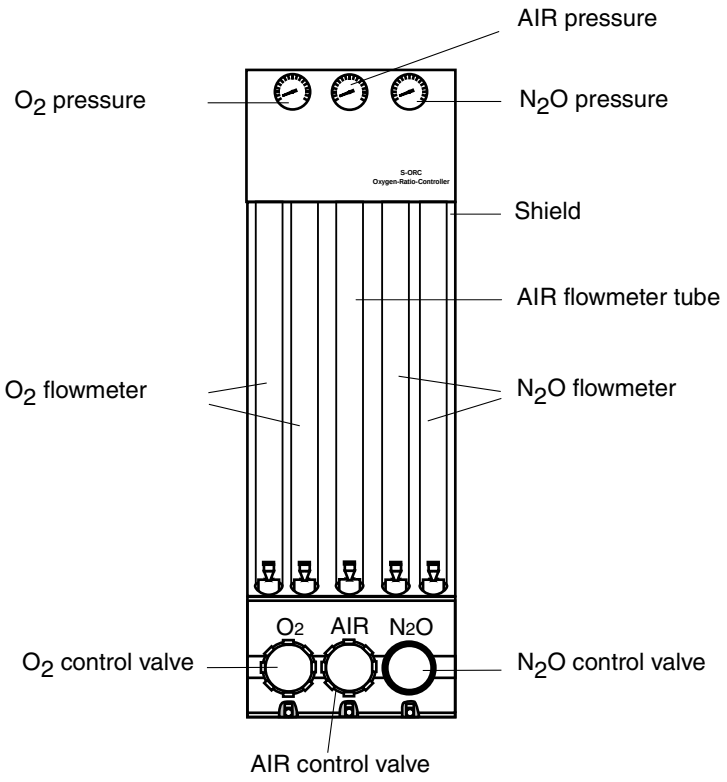

Fig. 87: Flowmeter block (3-gas version)

18.1.1 Testing the Flowmeter Block

- Check the flowmeter block using a separate flowmeter.

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18.1.2 Dismounting/Replacing the Flowmeter Block

- Switch control box off using ON/OFF switch (ON/OFF switch is located on rear panel of control box).
- Unplug power plug from AC outlet.
- Disconnect device from gas supplies.
- Remove fixing screws **1** from flowmeter block **2**.
- Pull flowmeter block slightly out making sure that shield **3** of flowmeter block **2** does not fall down.
- Slide shield **3** out of the flowmeter block **2**.
- Place shield **3** shield aside.

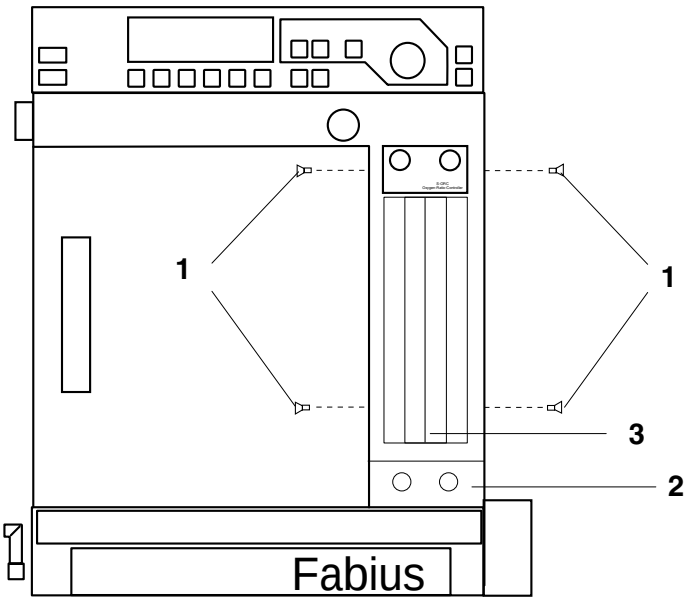

Fig. 88: Removing the flowmeter block

- Pull flowmeter block slightly out.

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- Before disconnecting hoses from rear panel of flowmeter block, mark them for later reassembly.
- Push in respective retaining ring **1** at hose connections **2** and, at the same time, pull out respective hose.
- Remove flowmeter block.

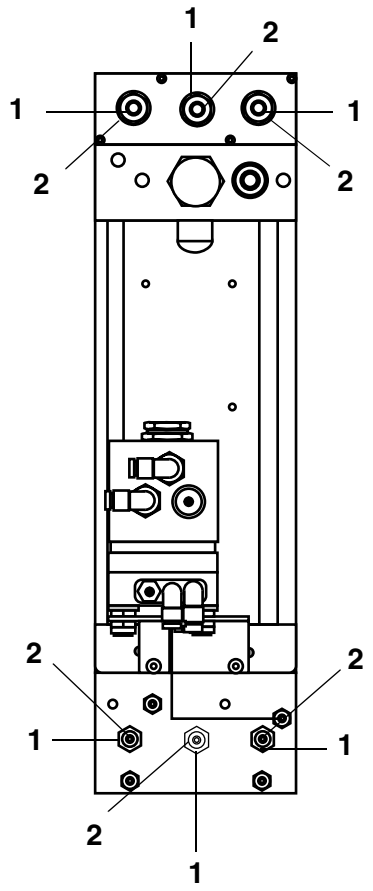

Fig. 89: Rear view of the flowmeter block (3-gas version), disconnecting hoses

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- Before disconnecting hoses **1**, mark them for later reassembly.

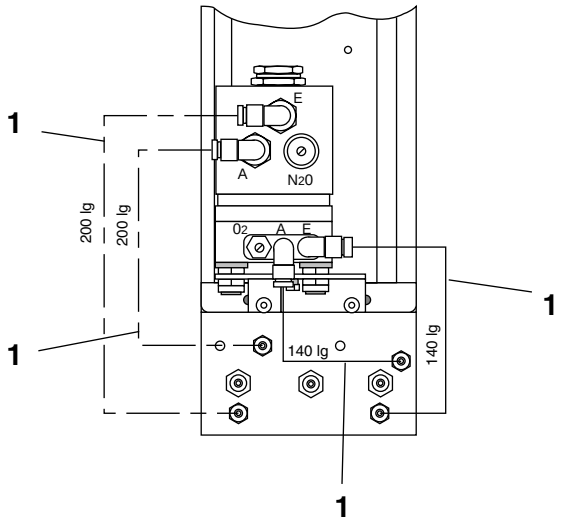

Fig. 90: Rear view of the S-ORC, marking hoses

- Push in respective retaining ring **2** at hose connections and, at the same time, pull out marked hoses.

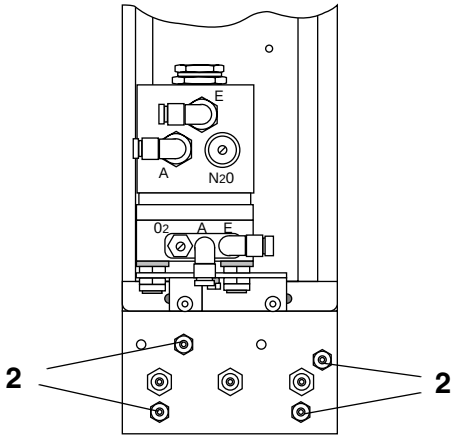

Fig. 91: Rear view of the S-ORC, removing hoses

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- Remove fixing screws **1** of S-ORC and mount S-ORC to new flowmeter block.

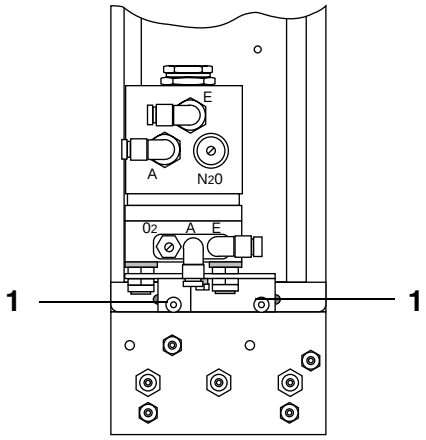

Fig. 92: S-ORC, removing the fixing screws

- Connect marked hoses to S-ORC by pushing them firmly into hose connections.
- Connect marked hoses of Fabius to new flowmeter block by pushing them firmly into hose connections.
- Check that hoses are properly connected by pulling them without using too much force.
- Mount shield to new flowmeter block.
- Mount new flowmeter block to Fabius.
- Check hose connections of flowmeter block and of S-ORC for leaks.
- Check function of flowmeter block using the Test Certificate.

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19 General Information About the S-ORC

The S-ORC is mounted to the flowmeter block. In case of repair, adjust it or, if it cannot be adjusted, replace the complete S-ORC.

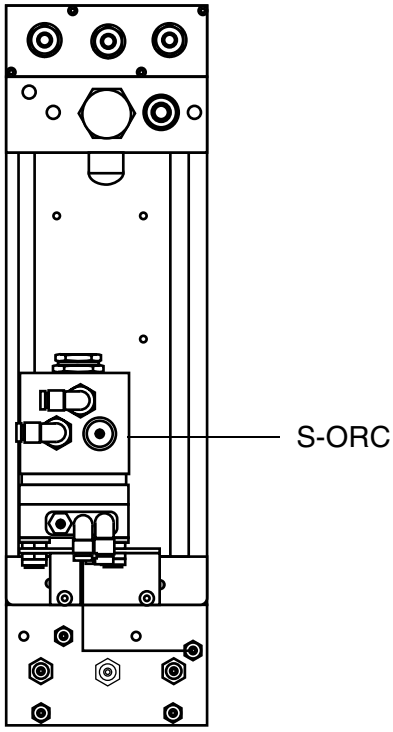

Fig. 93: Rear view of flowmeter block, showing location of the S-ORC

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19.1 Deleted H-ORC China Version. For information refer to Fabius 2600 series Service Manual P/N 4116028

Fig. 94: deleted

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Fig. 96: deleted

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Fig. 99: deleted

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19.2 Testing the S-ORC

19.2.1 Mechanical Pre-Adjustment

- Adjust adjusting screw **1** for O_2 such that it protrudes about 1 mm from valve element **2**.

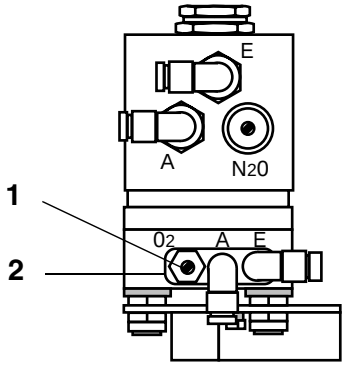

Fig.100: S-ORC, adjusting the O_2 flow

- Adjust adjusting screw **3** for N_2O such that it protrudes about 1 mm from valve element **4**.

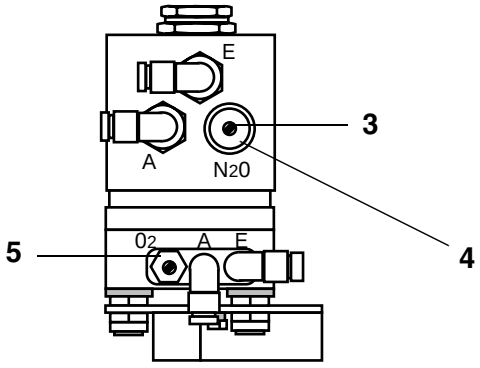

Fig.101: S-ORC, adjusting the N_2O flow

- Adjust distance between upper edge of valve elements **4** and **5** (see Figure above) and housing to approximately 10 mm.

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19.2.2 High-Pressure Adjustment

- Use a test pressure regulator to adjust a high pressure of 5 ±0.1 bar at a flow of 3 ±1 L/min.
- Use the O_2 pressure regulator to adjust a high pressure of 3 ±0.1 bar at a flow of 3 ±1 L/min.
- Use the N_2O pressure regulator to adjust a high pressure of 2 ±0.1 bar at a flow of 3 ±1 L/min.

19.2.3 Leak Tests

Carry out leak tests with the S-ORC fitted.

Diaphragm Compartments to Atmosphere

- Close all flowmeter block control valves.
- Disconnect fresh-gas hose from fresh-gas outlet.
- Remove anesthetic vaporizer.
- Connect a pressure gauge (measuring range greater than 1 bar) to fresh-gas hose.
- Build up a pressure of approximately 0.5 bar by opening O_2 flow control valve or AIR flow control valve.

Flowmeter block safety valve should not open yet. No gas should escape from the S-ORC and/or S-ORC vent hole.

Valve Seat

No N_2O should escape when O_2 flow control valve is closed and N_2O flow control valve is fully open.

19.2.4 Adjusting the S-ORC

- If S-ORC is outside tolerance of operating point, concentration values, or flow specified in the Test Certificate, check/adjust S-ORC as described below.

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19.2.5 Checking/Adjusting the O_2 Control Pressure

- Connect a pressure gauge (measuring range 100 mbar) to O_2 side inlet port **1** using a T-piece.
- Adjust O_2 flow control valve to 0.20 L/min.

The control pressure should be 25 mbar (±1 mbar).

- If the control pressure is not 25 mbar (±1 mbar) use adjusting screw **2** to adjust the control pressure on the O_2 side.

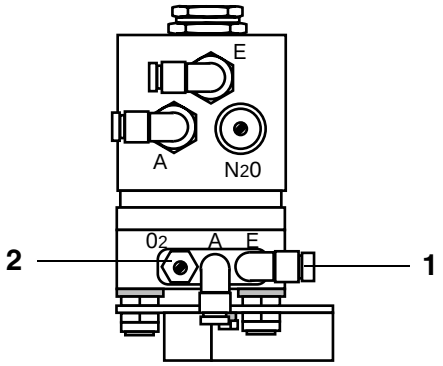

Fig.102: S-ORC, adjusting the O_2 control pressure

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19.2.6 Adjusting the Operating Point

- Fully open N_2O flow control valve on flowmeter block.
- Use O_2 flow control valve to adjust O_2 flow to 0.20 L/min.

The N_2O flow should be 0.05 L/min (±0.03 L/min).

- If N_2O flow is not 0.05 L/min (±0.03 L/min), proceed as follows:
- Loosen locknut **1**.
- Turn adjusting screw **2** counter-clockwise to decrease N_2O flow.
- Turn adjusting screw **2** clockwise to increase N_2O flow.

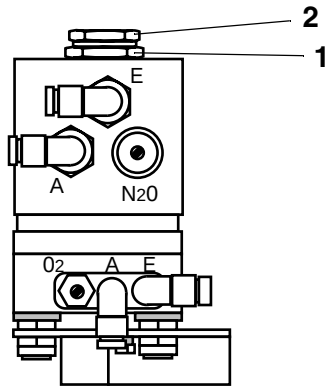

Fig.103: S-ORC, adjusting the operating point

- Secure locknut **1**.
- Re-check operating point.

N_2O flow should be 0.05 L/min (±0.03 L/min).

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19.2.7 Fine Adjusting O_2 Concentration (O_2/N_2O ratio)

Make sure O_2 sensor is functioning properly and has been calibrated. Check O_2 concentration using an O_2 analyzer (accuracy: 1 vol.% O_2).

- Fully open N_2O flow control valve on flowmeter block.
- Adjust O_2 flow control valve to 1 L/min.

N_2O flow should be 3 L/min (±0.3 L/min). O_2 concentration at fresh-gas outlet should be 25 vol.% O_2 (±3 vol.% O_2).

- If N_2O flow is not 3 L/min (±0.3 L/min) or if O_2 concentration at fresh-gas outlet is not 25 vol.% O_2 (±3 vol.% O_2), proceed as follows:
- Use adjusting screw **1** on N_2O side to adjust above mentioned values.

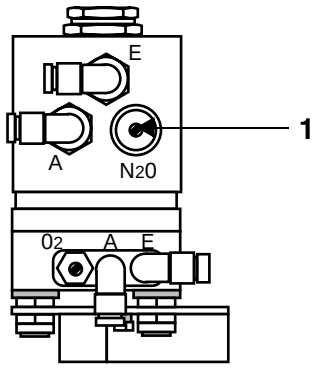

Fig.104: S-ORC, adjusting the N_2O flow

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19.2.8 Testing the O_2 Concentration (O_2/N_2O Ratio)

O_2 Concentration Test

- Make sure O_2 sensor is functioning properly and has been calibrated.
- After adjusting/readjusting S-ORC valve, check O_2 concentration using an O_2 analyzer (accuracy: 1 vol.% O_2).

O_2 Flow (L/min)		Concentration (vol.% O_2)
0.5 L/min ±0.05 L/min	Fully open N_2O flow control valve.	22 to 33
1.0 L/min ±0.1 L/min		22 to 28
3.0 L/min ±0.2 L/min		22 to 33

- If you do not need to adjust/readjust the previous S-ORC valve settings or if you have replaced the S-ORC, test according to Test Certificate using an O_2 analyzer (accuracy: 1 vol.% O_2).

19.2.9 Flow Test

- Fully open N_2O flow control valve.
- Slowly open O_2 flow control valve.

While the O_2 flow increases, the N_2O flow should increase to more than 9 L/min.

- Close O_2 flow control valve slowly and evenly.

The N_2O flow should decrease slowly and evenly.

- Test S-ORC using Test Certificate.

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19.3 Dismounting/Replacing the S-ORC

- Switch control box off using ON/OFF switch (ON/OFF switch is located on rear panel of control box).
- Unplug power plug from AC outlet.
- Disconnect device from gas supplies.
- Remove fixing screws **1** from flowmeter block **2**.
- Make sure shield **3** does not fall down, and pull flowmeter block **2** slightly out.

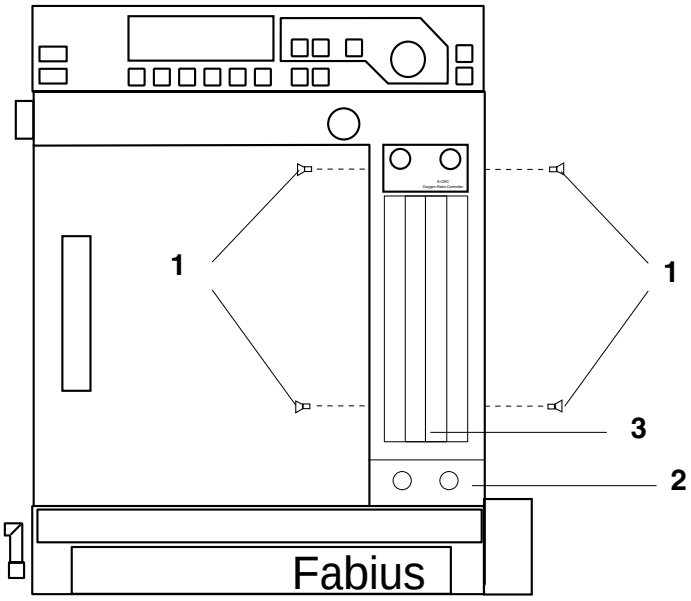

Fig.105: Removing the flowmeter block

- Slide shield **3** of flowmeter block **2** sideways and place it aside.

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- Before disconnecting hoses from rear panel of flowmeter block, mark them for later reassembly.
- Push in respective retaining ring **1** at hose connector **2** and, at the same time, disconnect respective hose from S-ORC.
- Remove flowmeter block.

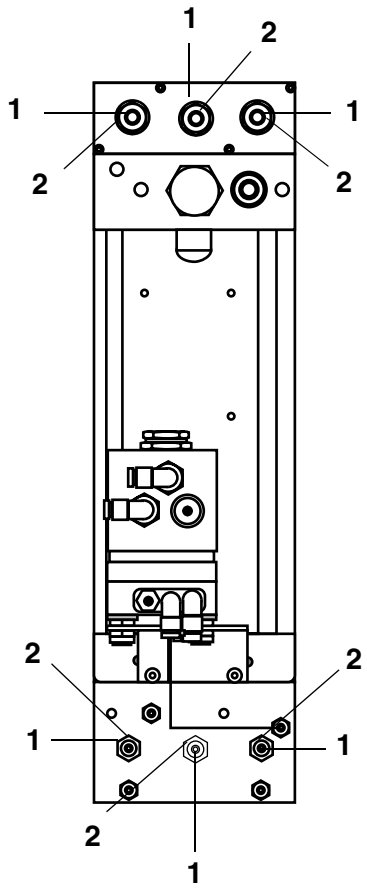

Fig.106: Rear view of the flowmeter block (3-gas version), disconnecting hoses

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- Disconnect hoses from hose connections **1** by pushing in the retaining rings and, at the same time, disconnecting the respective hose.
- Remove S-ORC fixing screws.
- Replace the S-ORC with a new one.
- Mount new S-ORC to flowmeter block.

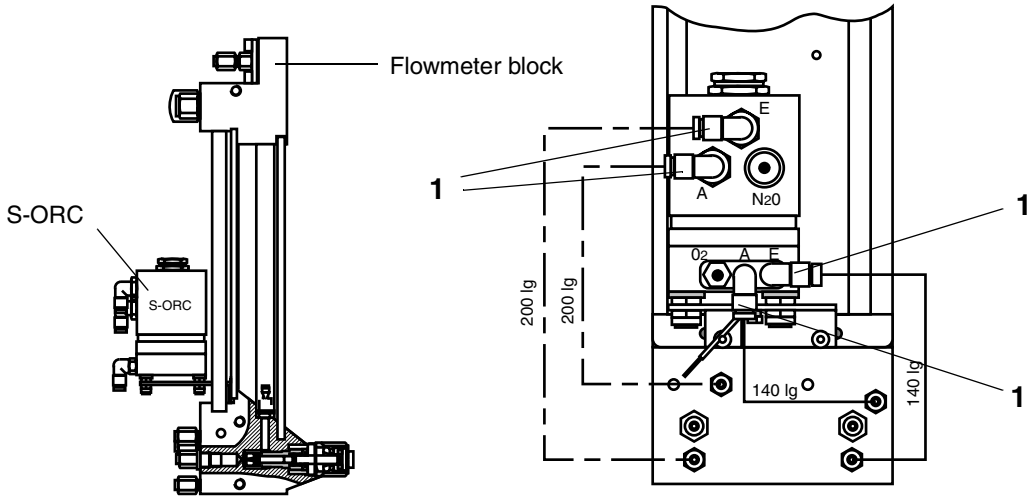

Fig.107: Side view of the flowmeter block (left)

- Connect previously marked hoses to S-ORC.
- Connect previously marked hoses to flowmeter block.
- Mount flowmeter block using the reverse method of that used for dismounting.
- Check S-ORC's function according to relevant Test Certificate.

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20 General Information About the Ventilator

In case of repair, replace (as applicable) the bag-type rolling seal, the rolling seal, or the complete motor.

20.1 Ventilator Components

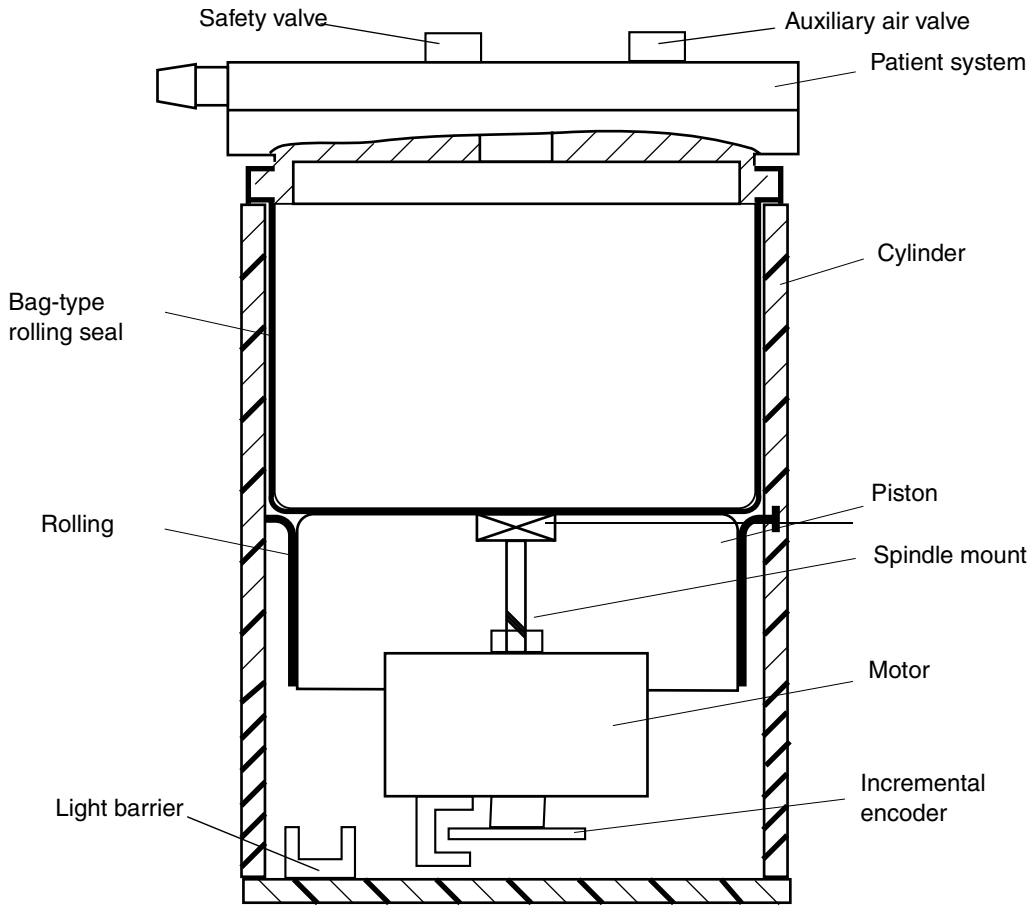

Fig.108: Sectional view of the ventilator

20.2 Checking the Ventilator

- Check ventilator in the debug mode (no ventilator error, VEN 0000) or according to Test Certificate.

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20.3 Dismounting the Ventilator from the Gas Box

- Switch control box off using ON/OFF switch (ON/OFF switch is located on rear panel of control box).
- Unplug power plug from AC outlet.
- Remove fastening screws **1** of cover **2** (secured to rear panel of Fabius) and place cover **2** aside.

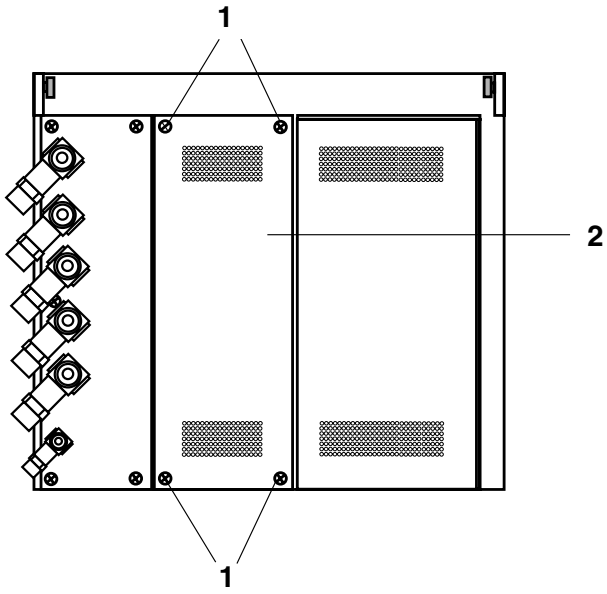

Fig.109: Rear view of Fabius, removing the fastening screws

Electrostatic discharge can damage electrostatic sensitive devices. Use a static-dissipative mat and a wrist strap when handling electrostatic sensitive devices.

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- Remove fastening screws **1** from pneumatics **2**.
- Loosen screw **3**.
- Lift up pneumatics **2**, pull it out carefully, turn it around, and slide it back into its compartment.

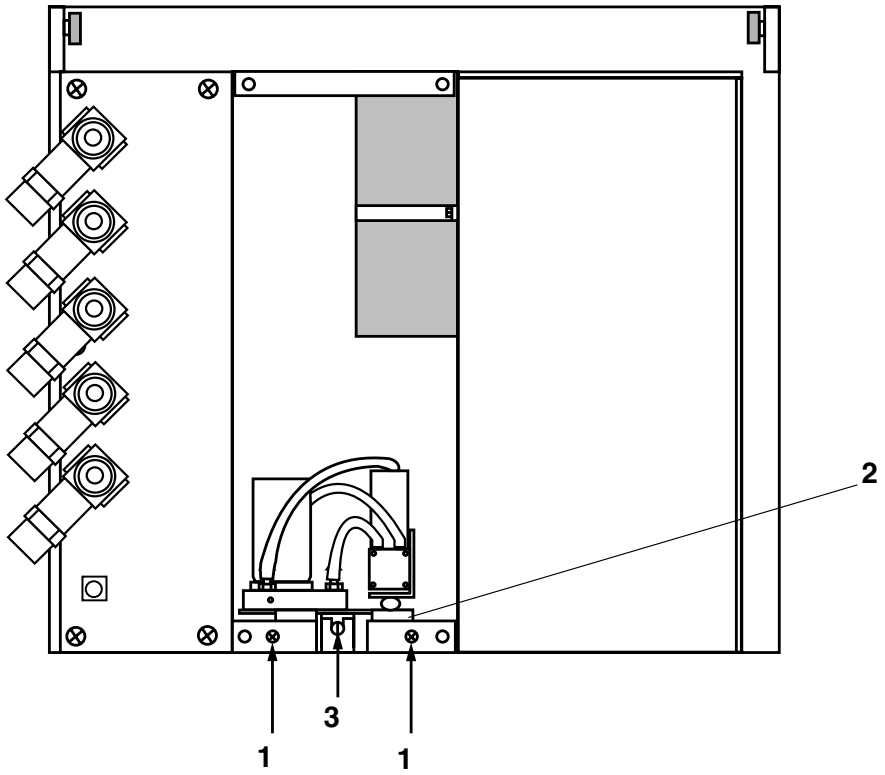

Fig.110: Rear view of Fabius, removing the pneumatics

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- Remove screw and washer **1** from the PEEP valve (see Figure below).
- Disconnect cable connectors **2** from Pneumatics Control PCB.
- Push disconnected cable connectors back into ventilator compartment.

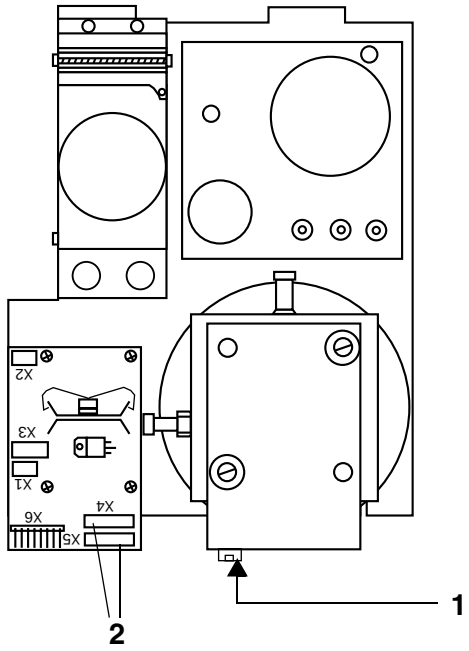

Fig.111: View of the pneumatics, removing the cable connectors

- Disconnect hose **3** (transparent) and hose **4** (blue) and push them back into the ventilator compartment.

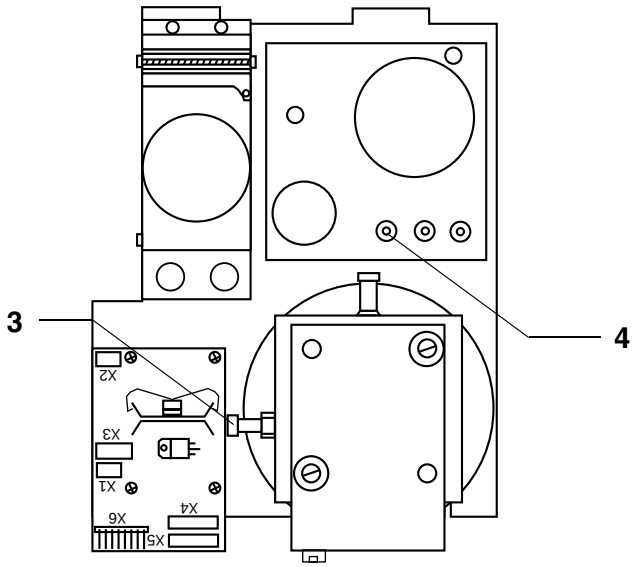

Fig.112: Top view of the pneumatics, disconnecting the hoses

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- Disconnect ventilator connector **1** from uninterruptible power supply.
- Push ventilator connector back into ventilator compartment.

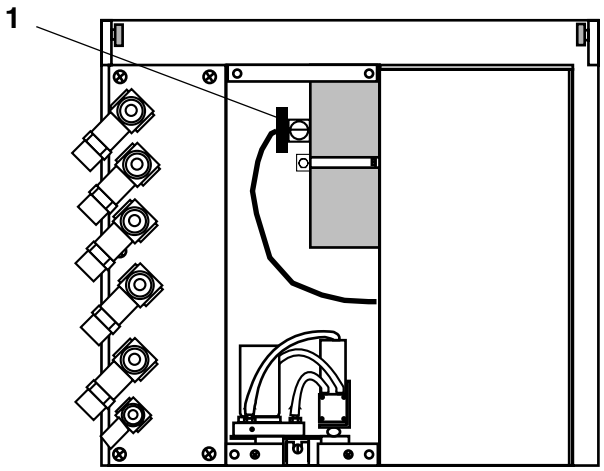

Fig.113: Rear view of Fabius, disconnecting the ventilator connector

- Hold patient system in place (to prevent ventilator from falling down) and remove fixing screw and washer **2**.

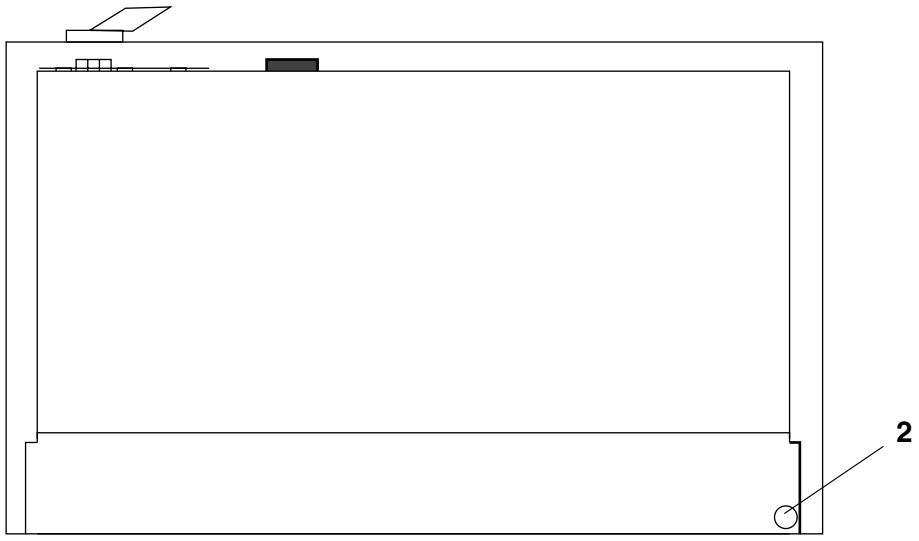

Fig.114: Top view of Fabius, removing fixing screw and washer

- Place ventilator on a stable surface.

20.4 Dismounting/Replacing the Motor

In case of failure, replace the complete ventilator with a new one.

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- Unplug power plug from AC outlet.
- Remove ventilator from trolley (see section "Dismounting the Ventilator from the Gas Box").
- Unlock patient system **1** by turning screws **2** one quarter of a full turn counterclockwise (90°) using a hexagon socket screw key.
- Remove patient system **1** and place it aside.

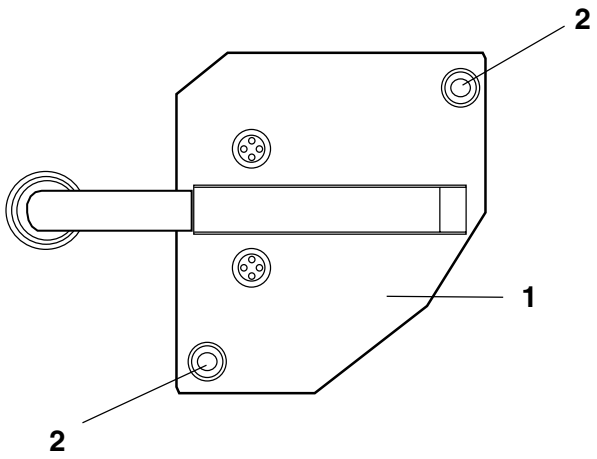

Fig.115: Top view of the patient system, removing the patient system

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- Remove bag-type rolling seal **1** by pulling it out of ventilator in direction of **A**.

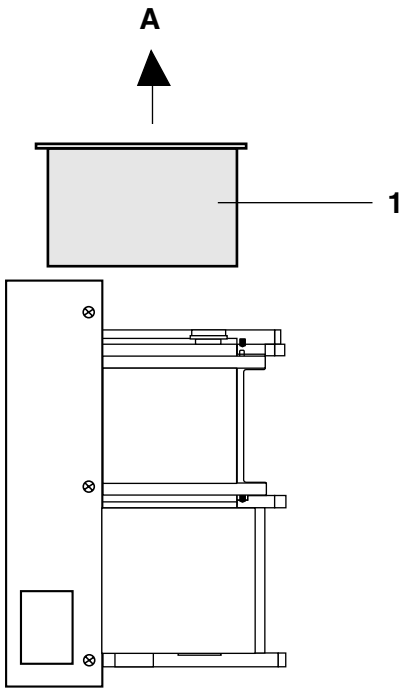

Fig.116: View of the dismounted ventilator, removing the bag-type rolling seal

- Disconnect hose from connection port **2**.
- Remove fixing screws and washers **3** from cover **4**.

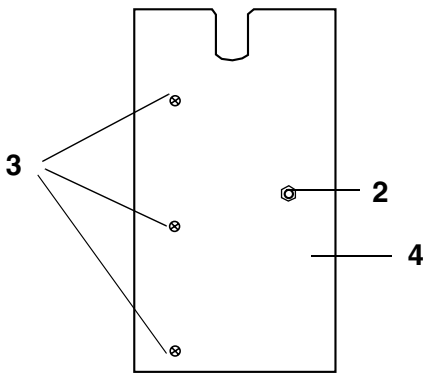

Fig.117: Side view of the ventilator, removing the fixing screws

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- Remove fixing screws **1** from cover of ventilator and remove hose from inside of cover.
- Place cover aside.

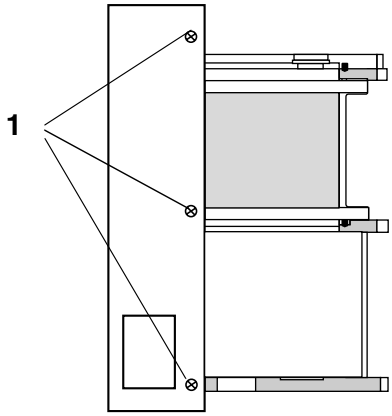

Fig.118: Side view of the ventilator, removing the fixing screws

- Remove fixing screws and washers **2** from cylinder **3**.
- Place cylinder **3** aside.

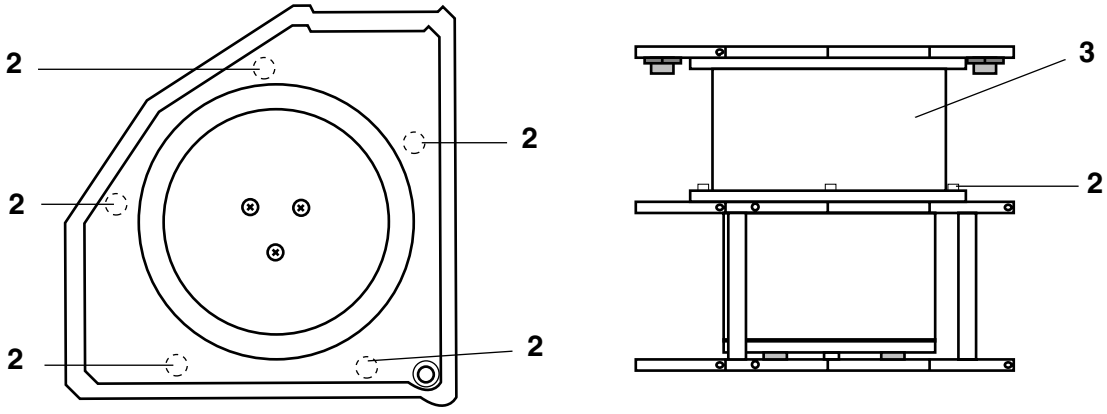

Fig.119: Top view of the ventilator, removing the fixing screws

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- Remove fixing screws **1** from piston and rolling seal **2**.

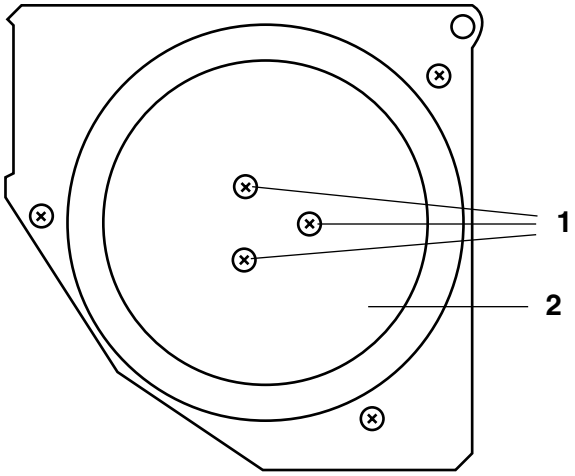

Fig.120: Top view of the ventilator, removing the fixing screws

- Remove piston and rolling seal and place them aside.
- Remove screws **3** from motor-cable strain relief **4**.
- Remove screws **5** from light barrier.
- Carefully cut off cable tie.

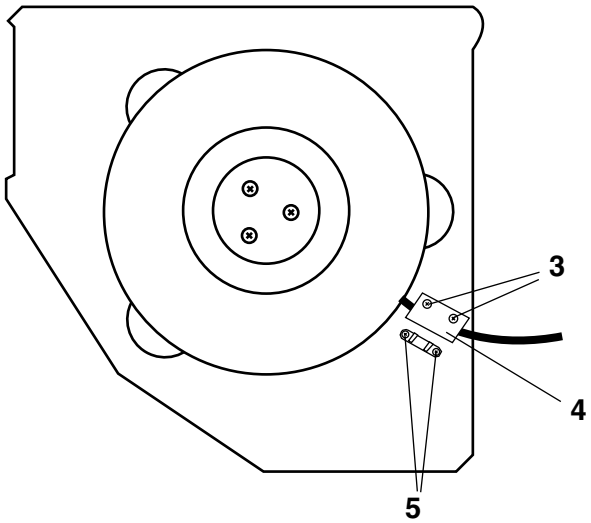

Fig.121: Top view of the motor, removing the strain relief

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- Turn motor upside down.
- Disconnect cable connector from motor.
- Remove screws **1** from motor.

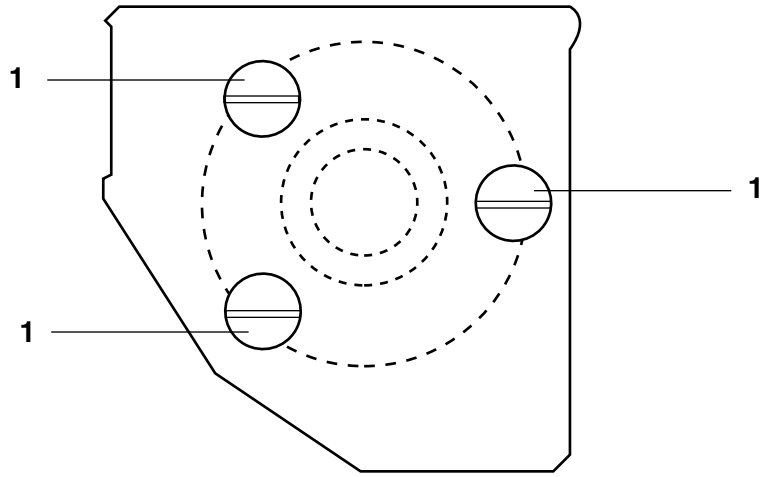

Fig.122: Bottom view of the motor, removing the fixing screws

- Replace the motor with a new one.
- Mount motor using the reverse method of that used for dismounting **making sure the cables are installed correctly**.
- Connect cable connector **2** to motor.

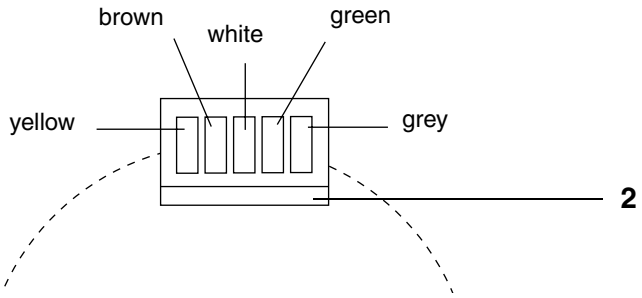

Fig.123: Top view of the ventilator, connecting the cable connector

- Mount ventilator to Fabius using the reverse method of that used for disassembly.
- Check motor's function according to Test Certificate.

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20.4.1 Dismounting/Replacing the Rolling Seal

- Unplug power plug from AC outlet.
- Unlock patient system **1** by turning screws **2** one quarter of a full turn counterclockwise (90°) using a hexagon socket screw key.
- Pull out patient system **1** and place it aside.

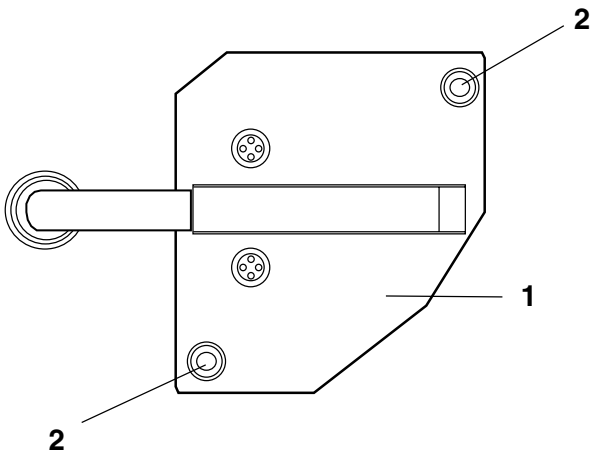

Fig.124: Top view of the patient system, removing the patient system

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- Remove bag-type rolling seal **1** by pulling it out of ventilator in direction of **A**.

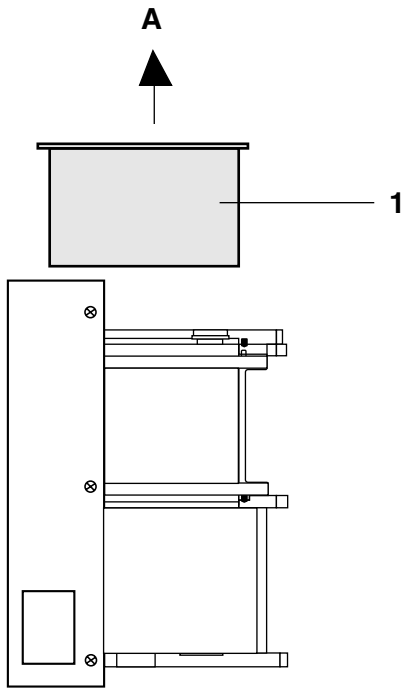

Fig.125: View of the dismounted ventilator, removing the bag-type rolling seal

- Disconnect hose from connection port **2**.
- Remove fixing screws **3** from cover.

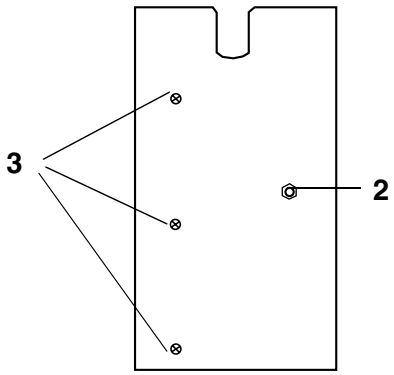

Fig.126: Side view of the ventilator, removing the fixing screws

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- Remove fixing screws **1** from cover of ventilator and remove hose from inside of the cover.
- Place cover aside.

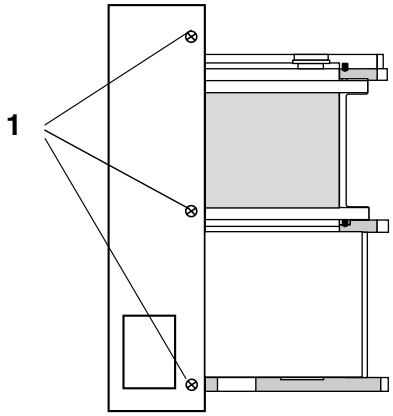

Fig.127: Side view of the ventilator, removing the fixing screws

- Remove fixing screws and washers **2** of cylinder **3**.
- Push cylinder **3** into ventilator compartment.

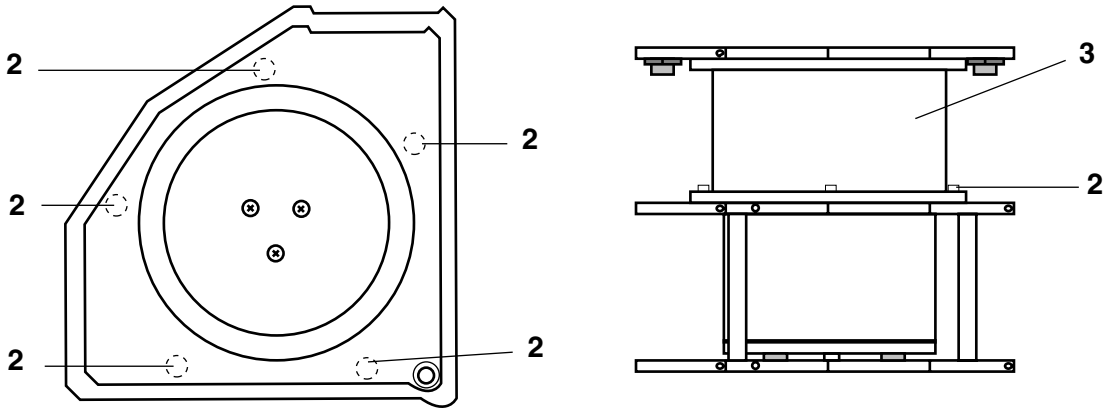

Fig.128: Top view of the ventilator, removing the fixing screws

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- Remove fixing screws **1** of piston and rolling seal **2**.

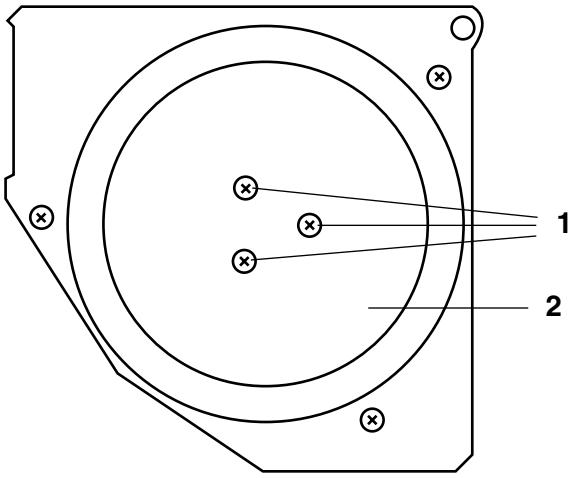

Fig.129: Top view of the ventilator, removing the fixing screws

- Remove piston and bag rolling seal and place them aside.
- Turn piston upside down.
- Remove rubber ring **3** from piston.
- Remove retaining ring **4** from groove of piston.

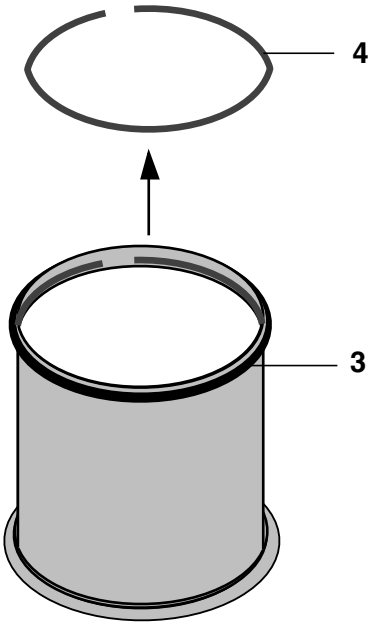

Fig.130: Removing the retaining ring

- Remove the bag-type rolling seal from piston.

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- If applicable, turn new bag-type rolling seal **1** inside out (**make sure small groove 2 points outwards**).
- Pull bag-type rolling seal **1** over cylinder down to cylinder bottom **3** (bag-type rolling seal should now protrude about 8 mm from rim of cylinder).

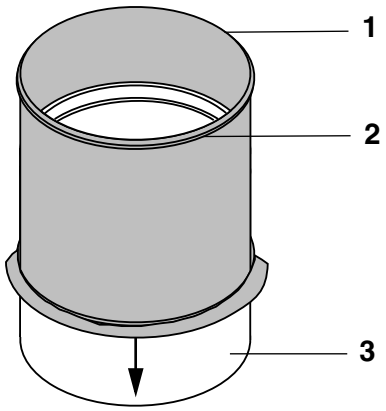

Fig.131: Pulling the bag-type rolling seal over the cylinder

- Fold protruding part of bag-type rolling seal **4** over rim of cylinder in direction of A and tuck bag-type rolling seal **4** into inner groove of cylinder in direction of **B** (**make sure bag-type rolling seal 4 is stretched tight over rim of cylinder**).

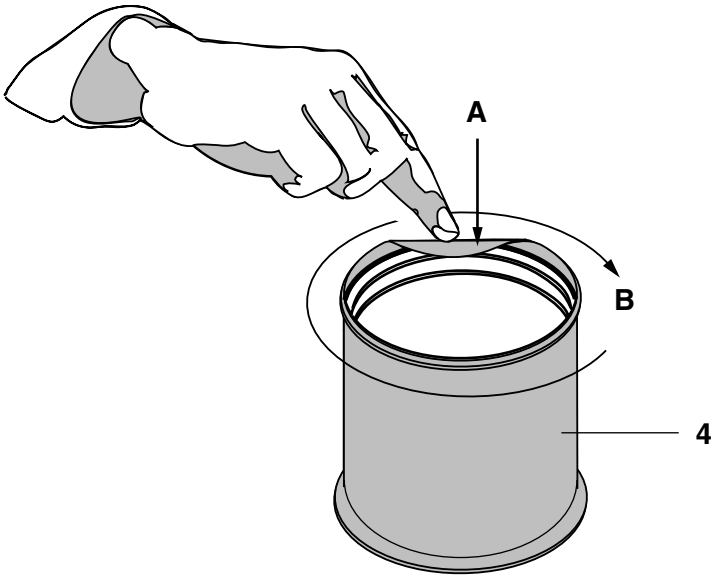

Fig.132: Tucking the bag-type rolling seal into the groove of the cylinder

- Secure tucked end of bag-type rolling seal using retaining ring **1** (**make sure retaining ring is properly inserted into groove of bag-type rolling seal**.)

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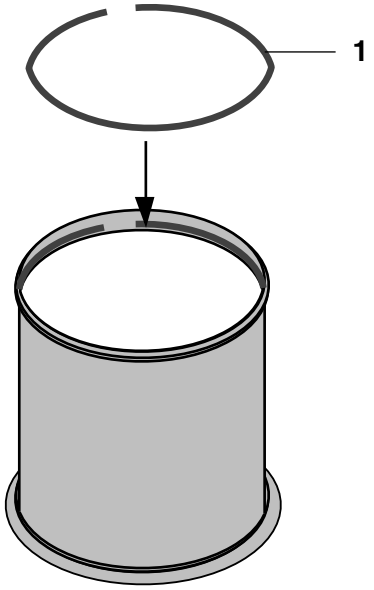

Fig.133: Inserting the retaining ring into the groove of the bag-type rolling seal

- Insert rubber ring **2** into outer groove of cylinder.

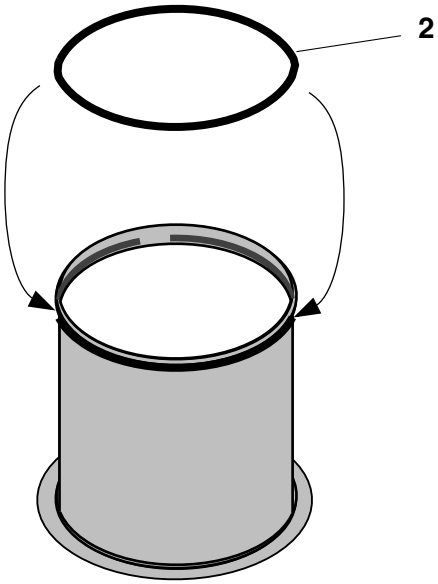

Fig.134: Inserting the rubber ring into the outer groove of the cylinder

- Turn spindle to lowest position.

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- Place piston **1** on the motor spindle plate and secure piston using screws **2**.

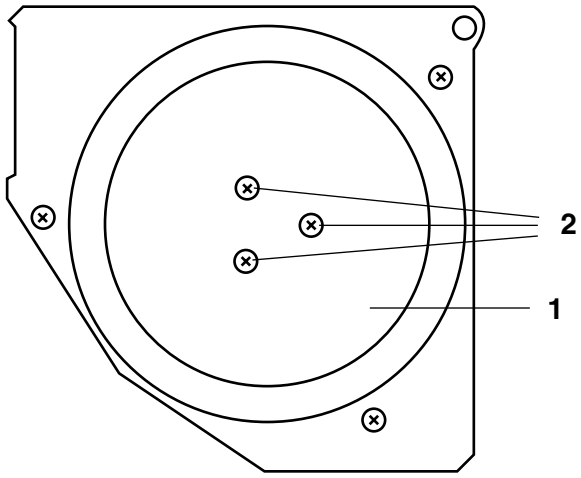

Fig.135: Top view of the motor, mounting the piston

- Work sealing section of rolling seal into its groove.
- Swivel cylinder out of ventilator compartment.
- Seal rolling seal by securing cylinder to bottom of cylinder housing (**do not twist rolling seal**).
- Secure cylinder to bottom of ventilator using fixing screws.
- Place bag-type rolling seal into cylinder.

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- Secure patient system **1** by tightening locking elements **2** of patient system (turn locking elements 90° clockwise).

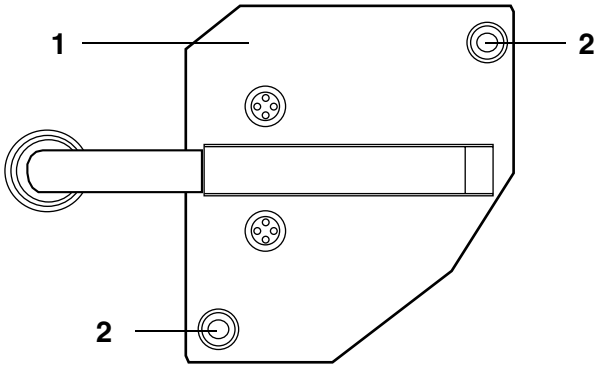

Fig.136: Top view of the patient system, securing the patient system

- Mount ventilator to Fabius using reverse method of that used for disassembly.
- Check ventilator function according to Test Certificate.

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21 General Information About the Uninterruptible Power Supply (Option)

The uninterruptible power supply (rechargeable batteries) must be replaced with a new one at 3-year intervals. In case of malfunction, the only replaceable single part is the fuse of the rechargeable batteries.

21.1 Dismounting/Replacing the Uninterruptible Power Supply

- Switch control box off using ON/OFF switch (ON/OFF switch is located on rear panel of control box).
- Unplug power plug from AC outlet.
- Remove fixing screws **1** from cover plate **2** (rear panel of Fabius) and place cover plate **2** aside.

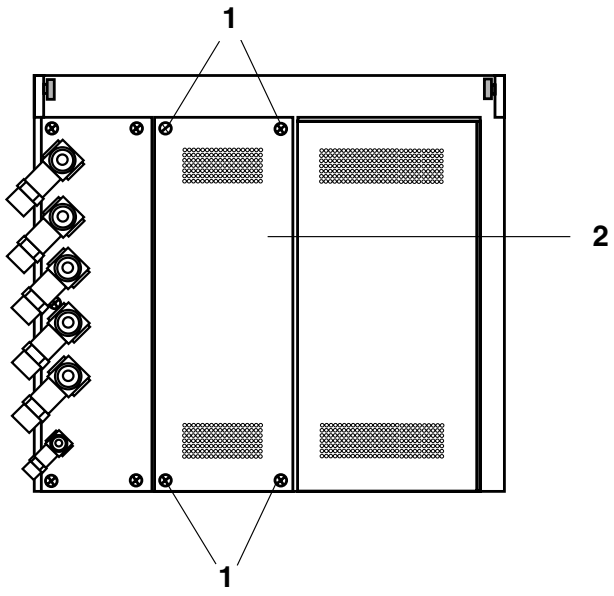

Fig.137: Rear view of Fabius, removing the uninterruptible power supply

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- Remove nuts and washers **1**.

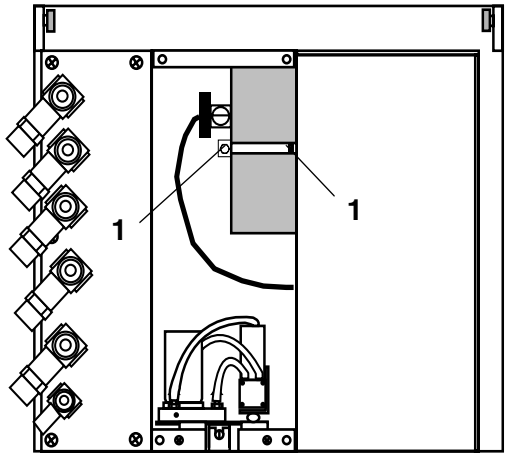

Fig.138: Rear view of Fabius, removing the rechargeable batteries

The uninterruptible power supply (UPS) of Fabius CE consists of a set of two rechargeable batteries. Rechargeable battery sets for Fabius CE are supplied by two different battery manufacturers (Sonnenschein and Panasonic) who use different "+" and "–" terminal assignments (see Figure 139). The terminal assignment of the respective rechargeable battery set brand must be observed when replacing a rechargeable battery set.

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WARNING:

Risk of personal injury.
No uninterruptible power supply in case of power failure if rechargeable batteries are not connected correctly. Make sure to connect rechargeable batteries correctly.

Rechargeable batteries from Sonnenschein and Panasonic have different contact assignments. Reversing the contacts may damage the device or blow the fuse (in the holder).

Strictly follow the contact assignments of the different rechargeable battery types when replacing rechargeable batteries (see Figure below).

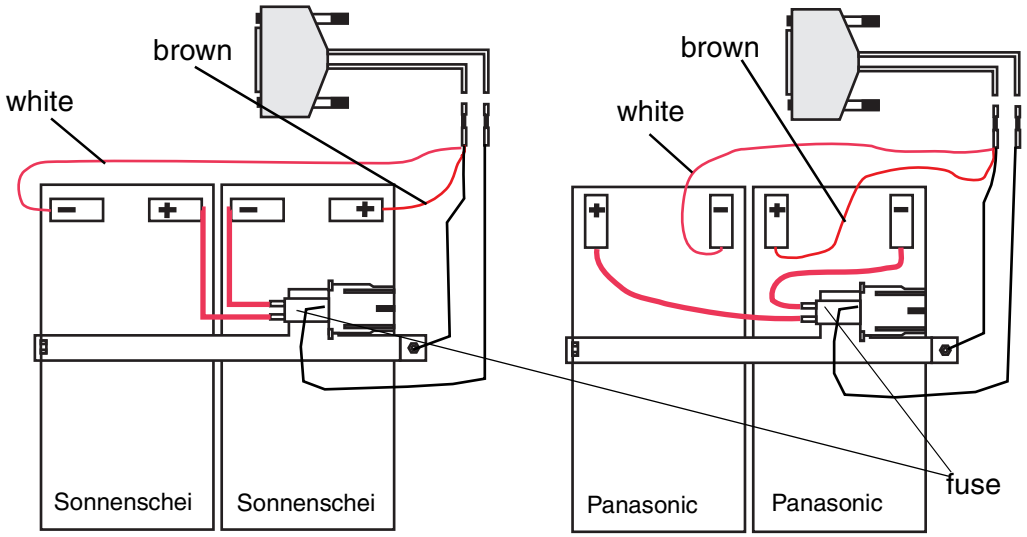

Fig.139: Contact assignments of different rechargeable batteries used in Fabius

- Replace rechargeable batteries with new rechargeable batteries.
- Mount cable lugs (see Figure above). Check that connections are correct before installing rechargeable batteries.
- Mount new rechargeable batteries to Fabius using angular mount. Do not forget to reconnect the ground line.
- Check whether you can switch on the device without AC power.
- Mount cover to rear panel of Fabius.
- Charge new batteries by connecting Fabius to AC outlet, switching Fabius on, and leaving it connected to AC outlet for 4 hours.

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22 General Information About the Pneumatics

The pneumatics comprises the following assemblies:

- Pneumatics Control PCB
- piston pump
- pressure sensor for vacuum measurement of piston pump/muffler.
- electronic PEEP valve

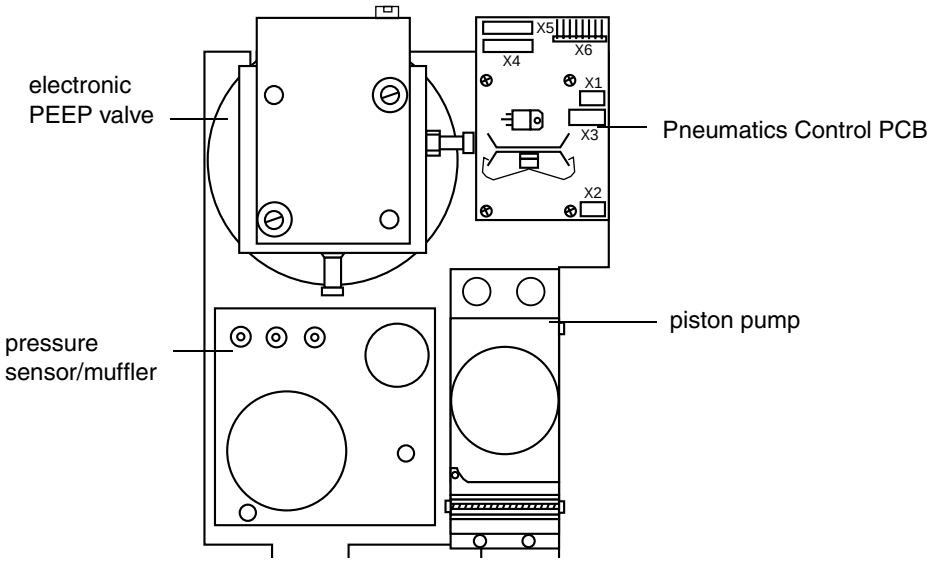

Fig.140: Position of pneumatic assemblies

Electrical plug-in connections on the Pneumatics Control PCB:

X 1	PEEP valve connection
X 2	piston pump connection
X 3	pressure sensor connection
X 4	ventilator connection
X 5	ventilator connection
X 6	control box connection

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22.1 Pneumatics Control PCB

In case of repair, replace the complete Pneumatics Control PCB.

22.1.1 Testing the Pneumatics Control PCB

- In case of failure, check Pneumatics Control PCB using the debug mode: (no ventilator error: VEN 0000)

22.1.2 Dismounting/Replacing the Pneumatics Control PCB

- Switch control box off using ON/OFF switch (ON/OFF switch is located on rear panel of control box).
- Unplug power plug from AC outlet.
- Remove fixing screws **1** from cover plate **2** (rear panel of Fabius) and place cover plate **2** aside.

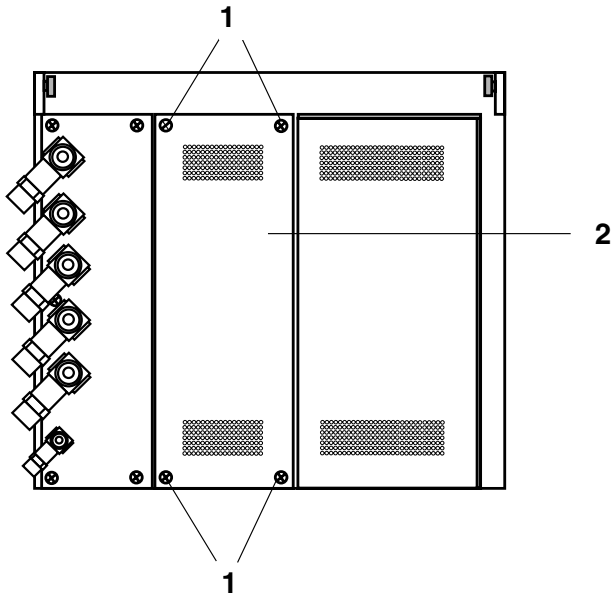

Fig.141: Rear view of Fabius, removing the cover plate

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Electrostatic discharge can damage electrostatic sensitive devices. Use a static-dissipative mat and a wrist strap when handling electrostatic sensitive devices.

- Remove fixing screws **1** from pneumatics **2**.
- Loosen screw **3**.
- Lift pneumatics **2** slightly up and pull it slightly out (you can latch pneumatics onto plates for convenience.)

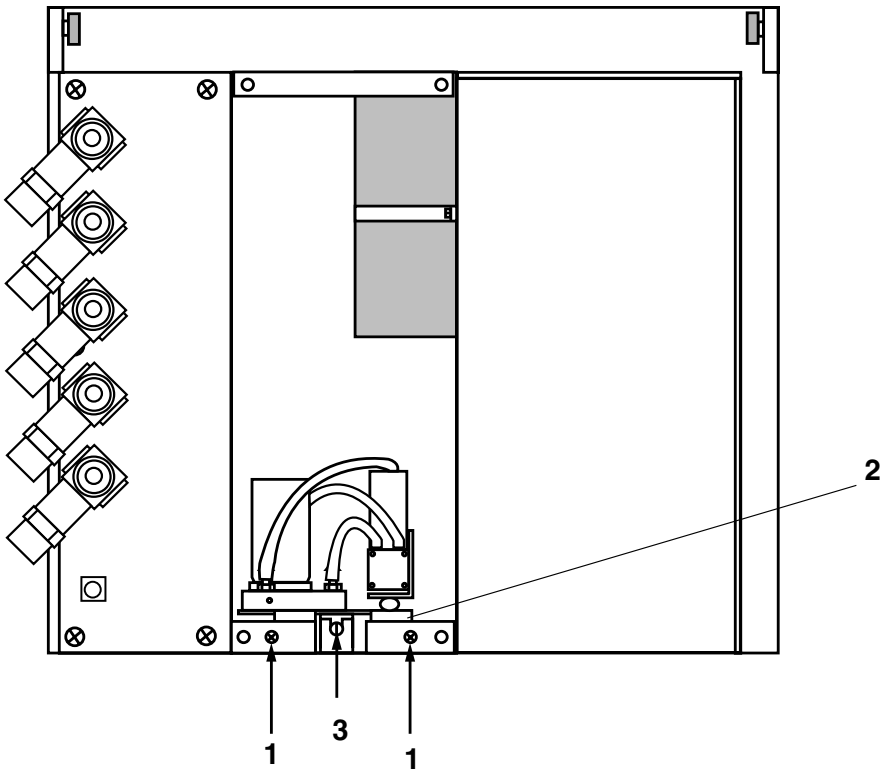

Fig.142: Rear view of Fabius, removing the pneumatics

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- Disconnect cable connectors **1** from Pneumatics Control PCB.
- Remove fixing screws **2**.

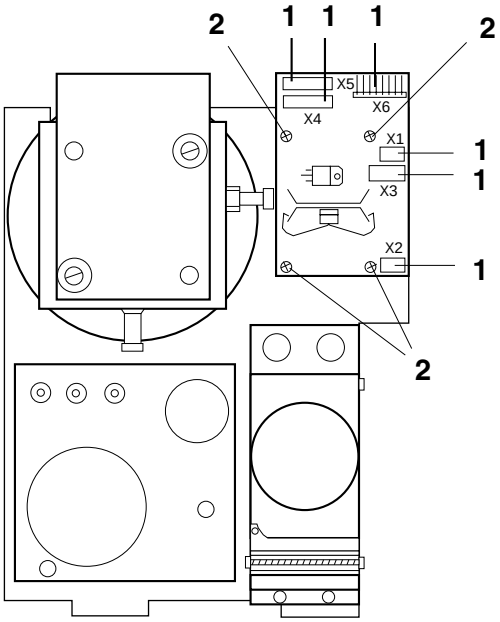

Fig.143: Removing the fixing screws from the Pneumatics Control PCB

- Replace the Pneumatics Control PCB with a new one.
- Secure new Pneumatics Control PCB to pneumatics using fixing screws.
- Connect cable connectors **1** to Pneumatics Control PCB.
- Mount pneumatics to Fabius using reverse method of that used for removal.
- Measure equivalent device leakage current according to Test Certificate.
- Measure protective conductor resistance according to Test Certificate.
- Check function of Pneumatics Control PCB according to Test Certificate.

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22.2 Piston Pump

In case of repair, replace the complete piston pump.

22.2.1 Checking the Piston Pump

- Check piston pump using the debug mode.

22.2.2 Dismounting/Replacing the Piston Pump

- Switch control box off using ON/OFF switch (ON/OFF switch is located on rear panel of control box).
- Unplug power plug from AC outlet.
- Remove fixing screws **1** from cover plate **2** (on rear panel of Fabius) and place cover plate **2** aside.

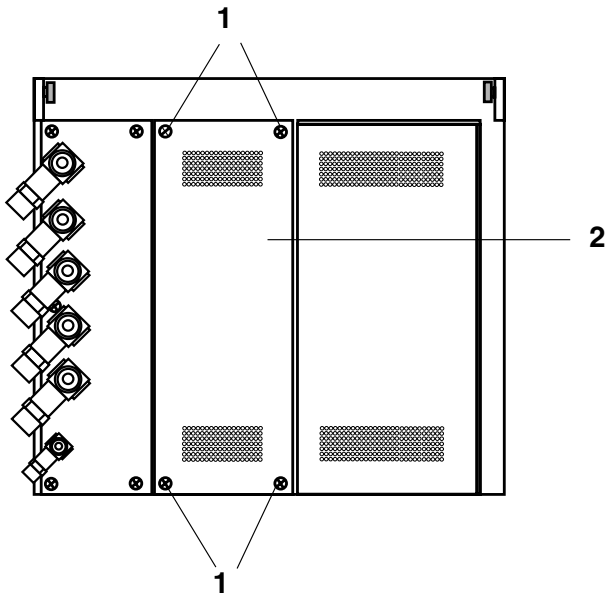

Fig.144: Rear view of Fabius, removing the cover plate

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Electrostatic discharge can damage electrostatic sensitive devices. Use a static-dissipative mat and a wrist strap when handling electrostatic sensitive devices.

- Remove fixing screws **1** from pneumatics **2**.
- Loosen screw **3**.
- Lift pneumatics **2** slightly up and pull it slightly out (you can latch pneumatics onto plates for convenience.)

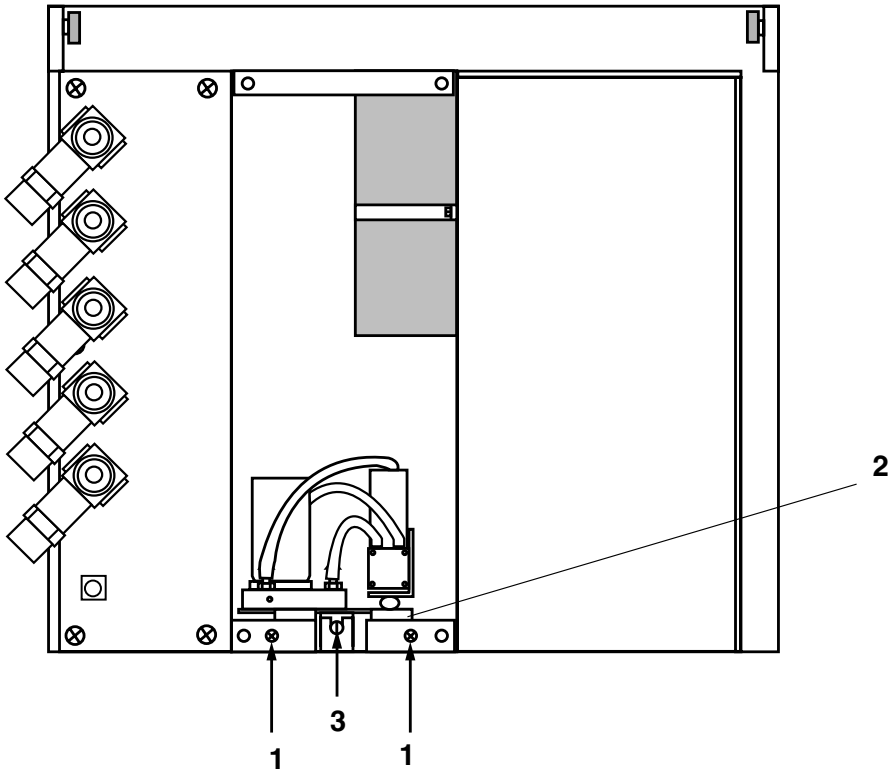

Fig.145: Removing the pneumatics

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- Disconnect connector **1**.
- Mark hoses **2** and **3** for later reassembly and disconnect them from piston pump connection.

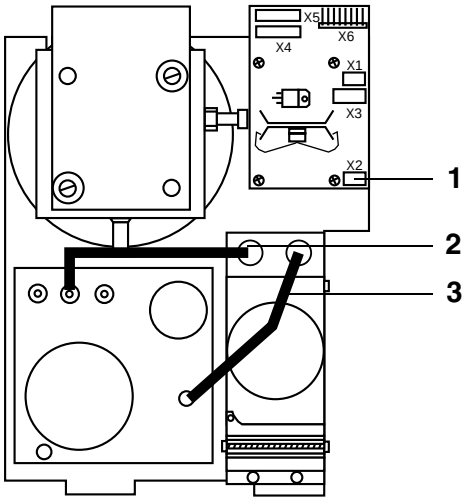

Fig.146: Top view of the pneumatics, removing the piston pump

- Carefully cut cable tie which fastens electrical cables.
- Push rubber mounts **4** upwards and out through pneumatics plate **5**.
- Mount rubber mounts **4** to new piston pump.
- Mount new piston pump to pneumatics plate **5** by carefully pushing rubber mounts **4** through pneumatics plate **5** using a screw driver.

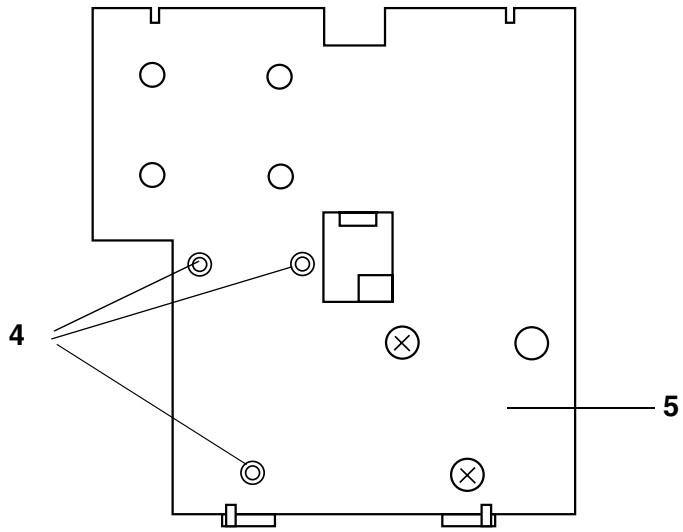

Fig.147: Bottom view of the pneumatics, removing the piston pump

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- Connect connector of piston pump to connection **1** of Pneumatics Control PCB.
- Connect hoses **2** and **3** (see previously applied markings) to piston pump **4** (see following Figure).
- Fasten electrical cables together using a new cable tie.
- Cut off any protruding length of cable tie.

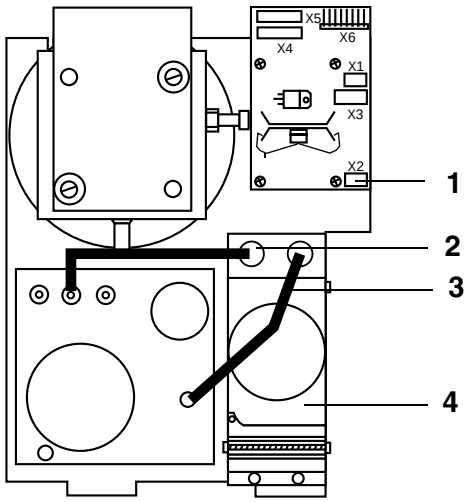

Fig.148: Top view of the pneumatics, connecting the piston pump

- Mount pneumatics to Fabius using reverse method of that used for removal.
- Measure equivalent device leakage current according to Test Certificate.
- Measure the protective conductor resistance according to Test Certificate.
- Check function of piston pump according to Test Certificate.

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22.3 Pressure Sensor

In case of repair, replace the complete pressure sensor.

22.3.1 Checking the Pressure Sensor

- Check pressure sensor using the debug mode: “PMEM” (Software 1.00) “Pvac” (Software 2.00).

22.3.2 Dismounting/Replacing the Pressure Sensor

- Switch control box off using ON/OFF switch (ON/OFF switch is located on rear panel of control box).
- Unplug power plug from AC outlet.
- Remove fixing screws **1** from cover plate **2** (on rear panel of Fabius) and place cover plate **2** aside.

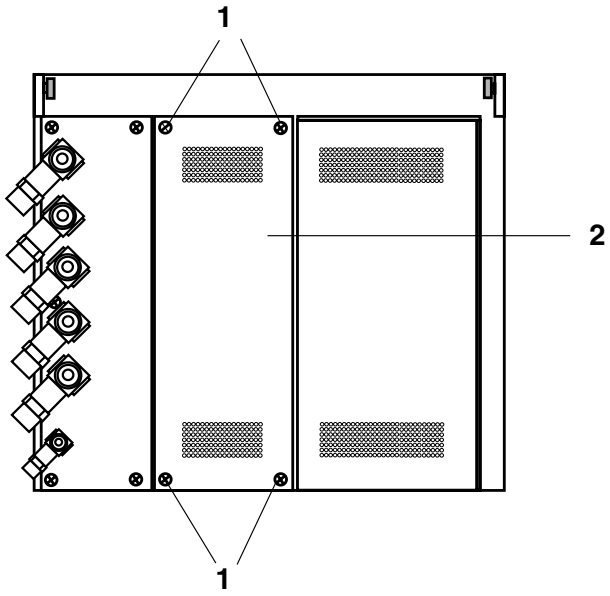

Fig.149: Rear view of Fabius, removing the cover

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Electrostatic discharge can damage electrostatic sensitive devices. Use a static-dissipative mat and a wrist strap when handling electrostatic sensitive devices.

- Remove fixing screws **1** from pneumatics **2**.
- Loosen screw **3**.
- Lift pneumatics **2** slightly up and pull pneumatics slightly out (you can latch pneumatics onto plates for convenience.)

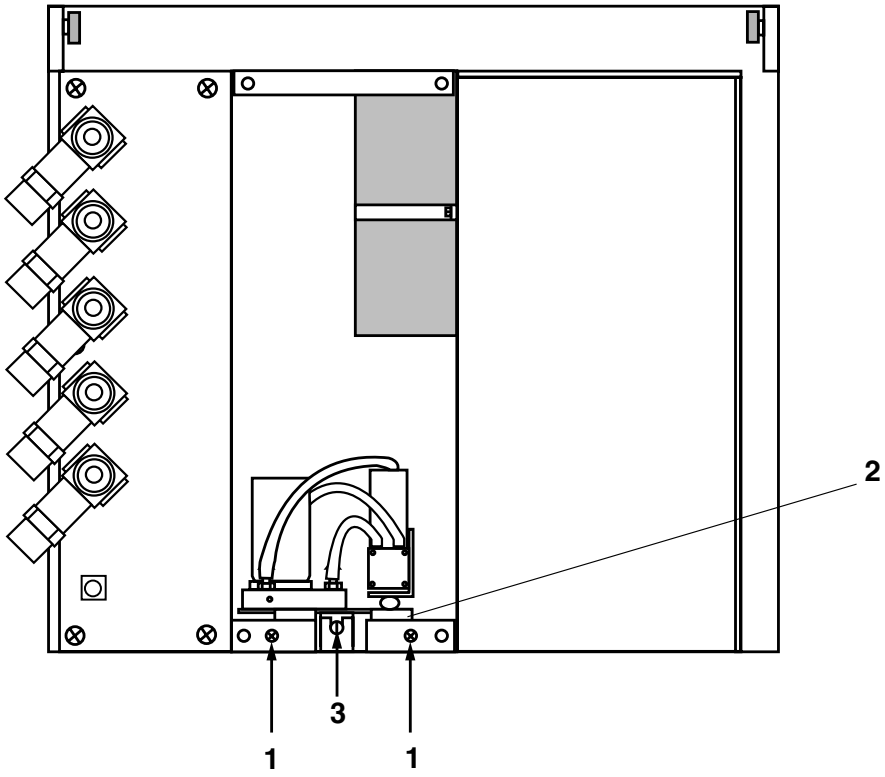

Fig.150: Rear view of Fabius, removing the pneumatics

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- Disconnect connector **1** from Pneumatics Control PCB.

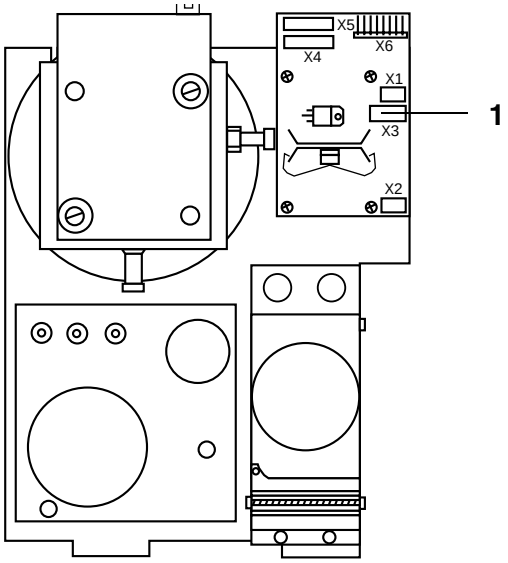

Fig.151: Top view of the pneumatics, removing the connector

- Carefully cut cable tie which fastens electrical cables together.
- Turn and remove pressure sensor **2**.

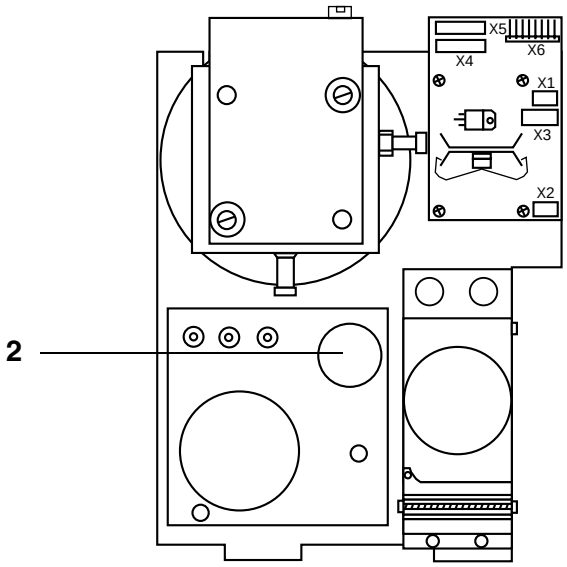

Fig.152: Top view of the pneumatics, removing the pressure sensor

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- Replace pressure sensor with a new one.
- Reconnect pressure sensor connector to Pneumatics Control PCB.
- Fasten all electrical cables together using a new cable tie.
- Cut off any protruding length of cable tie.
- Mount pneumatics to Fabius.
- Mount cover plate of pneumatics to Fabius.
- Measure equivalent leakage current according to Test Certificate.
- Measure protective conductor resistance according to Test Certificate.
- Perform a function test according to Test Certificate.

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22.4 Electronic PEEP Valve

In case of a repair, replace the complete electronic PEEP valve.

22.4.1 Testing the Electronic PEEP Valve

- Check function of electronic PEEP valve according to Test Certificate.

22.4.2 Dismounting/Replacing the Electronic PEEP Valve

- Switch control box off using ON/OFF switch (ON/OFF switch is located on rear panel of control box).
- Unplug power plug from AC outlet.
- Remove fixing screws **1** from cover plate **2** (on rear panel of Fabius) and place cover plate **2** aside.

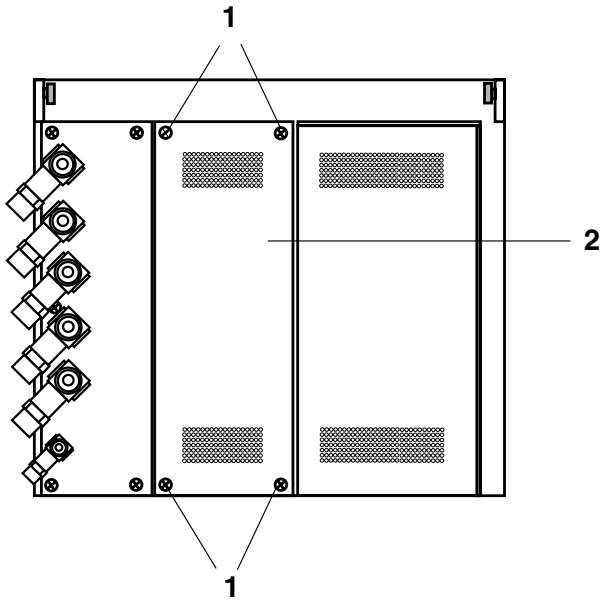

Fig.153: Rear view of Fabius, removing the pneumatics

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Electrostatic discharge can damage electrostatic sensitive devices. Use a static-dissipative mat and a wrist strap when handling electrostatic sensitive devices.

- Remove fixing screws **1** from pneumatics **2**.
- Loosen screw **3**.
- Lift pneumatics **2** up and pull pneumatics slightly out (you can latch pneumatics onto the plates for convenience.)

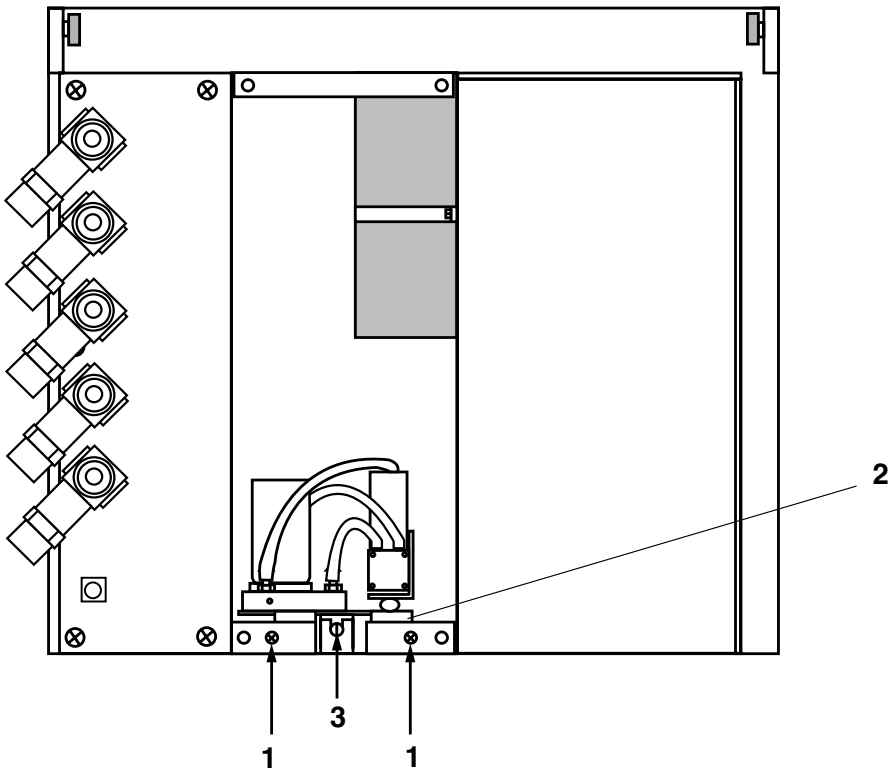

Fig.154: Rear view of Fabius, removing the pneumatics

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- Disconnect connector **1** from Pneumatics Control PCB.
- Mark hoses **2** and **3** for later reassembly.
- Disconnect marked hoses **2** and **3** from electronic PEEP valve **4**.
- Carefully cut cable tie which fastens electrical cables together.

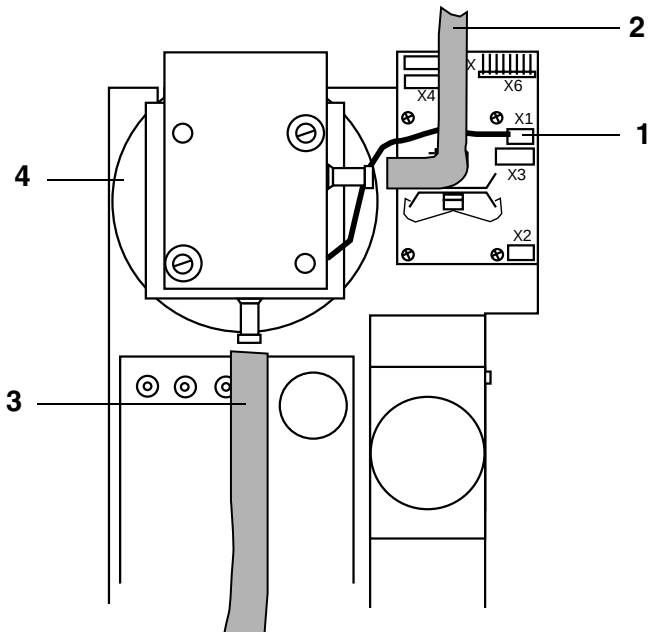

Fig.155: Top view of the pneumatics, disconnecting hoses and cables

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- Hold electronic PEEP valve **1 in place** and remove fixing screws and washers **2**.

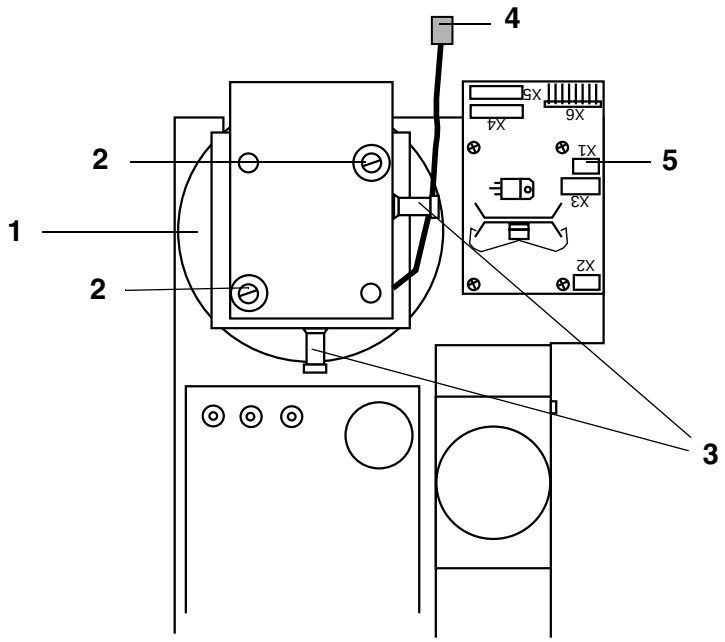

Fig.156: Top view of the pneumatics, replacing the electronic PEEP valve

- Apply Loctite #222 on threads of fixing screws **2** and mount new electronic PEEP valve to pneumatics.
- Connect hoses to connection ports **3** of electronic PEEP valve (**according to previously applied markings**).
- Connect connector **4** of electronic PEEP valve to connection **5** on Pneumatics Control PCB.
- Fasten all electrical cables together using a cable tie.
- Cut off any protruding length of cable tie.
- Mount pneumatics to Fabius using the reverse method of that used for removal.
- Connect gas supplies and electrical connections to Fabius.
- Connect complete breathing system (breathing hoses, Y-piece, breathing bag etc.) to circle absorption system.

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22.4.3 Checking the Electronic PEEP valve (Software 1.00)

- Switch control box on.
- Calibrate O_2 sensor in the standby mode.
- Calibrate flow sensor in the standby mode.
- Press “Menu” key.
- Select “keycode” by turning rotary knob.
- Confirm selection by pressing rotary knob.
- Select “112” by turning rotary knob.
- Confirm selection by pressing rotary knob.
- Select “Calibration pressure” by turning rotary knob.
- Confirm selection by pressing rotary knob.

Fabius calibrates the pressure sensor (Paw).

- Switch control box off and on again.
- Press “IPPV” key.
- Confirm selection by pressing rotary knob.
- Check that hose system has no leaks.
- Adjust fresh-gas flow to 0 L/min.
- Adjust PEEP value to 5 hPa, squeeze breathing bag, and check PEEP value displayed on control box (use standard settings for other PEEP values).
- Adjust PEEP value to 10 hPa, squeeze breathing bag, and check PEEP value displayed on control box (use standard settings for other PEEP values).
- Check Pmax function using standard settings and adjust Pmax values 25 hPa, 40 hPa, and 70 hPa on control box (make sure Y-piece is closed).
- Measure equivalent leakage current according to Test Certificate.
- Measure protective conductor resistance according to Test Certificate.
- Check function of electronic PEEP valve according to Test Certificate.

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22.4.4 Calibrating the PEEP Valve (software 2.00 or higher)

In software version 2.00 or higher, the electronic PEEP valve is calibrated automatically in the DrägerService Mode.

- Connect complete circle absorption system.
- Switch control box on.
- Calibrate O_2 sensor in the standby mode.
- Calibrate flow sensor in the standby mode.
- Press “Menu” key.
- Select “configuration”.
- Confirm selection by pressing rotary knob.
- Select “keycode” by turning rotary knob.
- Confirm selection by pressing rotary knob.
- Select “112” by turning rotary knob.
- Confirm selection by pressing rotary knob.
- Select “Cal. pressure” by turning rotary knob.
- Confirm selection by pressing rotary knob.

Fabius calibrates the pressure sensor (Paw).

- Connect a corrugated hose between the inspiratory nozzle and the expiratory nozzle.
- Close all flow control valves.
- Disconnect the breathing bag.
- Select “Cal. peepvalve” by turning the rotary knob.
- Confirm your selection by pressing the rotary knob.
- Do not disturb the calibration procedure.

Fabius automatically calibrates the electronic PEEP valve. After completion of the automatic calibration, the message "OK" appears on the display of the control box.

If the message "OK" is not displayed, proceed as follows:

- Repeat calibration as described above.

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If the message “OK” is displayed, proceed as follows:

- Connect complete breathing system (corrugated hoses, Y-piece, etc.) to circle absorption system.
- Make sure hose system has no leaks.
- Press “IPPV” key.
- Confirm selection by pressing rotary knob.
- Adjust fresh-gas flow to 0 L/min.
- Adjust PEEP value to 5 hPa, squeeze breathing bag, and check PEEP value displayed on control box (use standard settings for other PEEP values).
- Adjust PEEP value to 10 hPa, squeeze breathing bag, and check PEEP value displayed on control box (use standard settings for other PEEP values).
- Check Pmax function using standard settings and adjust Pmax values 25 hPa, 40 hPa, and 70 hPa on control box **(make sure Y-piece is closed)**.
- Measure equivalent leakage current according to Test Certificate.
- Measure protective conductor resistance according to Test Certificate.
- Check function of electronic PEEP valve according to Test Certificate.

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23 Patient System

In case of repair, replace the safety valve, the auxiliary air valve, or the complete patient system.

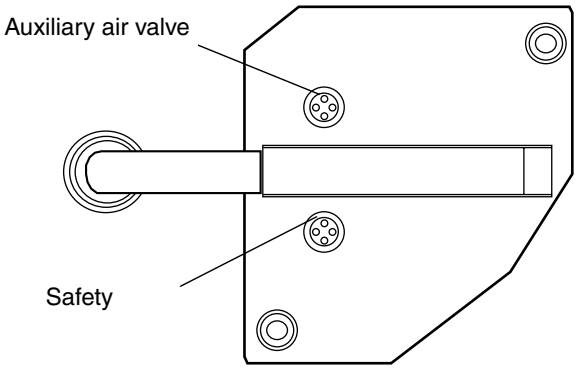

Fig.157: Top view of the patient system

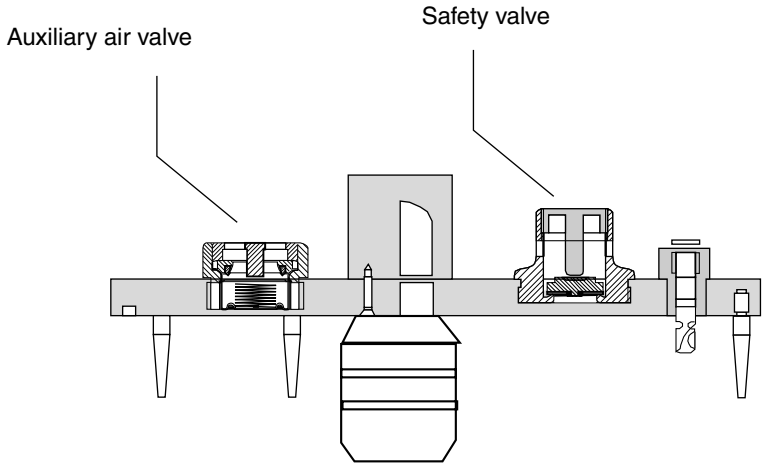

Fig.158: Side view of the patient system

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23.1 Dismounting/Replacing the Patient System

- Unlock patient system **1** by turning screws **2** one quarter of a full rotation (90°) counterclockwise using an Allen key.
- Lift and remove patient system **1**.

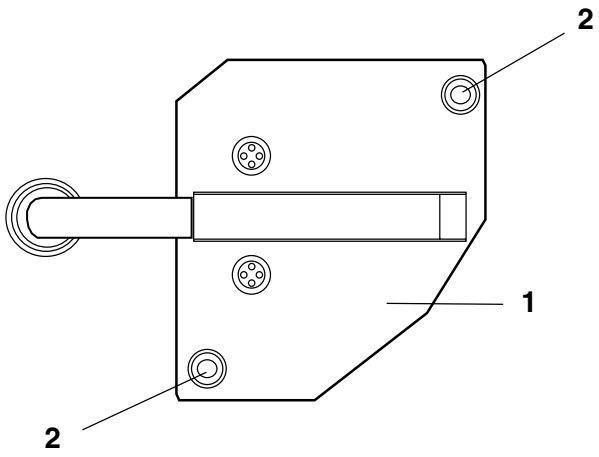

Fig.159: Removing the patient system

- Place new patient system **1** onto ventilator.
- Secure patient system **1** by turning screws **2** one quarter of a full rotation (90°) clockwise using an Allen key.

23.2 Safety Valve

In case of repair, replace the complete safety valve.

23.2.1 Testing the Safety Valve

- Check function of safety valve according to Test Certificate.

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23.2.2 Safety Valve Components

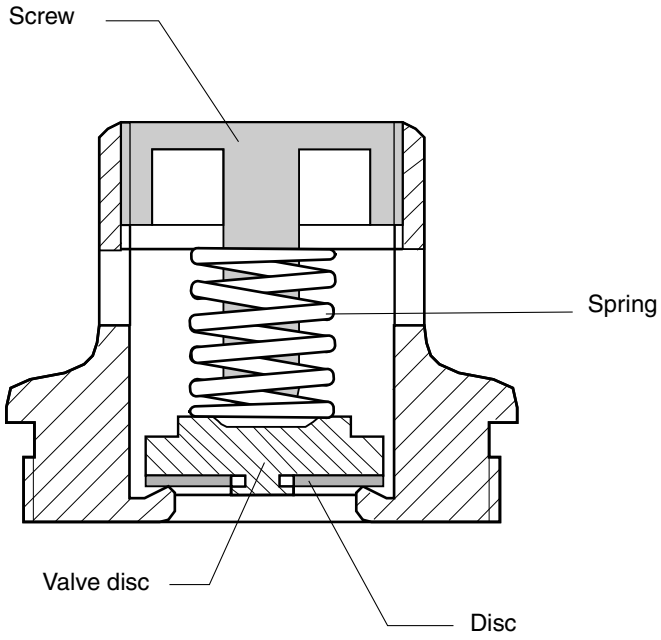

Fig.160: Sectional view of the safety valve

23.2.3 Dismounting/Replacing the Safety Valve

- Unscrew safety valve using a pair of plastic-jaw pliers.
- Remove residual Loctite from safety valve mount on patient system.
- Dispose of the old safety valve.
- Apply a small amount of Loctite #222 onto thread of the new safety valve and screw safety valve into patient system using plastic-jaw pliers.

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23.3 Auxiliary Air Valve

In case of repair, replace the complete auxiliary air valve.

23.3.1 Testing the Auxiliary Air Valve

- Check function of auxiliary air valve according to Test Certificate.

23.3.2 Auxiliary Air Valve Components

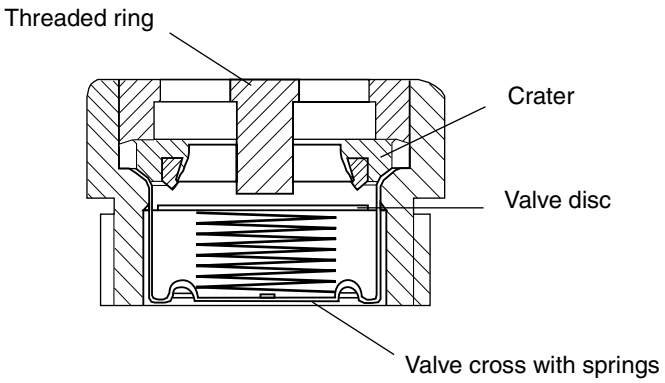

Fig.161: Sectional view of the auxiliary air valve

23.3.3 Dismounting/Replacing the Auxiliary Air Valve

- Unscrew auxiliary air valve using a pair of plastic-jaw pliers.
- Remove residual Loctite from auxiliary air valve mount on patient system.
- Dispose of the old auxiliary air valve.
- Apply a small amount of Loctite #222 onto thread of the new auxiliary air valve and screw auxiliary air valve into patient system using plastic-jaw pliers.

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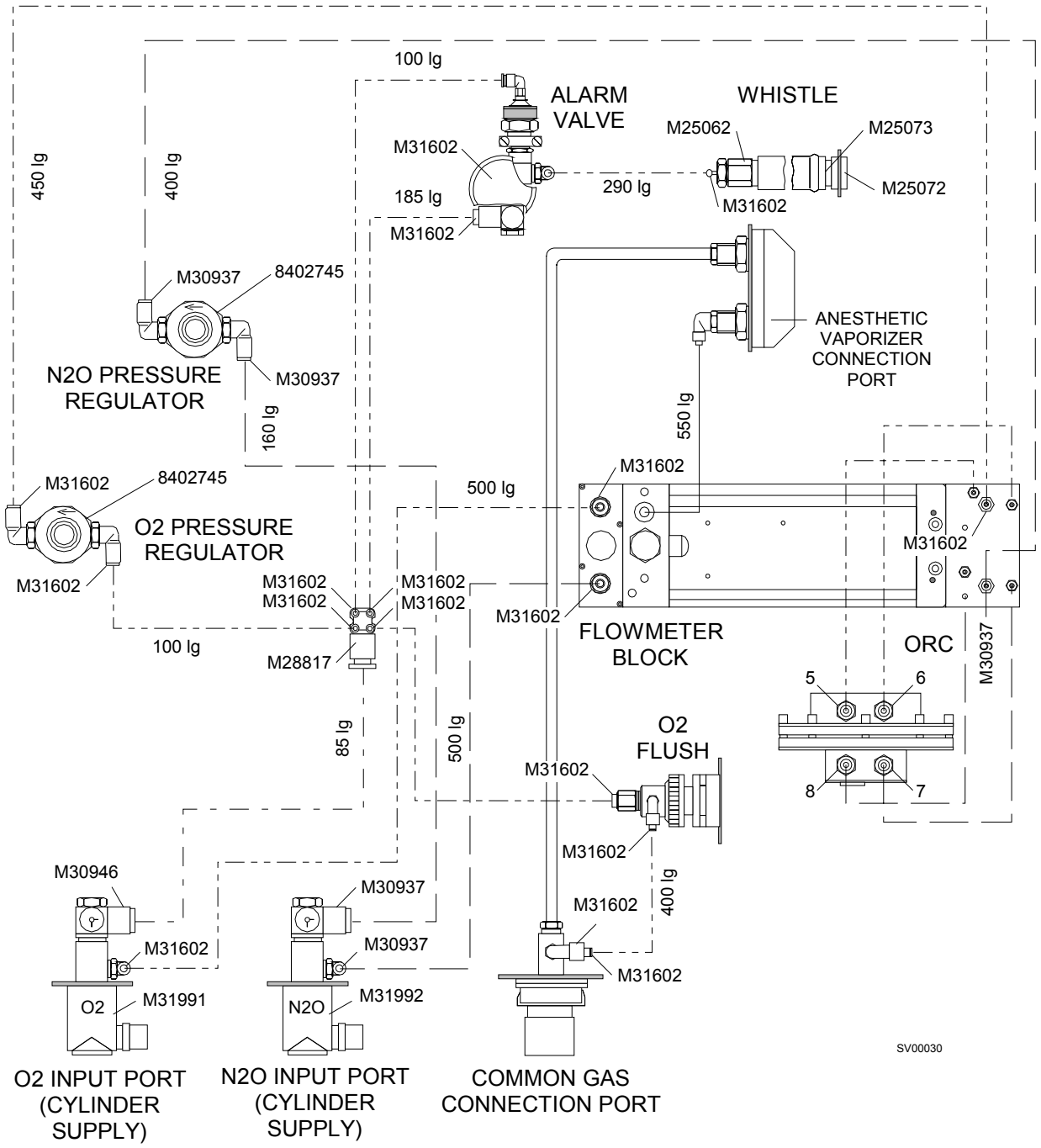
24 Tubing Diagram



HOSE, 2.7 x 0.65-PAE, BLUE, M 31989

HOSE, 2.7 x 0.65-PAE, WHITE, M 31989

HOSE, 4 x 1-PAE, WHITE, M 31989

HOSE, 4 x 1-PAE, NATURAL COLOR, M 31989

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Dräger

DrägerService®

4.0 Test Certificate

Fabius CE

File no.: 5330.200

Edition: 02.99

Installation site: _____

_____

_____

_____

Serial no.: _____

Date of delivery/ startup: _____

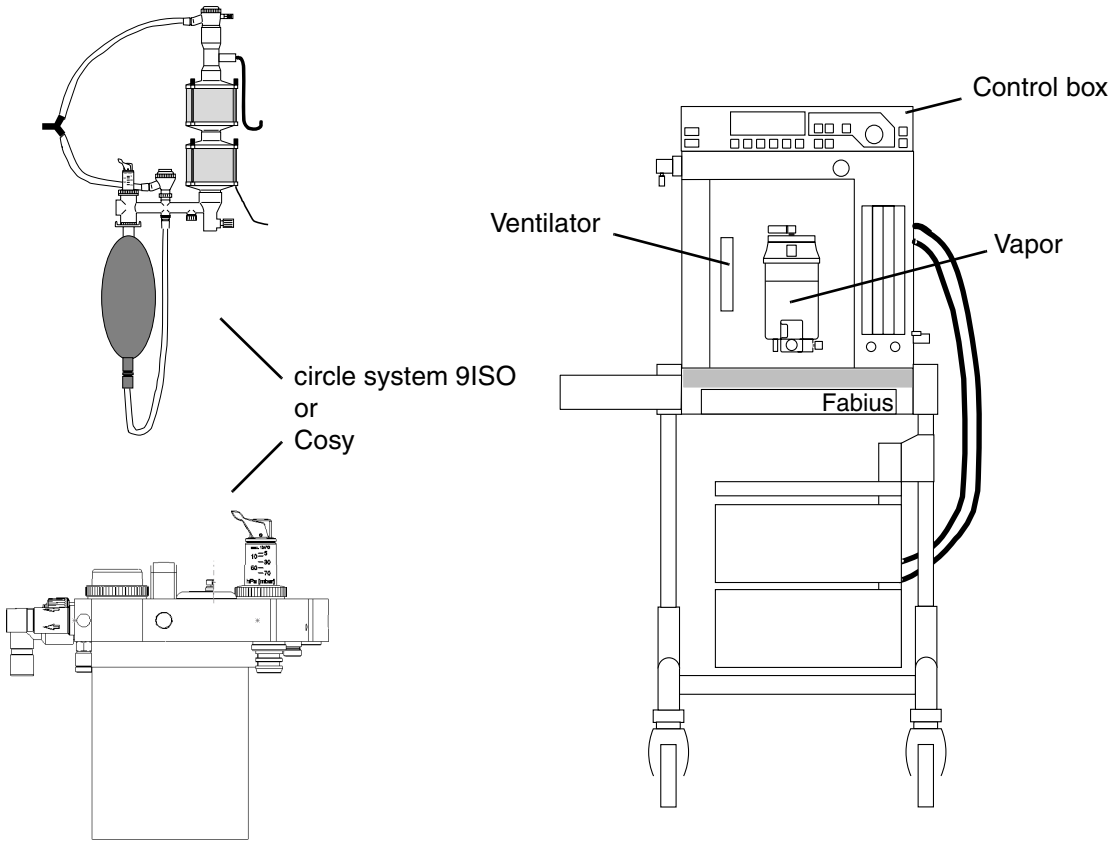
Invoice no. or delivery no.: _____

Other: _____

Explanation of Symbols

—	OK	C = Check condition
|	Defect/error/fault	O = Check function
◯	Spare parts used	L = Check for leaks
/	Report	V = Enter value
∩	Accessories missing	

Note:
TC 5327 applies to Vapor 19.n
TC 6495.200 applies to PM 8014
TC 6498.000 applies to PM 8040
TC 6494.300 applies to PM 8050
TC 6911 applies to anaesthetic gas extraction unit



sec4_testcert.fm
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Table 1: Fabius CE test equipment

Test Equipment	Part Number
-1 bar pressure gauge	7901514
1 bar pressure gauge	7901513
-30 + 120 mb pressure gauge	7901515
15 bar pressure gauge	2M5223
Digital barometer	7901843
Flowmeter unit	7901161
Test adapter	7900138
120 l flowmeter	7900718
Flowmeter	2M85502
ISO socket	M25647
Connecting sleeve	M13506
Bellows or disposable injector	7901541
Training thorax	7901082
Gas distributor	7901495
Adapter	7900045
Protective cap	M14405
Portable test set	7900955
Stopwatch	7910299
Test pressure reducer	7901482

Table 2: Fabius CE wearing parts replacement schedule

Quantity	Item	Part No.	Quantity	Item	Part No.
As required			**Every 2 years (PMS kit P/N 4115660), (Cyl kit P/N 4115664) incl. 1 year items plus the following:**		
3	sealing ring	M5128	2	valve discs (f-gas dec vlv)	M31188
1	sealing ring	M09257	1	diaphragm valve asm	M31806
3	sealing ring	M32014	2-3	strainers (pipeln chk vlv)	M19238
2	O-ring	08777	2-3	O-ring (pipeln chk vlv)	M19241
2	valve plates	M23225 or R00360	1-2	strainer (for cylinder operation)	M19238
1	collar (for secretion aspiration)	M26007	**Every 3 years (PMS kit P/N 4115661) incl. 1 year items plus the following:**		
1	float (for secretion aspiration)	M26007 set of 5: M24733	1	bag roller diaphragm	2600651
1	mica insulator (for secretion aspiration)	R13729 set of 10: R23192	1	O-ring (for bag roller diaphragm)	G60337
1	particulate filter (for AGS)	M33294	1	9V rechargeable battery (if applicable)	8301856
1	bacteria filter (for secretion aspiration)	CH102 set of 5: 6723976	2	12V rechargeable battery	1841416
Once a year (PMS kit P/N 4115659)			**Every 4 years (PMS kit P/N 4115662) incl. 1 year and 2 year items plus the following:**		
1	bacteria filter	8402868	1	diaphragm	M16497
1	bag roller diaphragm	2600650	**Every 6 years (PMS kit P/N 4115663), (Cyl kit P/N 4115665) incl. 1, 2 and 3 year items plus the following:**		
2	O-ring	4115864	1	diaphragm (for cylinder operation)	D15434
1	flow sensor meas. line	8410929	1	diaphragm (for cylinder operation)	D04941
1	Paw measuring line	8302841	2-3	rebuild kit (press reg)	8411129

Control box no.:

Circle system mount no.
Compact breathing system no.:

Inhalation valve no.:

Exhalation valve no.:

Ventilator no.:

Basic unit no.:

The serial number can be entered on reaching the appropriate test item.

The serial numbers of the exhalation and inhalation valves are marked on the screw-in valve craters.

1.	Unit, general		
1.1	Check on completeness and legibility of labelling	C	
1.2	Instructions for use and logbook available (ask user)	C	
1.3	Manual ventilator (bag resuscitator)	C O	

1.4		Shelf	C	
1.5		Writing surface	C O	
1.6		Swivel cabinet	C	
1.6.1		Drawers	C O	
1.7		Rollers	C O	
1.7.1		Brakes	C O	
1.8		Earthing stud	C	
1.9		Earthing cable (if fitted)	C O	
1.10		Mixed-gas hose	C	
1.10.1	*	Sealing ring M 5128 (3x)	C	
1.11		Swivel-out section, ventilator	C O	
1.12		Patient section	C	
1.13	*	Renew black bag roller diaphragm (item no. 2600650) once a year Date of next replacement: _____	C	
1.14	*	Renew black bag roller diaphragm (item no. 2600651) every 3 years with O-ring G 60337 Date of next replacement: _____	C	
1.15		Anaesthetic exhaust hose	C	
1.16		Anaesthetic filter equipment 2M 21262	C	
1.17		Corrugated hoses (ISO/ISO-click)	C	
1.18		Water traps 8404985 (if fitted)	C	

1.19		Manual breathing bag	C	
1.20		ISO Y-piece	C	
1.21		Mask (optional)	C	
1.22		Further accessories Check the respective scope.	C O	
2.		Circle system mount or compact breathing system (enter serial no. on page 2 of this TC)	C	
2.1	*	Flow sensor seals		
2.1.1		In circle system M 09257 (below flow sensor bracket) sealing rings in flow sensor bracket 2 x M 09257 blue, 2600693 red	C	
2.1.2		On Cosy 2600477 and O-ring 2M08777)	C	
2.2		Anaesthetic gas return coupling M 33149 (if fitted)	C O	
2.3		Absorber on Cosy M 29320	C	
2.3.1		Absorber cover	C	
2.3.2		Absorber canister M 29994	C	
2.3.3		Lip seal M 30455 and seal M 30456	C	
2.4		Absorber in circle system:		
2.4.1		Absorber jacket M 14125	C	
2.4.2		Absorber seals M 32028 and M 13386	C	
2.4.3		Tapers	C	
2.4.4	*	Sealing ring M 32014 at taper; renew if applicable	C	
2.5	*	Non-return valve (FGE valve) Renew valve disc M 31188 every 2 years Date of next replacement_____	C	

2.6		FGE valve in circle system	C	
2.6.1		Cones	C	
2.6.2	*	Sealing ring M 32014 on Cone, renew as necessary Date of next replacement_____	C	
2.7		On Cosy O-ring 6802087l	C	
2.8	*	Ventilator port O-rings 2M 08777 (x 2), renew as necessary	C	
2.9		Filter element in circle system	C	
2.10		ISO cones (for corrugated hoses)	C	
2.10.1		Cone	C	
2.11		Coupling M 26238 (for pressure measuring port)	C O	
2.12		Inhalation valve (enter serial no. on page 2 of this TC)	C	
2.12.1	*	Valve plates M 23225, R 00360; renew if applicable	C	
2.12.2		Valve crater Must not exhibit signs of damage. Pins must not be bent and there must be no surface damage inside the valve disc guide.	C	
2.12.3		Sealing ring M 09231	C	
2.12.4		Inspection cap	C	
		1x O-ring 2M 10296 and 2x O-ring 2M 29384	C	
2.13		Exhalation valve (enter serial no. on page 2 of this TC)	C	
2.13.1	*	Valve plate R 00360 or M 23225; renew if applicable	C	

2.13.2		Valve crater Must not exhibit signs of damage. Pins must not be bent and there must be no surface damage inside the valve disc guide.	C																		
2.13.3		Sealing ring M 09231	C																		
2.13.4		Inspection cap with PEEP valve attachment in circle system	C																		
2.14	*	PEEP valve Renew diaphragm 8410181 in circle system Diaphragm jacket M33401 on Cosy every 2 years Date of next replacement: _____	C																		
2.14.1		Sealing ring 2600479 on Cosy	C																		
2.15		 Pressure limitation valve (APL) in circle system mount (modified) Switching lever markings "IPPV/SPONT-MAN"	C																		
2.15.1		Cap	C																		
2.15.2		Stem guide	C O																		
2.15.3		Switching lever "IPPV/SPONT-MAN"	C O																		
2.16		Non-return valve (anaesthetic gas extraction)	C																		
2.16.1		Silicone disc	C																		
2.16.2		Hooked ring M 17786 in circle system	C																		
3.		Control box	C																		
3.1		Labelling legible	C																		
3.2		Housing	C																		
3.3		Back wall	C																		

3.4		O2 sensor adapter	C	
3.4.1		O-rings (2M 10296, green; 2M 10633, brown)	C	
3.4.2		O2 cable, plug	C	
3.5		O2 sensor socket	C	
3.6		Flow sensor hoses	C	
3.7		Flow sensor connections	C	
3.7.1		Flow sensor	C	
3.8		Pressure hose, pressure connection	C	
3.8.1		Bacteria filter 8402868 Replace once a every	C	
3.9		Connecting cable, interface M	C	
3.10		Connection socket, interface M	C	
3.11		Connecting cable, interface C	C	
3.12		Connection socket, interface C	C	
3.13		Earth leakage stud	C	
3.14		Fuses 220 V 2x T1A 1815083 110 V 2x T2A 1815113	C	
3.15		Main switch	C O	
3.16		Control box latches	C	
3.17	*	Replace 9 V rechargeable battery (8301856) every 3 years if fitted Date of next replacement: _____	C	

3.18	*	Replace 24 V rechargeable battery every 3 years 2x 1841416 Date of next replacement: _____	C		

4.		Gas connections			
4.1		CS inputs			
	*	Renew strainer M 19238 and O-ring M 19241 every 2 years.			
		O2	C		
		N2O	C		
		Optional: Air	C		
		Date of next replacement: _____			
4.2		CS connecting hoses Pay attention to plug coupling, country-specific colour-coding and connection encoding			
		O2	C		
		N2O	C		
		Optional: Air	C		
4.2.1		Sealing ring			
		O2 (M 07152)	C		
		N2O (M 07152)	C		
		Air (M 05128)	C		
4.3		Cylinder inlets Renew strainer M 19238 and O-ring M 19241 every 2 years.			
		O2	C		
		N2O	C		
		Date of next replacement: _____			
4.4		Cylinder option Connection hoses Cylinder pressure reducer			
		O2	C		
		N2O	C		

4.4.1		Sealing rings M 07152 (2x) O2	C	
		N2O	C	
5.		Cylinder pressure reducer O2, serial no.		
5.1		N2O, serial no.		
5.2	*	Replace diaphragms 2312600 every 6 years Date of next replacement: _____	C	
5.2.1		Annual output test Next test: Detach cylinder connection from Fabius and connect to measuring tube 7900718. Open cylinder slightly. With supply pressure 10 bar > 60 L/min. O_2	O	
		N_2O	O	
5.3		Sealing ring M 05045 With pin index pressure reducer O2	C	
		N2O	C	
5.4		2nd stage blow-off valves Check once a year. Connect test pressure reducer e.g. with DIN pressure hose to output o pressure reducer Opening pressure 7.0 $^{+\ 3.0}$ bar O2	O	
		N2O	O	
5.5		Static test every 6 months Test instructions: Connect output to pressure gauge (15 bar) test equipment part no. 2M 5223.		

Test values:

Gas	Supply pressure	Outlet		
O_2	> 80 bar	2.7-5.5 bar	O	
N_2O	> 45 bar	2.7-5.5 bar	O	

5.6	Connection hoses	C	
5.7	High-pressure gauge		
	O2	C	
	N2O	C	
6.	Cylinders		
6.1	Small O2 cylinders Supervisory authority inspection every 6 years	C	
6.2	All other cylinders every 10 years	C	
6.3	Check expiry date		

N2O and O2 class as medication

O2	C	
N2O	C	

6.4	Cylinder holder		
6.4.1	Buckle		
	O2	C	
	N2O	C	
6.5	Cylinder jackets (if provided)		
	O2	C	
	N2O	C	

7. Lack of O2 alarm

7.1 Alarm valve M 28480

* Replace diaphragm M 16497 every 4 years.

Date of next replacement: _____ C

7.2 Build up 5 bar with test pressure reducer by way of O2-CS connection.

Set $\dot{V}$ = 1L/min. at O2 flowmeter.
Slowly reduce test pressure.

Test value:
Signal must sound at 1.7 bar at the latest. O

7.3 Signal slowly stops sounding as pressure continues to drop; there is no deactivation. O

7.4 Slowly build test pressure back up again. Alarm must stop sounding at 2.7 bar at the latest. O

7.5 Warning time
Establish O2 supply (min. 15 s vessel filling time) and interrupt again.
Rapidly dissipate pressure in system.

Warning time ≥ 7 s O

---

8. *Pressure regulator 8402745*
O_2,N_2O,Air
Renew diaphragm and inlet valve
* S-Set 8411 129 every 6 years.

Date of next replacement: _____ C

Downstream pressure is only tested when parts have been replaced.

8.1 Pressure regulator O2 measuring tubes
Supply pressure(5...5,5bar)
Test value: P_{dyn} 3,0 ± 0,2bar O L

8.2	Pressure regulator N_2O measuring tubes Supply pressure (5...5,5bar) Test value: P_{dyn} 2,0 ± 0,2bar	O L	
8.3	Pressure regulator Air measuring tubes Supply pressure (5...5,5bar) Test value: P_{dyn} 1,5 ± 0,2bar	O L	
9.	O2 bypass (flush valve) Functional test		
	Test set-up: Connect mixed-gas outlet to 120 L flowmeter (7900718)		
	Test value: At 5 bar dyn. supply pressure $\dot{V}$ = 39 - 70 L/min.	O	
	Test value: At 3 bar dyn. supply pressure $\dot{V}$ = 27 - 43 L/min.	O	
	Pushbutton must return to rest position on being released.	O	
10.	Ejector outlet		
10.1	Sampling coupling (O2)	O L	
	O2 drive hose	O L	
10.2	Capacity		
	Supply via O2 pressure reducer inlet or O2-CS inlet. Air-CS supply depressurised.		
	Test value: Sampling coupling $\dot{V}$ > 50 L/min.	O	
	Connect coupling to secretion aspirator. Open shutoff valve of secretion aspirator.		
	Test objective: Ejector-type secretion aspirator runs.	O	
11.	Secretion aspirator (optional)		
11.1	Ejector-type secretion aspirator assembly	C	
11.1.1	Connecting hose	C L	

11.1.1.1		Sealing ring	C L	
11.1.2	*	Renew bacteria filter CH 102 (set of 5: 6723976)	C	
11.2		Vacuum-type secretion aspirator assembly	C	
11.2.1		Vacuum connecting hose	C L	
11.2.1.1		Sealing ring	C L	
11.3		Frame	C	
11.3.1		Cylinder holder	C	
11.3.2		Connection hose	C	
11.3.3		Secretion aspiration hose M 25780	C	
11.3.4		Secretion sight glass/fingertip	C	
11.4		Jar M 20091, 2x	C	
11.5		Jar cap	C	
11.5.1	*	Check tightness of collar M 26008 (renew if applicable).	C	
11.6	*	Float M 26007 (renew if applicable - set of 5: M 24733)	C	
11.6.1		Freedom of movement To check: Connect up aspirator assembly Build up vacuum Turn jar round Float is sucked in Turn jar round Shut off vacuum Float drops back	O	
11.7		Relief valve (if fitted)	C L	
11.7.1		Mica insulator R 17329 (renew if applicable - set of 10: R 23192)	C	
11.8		Ejector Connect up test vacuum gauge via secretion jar. Capacity: p = > -0.8 bar Of which: p = -0.7 bar in 10 s	O	

11.9	Pressure gauge Comparison measurement Tolerance ± 4% of full scale value	C O	
11.10	Shutoff valve	O L	
11.11	Vacuum control valve (vent valve)	O L	
11.12	Pushbutton rapid vent valve (vacuum operation only)	O L	

12.	AGS system (optional)	C	
*	If applicable, replace particulate filter M 33294		
	When using one of the two surplus gas connections: Plug fitted in socket on side of AGS mounting system.	C	
	When using both surplus gas connections: Plug removed from socket on side of AGS mounting system.	C	
	AGS functional check Press plug into outlet point of anaesthetic extractor until it engages.		
	Indicator turns green.	O	
	Float in flowmeter of AGS system moves between upper and lower mark.	O	
	Detach extractor from wall socket.		

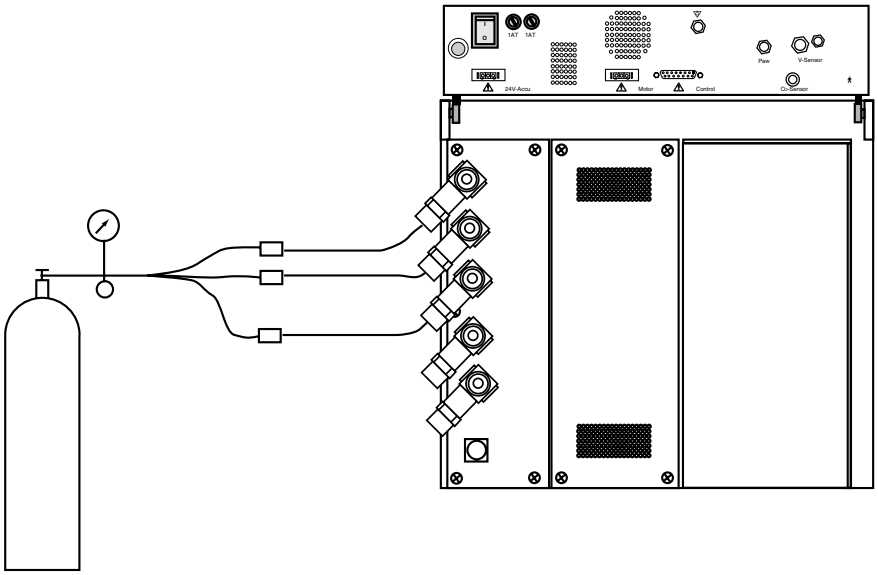
13.	Vapor plug-in system housing section		
*	Renew O-ring U 4314 (2 x each Vapor) once a year	C	
	Date of next replacement: _____		

14.	Safety valve, flowmeter unit		
	Perform test once a year.		
	Connect mixed-gas socket to precision pressure gauge +1.0 bar, 7901513. Uncouple Vapor. N2O control valve closed. Set $\dot{V}$ = 9 L/min. at O2 flow control valve. Test value: Safety valve opens at p = < 1.0 bar	O	

15. Leak test

Perform leak test between gas source and flow control valve.

Test prerequisites:
All gas supplies depressurised.
Flow control valves closed.



15.1 O2-air/N2O-CS operation
Connect CS connection hoses with test adapter 7901495 to test cylinder (test pressure reducer).

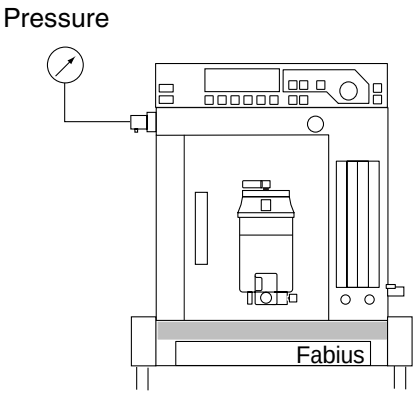
Test set-up:

Build up test pressure of 5 bar.
All flow control valves at anaesthesia machine closed.
Close cylinder valve following pressure equalisation.

Test values:
Cylinder pressure indicated (high-pressure gauge of test cylinder) may not drop by more than 10 bar within 2 minutes. O

16. Low-pressure leak test

Connect mixed-gas socket to pressure gauge -30...+120 mbar (7901515) or digital pressure gauge (7901843). Establish all gas supplies. All flow control valves closed.



16.1 No build-up in pressure is permissible with O2 flow control valves closed. O

16.2 With Vapor uncoupled, build up pressure of 120 mbar via O2 flow control valve.

Test value:
Perm. gas flow < 0.1 L/min. O

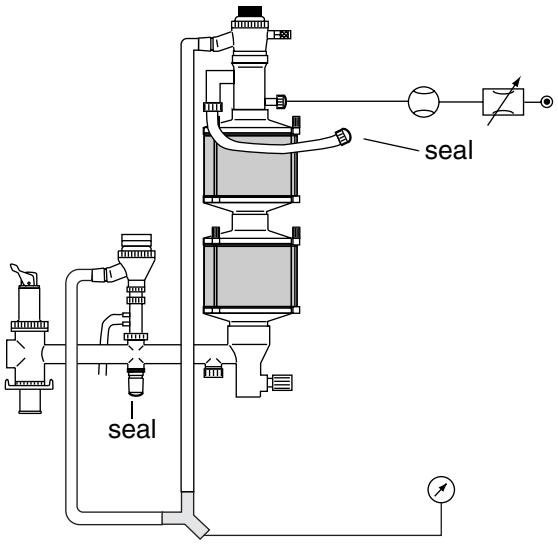
16.3 With Vapor coupled up as for item 16.2

Test value:
Perm. gas flow < 0.1 L/min. O

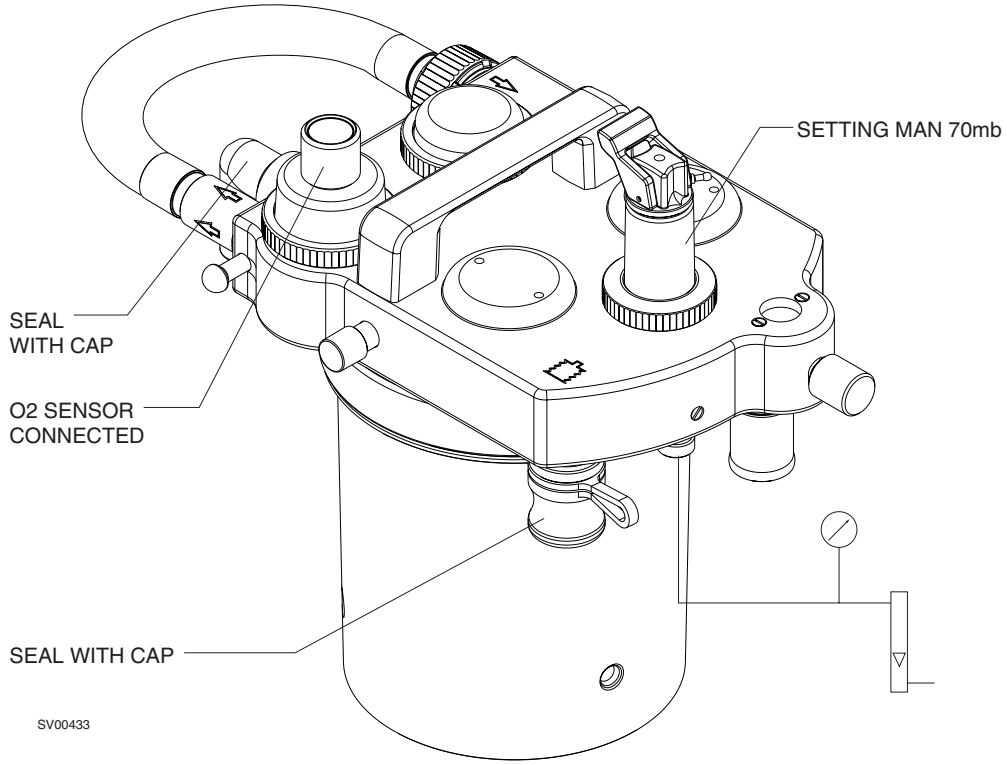
17. Circle system leak test

Flow sensor connected. Alternatively, flow for test items 17.1 and 17.2 can be supplied by anaesthesia machine if:
Machine has previously passed leak test and result of overall leak test (low-pressure system of anaesthesia machine plus circle system) does not exceed $\dot{V} \leq$ 0.1 L/min.
Pressure measurement is then performed with Paw sensor in MAN.

17.1 Test set-up circle system:



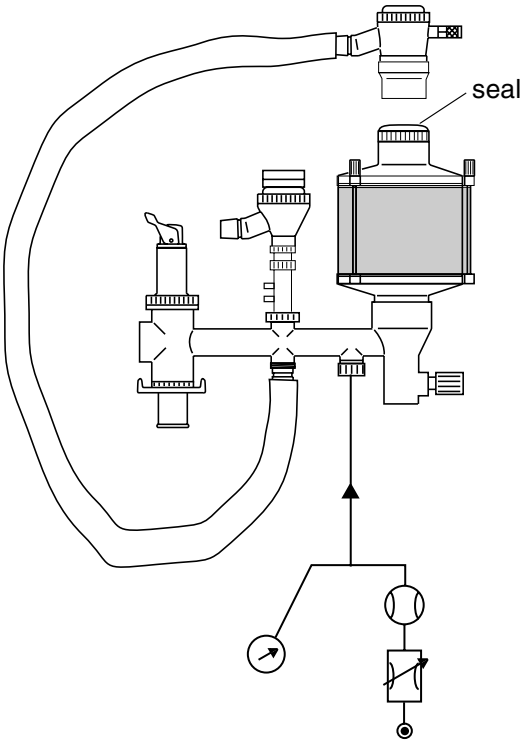
COSY leak test:



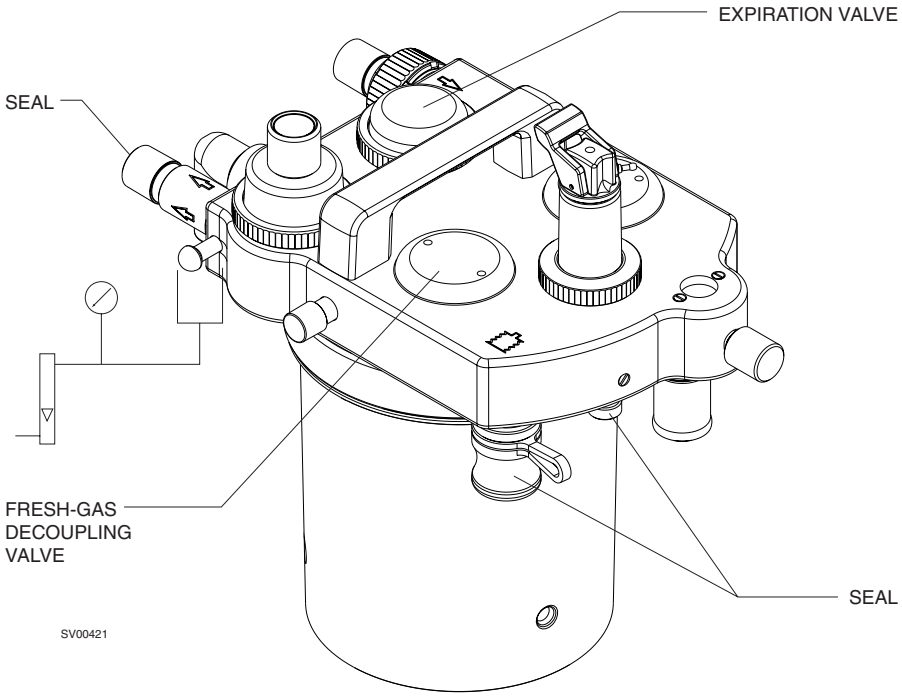
Switch pressure limitation valve to "MAN" and set to 70 mbar. Build up test pressure of
p = 40 mbar.
Test value: Gas flow $\dot{V} \leq 0.1$ L/min. O

17.2 Testing of inhalation and exhalation valves

Remove adapter. Seal absorber with protective cap (M 14405). Remove manual breathing bag. Connect up pressure gauge
-30/+120 mbar, rotameter as shown.



Outlet valve function test:



	Build up pressure of p = 40 mbar Perm. gas flow < 0.1 L/min. Assemble circle system	O	
17.3	Cosy inlet valve test Valve port open. APL valve set to Man, 70 mbar. Connect pressure gauge and flow tube to inspiratory port via connecting sleeve M 13506 Permissible gas flow rate <0,05 l/min	O	
17.4	Cosy outlet valve test Ventilator, fresh-gas port, inspiratory port closed. Connect pressure gauge and flow tube to adapter bag. Build up pressure of p = 40 mbar Permissible gas flow rate <0,05 l/min	O	
18.	Flowmeter unit	C	
18.1	Protective glass	C	
18.2	Pressure gauge	C	
19.	Control valves		
	 Pay attention to country-specific colour and haptic coding. O2	C O	
	N2O	C O	
	Optional: Air	C O	
19.1	Set flow rate of 1 L/min. Exert axial tension/compression on stem and then release. Permanent change in flow from set flow rate: $\Delta V \leq 0.3$ L/min. O2	O	
	N2O	O	
	Optional: Air	O	

19.2 End stop of control valves

Open fresh-gas outlet
Open control valves
Maximum flow with valves fully open

O2 and N2O > 9 L/min. in each case	O	
O2 and air > 9 L/min. in each case	O	
Air option only > 14 L/min.	O	

Checking pressure reducers if respective max. flow is not attained.

19.3 Function of flowmeters
Reduce each flowmeter from maximum flow to zero in 4 stages.

19.4 Test objective:
Float must never become caught (with unit horizontally aligned) O

19.5 Flow comparison measurement (perform once a year)

Testing:
Connect flowmeter unit (7901161) to mixed-gas outlet.

Comparison measurement of at least 3 flow values in range between 50 mL/min. and
3 L/min. for O2/N2O and between 500 mL/min. and 6 L/min. for air.

Test objective:
Measured values within tolerance of ±10 %.

O2	O	
Air	O	
Total O2 and N2O flow	O	

19.5.1 Smooth and even rotation of float of O2 and N2O low-flow flowmeter at 0.2 L/min. O

Close control valves

20. S-ORC

20.1 Rating plate at flowmeter unit

C

20.2 Functional test
Establish gas supply.
Remove Vapor.
Mixed-gas outlet open

Open N2O control valve as far as it will go

Open O2 control valve once as far as it will go and close again

20.2.1 S-ORC control action

O_2 flow setting:	N_2O flow must be:	
0	0	O
0.2 + 0.07/-0.05	N_2O starts to flow	O
0.5	1.2 - 1.8	O L
3.0	6.0 - 10	O L

Control valves on 0, Connect hoses

---

21. Control box function test
Plug in mains plug, switch on unit

21.1 Visual and acoustic alarm
All LEDs are briefly actuated O

Acoustic alarm sounds O

21.2 Mains failure alarm
Pull mains connector.
Alarm sounds O
In batter-powered operation the message „Battery mode“ and the battery symbol appear. O
Plug in mains connector

21.3 Calibrate pressure sensor

In Service mode set pressure sensor to zero. (Keycode 112)
Detach pressure gauge tube to do so.

Calibration successful. O
(Otherwise replace pressure sensor 18 31 887)
Switch unit off and back on again.

Set to Man/Spont.
Connect bellows or disposable syringe and pressure gauge (-30 - +120 mbar) to pressure gauge tube.

Build up pressure 40 mbar + 0,5 mbar.
Display "P_{mean}" rises to 40 $\pm$ 2 V

Remove test set-up.

Connect P_{AW} an hose to control box.

21.4 Set O2 sensor to zero

Call up zeroing page by pressing

Calibrate O2 sensor with 100 % by vol. O2

Attach insp. O2 sensor to test adapter, item no. 7900138.

Connect fresh-gas outlet to test adapter.
Flush with approx. 100 % O2 (1 L/min.) for approx. 1 minute.
Then trigger calibration.

Calibration is completed after max. 4 minutes. O

21.5 O2 sensor test:

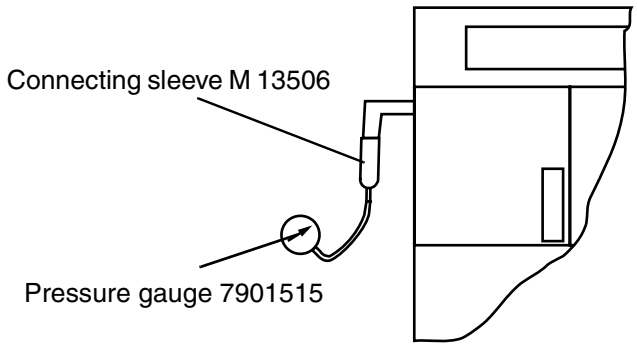
Switch to MAN/SPONT. Expose sensor to ambient air for approx. 2 minutes

18 - 24 % by vol. O2 is displayed on completion of this period. O
If not, replace sensor capsule.

Plug in O2 sensor
Remove test set-up.

21.6 Pressure-limiting valve test

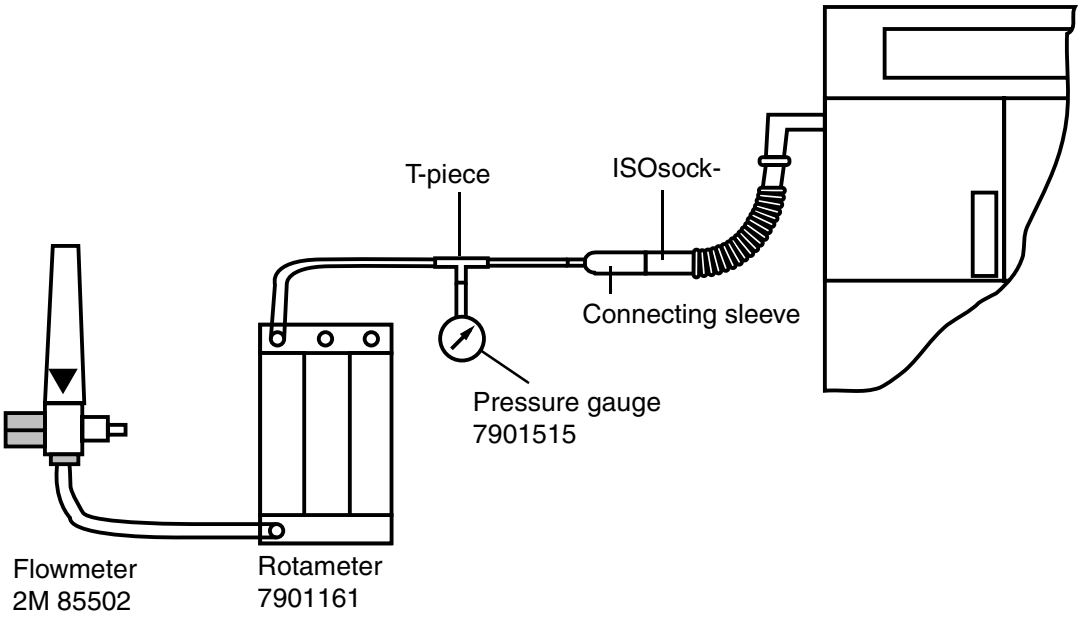
On control box IPPV, set
p_{max} = 40mbar
f_{IPPV} = 6/min
TI:TE = 1 : 1
TIP:TI = 10 %
PEEP =0mbar
V_t = 380 mL



Connect -30/+120 mbar pressure gauge to ventilator outlet.
Relief valve opens at 75 ± 5 mbar (maximum pressure) O

21.7 Testing of ancillary air valve:
Flow control valves on 0. Vacuum valve opens at -2.5 to -6 mbar (minimum pressure) O

21.8 Freedom from leaks in piston chamber
Select Man/Spont mode.
Connect flowmeter and pressure gauge to ventilator connection. Piston in upper end position.



Use flowmeter to set stable pressure of 30 mbar.
Set flow (leakage rate) must be < 20 mL/min. V

Remove test set-ups, connect ventilator hose

21.9 Sealing in vacuum:

Set Fabius to IPPV. P indication in Debug mode is 200 ± 50hPa. O

Set ventilator to standby.
P indication must fall by no more than 100 hPa within 3 s. O

---

22. Testing type of gas, cylinder operation (optional)

22.1 O2 supply, cylinder

All gas supplies depressurised
Open O2 cylinder
Open all control valves
Set $\dot{V}$ = 0.8 L/min. at O2 control valve

O2 flowmeter:
Flow remains on $\dot{V}$ = 0.8 L/min. O
No reading on any other flowmeter
($\dot{V}$ = 0 L/min.) O

22.2 N2O supply, cylinder
Open N2O cylinder
(O2 cylinder is open)
Set $\dot{v}$ = 0.8 L/min. at O2 flowmeter
Open all other control valves

N2O flowmeter indicates $\dot{v} \approx$ 1.6...2.6 L/min. O

Close N2O cylinder

N2O flowmeter:
Flow drops back to $\dot{v}$ = 0 L/min. O

O2 flowmeter:
Flow remains on $\dot{v}$ = 0.8 L/min. O

Close O2 and N2O cylinder.
Depressurise system
Close control valves

---

23. Testing type of gas, CS operation

All gas supplies depressurised
All pressure gauges for CS depressurised O

23.1 O2-CS
Establish O2-CS supply
Pressure gauge for O2 indicates CS pressure O
Actuate O2 bypass valve.
Gas flows O

Set O2 flowmeter to $\dot{v}$ = 0.8 L/min.
Fully open N2O control valve.
N2O float at rest. O

23.2 N2O-CS
Establish N2O supply
Pressure gauge for N2O indicates CS pressure O
Set O2 flowmeter to $\dot{v}$ = 0.8 L/min.
N2O flowmeter indicates $\dot{v}$ = 1.6...2.6 L/min.' O
Uncouple N2O-CS connector

N2O flowmeter:
Flow drops to $\dot{v}$ = 0 L/min. O

O2 flowmeter:
Flow remains on $\dot{v}$ = 0.8 L/min. O

23.3 Air-CS (if fitted)
Establish O2, N2O and air supply
Pressure gauge for air indicates CS pressure. O
Fully open N2O control valve
Set air flowmeter to $\dot{v}$ = 1 L/min.

Test objective:
Air flowmeter indicates $\dot{v}$ = 1 L/min. O

O2 flowmeter indicates $\dot{v}$ = 0.8 L/min. O

N2O flowmeter indicates $\dot{v}$ = 1.6 - 2.6 L/min. O

Uncouple O2-CS connector, trigger O2 flush.

Air flowmeter indicates $\dot{v}$ = 1 L/min. O

O2 flowmeter indicates $\dot{v}$ = 0 L/min. O

N2O flowmeter indicates $\dot{v}$ = 0 L/min. O

Uncouple air-CS connector.
Air-CS pressure display falls.

Air flowmeter indicates $\dot{v}$ = 0 L/min. O
Close fine control valves, connect CS hoses.

24. Functional test of ventilation mode

Switch on Fabius and run through self-test.

Unit switches to standby on completion of self-test.
No error messages. O

Connect up test thorax 7901082.

24.1 Manual ventilation
Select Man/Spont

Fresh-gas flow $\dot{v}$ = 3 L/min.
APL valve set to MAN, 30 mbar.
Use manual breathing bag to perform manual ventilation. O

24.2 Spontaneous breathing
Test set-up as above:

APL valve set to SPONT/IPPV

Test objective:
Spontaneous breathing must be possible with test thorax. O

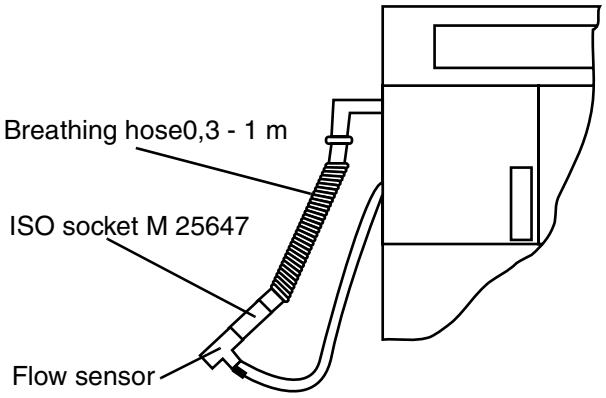
24.3 Flow sensor zeroing:

(With SW > 2.5 check that gas type is set to AIR)
Move to STANDBY. Detach hoses of flow sensor from control box.

Call-up zeroing page by pressing

Zero flow sensor.
Zeroing successful.. O

Move to IPPV and set a fresh-gas flow of 3 L/min. Reconnect hoses, connect flow sensor to ventilator output as per drawing.



Set
pmax = 70mbar
V_T =500 mL
f_{IPPV} = 6/min
TI:TE = 1 : 1
TIP:TI = 10 %
PEEP = 0mbar

Measured flow = 420 - 580 mL V

Install flow sensor.
Upgrade unit ready for operation.

24.4 IPPV ventilation
Setting:
APL valve set to IPPV
Make the following control box settings:
Pmax = 70 mbar
Vt = 380 mL
fippv = 12 1/min.
TI:TE= 1:1
TIP:TI = 10%
PEEP = 0 mbar
Test thorax connected
Press IPPV button
Display: IPPV mode?
Press button

	Unit starts ventilation.	O	
	Drive runs quietly and smoothly	O	
24.5	Display V_{te} = 300 - 450 ml	O	

24.6 Peep pressure

Steady-state control after max. 10 breaths.
Adapt pressure warning limits if necessary
Press PEEP parameter button.

Display indicates ventilator settings.
Set the following Peep values.

Setting	Test value:		
0	Ppeep = 0 + 2 hPa	V	
10	Ppeep = 10 ± 2 hPa	V	
15	Ppeep = 15 ± 3 hPa	V	

Set Ppeep = 0 hPa.

24.7 Pmax check:

Seal off Y-Piece. Connect pressure gauge to P_{AW} port.
Set following Pmax values:

Setting	Test value:		
25	P = 25 + 5 hPa	V	
40	P = 40 ± 5 hPa	V	
60	P = 60± 5 hPa	V	
70	P = 70± 5 hPa	V	

24.8 APL valve check:

Set Fabius to „MAN“ .
Increase fresh-gas flow to 5 L/min.
Y-piece is sealed.
Set APL valve to „MAN“, 30 mbar.

Pressur display:
27 -33 hpa V

Set APL valve to „IPPV/SPONT“
Pressure display:
0-3mbar V

Set flow to zero, unit set to STANDBY.

25. Safety tests

25.1 Power cord C

25.2 Protective conductor test as per VDE 751
Test objective: R < 0.2Ω V

25.3 Equivalent unit leakage current

Fabius mains switch on.

Subsequent measurements may exceed the first-measured value by max. 50 % but must at the same time be ≤ 750 µA. V

First-measured value

Ileak ≤ 750 µA µA

Note:
The first-measured value is always to be transferred to a new TC.

26. Assemble unit and all accessories ready for operation.

Check tightness and proper attachment of all hose connections.

Supply unit to customer ready for operation.

27. Tests carried out by/on:

Name:

Date:

Signature:

28. * These steps are regarded as repair work and are therefore not included in the inspection service price.

29. Report:

5.0 Spare and Replacement Parts

Part numbers for field-replaceable items on the Fabius anesthesia system are listed on the following pages, along with part numbers for related hardware and cables.

The item numbers are keyed to the accompanying illustrations to aid in identifying the item and its location.

ASSEMBLY/PART PAGE

Fabius Trolley 5-2, 5-3
Pin Index Trolley Assembly 5-4, 5-5
Writing Tray 5-6, 5-7
Gasbox, including vapor mounts 5-8, 5-9
Flowmeter assembly 5-10, 5-11
Gas inlet assemblies . . . . . 5-12 thru 5-15
Circle 9 System: Support 5-16, 5-17
Circle 9 System: Inspiratory valve 5-18, 5-19
Circle 9 System: Expiratory valve 5-20, 5-21
Circle 9 System: Absorber. 5-22, 5-23
Circle 9 System: Intermediate piece 5-24, 5-25
COSY Compact Breathing System 5-26, 5-27
COSY Absorber Top 5-28, 5-29
COSY Absorber Canister 5-30, 5-31
Control Box, Front Bezel Assembly, Fuse Data. 5-32, 5-33
Ventilator Assembly. 5-34, 5-35
Battery Assembly 5-36, 5-37
Pneumatic Control System (early design). 5-38, 5-39
Pneumatic Control System (later design) 5-39A, 5-39B
A-cone Switch, Fresh Gas Hose, Power Cord Assemblies 5-40, 5-41
Flow sensor, O2 Sensor, Pressure Sensor Hose 5-42, 5-43
Optional Items:
Bain Circuit Adapter, Breathing Pressure Gauge 5-44, 5-45
Cylinder Conversion Kit. 5-46, 5-47
Semi-Open Adapter Assembly 5-48, 5-49

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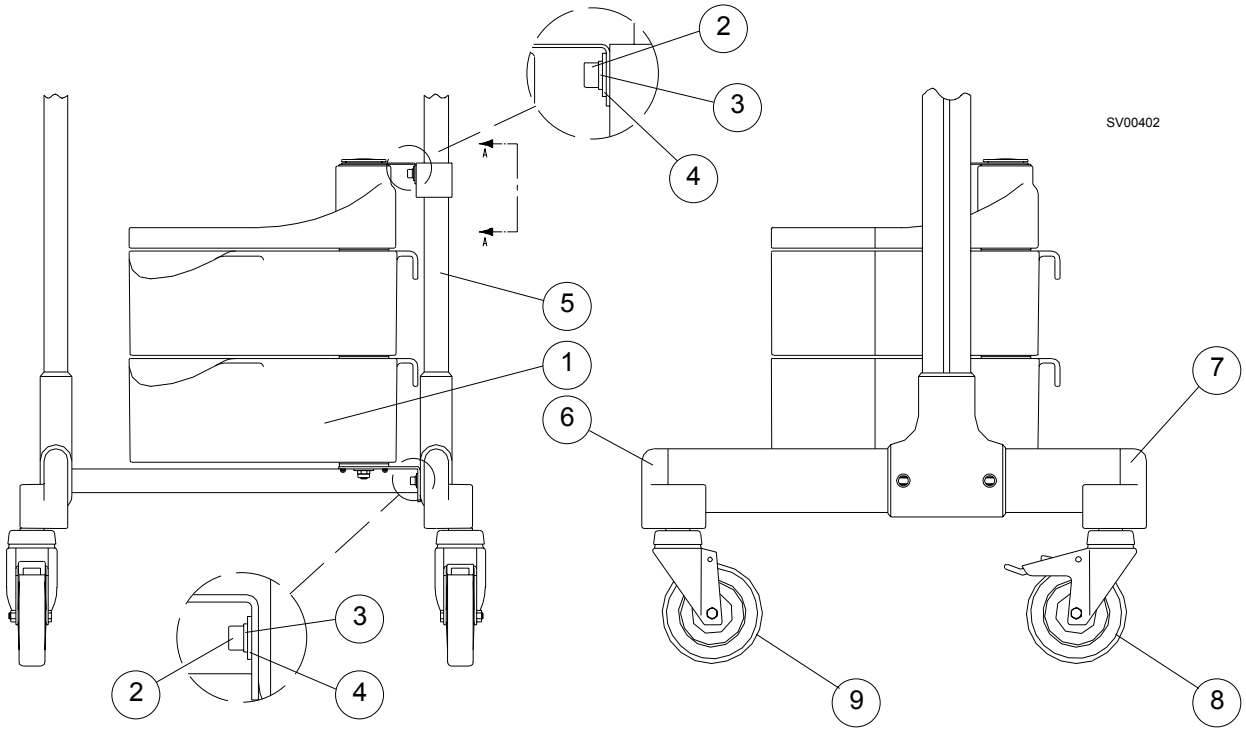

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ITEM	DESCRIPTION	PART NUMBER
	Fabius Trolley	2603200
1.	Drawer assembly	2600260
	Drawers	2M20638
2.	Screw, M6 x 16 (4x)	1331922
3.	Washer, DIN 127-x 12CRNI 177 (4x)	1333941
4.	Washer (4x)	1292358
5.	Chassis	2600210
6.	Wheel holder, right (2x)	2600258
	New part number	4116143-001
7.	Wheel holder, left (2x)	2600259
	New part number	4116142-001
8.	Locking caster (2x)	M34523
9.	Caster (2x)	M34524

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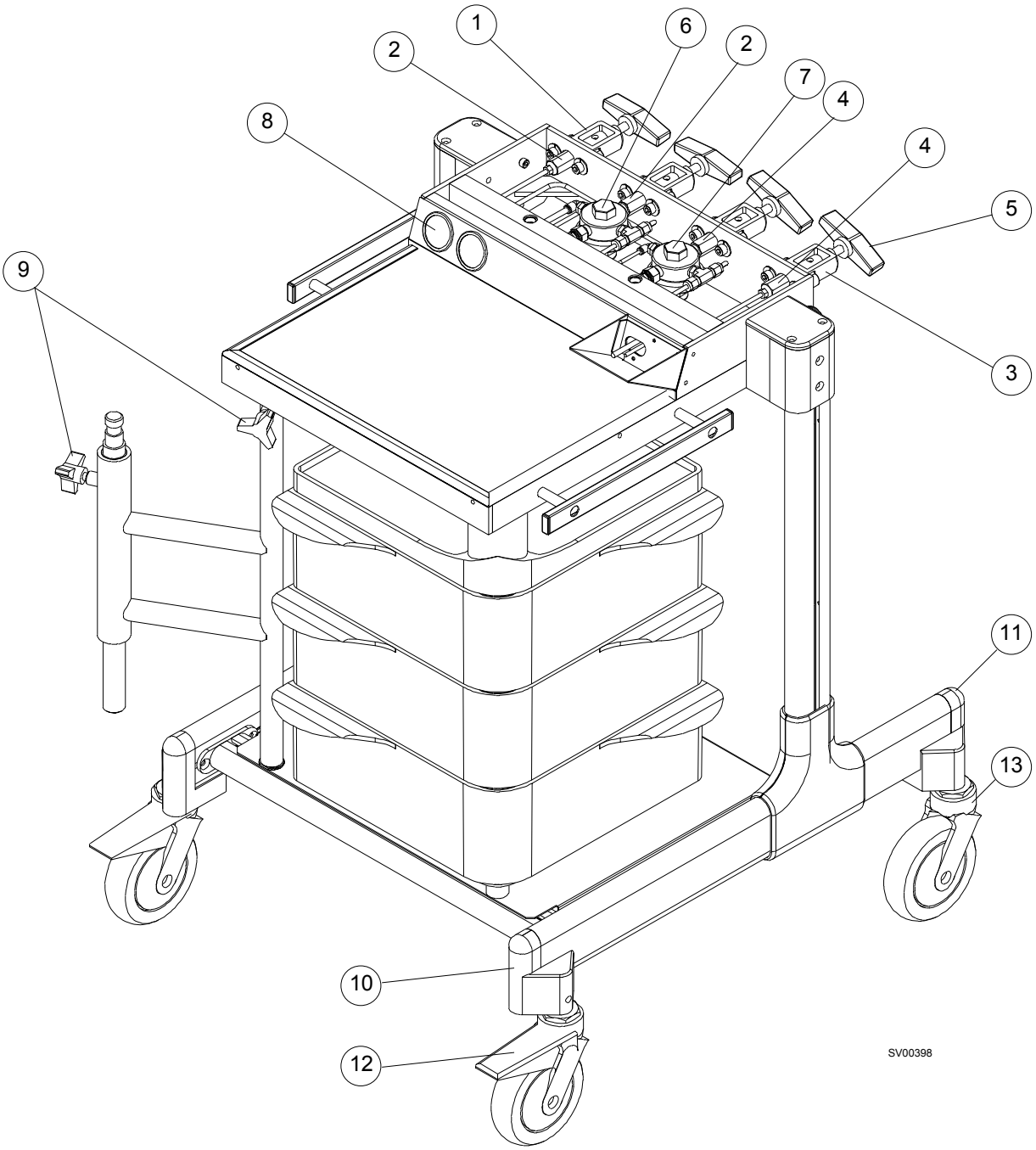

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ITEM	DESCRIPTION	PART NUMBER
	Pin Index Trolley Assembly (3 drawer)	4115907
1.	Yoke, O2 (2x)	1101620
2.	Check valve assembly, O2 (2x)	4113932-001
3.	Yoke, N2O (2x)	1101621
4.	Check valve assembly (2x)	4111792
	Parts common to all yokes:	
5.	Handle	4113536
	Screw, (index pin), sltd, 0.157OD x 6-32 x 0.718L (2x per yoke)	4105929
	Plug & chain assembly	4112755-001
6.	Regulator, O2	4103590
7.	Regulator, N2O	4103591
8.	Gauge, 3000 psi (2x)	4115928
	Hose, 4 x 1 PAE white, 660 mm	1210165
	Hose, 2.7 x 0.65 PAE blue, 440 mm	1210211
9.	Wing screw, 3/8-16 x 1 in. (2x)	1100078
10.	Wheel holder, right (2x)	2600258
	New part number	4116143-001
11.	Wheel holder, left (2x)	2600259
	New part number	4116142-001
12.	Locking caster (2x)	M34523
13.	Caster (2x)	M34524
	Other trolley options:	
	Pin Index Trolley (Dodhy)	4115198
	Pin Index Trolley (no drawer)	4115907-001

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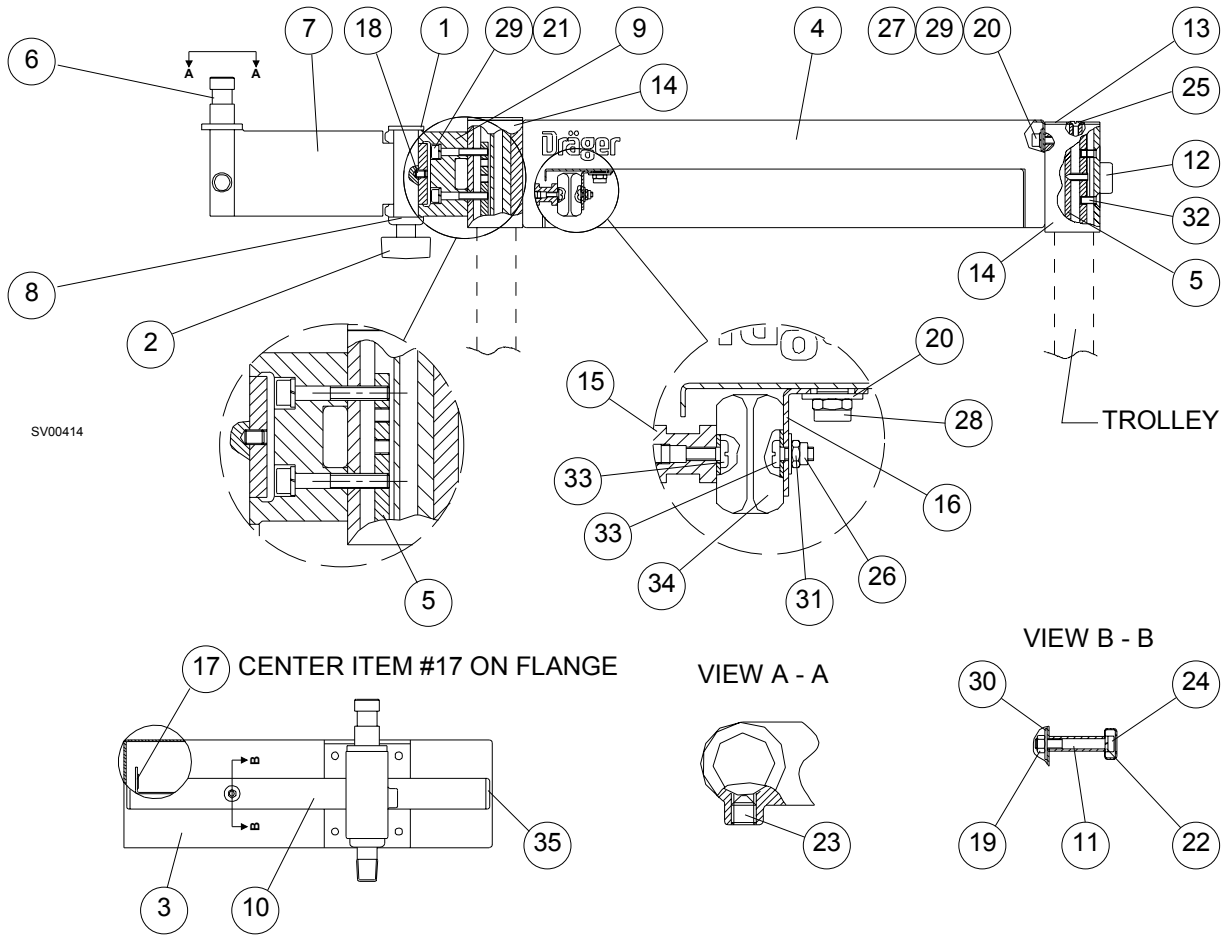

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ITEM	DESCRIPTION	PART NUMBER
	Writing Tray	4115174
1.	Hinge arm shaft group	2600223
2.	Locking screw handle	2600230
3.	Table	2600240
4.	Writing plate	2600250
5.	Plate (2x)	2600201
6.	Hinge bolt	2600221
7.	Hinge arm	2600226
8.	Locking plate	2600227
9.	Hinge arm holder	2600229
10.	Left rail	2600238
11.	Spacer (3x)	2600239
12.	Right rail	2600244
13.	Plate (2x)	2600246
14.	Clip (2x)	2600248
15.	Drawer stand (4x)	2600251
16.	Angle (square bar) (2x)	2600252
17.	Sponge tape	2690059
18.	Screw, skt hd M6 x 8 A4 DIN 471	1264273
19.	Nut, hex M8 DIN 934 - M A4/051 (3x)	1267582
20.	Washer (12x)	1292358
21.	Screw, M6 x 45 (2x)	HW01122
22.	Lock washer, split M8 - DIN 7980 (3x)	1314440
23.	Screw, set	1324586
24.	Screw, skt hd M8 x 60 - DIN6912 (3x)	1329952
25.	Screw, M5 x 16 A (4x)	1331442
26.	Washer, B4.3 DIN 9021 - A4 (4x)	1331914
27.	Screw, M 6 x 16 (8x)	1331922
28.	Nut, hex M6 (4x)	1333062
29.	Washer, DIN 127 x 12 CRNI 177 (10x)	1333941
30.	Washer, A8.4 DIN 125 - A4/051 (3x)	1324780
31.	Nut, hex M4 (4x)	1336002
32.	Screw, M6 x 16 DIN 7991 - A4 (2x)	1338811
33.	Screw, M4 x 10 DIN 7985 (8x)	1342606
34.	Telescope rail (2x)	2M18364
35.	End cap (4x)	G60455

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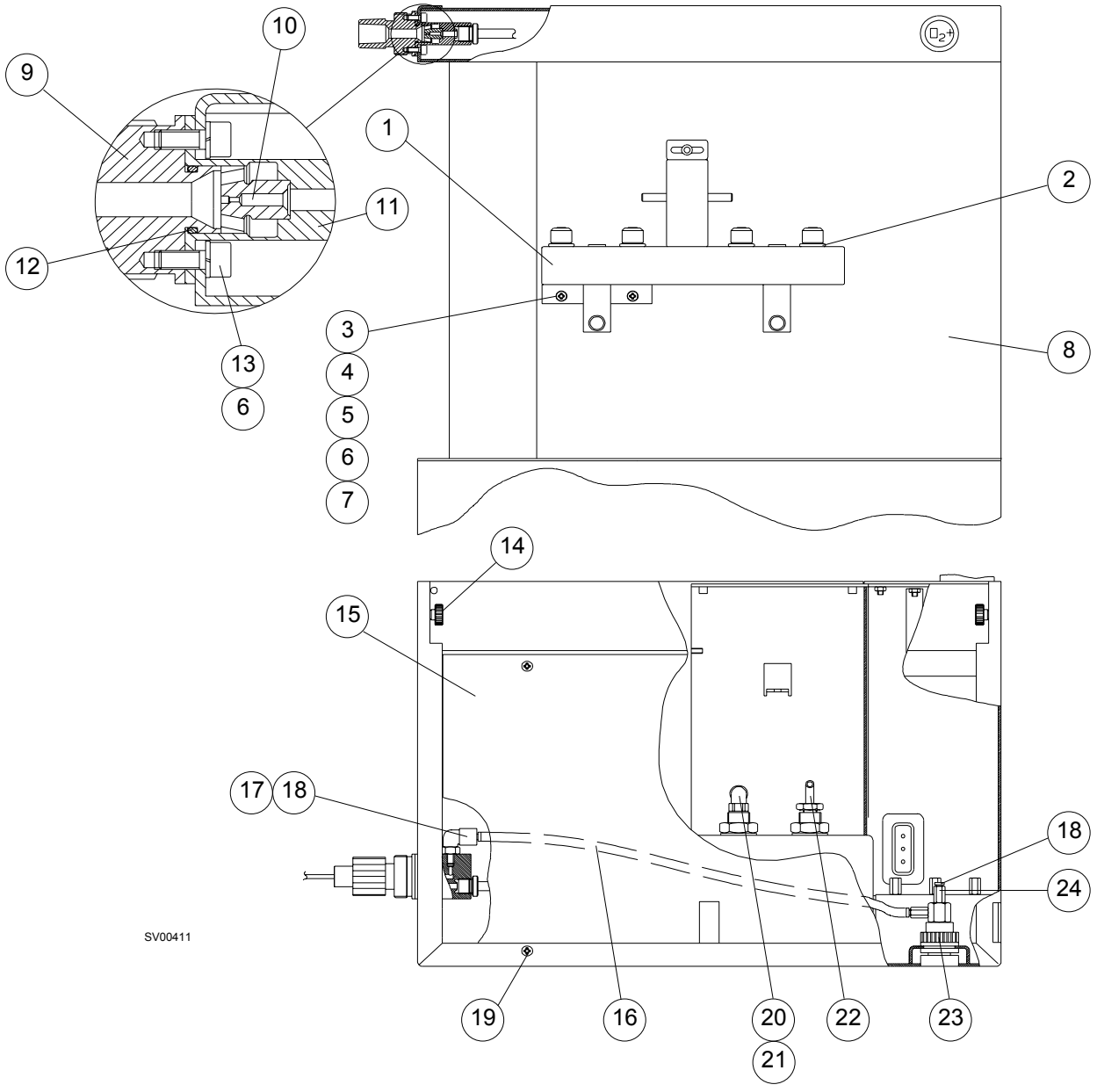

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ITEM	DESCRIPTION	PART NUMBER
	Gasbox Assembly	4115234
1.	One position vapor mount.	4115254
	Two position vapor mount (illustrated)	4115019-001
	One vapor mount Selectatec	M35125
	Two vapor mount Selectatec	M35115
2.	O-ring.	4115864
3.	Screw, PH flt hd M4 x 12 - DIN 965	1339966
4.	DW nut, hex M4 DIN 934	1328956
5.	Washer, flat M4.3 DIN 125	1327542
6.	Washer, lock split M4 DIN 7980	1293680
7.	Block holder	2600098
8.	Box housing	2600510
9.	Mix gas cone connector	2600501
10.	Pressure nozzle	2600502
11.	Connector lump	2600503
12.	O-ring	E20278
13.	Screw, M4 x 10 DIN 912 - A4/051 (2x)	1320858
14.	Bolt (2x)	2M17338
15.	Top door group	2600529
16.	Hose, 2.7 x 0.65 PAE white (380 mm)	1210157
17.	Angle connection	M30953
18.	Washer, M4 white	M31602
19.	Screw, PH flt hd M4 x 8 DIN 965 (8x)	1339958
20.	Angle connection	M30961
21.	Collar, 6mm white	M31603
22.	Pipe, V to MGC.	2600590
23.	O2 flush valve assembly	M31774
24.	Straight connector M5	M30952

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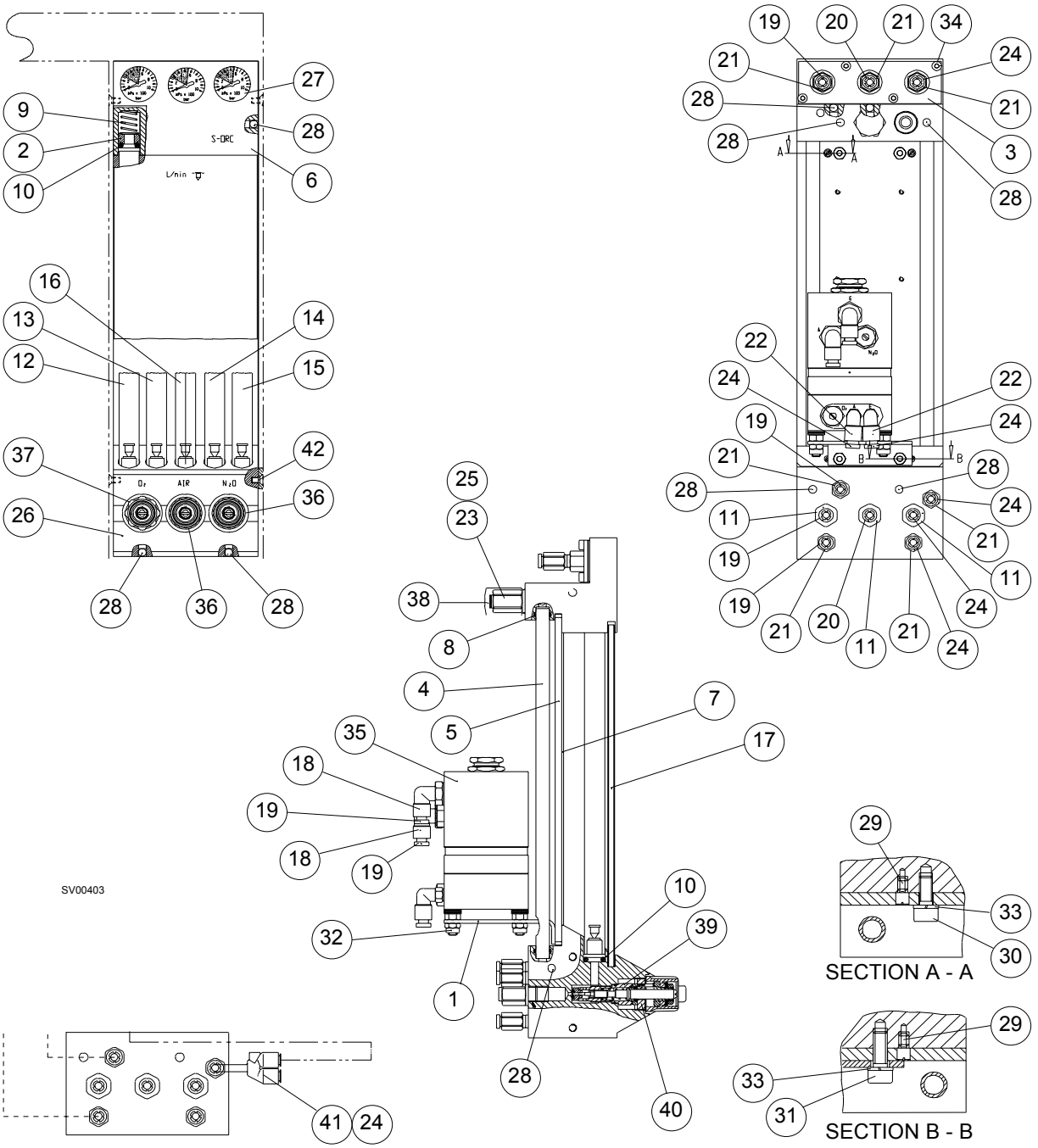

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ITEM	DESCRIPTION	PART NUMBER
	Flowmeter assemblies	2603012 (illustrated), 2603504, 2600332, 2605010
1.	ORC mounting plate	4116069
2.	Hanger (1x per tube)	2600303
3.	Upper rear tubing plate	2600316
4.	Tube (2x)	2600317
5.	Rear panel	2600318
6.	Upper flowmeter block	M33601
7.	Glueing foil	2600320
8.	O-ring (4x)	M16201
9.	Spring (1x per tube)	M12928
10.	O-ring (2x per tube)	M34329
11.	Fitting, pilot to Divan (3x)	M28816
12.	Flow tube, O2, 0.02 - 0.50 L/min	4115648
13.	Flow tube, O2, 0.55 - 10 L/min	4115649
14.	Flow tube, N2O, 0.02 - 0.5 L/min	4115650
15.	Flow tube, N2O, 0.55 - 10 L/min	4115651
16.	Flow tube, Air	4115647
17.	Washer, DIN 7168	M30297
18.	Fitting, 90° elbow G 1/8(2x)	M30935
19.	Washer, 4 mm blue (6x)	M30937
20.	Ferrule, pilot to Divan (2x)	M30963
21.	Fitting, straight, M5 (7x)	M30952
22.	Fitting, 90° elbow (2x)	M30953
23.	Fitting, Luer	M30960
24.	Washer, M4, white (8x)	M31602
25.	Collar	M31603
26.	Bottom flowmeter block	M32641
27.	Pressure gauge (3x)	M33402
28.	DW Ball (plug) (12x)	1270656
29.	Screw, M3 x 4 DIN 927 - A2/051 (4x)	1329383
30.	Screw, M4 x 10 DIN 912 - A4/051 (2x)	1320858
31.	Screw, M4 x 12 DIN 912 - A2 (2x)	1293664
32.	Nut, hex, M5 DIN 980 - A4/051 (4x)	1335618
33.	Washer, spring, M4 DIN 127 (4x)	1331345
34.	DI screw (4x)	1331930
35.	Proportional valve (ORC)	M32940
36.	Knob, A1 (2x)	2600304
37.	Knob. ISO	2600309
38.	Safety valve	4115950
39.	Flow control valve (3x)	4115871
40.	Valve, pillar (3x)	4115951
41.	Y-plug	M30962
42.	Screw, M5 x 10 DIN 7991 - 8.8/155 (4x)	1336134
	Hose, 2.7 x 0.65 PAE - blue (820 mm total)	1210211
	Hose, 2.7 x 0.65 PAE - bl/white (500 mm total)	1210181
	Hose, 2.7 x 0.65 PAE - white (610 mm total)	1210157
	DW hose, 4mm x 1mm PAE NF clear (550 mm total)	1210173

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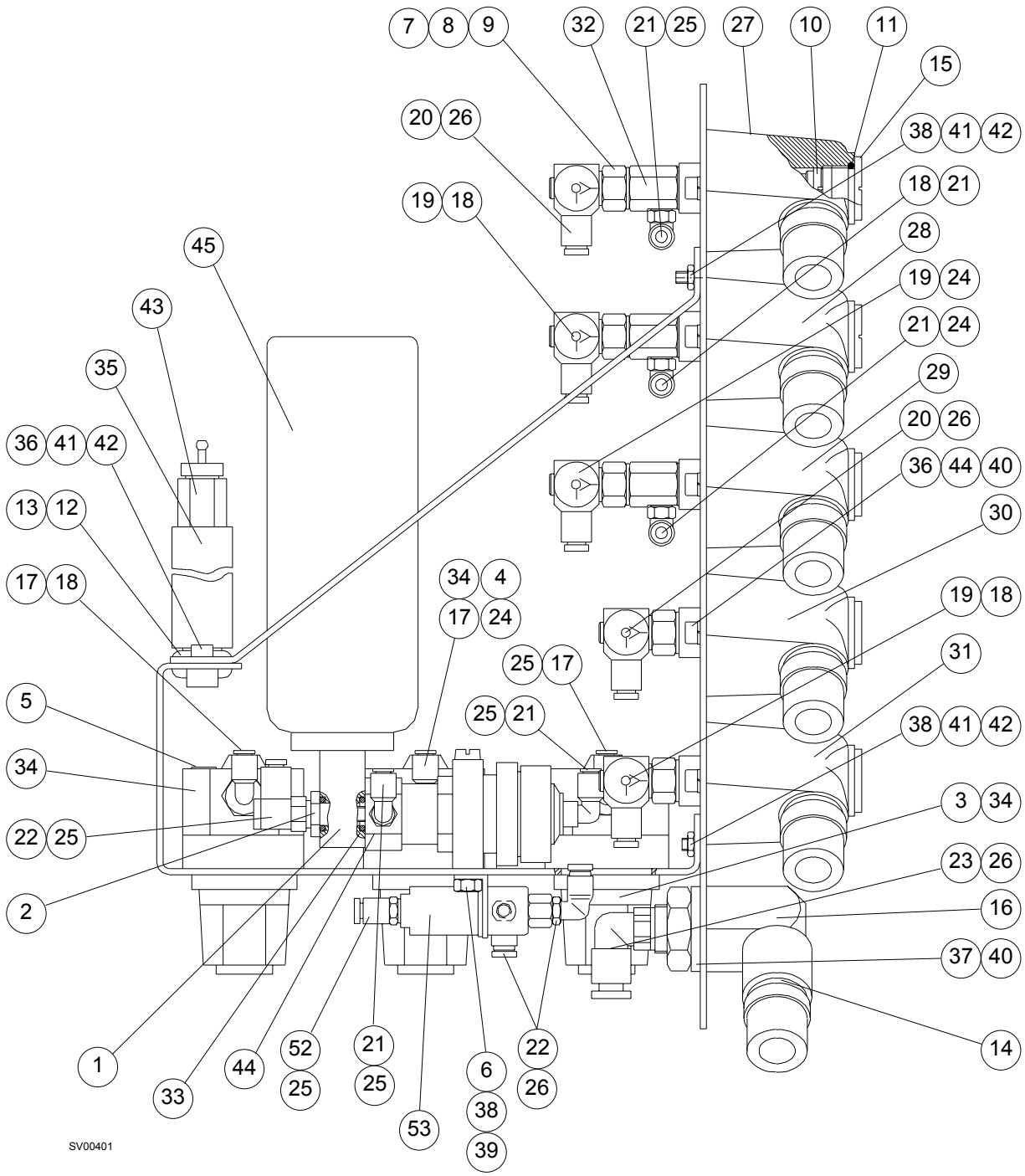

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ITEM	DESCRIPTION	PART NUMBER
	3-Gas inlet assembly (illustrated)	2603015
	2-Gas 5 connector inlet assembly	2601002
	2-Gas US/light inlet assembly	2605020
	3-Gas US/light inlet assembly	4115848
1.	Capacity holder	2600583
2.	Screw, gas	2600584
3.	Label, O2 regulator	2690056
4.	Label, Air regulator	2690057
5.	Label, N2O regulator	2690058
6.	Screw, M4 x 45 DIN 84 A4/051	1329189
7.	O-ring (Item 8, 9, or 10 selected at assembly) (3x)	M07142
8.	O-ring (3x)	M07143
9.	O-ring (3x)	M07144
10.	Filter inst. (5x)	M19238
11.	O-ring (5x)	M19241
12.	Socket	M25072
13.	Socket	M25073
14.	Connector, Air/O2 NIST	M34975
15.	Screw, closing	4115840
16.	Connection piece	M29118
17.	90° connector G 1/8(6x)	M30935
18.	Washer, 4mm blue (10x)	M30937
19.	One way angle connector G 1/8(3x)	M30945
20.	One way angle connector G 1/8(2x)	M30946
21.	Angle connector (7x)	M30953
22.	One way angle connector M 1/8	M30956
23.	Angle connector, M5	M30961
24.	Ferrule, pilot to Divan (4x)	M30963
25.	Washer, M4 white (15x)	M31602
26.	Collar, 6mm white (12x)	M31603
27.	Housing, O2	M31991
28.	Housing, N2O	M31992
29.	Housing, Air	M31993
30.	Housing, O2	M32311
31.	Housing, N2O	M32312
32.	Intermediate piece (3x)	M33283
33.	O-ring (2x)	M20274
34.	Pressure regulator (3x)	8402745
35.	Hose, trans 2 x 3 SI NF DWN 2516 340mm	1198912
36.	Screw, M4 x 10 DIN 912 - A4/051 (11x)	1320858
37.	Washer, lock DIN 6798	1270850

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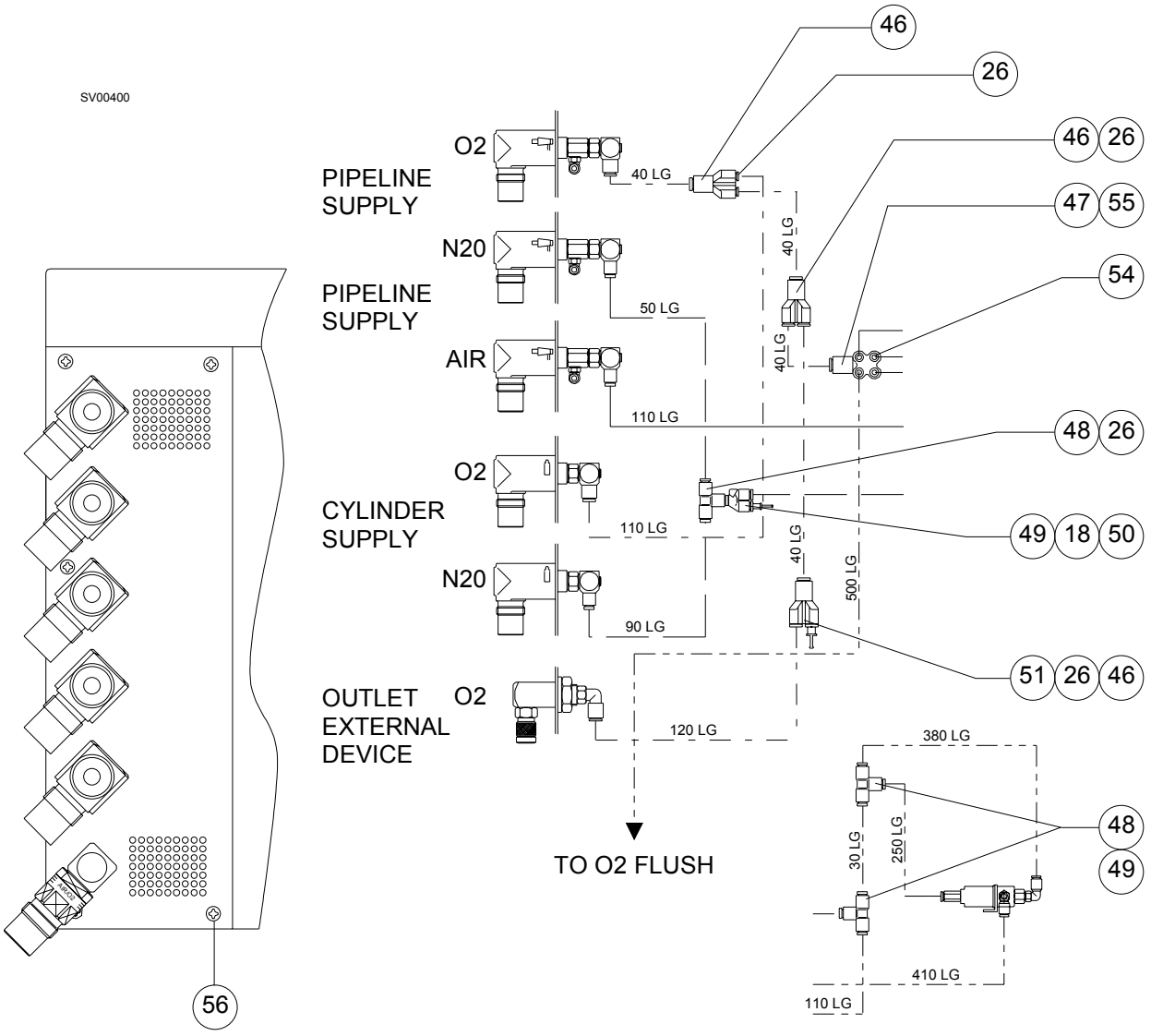

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ITEM	DESCRIPTION	PART NUMBER
	Gas inlet assembly continued	
38.	DW-nut, hex M4 DIN 934 (5x)	1328956
39.	Washer, flat M4.3 DIN 125 (12x)	1327542
40.	Nut, hex M16 x 1.5 BM DIN 439 - A2	1335006
41.	Washer, spring M4 DIN 127 (14x)	1331345
42.	Washer, B4.3 DIN 9021 - A4 (4x)	1331914
43.	Injector	M25062
44.	Alarm	2600480
45.	Volume asm	M33582
46.	Y-pipe (3x)	M31424
47.	Y-pipe	M28817
48.	T-connector (3x)	M32803
49.	Y-plug	M30962
50.	Contact, 4mm	M31348
51.	Contact, 6mm	M33257
52.	Straight connector M5	M30952
53.	Input valve, vent, complete	M32773
54.	Button, manual, REL 5.85 ID (4x)	4115551
55.	Buton, manual, REL 7.75 ID	4115552
56.	Screw, pan hd M4 x 8 DIN 7985 (5x)	1340778
	Hose, 2.7 x 0.65 PAE blue (total 650 mm)	1210211
	Hose, 2.7 x 0.65 PAE bl/wht (total 510 mm)	1210181
	Hose, 2.7 x 0.65 PAE white (total 2855 mm)	1210157
	Hose, 4 x 1 PAE wht (total 390 mm)	1210165

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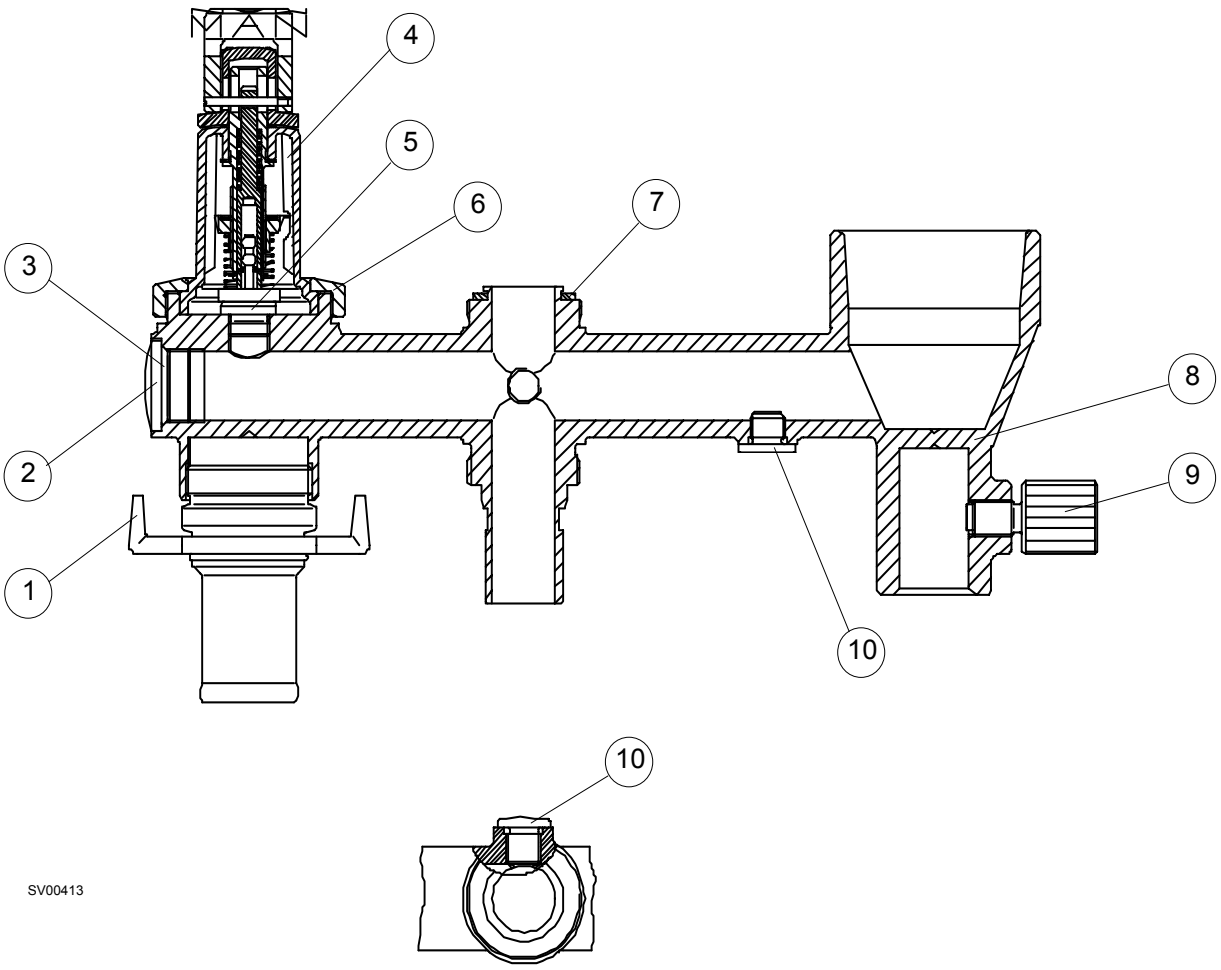

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ITEM	DESCRIPTION	PART NUMBER
	Circle 9 System	2603100
	Circle 9 System Support	2600110
1.	Non-return valve	M32579
	Hook spring ring	M17786
2.	Screw plug	2600101
3.	O-ring	R26807
4.	APL valve	2600112
5.	Crater screw	M17774
6.	Union nut	2600107
7.	O-ring	M09257
8.	Housing	M32576
9.	Clamp screw	2600102
10.	Small plug (2x)	2600103

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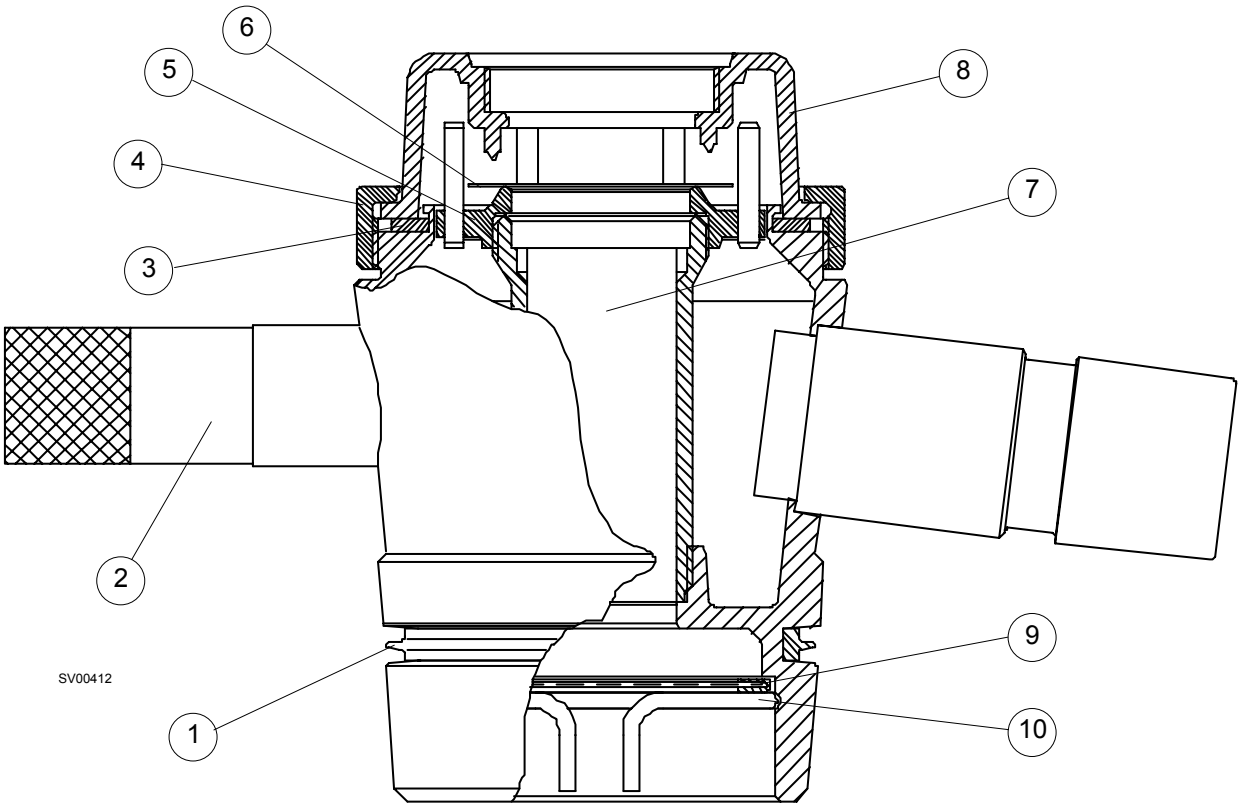

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ITEM	DESCRIPTION	PART NUMBER
	Circle 9 System (continued)	2603100
	Inspiratory valve	2600120
1.	O-ring	M32014
2.	Coupling	M26238
3.	O-ring	M09231
4.	Union nut	2600124
5.	Valve crater	M30413
6.	Valve disk	R00360
7.	Spacer	2600127
8.	Cap	M21482
9.	Filter insert asm	M19597
10.	Locking ring	M19602

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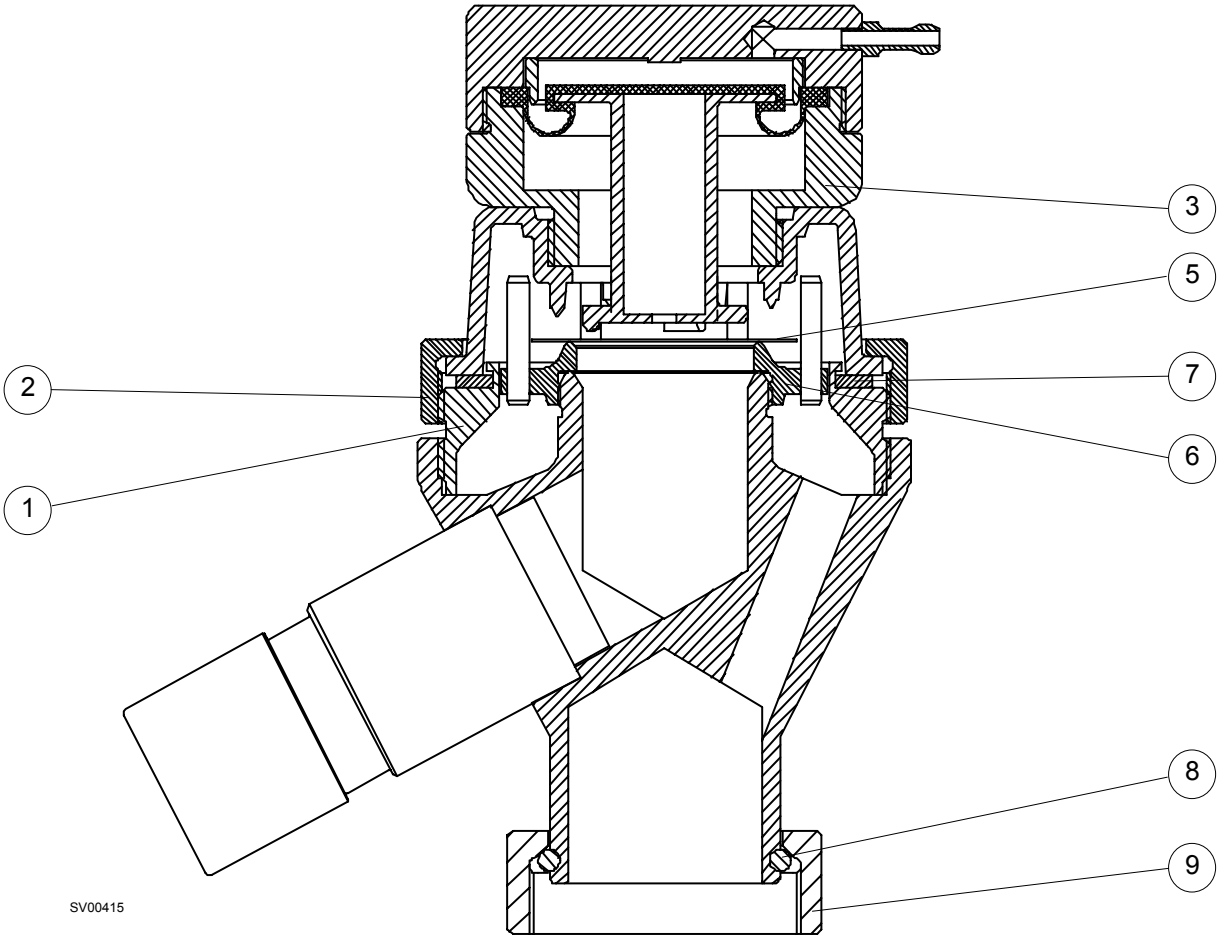

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ITEM	DESCRIPTION	PART NUMBER
	Circle 9 System (continued)	2603100
	Expiratory valve	2600140
1.	Upper nut	2600144
2.	Union nut	2600124
3.	E.V Control assembly	2600150
4.	Valve body	2600145
5.	Valve disk	R00360
6.	Valve crater	M30413
7.	O-ring	M09231
8.	Spring ring	M09224
9.	Nut	2600141

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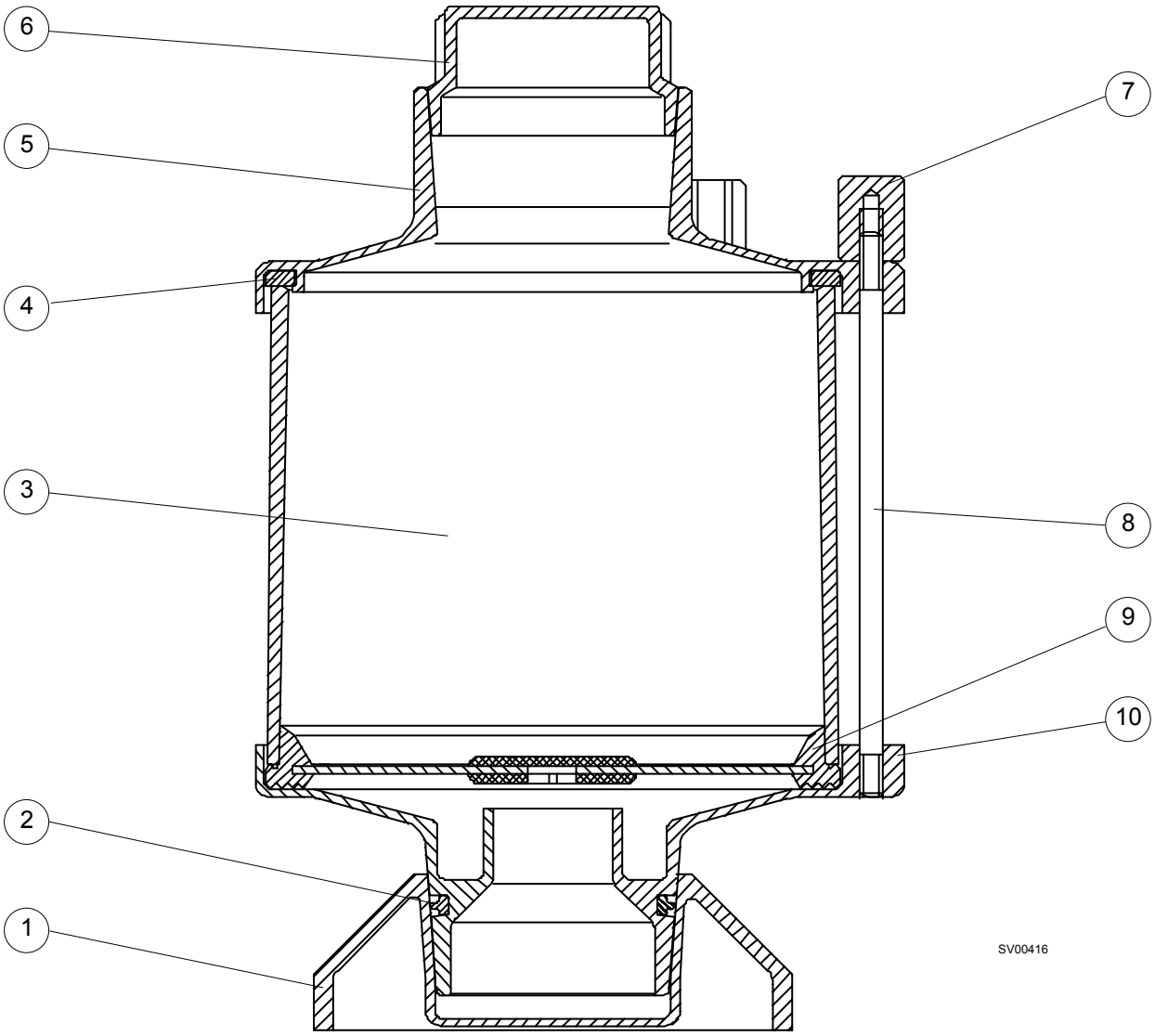

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ITEM	DESCRIPTION	PART NUMBER
	Circle 9 System (continued)	2603100
	Absorber	2600180
1.	Absorber cap, lower	M14406
2.	O-ring	M32014
3.	Absorber jacket (cylinder)	M14125
4.	O-ring	M13386
5.	Cover, top	2600188
6.	Absorber cap, top	M14405
7.	Nut	2600181
8.	Stud	2600182
9.	Absorber seat	M32028
10.	Cover, bottom	2600185

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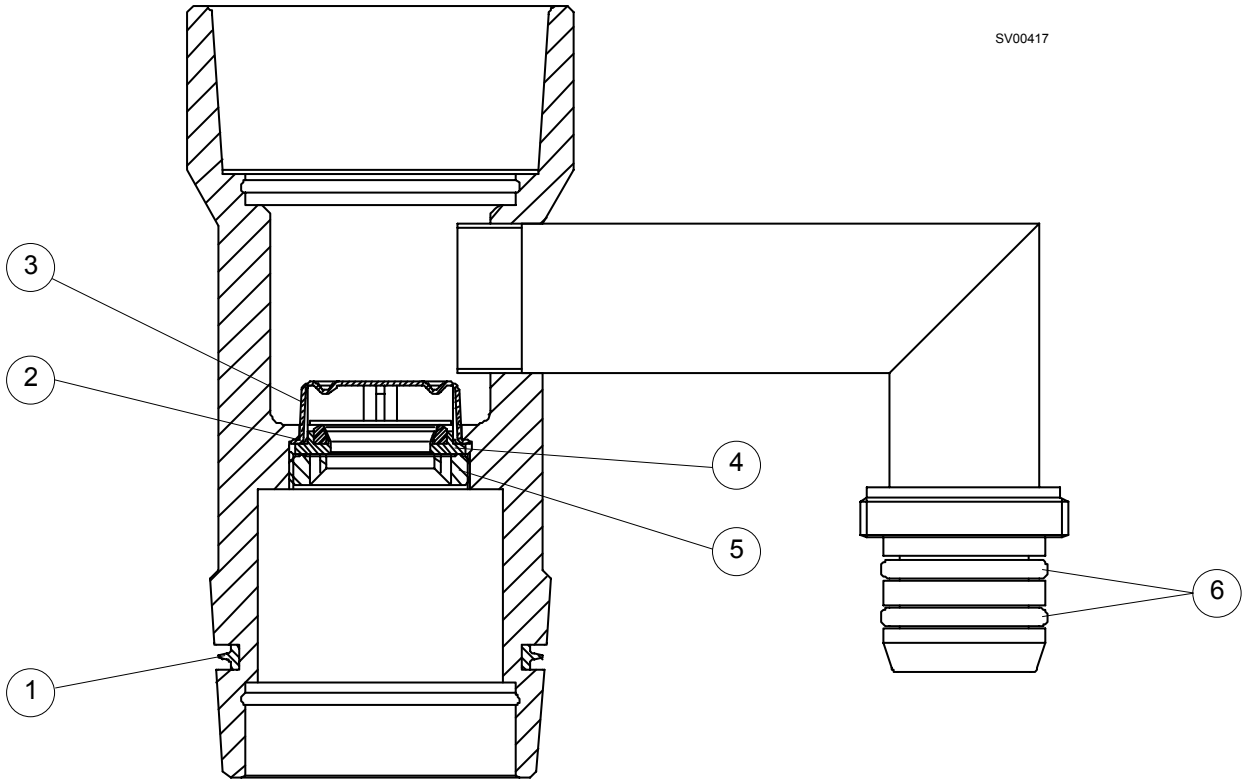

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ITEM	DESCRIPTION	PART NUMBER
	Circle 9 System (continued)	2603100
	Intermediate piece	2600160
1.	O-ring	M32014
2.	Valve screw	M31188
3.	Spring cross	M17450
4.	Crater	M32480
5.	Ring nut	M32479
6.	O-ring (2x)	2M08777

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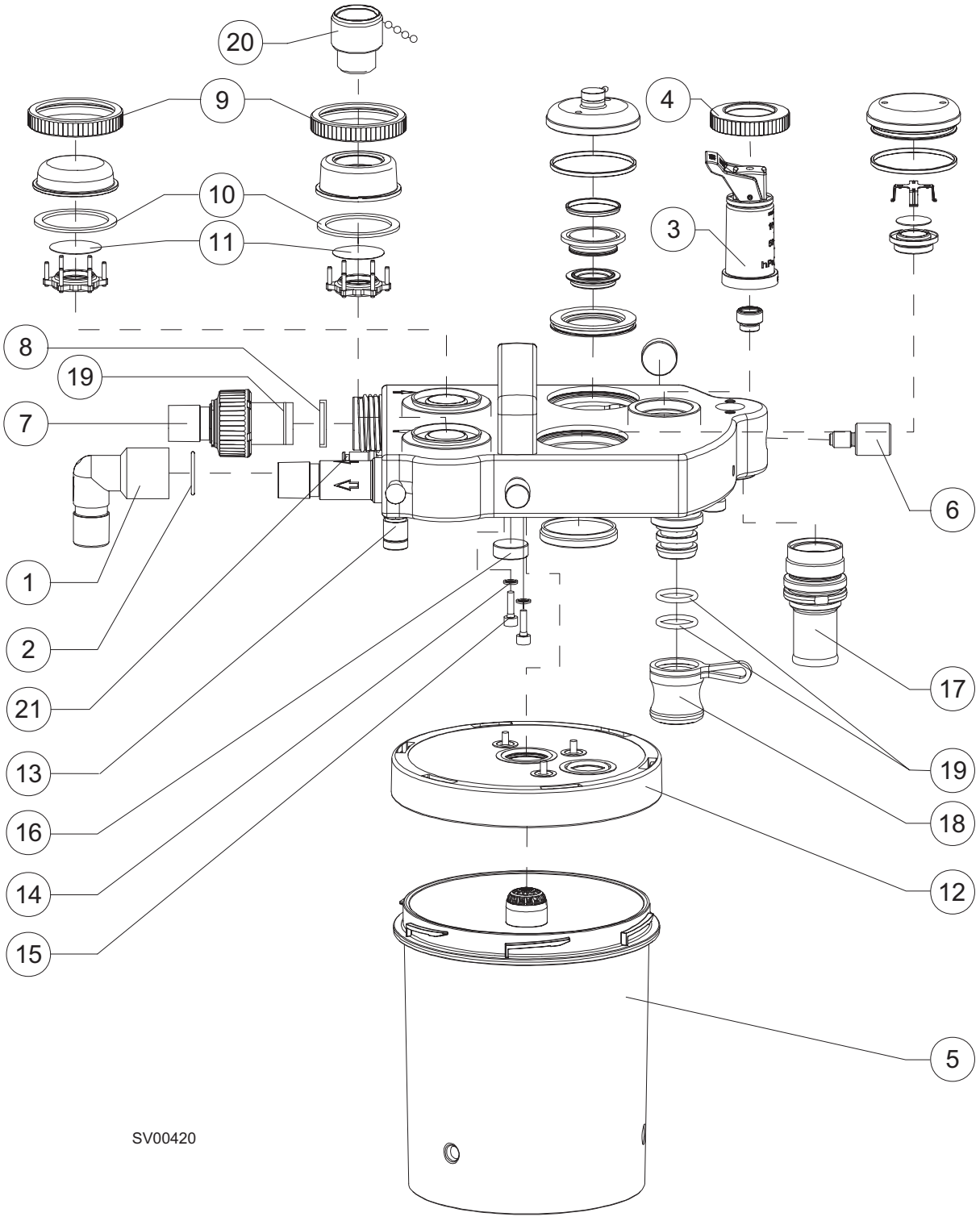

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ITEM	DESCRIPTION	PART NUMBER
	COSY assembly, modified	4115193
	Compact Breathing System COSY	2600741
1.	Angle terminal	2600469
2.	O-ring	M20622
3.	APL valve	2600457
4.	Union nut	2600454
5.	Absorber (see parts breakdown on a following page)	M29320
6.	Adjusting screw	M20031
7.	Expiration bushing	2600463
8.	Packing ring	2600477
9.	Union nut (2x)	M30453
10.	Packing ring (2x)	M09231
11.	Valve disk (2x)	M23225
12.	Absorber top (see parts breakdown on a following page)	AF00495
13.	Coupling	M26238
14.	Washer with sealing lip (2x)	M30454
15.	Screw, M5 x 16 DIN 912 - A4/051 (2x)	1329227
16.	Screw plug	2600461
17.	Non-return valve	M32543
18.	Cap	M33972
19.	O-ring (2x)	2M08777
20.	Plug assembly	4115265
21.	Quick disconnect fitting (for sample-gas return port)	M33149

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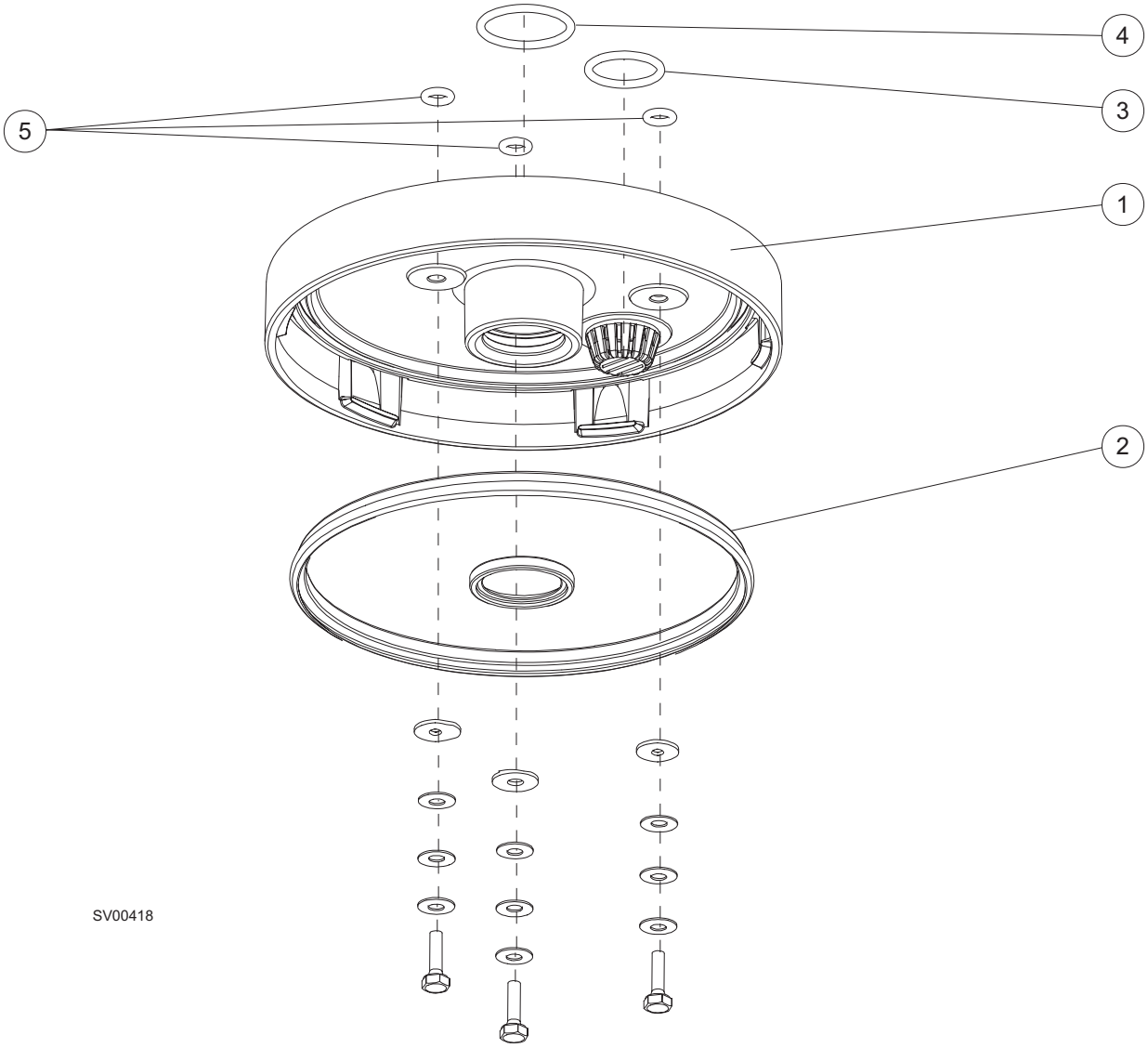

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ITEM	DESCRIPTION	PART NUMBER
	COSY Absorber Top	AF00495
1.	Absorber top piece	M33013
2.	Lip seal	M30455
3.	O-ring	R50313
4.	O-ring	R18352
5.	O-ring (3x)	4302469

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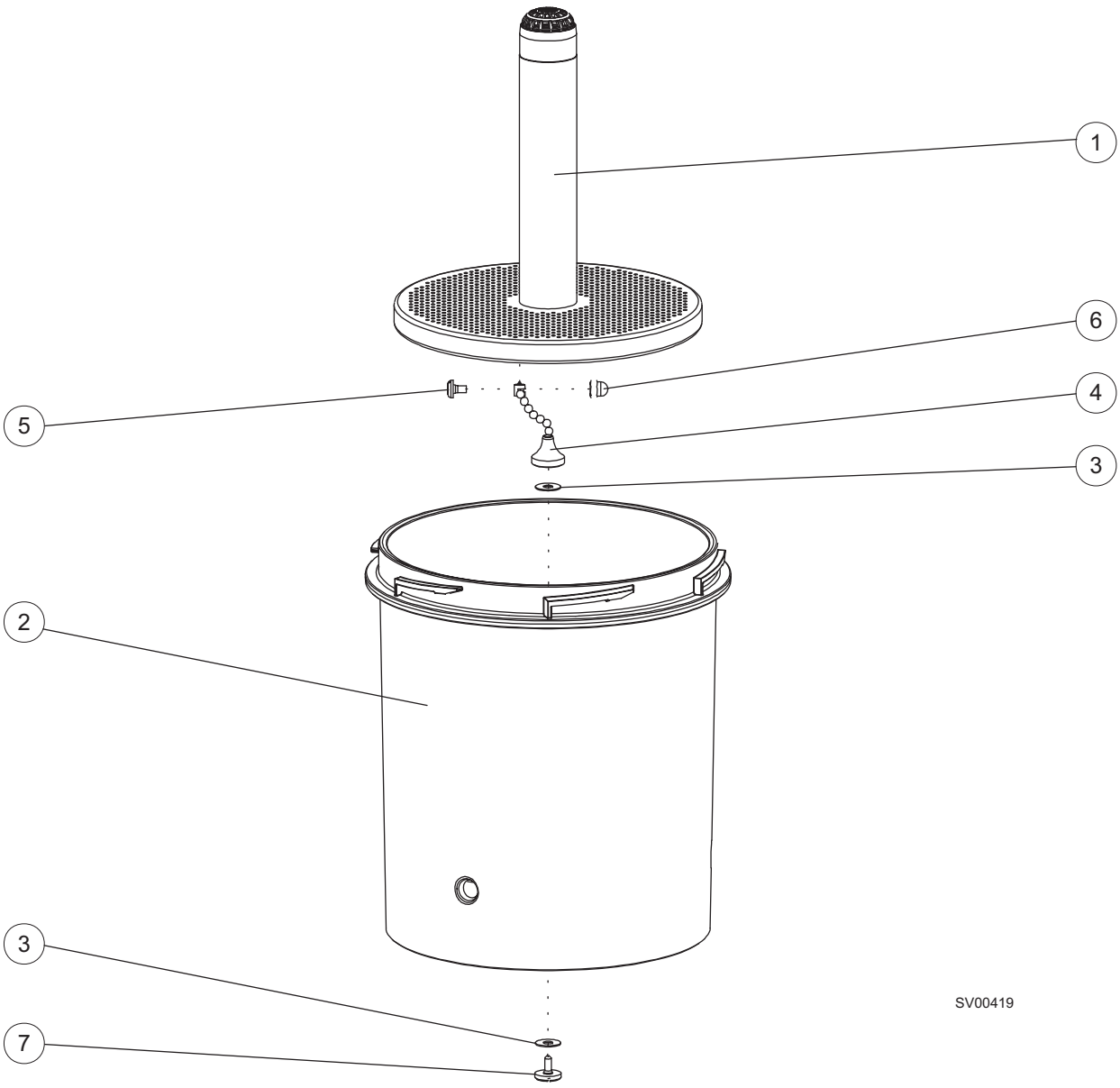

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ITEM	DESCRIPTION	PART NUMBER
	COSY Absorber Canister	M29320
1.	Screen insert	M29999
2.	Canister	M29994
3.	Packing ring	M30563
4.	Bead chain	M30562
5.	Screw, oval hd AM4 x 6 DIN 85 - A4	1315838
6.	Acorn nut, M4 DIN 1587 - M A4/051	1334751
7.	Screw, M4 x 8 DIN 921 - A2	1336029

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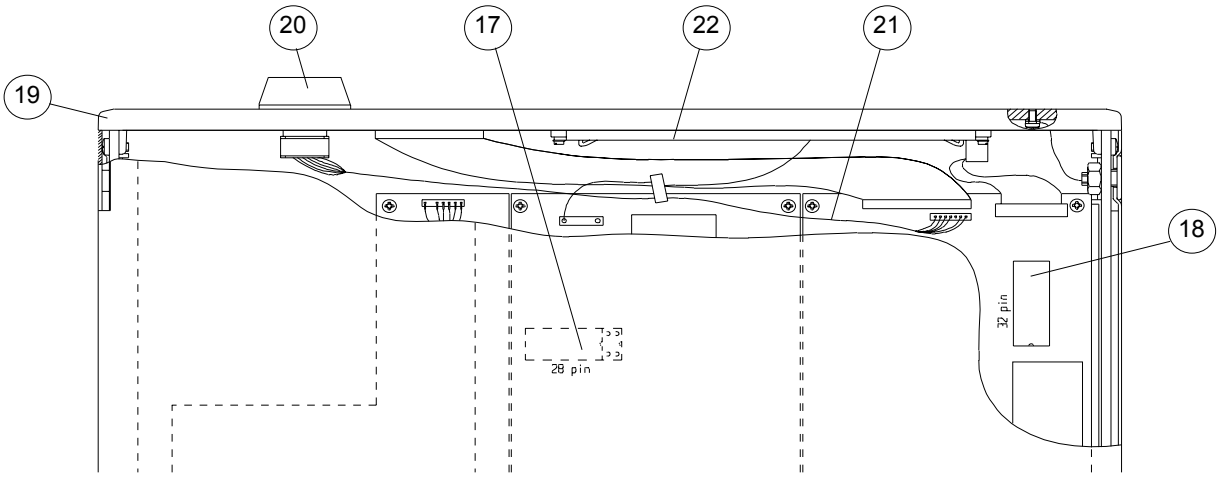

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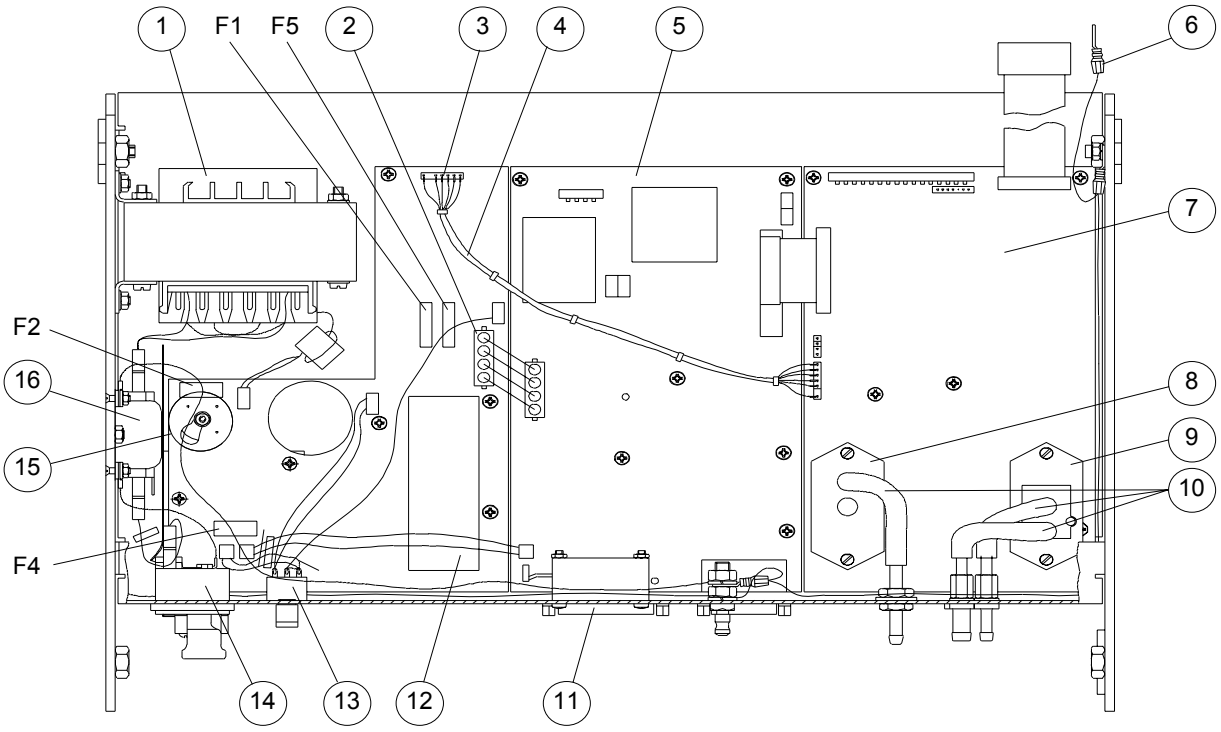

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ITEM	DESCRIPTION	PART NUMBER
	Control Box	4115255 (110V), 4115656 (220V France), 2600350 (220V)
1.	Transformer assembly	4115820
2.	Cable assembly, power	2600393
3.	Power supply PCB assembly	8201971
4.	Cable assembly, PS/control	2600392
5.	Power control PCB assembly	8201951
6.	Ground wire assembly	2600398
7.	Control PCB assembly	8201961
8.	Pressure sensor, 100 mB	1837311
9.	Pressure sensor, ±4 mB	1843060
10.	DW hose, 4mm x 2.5mm clear SI	1205102
11.	Fan assembly	2600397
12.	Cable assembly	2600387
13.	Switch assembly	2600399
	New part number	4116627
14.	Power inlet and cable assembly, 110 volt models	4115445
	Fuse, 2A (2x)	1815113
	Power inlet and cable assembly, 220 volt models	2600389
	Fuse, 1A (2x)	1815083
15.	Rectifier	1812637
16.	Mains filter	1814753
17.	Firmware, reg, ver 2.70	4115599
18.	Firmware, mstr, ver 2.70	4115598
19.	Front bezel assembly	2600355
	French/Fabian version	4115654
20.	Rotary knob	M29655
21.	Cable assembly, rotary knob	2600391
22.	Display assembly	2600374

Power Supply PCB Fuse data:

F1 5x20 mm time lag, 1.6 A	EC01200-001
F2 5x20 mm time lag, 3.15 A	EC01200-003
F4 5x20 mm time lag, 4 A	EC01200-004
F5 5x20 mm time lag, 2.5 A	EC01200-002

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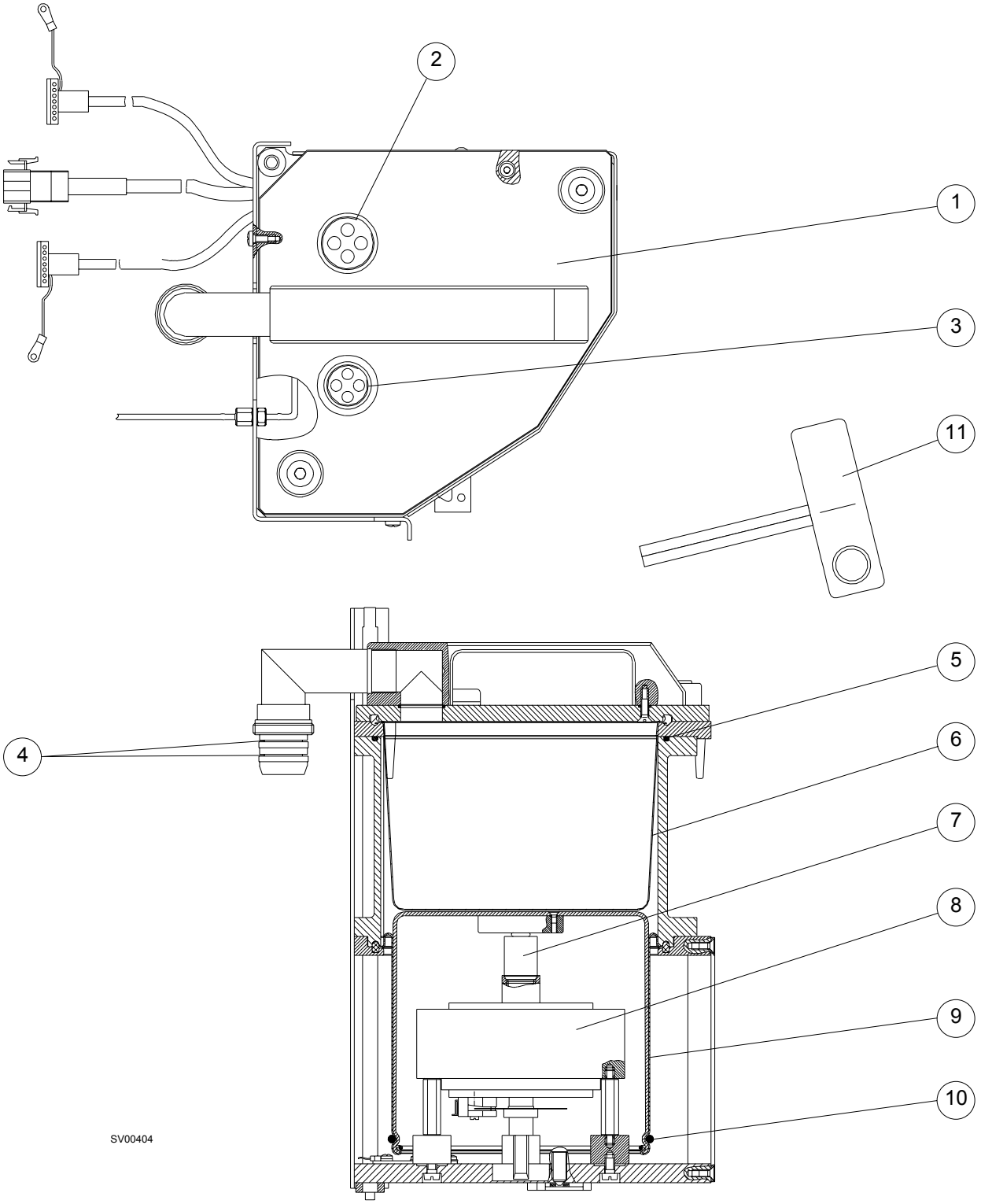

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ITEM	DESCRIPTION	PART NUMBER
	Ventilator Assembly	2600600
	New part number	2600770
1.	Patient system	2600610
2.	Additional air valve	2600670
3.	Safety valve	2600680
4.	O-ring (2x)	2M08777
5.	O-ring	2600629
6.	Diaphragm, patient side	2600650
7.	Spindle assembly	2600635
8.	Motor assembly	2600702
	New part number	4116526
9.	Diaphragm, piston side	2600651
10.	O-ring	G60337
11.	Hex wrench, T-handle	1640623

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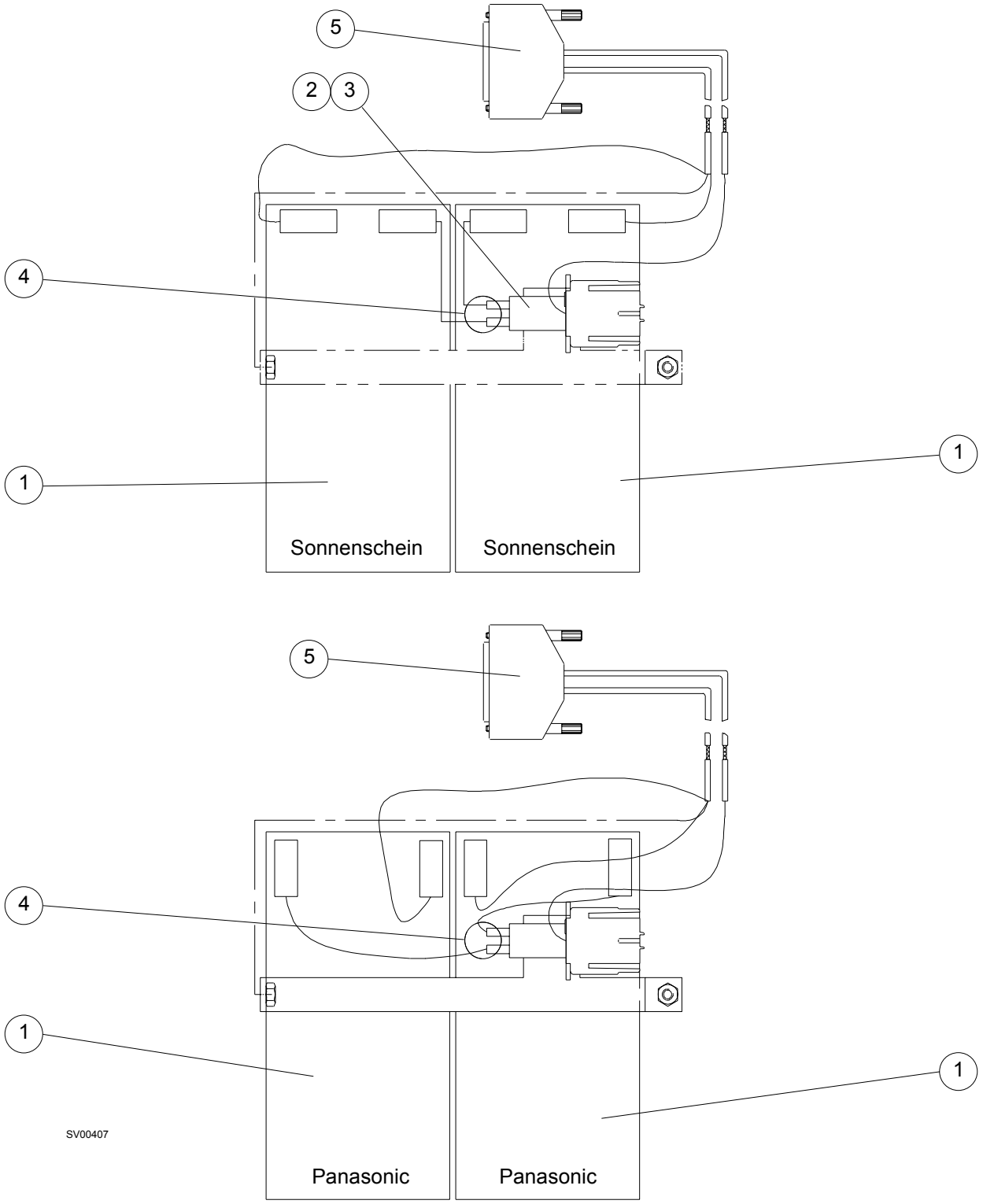

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ITEM	DESCRIPTION	PART NUMBER
	Battery assembly	2600654
1.	Battery, rechargeable (2x)	1841416
2.	Fuse, T3.15A	1815148
3.	Fuse holder	1832662
4.	Cable assembly, batteries to fuse holder	2600659
5.	Cable assembly, batteries to connector	2600658

NOTE: Battery manufacturers shown in the illustration have different terminal arrangements and polarities. Refer to the repair instructions for details.

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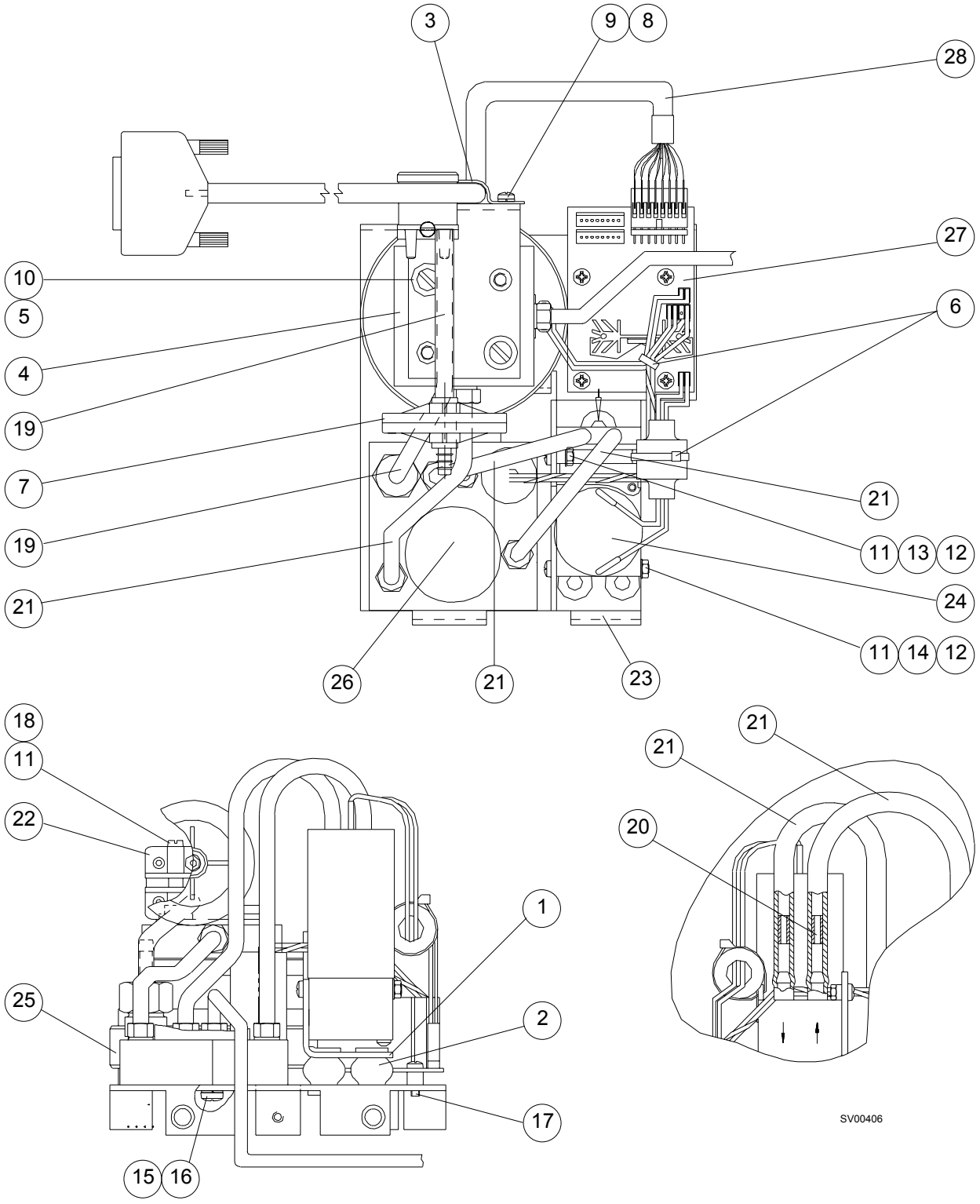

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ITEM	DESCRIPTION	PART NUMBER
	Pneumatic Control System (early design)	2600550
1.	Pump mounting plate	2600554
2.	Vibration isolator (3x)	2600569
3.	Cable clip, 2 x 8	2600526
4.	Plate	M30530
5.	Bushing (2x)	8408312
6.	Tie strap (2x)	8712007
7.	Filter	8402868
8.	Screw, M3 x 5 DIN 7985 (2x)	1340719
9.	Washer - L/S B3 DIN 127 - X12 CRNI177 (2x)	1309749
10.	Screw, M5 x 10 A DIN 84 (2x)	1329618
11.	Nut, hex M3 (3x)	1334913
12.	Washer, A3.2 DIN 1.25 - A4 (2x)	1341782
13.	Screw, M3 x 8	1343068
14.	Screw, M3 x 35	1342150
15.	Washer, spring M4 DIN 127 (2x)	1331345
16.	Screw, M4 x 6 (2x)	1338862
17.	Screw, M3 x 10 (4x)	1343076
18.	DI screw	1333828
19.	Hose, 2.5 x 2 SI (170 mm)	4115747
20.	Hose, 2 x 1 SI red (20 mm)	1204793
21.	Hose, 4 x 1.5 SI NF clear (370 mm)	1190520
22.	Volume assembly	8408765
23.	Mounting plate assembly	2600551
24.	Pump assembly	2600564
25.	PEEP valve assembly	2600573
26.	Pneumatic block assembly	2600560
27.	PCB assembly, pneumatic	8202081
28.	Cable assembly, pneumatic control	2600562

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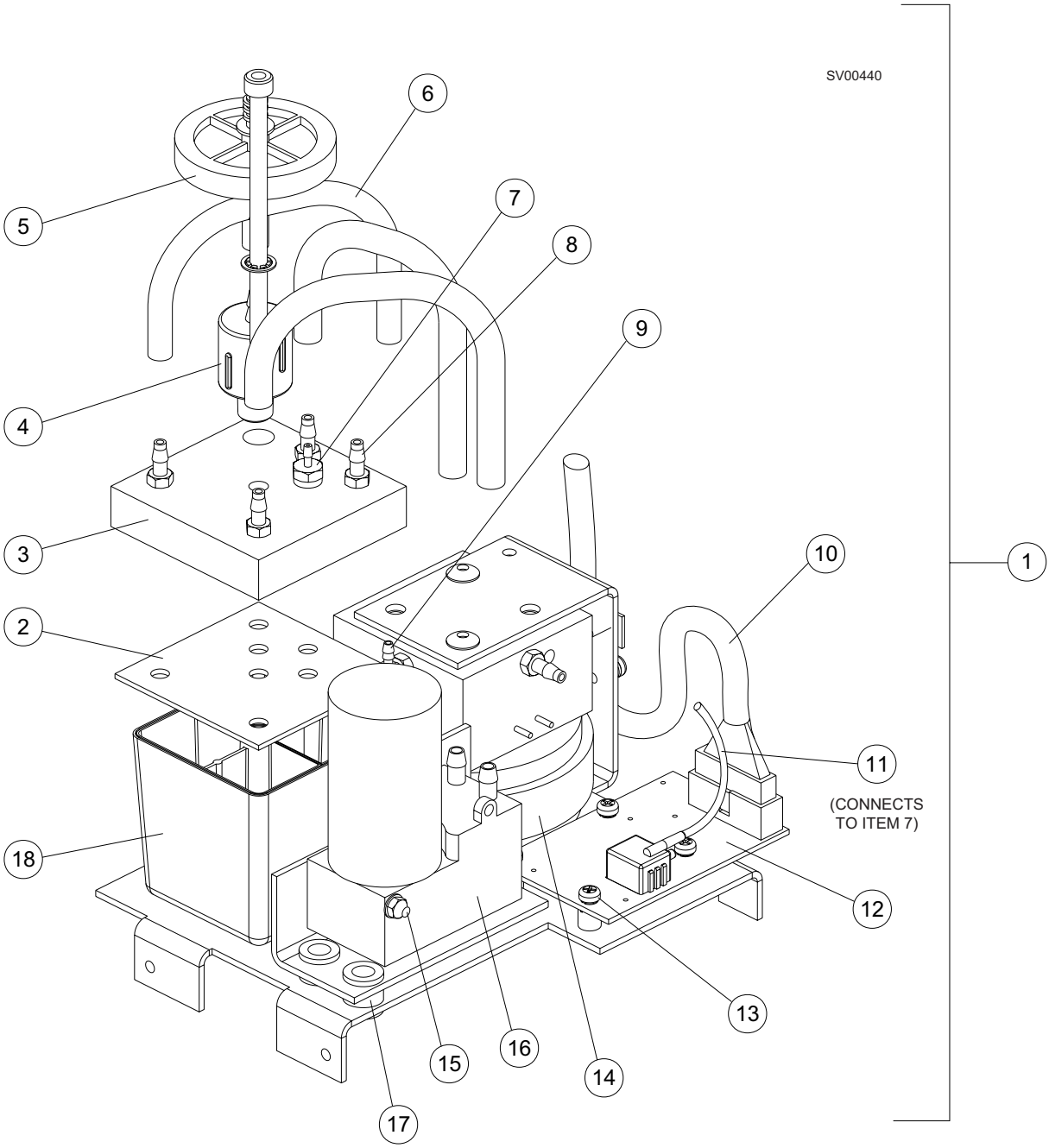

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ITEM	DESCRIPTION	PART NUMBER
1.	Pneumatic (PEEP Control) Assembly (later design)	4116213
2.	Gasket, top	4116156
3.	Plate, top	4116155
4.	Vacuum valve	4116154
5.	Filter	8102868
6.	Hose 2.5 x 2 SI (5 in. 3x)	4115747
7.	Fitting, 1/16 ID x 10-32M w/seal	4112707-001
8.	Fitting, straight, 3/32 ID hose x 10-32 M (4x)	4114732
9.	Fitting, ell, 3/32 ID hose x 10-32 M (replaces existing fitting)	4114733
10.	Cable Assembly	2600562
11.	Hose, natural, 0.075 ID x 0.030 W (10 in.)	ML08003
12.	PCB Assembly	4116121
13.	Screw, M3 x 10 (4x)	1343076
14.	PEEP Valve Assembly	2600573
15.	Nut, hex M3	1334913
	Washer, A3.2 DIN 1.25-A4	1341782
	Screw, M3 x 35	1342150
16.	Pump Assembly	2600564
17.	Vibration Isolator (3x)	2600569
18.	Muffler	4116158

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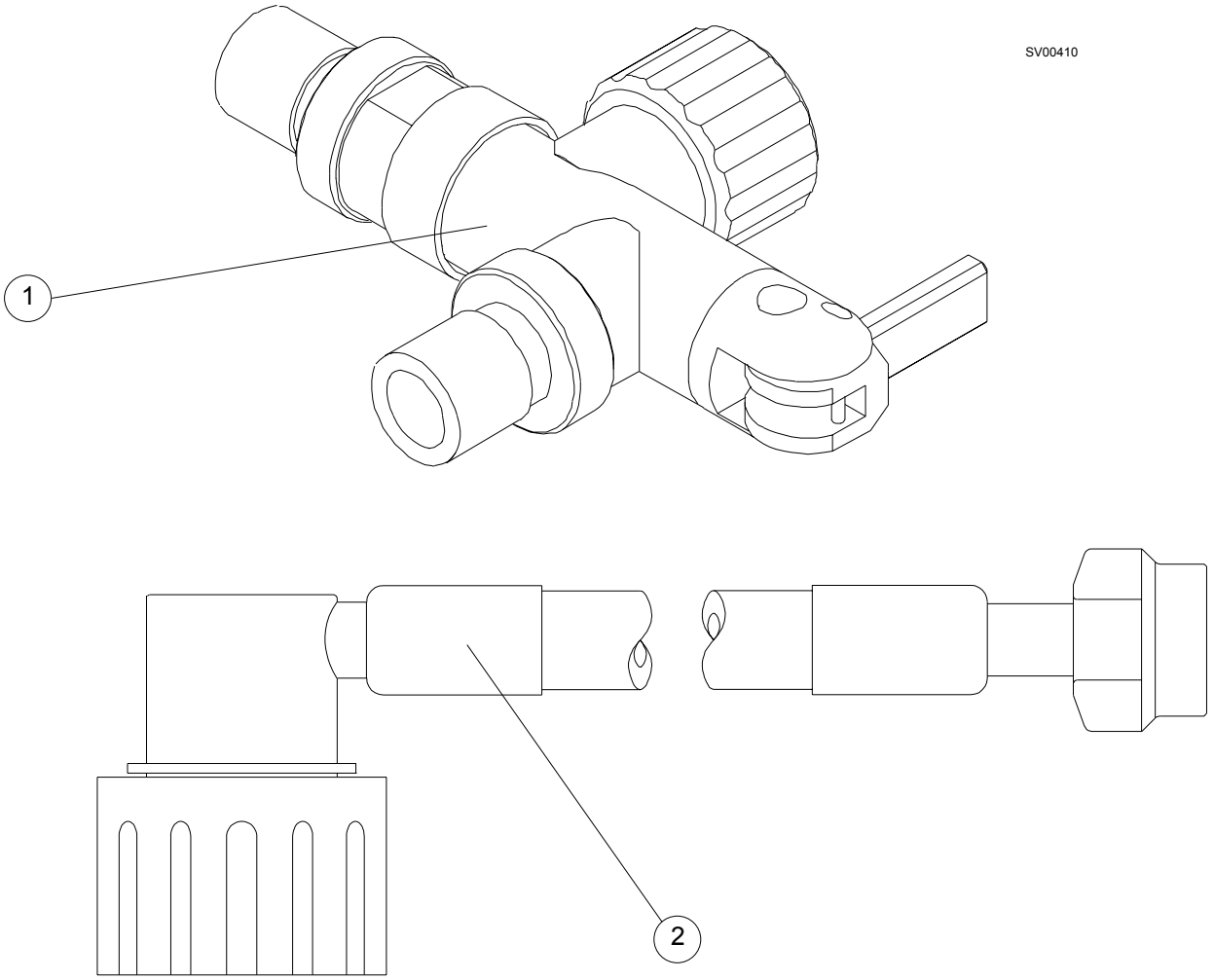

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ITEM	DESCRIPTION	PART NUMBER
1.	A-cone Switch Assembly	4115226
2.	Fresh gas hose	2600170

Power Cord assemblies:

Austria, Belgium, Finland, France, Germany, Greece, Italy, Netherlands, Norway, Portugal, Spain, Sweden	4115367
Denmark	4115369
Switzerland	4115375
UK, Ireland	4115377
Mexico, Central America	4115379
Argentina	4115380
Australia, New Zealand	4115382
China	4115383
India, South Africa	4115385
Israel	4115387
Japan	4115388

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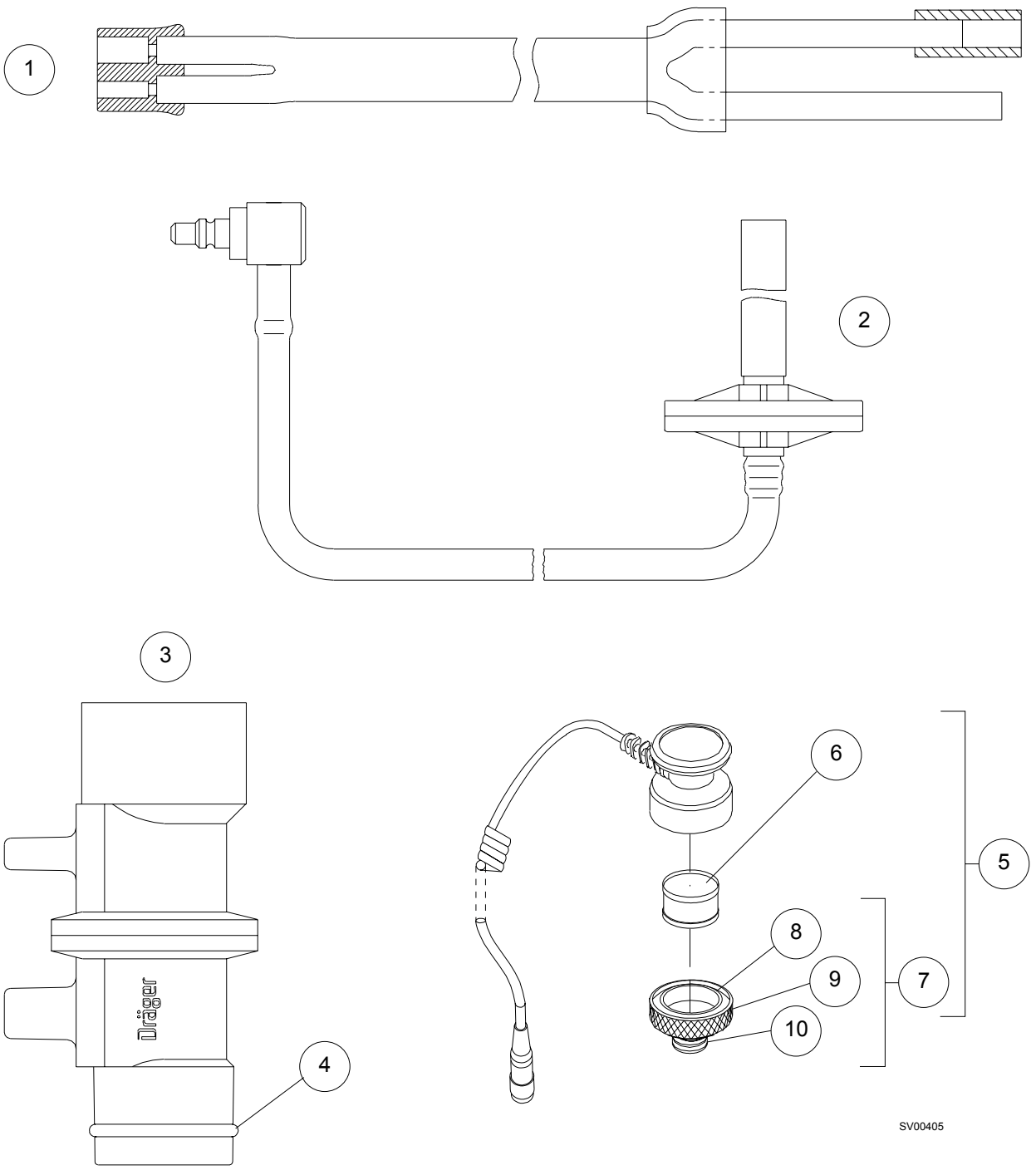

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ITEM	DESCRIPTION	PART NUMBER
	Sensor Set	2600340
1.	Flow sensor hose assembly	8410929
2.	Pressure measuring hose assembly	8302841
3.	Flow sensor assembly	8412034
4.	O-ring	R26807
5.	Oxygen Sensor: Complete Assembly, including capsule	4110374
6.	Sensor Capsule	6850645
7.	Housing Assembly	4106363
8.	O-ring, #025 (viton)	4105791
9.	Adapter (cover)	4106385
10.	O-ring, #016 (viton) (2x)	4106388

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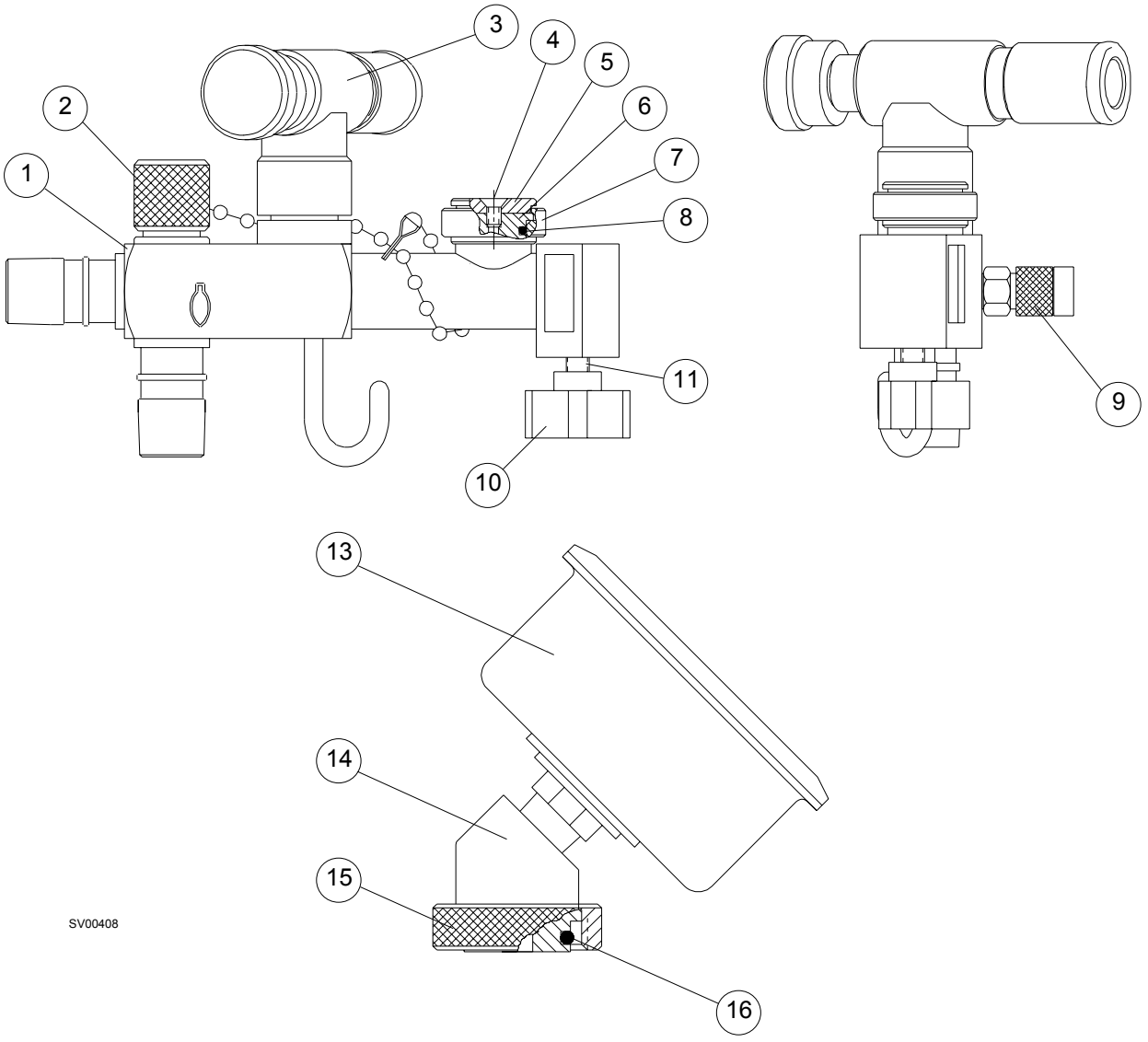

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ITEM	DESCRIPTION	PART NUMBER
	Bain Circuit Adapter	4115225
1.	Body assembly	4115272
2.	O2 sensor plug assembly	4115265
3.	APL valve	4115271
4.	Screw, flat hd skt 8-32 x 3/8in.	HW03005
5.	Cap, gauge swivel	4115269
6.	Gauge mount	4115270
7.	Nut, round 1 3/8 D x 1/8-18 F	4105857
8.	O-ring, #115 (silicone)	4105771
9.	Coupling, Atmo	M26238
10.	Wing nut	4105699
11.	Set screw, cup pt 5/16-18 x 1 1/4in.	HW04031
12.	Label, NAD Bain Circuit	4115268
	Items not illustrated:	
	Fresh gas hose	4115267
	Breathing bag, 2.0 L w/22mm bushing	9995320
	Hose, corrugated. 22 in. w/22mm bushing	9995123
	Adapter, 22mm (M) x 22mm (M)	M25647
	Instruction manual, Bain Circuit Adapter	4106013-003
	Breathing Pressure Gauge Assembly (bain circuit option)	4115275
13.	Gauge, 20/80 cm H2O	4115273
14.	Gauge mount	4105835
15.	Nut, round 1 3/8 D x 1/8-18 F	4105857
16.	O-ring, #115 (silicone)	4105771

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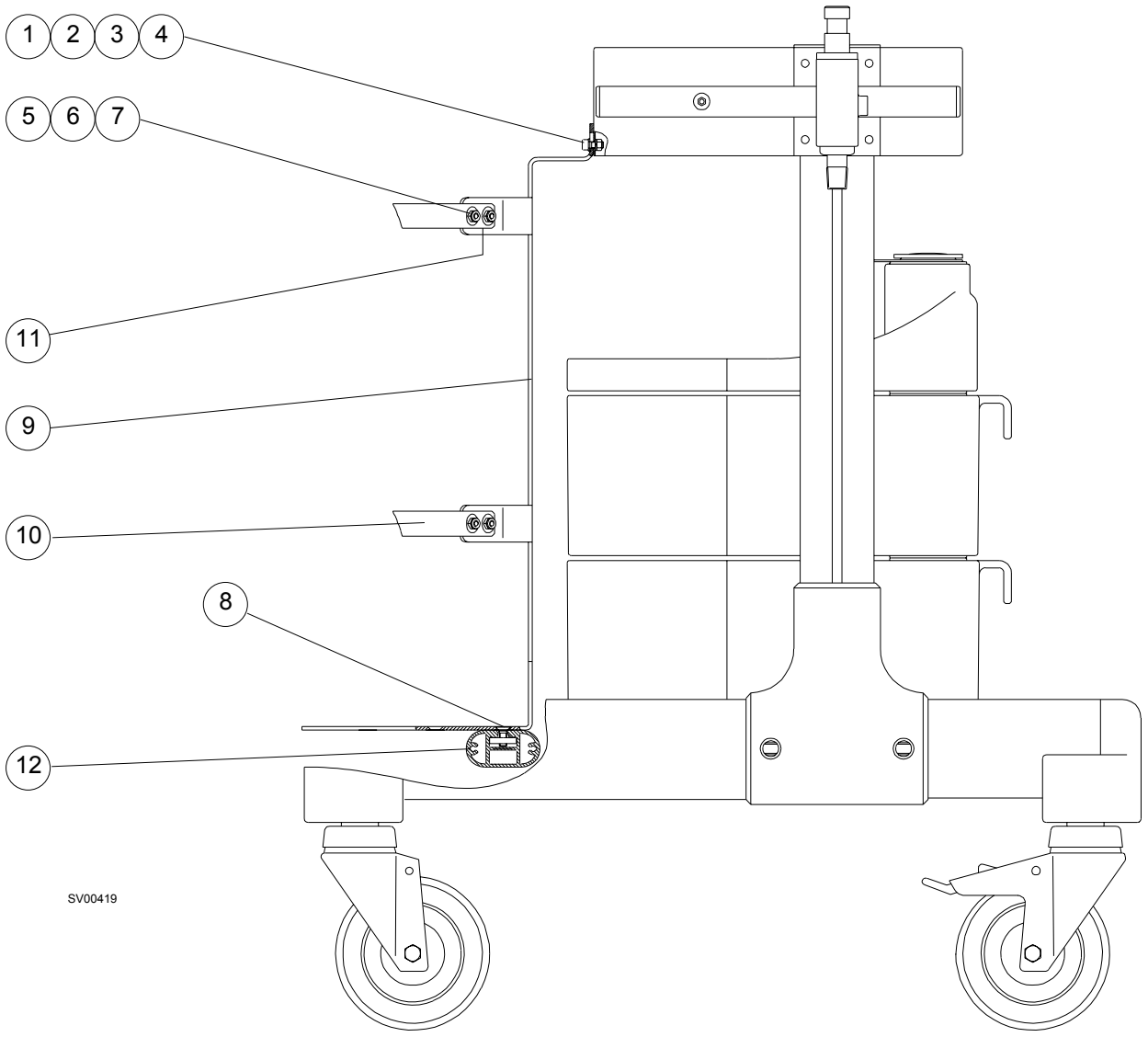

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ITEM	DESCRIPTION	PART NUMBER
	Cylinder Conversion Kit	2600720
1.	Screw, M5 x 12 (2x)	1263102
2.	Nut, hex M5 (2x)	1267477
3.	Washer, spring B5 (2x)	1300849
4.	Washer, A5.3 (2x)	1326279
5.	Washer, B5.3 (16x)	1329472
6.	Nut, hex M5 DIN 980 - A4/051 (16x)	1335618
7.	Screw, M5 x 10 DIN 7991 - 8.8/155 (16x)	1336134
8.	Screw, M6 x 16 DIN 7991 - A4 (2x)	1338811
9.	Cylinder support (2x)	2600722
10.	Belt (4x)	M19101
11.	Grommet strip (8x)	M21599
12.	Plate (2x)	M29110

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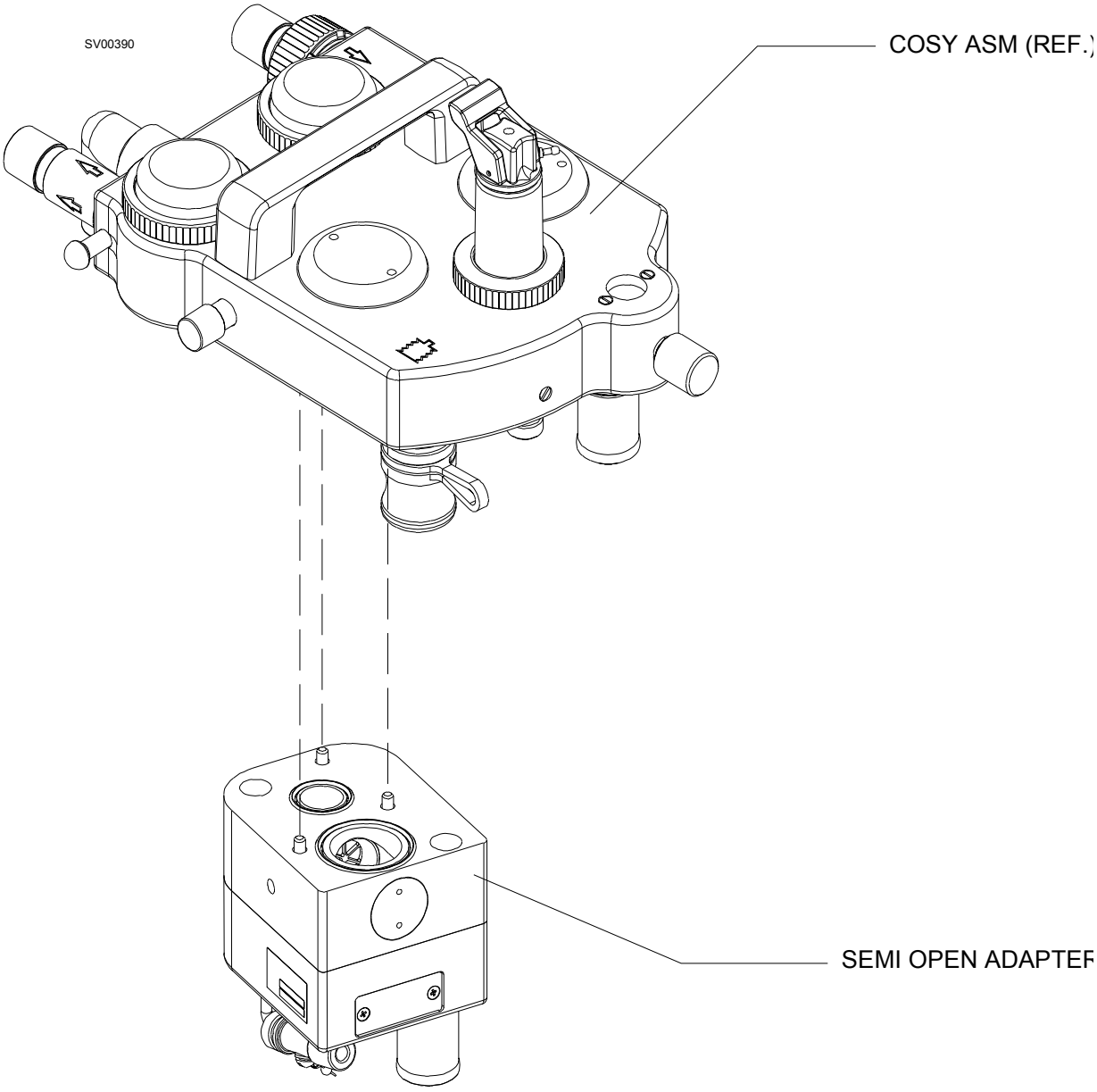

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ITEM	DESCRIPTION	PART NUMBER
	Semi-Open Adapter Assembly	4115227

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6.0 Fault-Cause-Remedy

Fault	Cause	Remedy
A continuous audible alarm is given. No visible alarm appears on the display.	Fabius is not connected to mains power supply.	Connect Fabius to mains power supply.
	The rechargeable batteries are flat.	Recharge the batteries.
	Machine fault.	Inform DrägerService.
APNEA PRESSURE	Inappropriate fresh-gas supply.	Ensure appropriate fresh-gas supply.
	No ventilation.	
	Leak in hose system.	Check hose system.
APNEA VOLUME	No ventilation – no expired volume for 15 seconds.	Check ventilator.
	Inappropriate fresh-gas supply.	Ensure appropriate fresh-gas supply.
	Kinked hose.	Check hose system.
	Leak in hose system.	Check hose system.
APNEA PRESS OFF	The lower alarm limit for the airway pressure (Paw) is off in the IPPV mode.	Switch on the lower alarm limit for the airway pressure (Paw).
BATTERY LOW	The battery voltage of the uninterruptible power supply (UPS) is too low.	Recharge the batteries of the UPS by running Fabius from the mains power supply for four hours.
BATTERY POWERED	Fabius is not connected to mains power supply (Fabius is powered from the batteries (UPS)).	Connect Fabius to mains power supply.
	The mains power supply failed.	Check the mains power supply.
CHECK BATTERY	The backup battery is not functional.	Replace fuse.
		Inform DrägerService.

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Fault	Cause	Remedy
CHECK VENTILATOR	The ventilator is not assembled correctly.	Check the diaphragm and close the housing of the patient system. Select standby mode and switch back to IPPV mode.
CONT HIGH PRESS	The APL valve is in the position MAN during IPPV.	Switch APL valve to IPPV/SPONT.
DEVICE TEMP HIGH	The device temperature is too high.	Check for external heat sources. Check the fan.
EX-VALVE LEAKAGE	There is a leak in the expiratory valve.	Check the expiratory valve.
FiO_2 HIGH	The O_2 flush is in use, the fraction of inspired O_2 exceeds the upper alarm limit.	Check the O_2 setting on the flowmeter block. Check the concentration setting on the anesthetic vaporizer.
FiO_2 INOP	The O_2 sensor has not been calibrated correctly. The O_2 sensor has been replaced but not calibrated. Spent O_2 sensor. Faulty O_2 sensor cable.	Calibrate the O_2 sensor. Calibrate the O_2 sensor. Replace the O_2 sensor and calibrate it. Replace the O_2 sensor cable and calibrate the O_2 sensor.
FiO_2 LIMIT < 21%	The lower limit FiO_2 is between 18% and 20%.	Set appropriate FiO_2 lower limit.
FiO_2 LOW	The FiO_2 is below the lower alarm limit.	Check the O_2 supply. Check settings on flowmeter block.

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Fault	Cause	Remedy
FLOW INOP	The flow sensor has not been calibrated.	Calibrate the flow sensor.
	The flow sensor is faulty.	Replace the flow sensor and calibrate it.
	The flow sensor has been replaced but not calibrated.	Calibrate the flow sensor.
	The flow sensor hose is faulty.	Replace the flow sensor hose and calibrate the flow sensor.
MEMORY ERROR	Internal data loss.	Switch Fabius off and on. Inform DrägerService, if necessary.
MV HIGH	The upper alarm limit for the minute volume has been exceeded.	Calibrate the flow sensor (see Instructions for Use).
	The flow sensor has not been calibrated.	Calibrate the flow sensor.
	The flow sensor is faulty.	Replace with new flow sensor and calibrate new flow sensor.
MV LOW	The minute volume has decreased below the lower alarm limit.	Check the minute volume.
	The hose is blocked/kinked.	Check the hose system.
	There is a leak in the breathing system.	Check the breathing system.
	Reduced volume during pressure limitation.	Leak test the breathing system.
	Reduced lung compliance.	Adjust the ventilation parameters correctly.
	The flow sensor has not been calibrated.	Calibrate the flow sensor.
	The flow sensor is faulty.	Replace with new flow sensor and calibrate new flow sensor.

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Fault	Cause	Remedy
Paw HIGH	The upper alarm limit (Paw) has been exceeded.	Check the upper alarm limit (Paw) setting.
	The hose is kinked.	Check the hose system.
	The upper alarm limit (Paw) has been set too high.	Correct the upper alarm limit (Pmax) setting.
Paw NEGATIVE	Insufficient fresh-gas supply.	Increase the fresh-gas flow.
POWER SUPPLY INOP	Power supply is fault.	Inform DrägerService.
PRESSURE INOP	Faulty pressure sensor.	Inform DrägerService.
PRESSURE LIMIT	Set tidal volume has not been delivered completely.	Increase Pmax value. Decrease V_T value.
SET APL TO IPPV	The APL valve is switched to MAN in the IPPV mode.	Switch the APL valve to SPONT/IPPV.
SETTINGS LOST	The set parameters or calibration values have been lost.	Check the set parameters or calibration values and correct, if necessary.
VENTILATOR INOP	Internal machine fault.	Switch Fabius off and on.
	IPPV mode is not operational.	Inform DrägerService.
VOL ALARM OFF	The lower alarm limit for MV is off in the IPPV mode.	Set the appropriate lower alarm limit for MV.

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7.0 Changes

Record all changes and modifications made to the machine.

Type of Change	Date

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8.0 Technical Memo

1 Troubleshooting, Fabius CE

1.1 New software 2.50

A new software package has been developed for the Fabius CE.
General replacement in the field is not planned!
The factory will, however, be shipping new Fabius units with the software release 2.50.
The modification set for Fabius 2600678 software release 2.50 is currently in production.

The 2.50 has implemented the following improvements over the predecessor version 2.0:

- Use of newly plotted characteristics of the flow sensor
- Manual gas type setting for flow measurement via a user menu.
  Important note: If the user sets the incorrect gas type, the flow measurement may produce larger errors than defined in the specification.
- Other base languages: German, French, Spanish, Portuguese, Italian
- Supplementary language: Russian
- Improvement of flow measurement by pre-filtering of the flow-AD measured value
- Improved PEEP valve calibration
- Revised calibration status generation for pressure sensor in Service mode. (safeguard against misoperation)

1.2 Software 2.60, 2.70

This software version adds the French language to software selection for the Fabian machine.

1.3 Software 2.80

Adds warning message on screen to check APL valve setting when switching from manual ventilation mode to IPPV mode.

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Fabius NAD Service Manual

Rev. C summary of changes

Page	Description
iii	Revised TOC to include later design pneumatic control sys
3-142	Added note: ref. parts list for illus of early & later design pneu asm
5-1	Revised local TOC to include later design pneumatic control sys
5-39	Added early design notation to existing pneumatic control sys
Added 5-39A, 5-39B	Illus & P/L for later design pneumatic control sys

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