

**MINE RESCUE
AND
RECOVERY**

MINE RESCUE

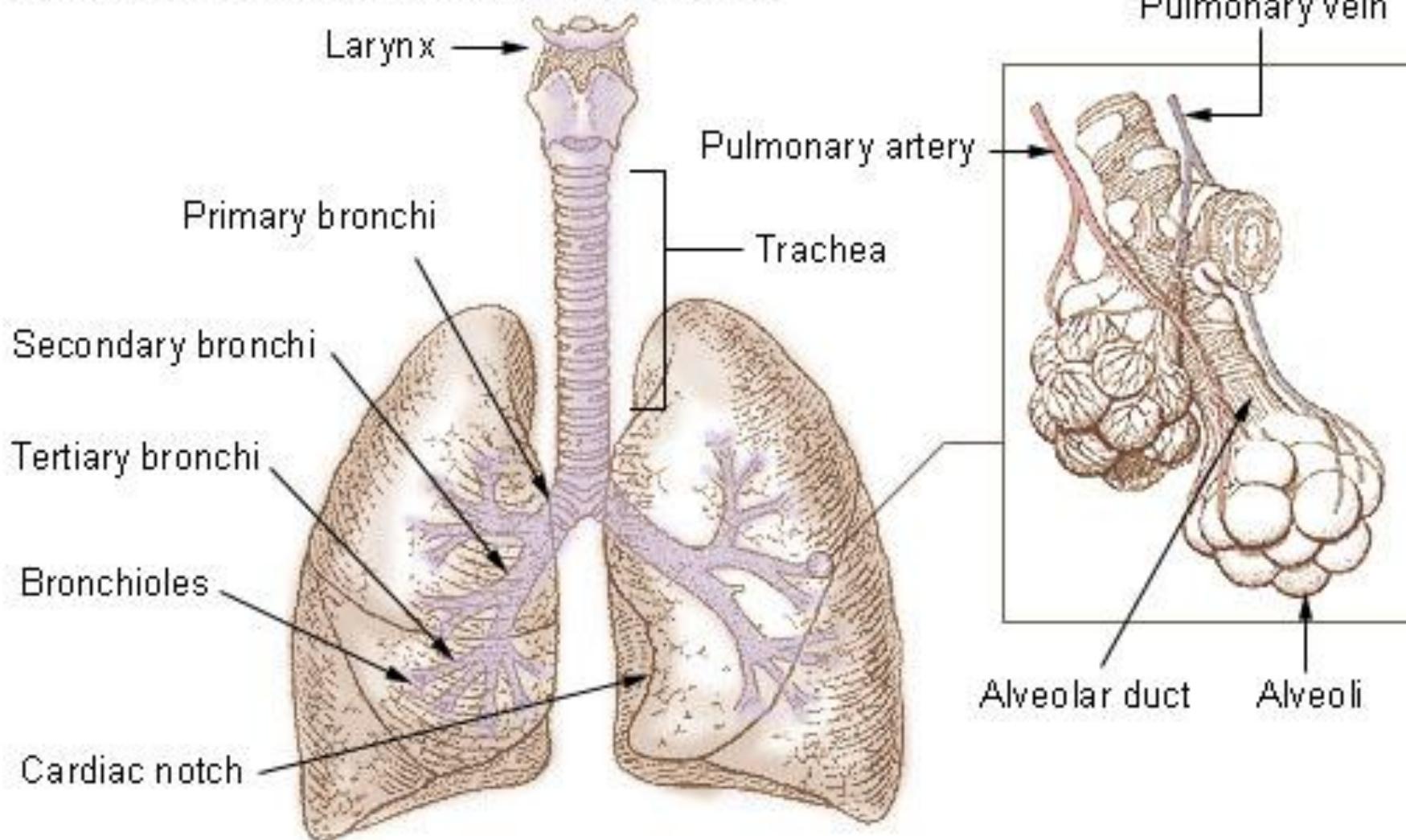
- Deals with all measures and devices used for working in irrespirable and toxic atmospheres occurring in mines for
 - firefighting and sealing off mine fires and
 - conducting rescue and recovery operations speedily and safely.
- the most important objective of mine rescue is saving of lives of men overcome by toxic gases or O₂-deficient atmospheres.

- In the event of a fire or explosion in underground coal mines, the air is likely to be irrespirable because of toxic gases or the absence of O₂.
- Therefore, all underground coal miners are required to have access to emergency escape breathing apparatus.
- In order to recover the mine after a fire or explosion, or to rescue trapped miners, mine rescue teams use long-duration, closed-circuit, self-contained breathing apparatus for respiratory protection.
- These are commonly called **rescue breathing apparatus (RBA)**.

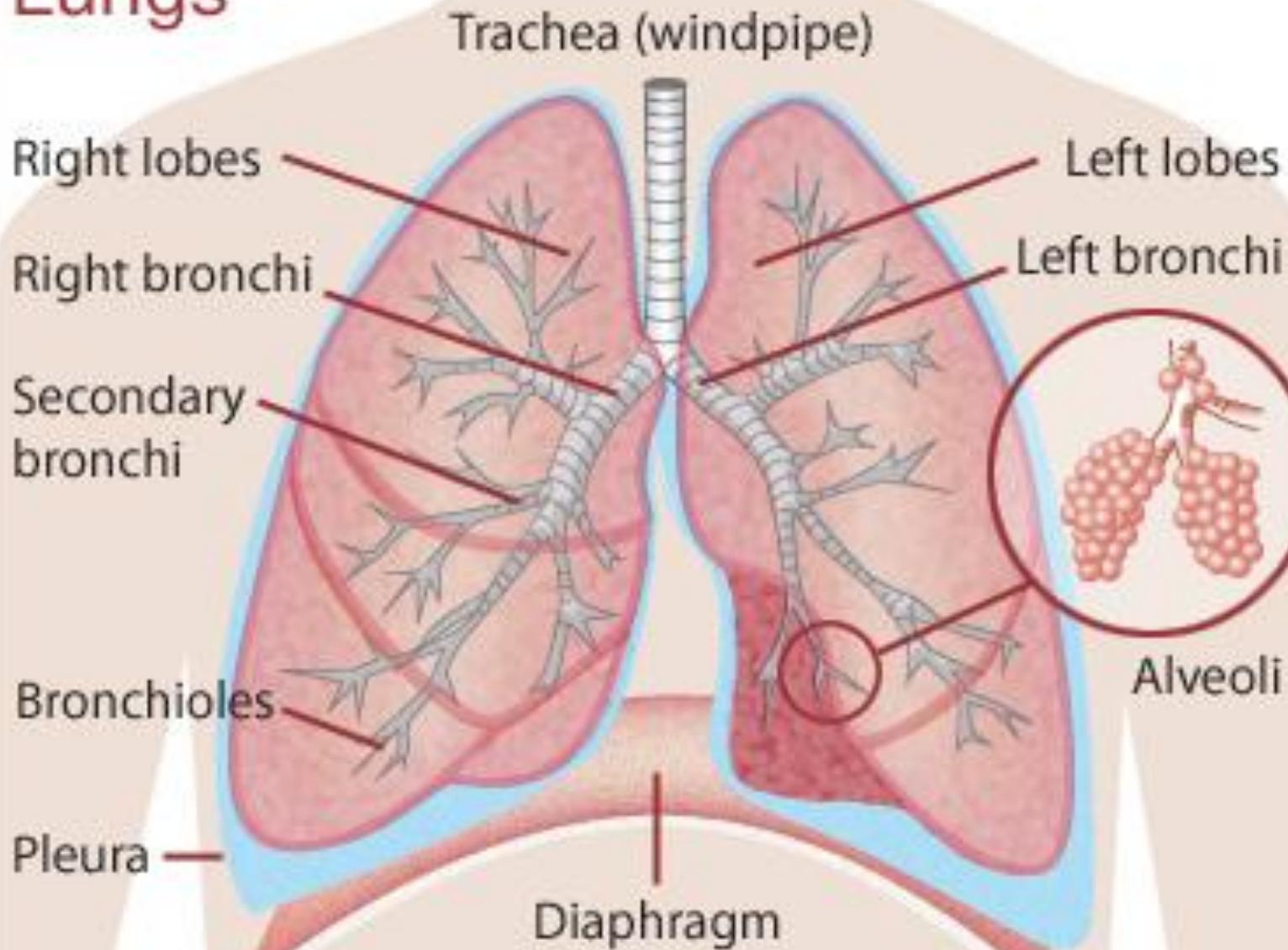
HUMAN RESPIRATORY SYSTEM

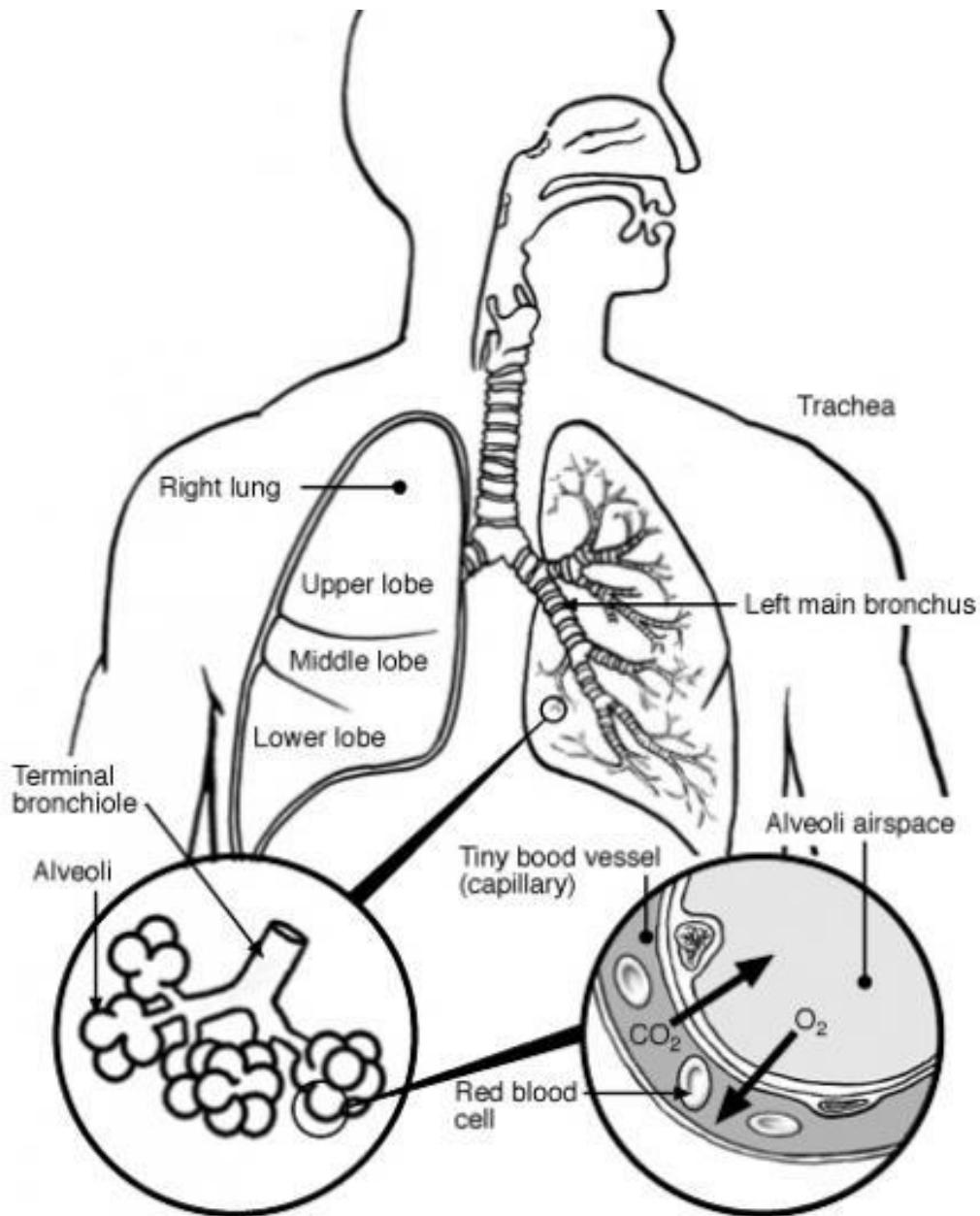
- When a person inhales air or O₂, it is drawn into the lungs down the trachea (windpipe) due to rhythmical respiratory movements of the chest.
- The trachea divides into a no. of bronchial tubes which end in multitudes (altogether 6 millions) of minute air-sacs or alveoli which form the ultimate structure of the lungs.
- The alveoli are lined with a thin membrane over which the circulating blood is spread in microscopic network of innumerable capillaries which, if joined in one tube, would stretch over 3000 km.
- The red cells in them would have a surface for absorption of O₂ of about 100 m².

Bronchi, Bronchial Tree, and Lungs



Lungs





The lungs contain millions of tiny alveoli

Oxygen (O_2) from air breathed in, goes into the red blood cells via alveoli. Carbon dioxide (CO_2) goes from the red blood cells into alveoli and breathed out

Lung showing alveoli

- During the brief exposure in the alveoli, there is interchange of gases between the air and blood.
- The red cells of the venous blood combine with a fraction of the inhaled O₂ depending on the quantity and ability of the contained haemoglobin, while the blood parts with its CO₂ and water vapour (respiratory exchange).
- Under normal conditions, 100 ml of blood carry from the lungs 18.5 to 20 ml of O₂, out of which only 0.36 ml is in solution and the rest in chemical combination.
- The circulating blood requires a continuous intake of O₂ and the lungs require an intermittent intake of O₂ but in a regular way which is provided by human breathing.
- If the supply of O₂ to the blood stream or the lungs is stopped for a few seconds, it results in death.

Respiratory quotient (RQ) or respiratory coefficient

- It is a unit less number used in calculations of basal metabolic rate (BMR).
- The CO₂ given out is often less than the O₂ absorbed in the same time.
- The ratio of CO₂ given out to the O₂ consumed is called RQ and calculated as follows:

$$\mathbf{RQ = CO_2 \text{ eliminated} / O_2 \text{ consumed}}$$

- It depends on the type of diet taken. With normal diet, RQ = 0.85.

Some terminologies

- **Respiratory air or tidal volume (TV):** It is the quantity of air (about 500 ml) a man inspires or expires with quiet respiration.
- **Complementary air:** It is the additional amount of air (1500 ml) one can take in on a very deep breath.
- **Reserve air:** It is the amount of air on a subsequent very deep expiration one can give out (about 1500 ml) in addition to the 2000 ml just breathed in.

- **Vital capacity (VC) of the lungs:** It is the maximum amount of air a person can expel from the lungs after a maximum inspiration.
- It is equal to the **inspiratory reserve volume (complementary air) + the tidal volume + the expiratory reserve volume (reserve air).**
- It varies in different persons depending on age, health and respiratory training.
- It is related to the body surface area and amounts to 2.6 litres/m² surface area.
- A normal adult has a vital capacity between 3 and 5 litres.
- After the age of 20 the vital capacity decreases approximately 250 cc per ten years.
- A person's vital capacity can be measured by a spirometer.

- **Residual air:** It is the amount of air (about 1200 ml), which occupies the anatomical dead space and can not be breathed out.
- It is by no means pure air and contains about 5 to 6% CO₂, 13 to 14% O₂ and 80% N₂.
- **Functional residual capacity:** It is the vol. of air remaining in the lungs after a normal expiration.

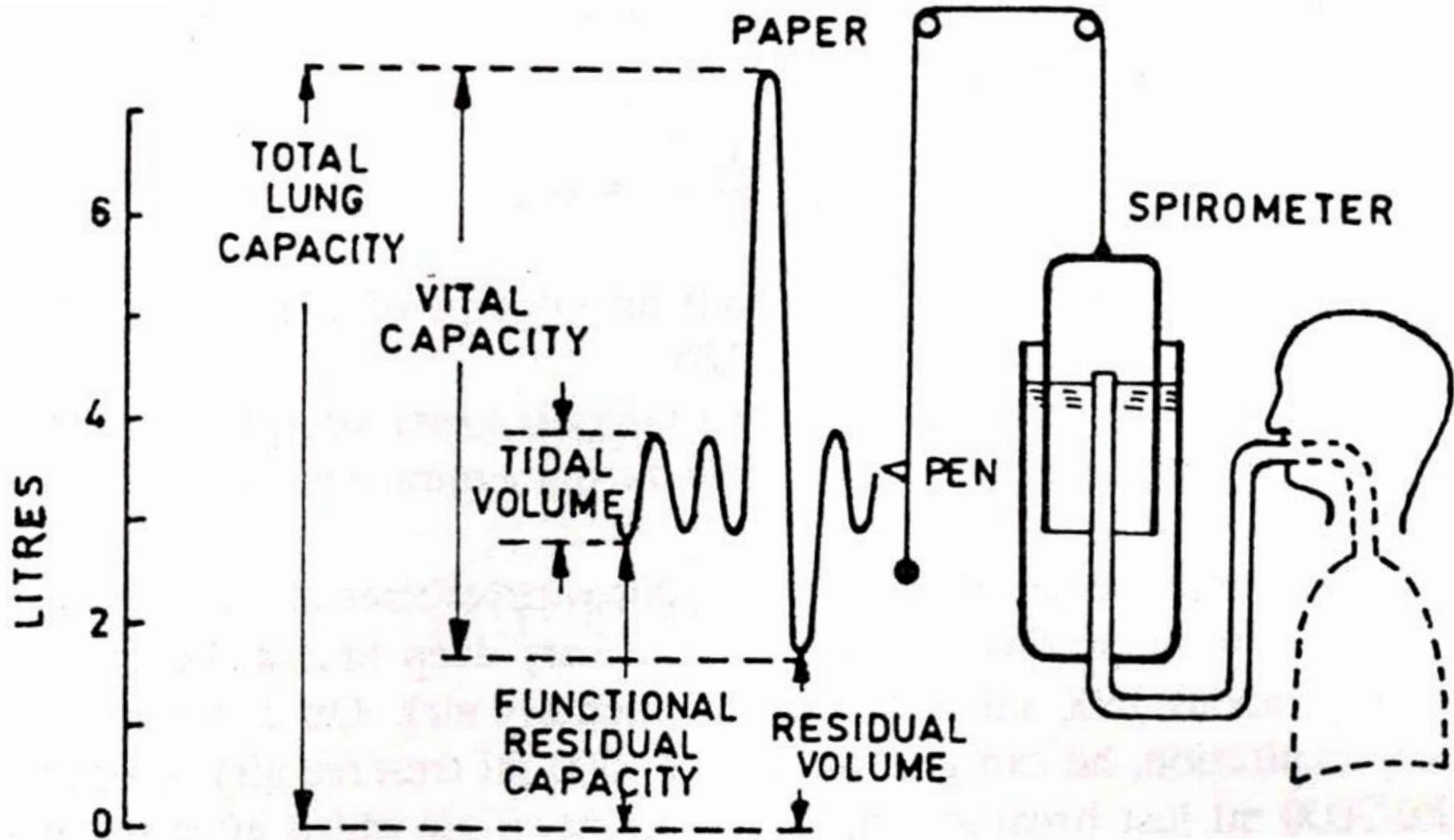
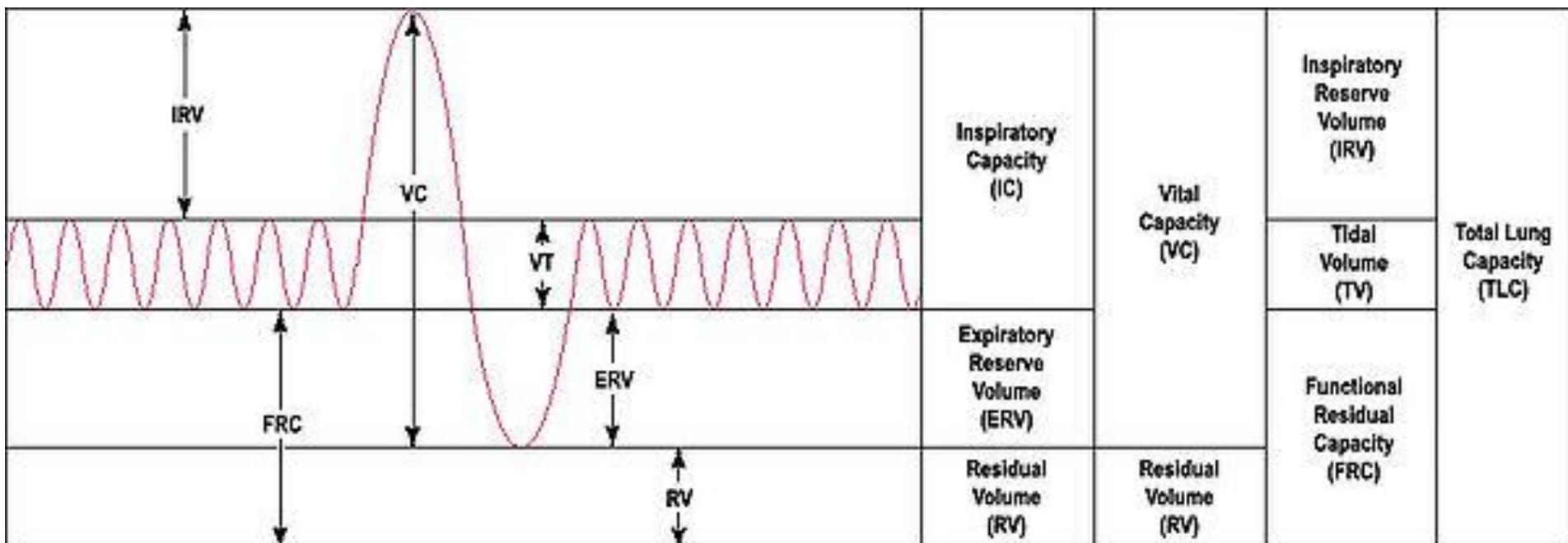


Fig. Lung volumes



Output of a 'spirometer'

Table 7.1: Air and oxygen consumption for different degrees of exertion

Activity	Air inhaled litres/minute	O ₂ -consumption litres/minute
Resting	8–10	0.3–0.4
Walking with rescue apparatus	15–20	0.6–0.9
Rescue drill	20–30	0.9–1.3
Moderate work with pauses	30–40	1.3–1.8
Hard work with pauses	40–50	1.8–2.3
Very hard work for short duration	60–90	2.7–4.0

GENERAL FEATURES OF THE APPARATUS

- All of the apparatus are similar in their basic functions, which are to provide O₂ and absorb CO₂ produced by, the user.
- The standard parts of the breathing apparatus coming into contact with the user's exhaled air are the face mask, breathing hoses, CO₂-absorbent canister and breathing bag.
- O₂ is stored in the apparatus as either a solid (potassium superoxide (KO₂)), a liquid, or a gas.
- The CO₂ absorbents used were lithium hydroxide (LiOH), calcium hydroxide (CaOH), sodium hydroxide (NaOH), or a combination of these usually simply poured into a canister (packed-bed design).

- In general, exhaled air is channeled through the exhalation breathing hose to the CO₂-absorbent canister where the user's CO₂ is absorbed, and then to the flexible breathing bag.
- It is stored there until it is drawn through the inhalation hose and into the user's lungs upon inhalation.
- In most compressed-O₂ apparatus, the O₂ flows at a constant rate to the breathing bag and is supplemented at times of higher O₂ consumption by a demand valve triggered by either low bag volume or a threshold inhalation pressure.
- In contrast, when O₂ consumption is lower than the constant flow, the breathing bag fills to capacity and begins venting to ambient through a relief valve triggered by either high bag volume or a threshold exhalation pressure.

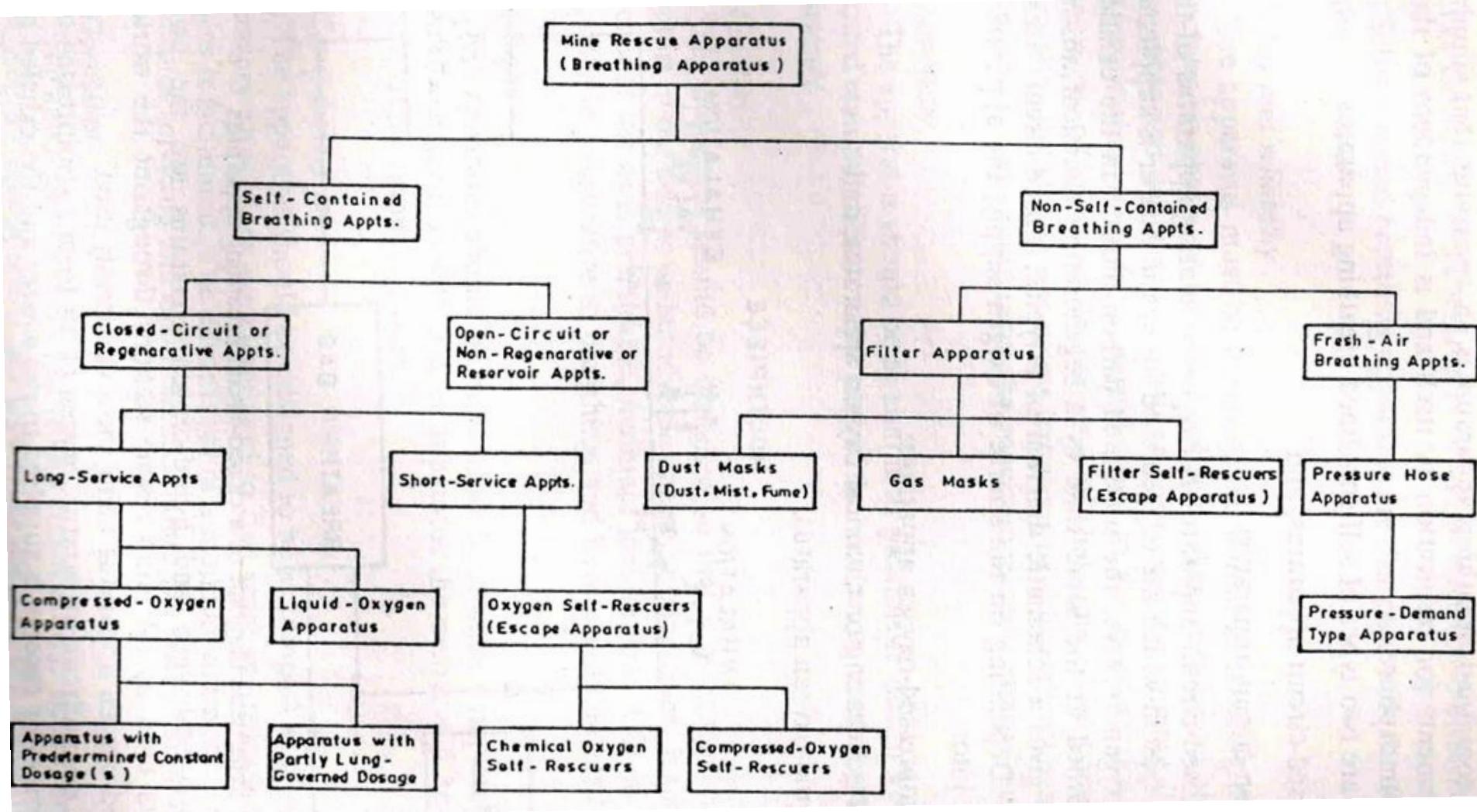
Rescue equipment and their uses

- Mine rescue apparatus, also called **respirators or respiratory protective equipment** primarily provides protection to human breathing system against poisonous and irrespirable gases.
- It includes:
 - Reviving apparatus
 - Escape apparatus
 - Self rescuers
 - Gas masks and
 - Self-contained breathing apparatus with compressed O₂ or liquid O₂.

- They are primarily used for respiratory protection of men employed
 - in fighting mine fires and
 - in rescue and recovery work after explosions.

Classification of rescue apparatus

- Generally fall into the following three main classes:
 - a. Self-contained breathing apparatus (SCBA)
 - b. Filter apparatus or filter respirators
 - c. Fresh-air tube breathing apparatus or supplied air respirators.



Self-contained breathing apparatus (SCBA)

- It is an apparatus that supplies all the requirements for respiration by itself and is independent of the surrounding atmosphere.
- Sometimes referred to as a **Compressed Air Breathing Apparatus (CABA)**, **Air Pack**, or simply **Breathing Apparatus (BA)** is a device worn by rescue workers, firefighters, and others to provide breathable air in an **IDLH** (Immediate Danger to Life and Health) atmosphere.

Types: Two types

- **Closed-circuit apparatus:** It is regenerative type in which the O₂ used up by the wearer is supplemented from an O₂ reserve. The unwanted CO₂ in the exhaled air is absorbed at the same time by a regenerating chemical absorbent. Depending on the source of O₂ supply, it may be divided into:
 - Compressed-oxygen apparatus: most commonly used by all mine rescue stations throughout the world
 - Self-generating or chemical oxygen apparatus and
 - Liquid-oxygen apparatus.
- **Open-circuit apparatus:** O₂ or compressed air reserve is supplied to the wearer and the exhaled O₂ or air is discharged into the open and is put to no further use. **Also called reservoir or non-regenerative apparatus.**

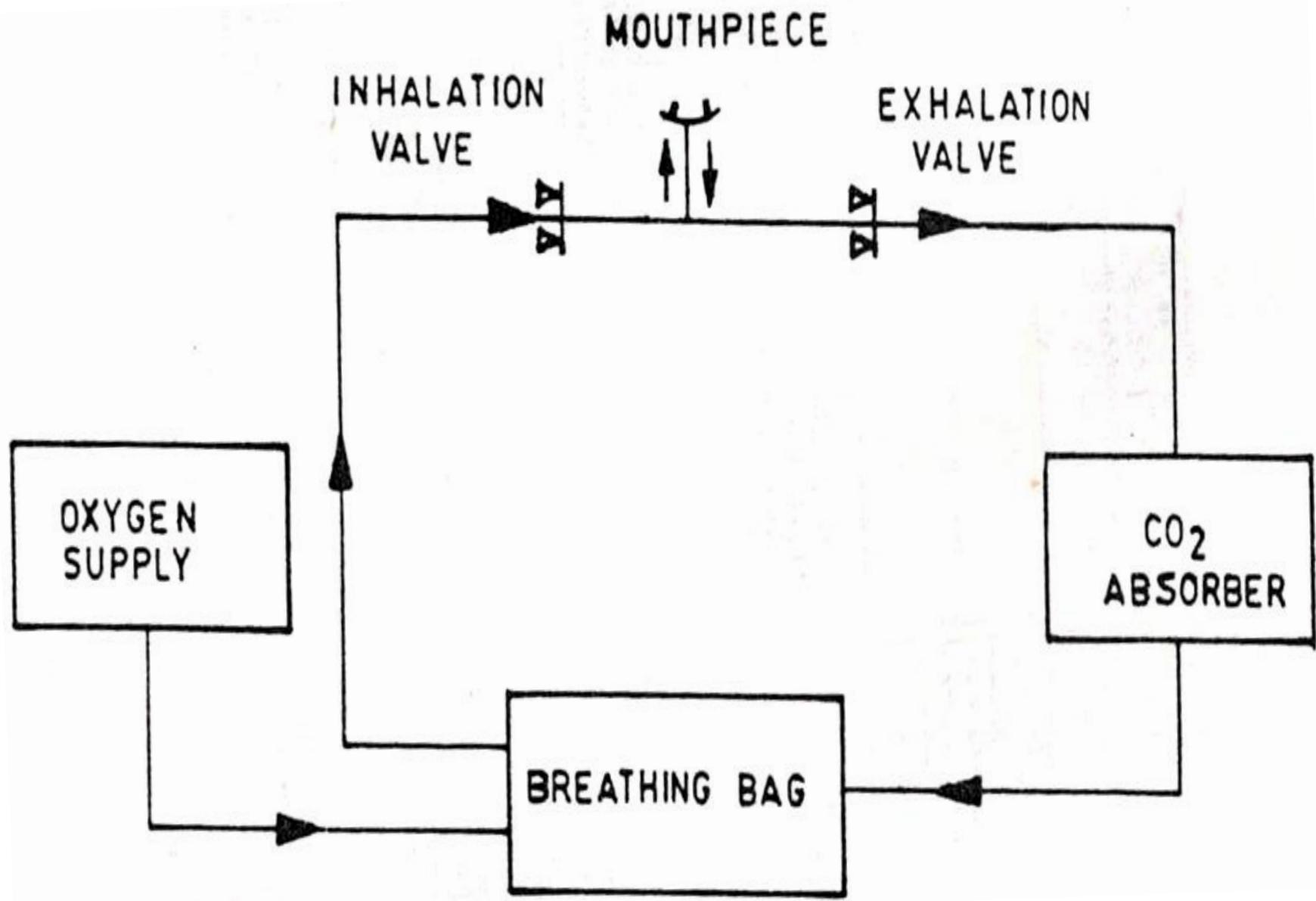


Fig. Schematic diagram of a closed-circuit breathing apparatus

General requirements of self-contained breathing apparatus

The apparatus are designed with the following objectives

- **Safety and reliability:** Apparatus must be designed on sound engineering and scientific principles so that it is safe and reliable when used under the most unfavorable and dangerous conditions encountered in mining.
- **Simplicity:** Should be as simple as possible in design.
- **Comfort:** It should give max possible comfort to the wearer under adverse operating conditions.
- It should provide
 - as cool an air as possible,
 - maintain low levels of CO₂ in the inspired air,
 - offer low resistance to breathing, and
 - have suitable head harness.

- **Weight:** Should be reasonably light when completely assembled and fully charged so that the wearer will be able to perform a larger amount of work.
- **Compactness:** Should be as compact as possible and unnecessary projections are eliminated so that work in intricate and confined spaces is facilitated.
- **Durability:** Should be robust in construction.
- Before officially approved for use in mines, all individual parts of the apparatus must pass laboratory and practical approval tests.

The design and construction must:

- Permit the apparatus to be worn without undue discomfort and in such a manner that it is practicable for the wearer to escape and not unduly impede the wearer when walking or in a crouching position, crawling or maneuvering in confined areas
- Give trouble free operation over the range of -5°C to 60°C (note: storage of the apparatus must be within the temperature range specified by the manufacturer)
- Prevent leakage from the circuit to atmosphere except through a relief valve or exhalation valve on compressed air apparatus.
- Allow parts of the apparatus to be effectively sealed from atmospheric air during storage
- Be such that the use of aluminium is limited to those applications that may be justified on the grounds of safety and health
- Where change-over is required, be designed for easy removal when changing from one unit to another.

General design requirements of closed-circuit modern self-contained compressed-O₂ breathing apparatus

- **A steel cylinder:** of 1 or 2 ltr capacity containing medical O₂, under pressure not less than 120 bar (usually 135, 150, 200 or 300 bar) for supplying the wearer with O₂.
- It is fitted with a main valve which should be opened fully and locked in the open position when the apparatus is being worn.
- **A pressure reducing valve:** to reduce the pressure of O₂ contained in the cylinder and allow it to be supplied to the wearer at a fixed rate and at a pressure slightly higher than the atmosphere.
- **A regenerator purifying canister or purifier cartridge:** to absorb the CO₂ exhaled by the wearer.

- It is a removable sheet metal container or canister charged or filled with a specially prepared chemical which will completely absorb CO₂ over the prescribed wearing period.
- As a regenerative chemical, alkali (anhydrous sodium hydroxide), lithium hydroxide, and soda-lime (a mixture of NaOH and CaOH) are used.
- **A breathing bag:** to serve as an air reservoir from and into which the wearer breaths. It also provides flexibility to the circulatory system.
- It is made of high-grade rubber and of 4 to 6 ltr capacity.

- **A mouthpiece or face piece assembly:** to permit breathing entirely through the mouth or nose.
- The mouthpiece assembly consists of
 - A soft rubber mouthpiece shaped to fit snugly between the lips and teeth of the wearer
 - A nose clip
 - A T-shaped connecting piece
 - Two inhalation and exhalation breathing tubes that connect the rest of the apparatus
 - A head harness that holds the mouthpiece in place.
- **The headpiece assembly** consists of
 - A moulded rubber facepiece
 - A connecting piece and
 - Breathing tubes

- The all-vision or wide-vision facepiece covering the whole face permits breathing through the nose and also protects the eyes without use of goggles.
- **The breathing tubes:** of 25-mm dia strong highly flexible, deeply corrugated tubes of ageing resistance rubber with a fabric insert or neoprene.
- **Inhalation and exhalation valves:** to compel circulatory air to travel in one direction. Usually spring loaded mica-disc type or of neoprene rubber type and extremely sensitive.
- **A pressure gauge:** to indicate the wearer the available supply and duration of O₂ in the cylinder.
- **A bypass valve:** to supply O₂ direct to the wearer when the reducing or the lung-governed valve through any cause fail to act properly. Usually designed as a self-closing push-button valve.

- **A lung-governed O₂ admission valve or regulator:** to supply the exact quantity of O₂ to the wearer which his exertion may demand.
- **Warning signals or alarms:** to give a clearly audible whistling or hooting sound in case the reducing valve fails to shut off at the proper pressure or the cylinder is approaching exhaustion.
- **A relief or excess pressure valve:** to release any excess pressure and to avoid accumulation of N₂ in the respiratory system.
- May be located on the face piece or on the breathing bag and operated manually or automatically by the breathing bag itself when it expands.

- **A pre-flushing device:** to automatically flush out the apparatus with 7-8 ltrs of O₂ when the cylinder valve is opened to purge the N₂-rich ambient air initially found in the breathing circuit.
- **A saliva trap:** to accumulate saliva of the wearer.
- It is located either in the inhalation tube or at the base of the mouthpiece or face piece.
- May be provided with a release valve to permit discharge of saliva accumulation.
- **A casing:** to protect the breathing bag, regenerator, reducing valves and other vital parts against direct blows and falling material.
- Made of light metal of great strength, tough moulded fibreglass, or stainless steel and so designed to permit ease passage through narrow mine workings.

Self-contained closed-circuit compressed-oxygen breathing apparatus

- The idea of developing portable breathing apparatus was mooted by Alexander von Humboldt in 1795.
- All of the apparatus are similar in their basic functions, i.e. to provide O₂ and absorb CO₂ produced by the user.
- The various apparatus of this form includes:

Fleuss (1879)	Audos (1919)
Schamrock (1897)	Paul (1920)
Giersberg (1901)	Fenzy (1921)
Pneumatophor Walcher-Gaertner (1903)	McCaa (1926)
Draeger (1904)	Draeger BG 170/400 (1952)
Meco, Westfalia or Securitas (1906)	Auer 54/400 (1954)
Fleuss-Davis (1906)	Draeger BG 172 (1956)
Weg (1907)	Draeger BG 174 (1962)
Tisset (1907)	Draeger BG 174 A (1966)
Gibbs (1917)	Sefa (1987)

Classification of compressed-oxygen breathing apparatus

A. Classification based on service time:

1. **long-service apparatus:** Used for periods of 2 or more hrs by rescue crews for long-range rescue and recovery work.
 - Has an O₂ reserve of 300 to 400 ltrs.
2. **Short-service apparatus:** Used as auxiliary apparatus for short periods of $\frac{1}{2}$ to $\frac{3}{4}$ of an hour for rescuing miners in an emergency.
 - They have an O₂ reserve of 120, 150 or 200 ltrs.

B. Classification based on the type of O₂ feed or dosage:

1. Apparatus with a constant dosage supplemented by manual operation of a bypass valve:

- O₂ is supplied at a definite predetermined rate of 2 l/min when the wearer is working hard.

2. Apparatus in which the dosage is entirely lung-governed:

- O₂ supply is purely governed by the movement of the lungs of the wearer.

3. Apparatus with a constant and lung-governed dosages:

- O₂ is supplied to the wearer at a constant rate of 1.5 l/min and if he requires more, a lung-governed O₂ admission valve provides an additional supply which his exertion may demand.
- Widely used throughout the world.

Details of some of the breathing apparatus

Apparatus	Rated duration, hr	Country of origin	Gas supply	Weight, kg
Biomarine BioPak 45	0.75	U.S.A.	Compressed O ₂	7.7
Biomarine BioPak 60	1	U.S.A.	Compressed O ₂	11.4
Biomarine BioPak 240	4	U.S.A.	Compressed O ₂	17.7
Draeger BG-174A	4	Germany ...	Compressed O ₂	15.8
Draeger BG 4	4	Germany ...	Compressed O ₂	13.5
Litton LITPAC II	2	U.S.A.	Compressed gas ...	13.6
MSA Air Mask	1	U.S.A.	Compressed air	16.0
MSA Chemox	1	U.S.A.	Chemical O ₂	6.1
MSA McCaa	2	U.S.A.	Compressed O ₂	17.7
Sabre SEFA	2	U.K.	Compressed O ₂	16.0
Scott Rescue-Pak	4	U.S.A.	Compressed O ₂	15.9
Siebe Gorman Aerorlox	3	U.K.	Liquid O ₂	13.4
Siebe Gorman Proto	3	U.K.	Compressed O ₂	15.0
Ten				
Survivair LP-120	2	U.S.A.	Compressed O ₂	10.0

Draeger Model BG 174 Apparatus

- Manufactured by Draegerwerk AG, Lubeck, GRG.
- It is a closed-circuit with a constant and lung-governed dosage of O₂.
- It is widely used as a standard mine rescue apparatus in many countries.

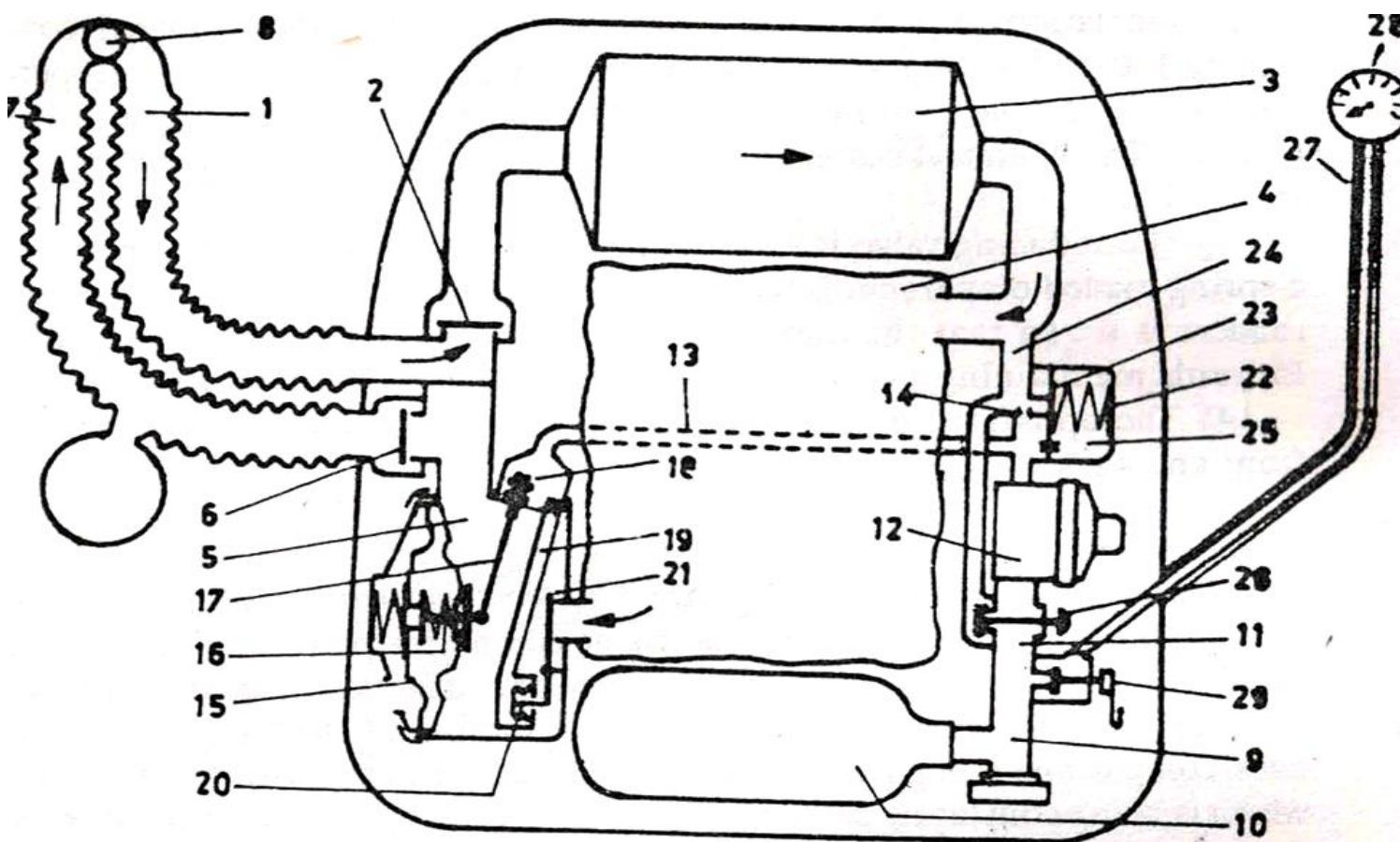


Fig. 7.6: Draeger self-contained compressed-oxygen breathing apparatus Model BG 174

1 - exhalation tube; 2 - exhalation valve; 3 - regenerator; 4 - breathing bag;
 5 - valve assembly; 6 - inhalation valve; 7 - inhalation tube; 8 - connection
 socket; 9 - cylinder valve; 10 - oxygen cylinder; 11 - oxygen regulator;
 12 - pressure reducer; 13 - oxygen-supply tube; 14 - constant-flow dosage
 valve; 15 - control diaphragm; 16 - excess pressure valve (cotter pin with
 sealing gasket); 17 - stem/lever of lung-demand valve; 18 - lung-demand valve;
 19 - control line; 20 - warning signal control bellows; 21 - warning signal
 flap; 22 - preflushing device; 23 - pre-flushing valve; 24 - pre-flushing line;
 25 - control chamber; 26 - by-pass valve; 27 - high-pressure line; 28 - pressure
 gauge

Specifications of BG 174:

Endurance (normal)	4 hrs hard exertion at a working pressure of 200 bar
Cylinder capacity, empty	2 ltrs
Cylinder capacity at 200 bar	400 ltrs
Breathing bag capacity, full	6 ltrs
O2 flow rate constant dosage	1.5 ltrs/min
Lung-governed dosage	As required
Weight of apparatus	12.8 kg

Special features of the apparatus:

- O₂ regulator comprises of a pressure reducer, an automatic pre-flushing device, a bypass valve and a pressure gauge shut-off valve.
- The lung-demand valve is a diaphragm-operated stem valve in a valve box or housing. It is actuated by the control diaphragm responding to small –ve pressure resulting from inhalation. The diaphragm also actuates a relief valve to dissipate the excess circuit pressure.
- A pre-flushing device automatically purges N₂ from the breathing circuit with a burst of 7 ltrs of O₂ hwn the cylinder valve is opened.
- Apparatus is mounted on the back of the wearer.
- A dry ice cooler may be substituted for the saliva trap in the inhalation tube to cool the inhaled air temp. to 15°C.
- Anhydrous NaOH (1.5 kg) is used as CO₂ absorbent.

Draeger BG-174A

- It is the most widely used long-duration closed-circuit compressed-O₂ breathing apparatus in the world with a disposable CO₂-absorbent canister.
- Originally certified in 1966 by the U.S. Bureau of Mines (USBM) as a 2-hr apparatus.
- It was NIOSH-certified in 1975 as a 4-hr apparatus.
- The O₂ cylinder contains approximately 395 L of O₂ at the recommended fill pressure of 3,135 psi at room temperature.
- The BG-174A has a constant flow of O₂ of 1.5 L/min ATPD plus a pressure-activated demand valve.
- The relief valve is also pressure-activated.

- The CO₂ absorbent is NaOH suspended in a crisscross, corrugated-screen bed designed to prevent the NaOH from melting into a solid mass during use.
- The user exhales into the face mask, through the exhalation hose, past the exhalation check valve, through the CO₂-absorbent canister, and into the breathing bag.
- Upon inhalation, the user draws air from the breathing bag, through the valve box and inhalation check valve, through the inhalation hose, and back to the face mask.
- The face mask includes a wiper that removes condensation from the inside of the lens.
- If the user's O₂ consumption rate is higher than the O₂ constant flow rate and the circuit contains a large quantity of N₂, the O₂ concentration in compressed-O₂ apparatus can fall to subambient levels before the demand valve is activated.



Figure 7.—Draeger BG-174A.

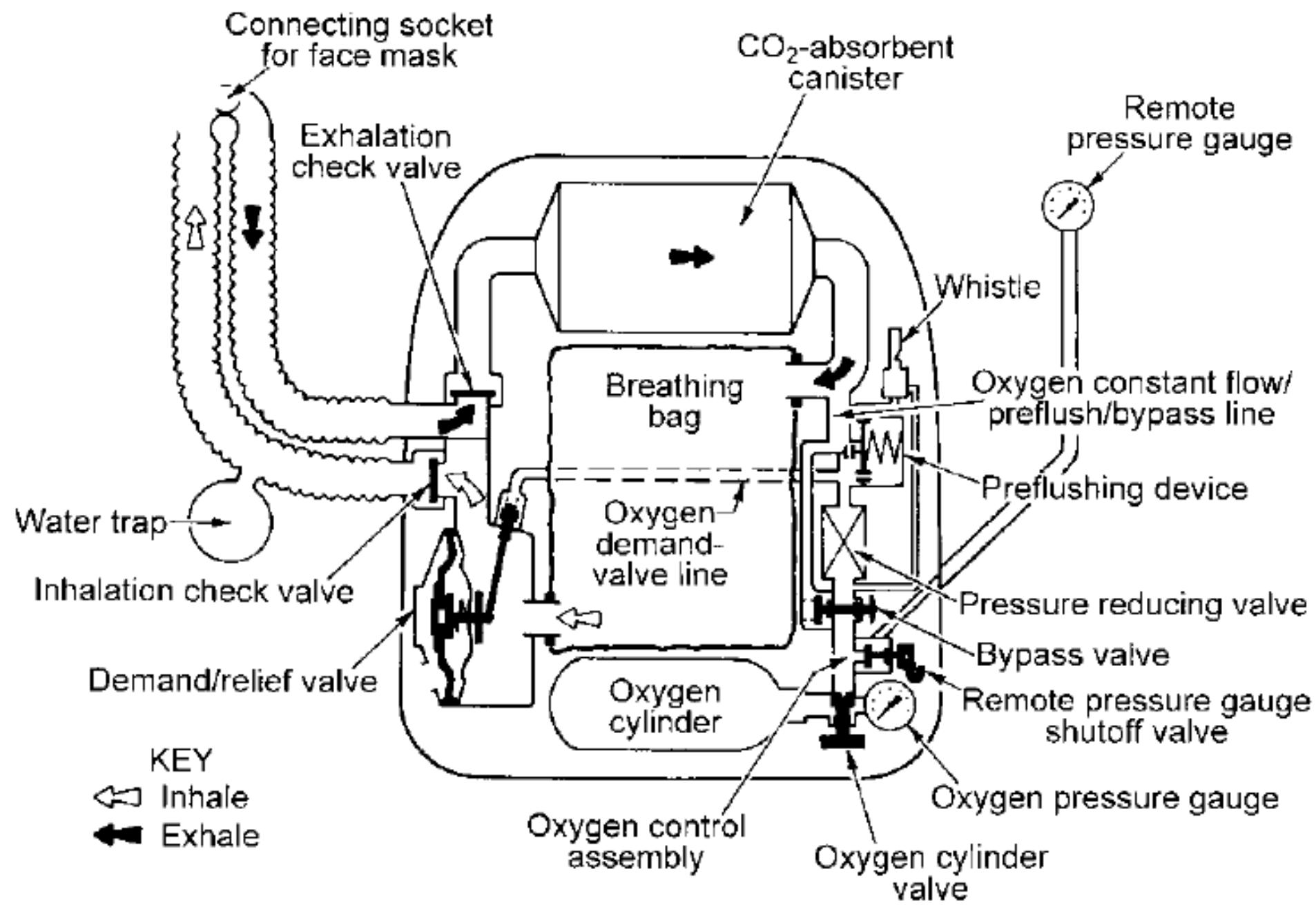


Figure 8.—Draeger BG-174A schematic.

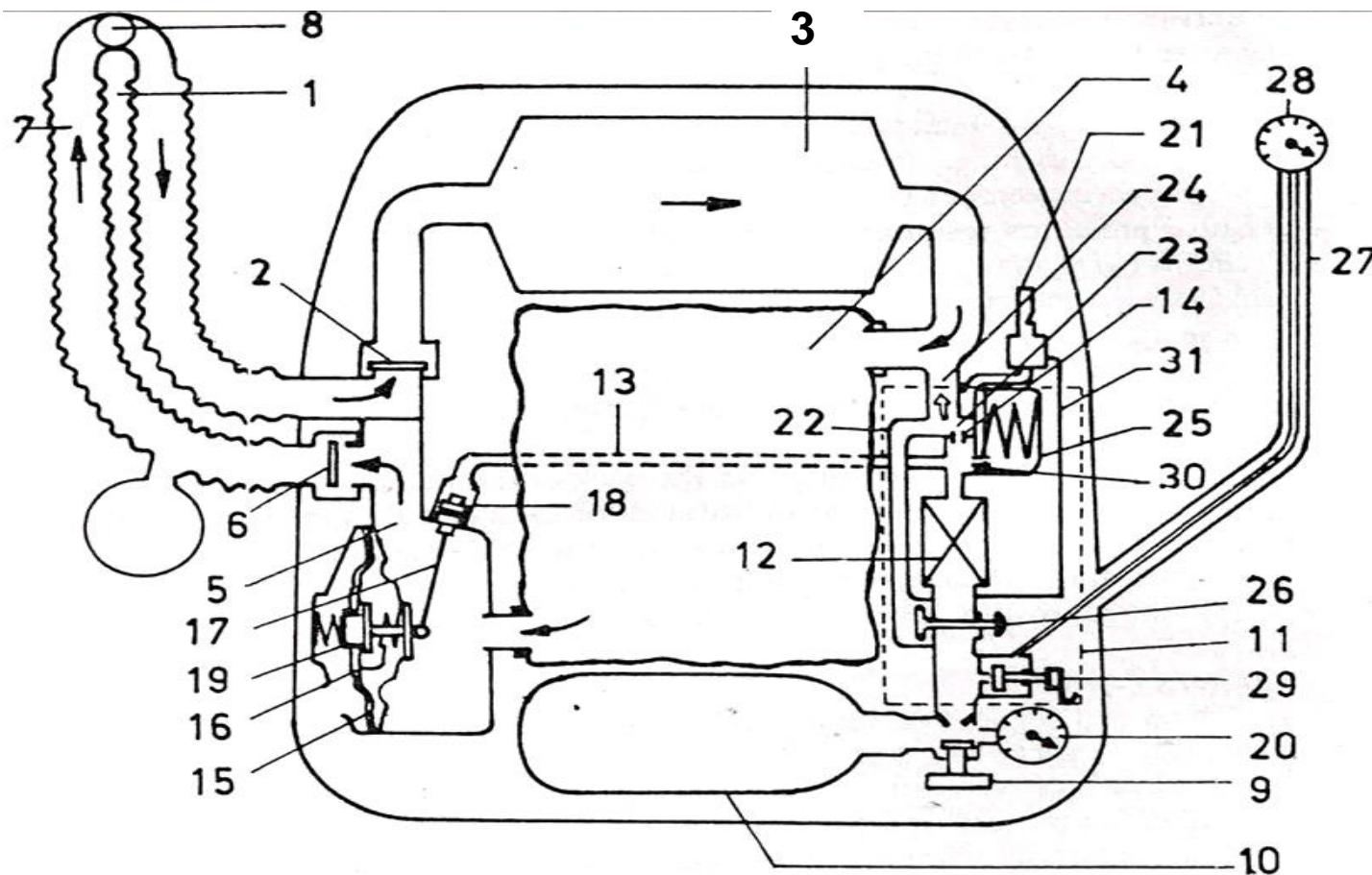


Fig. 7.7: Draeger self-contained compressed-oxygen breathing apparatus Model BG 174A

1 - exhalation tube; 2 - exhalation valve; 3 - regenerator; 4 - breathing bag;
 5 - valve assembly; 6 - inhalation valve; 7 - inhalation tube; 8 - connection
 socket; 9 - cylinder valve; 10 - oxygen cylinder; 11 - oxygen regulator;
 12 - pressure reducer; 13 - oxygen-supply line of demand valve; 14 - constant-
 flow dosage nozzle; 15 - control diaphragm; 16 - pressure pin with gasket;
 17 - demand valve stem/lever; 18 - lung-demand valve; 19 - release valve
 system; 20 - pressure gauge; 21 - warning device; 22 - preflushing device;
 23 - pre-flushing valve; 24 - oxygen line; 25 - control chamber; 26 - by-pass
 valve; 27 - high-pressure line; 28 - pressure gauge; 29 - pressure gauge shut-
 off valve; 30 - pre-flushing dosage nozzle; 31 - control mechanism for warning
 device

All dimensions in centimeters

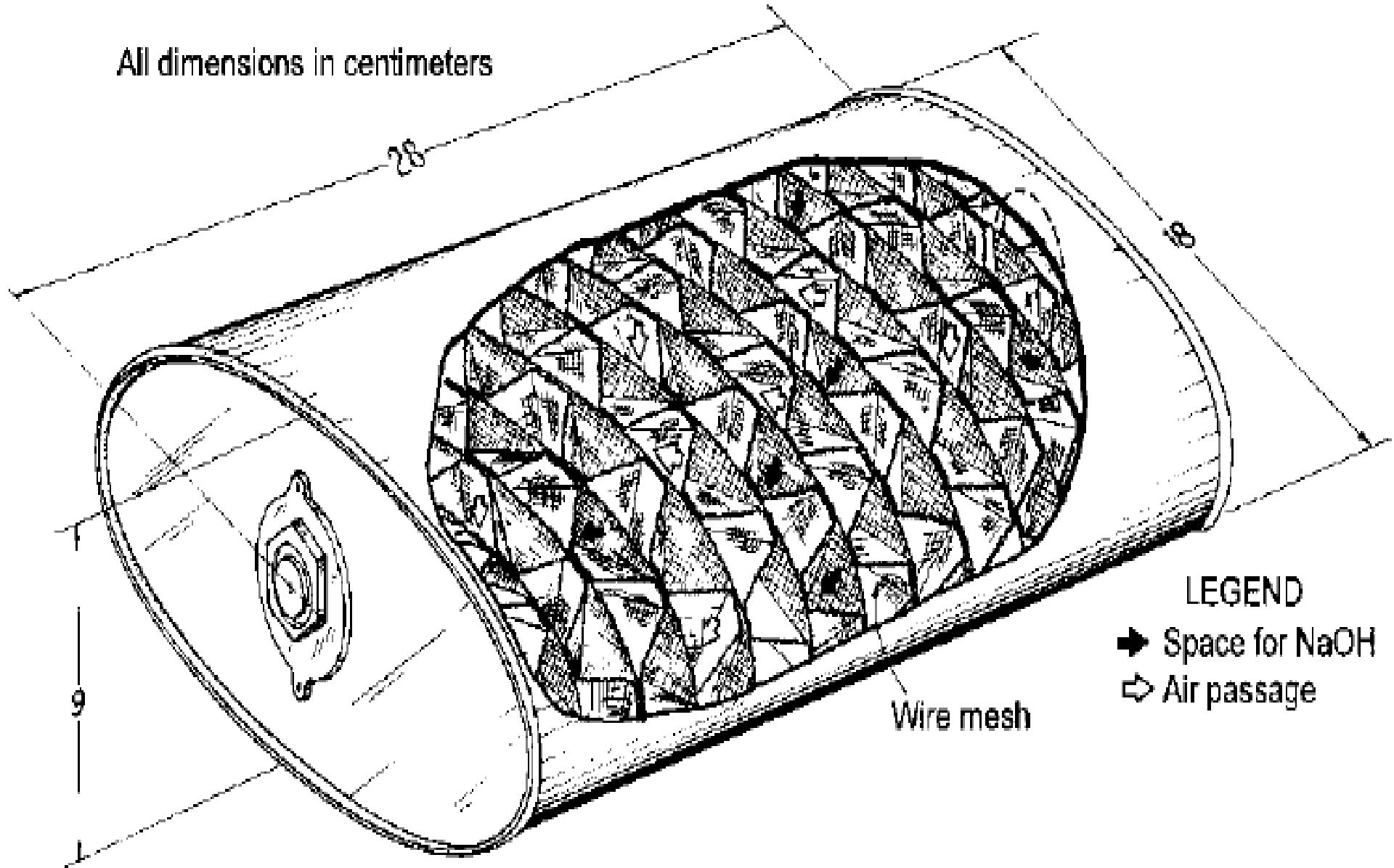


Figure 9.—Draeger BG-174A canister schematic.

Additional features in Draeger BG-174A

BG-174A is essentially same as Draeger BG-174 except for the following:

- It has 3- and 4-hour approval ratings.
- The low-O₂ warning device is located in the O₂ regulator instead of in the demand regulator assembly or valve box.
- A second pressure gauge is mounted on the O₂ cylinder.
- It incorporates a divider in the breathing hose facepiece connector.
- The O₂ metering nozzle is located on the O₂ regulator.
- The cylinder valve is of ‘step clutch’ design.

Draeger BG 4

- It is a compressed-O₂, closed-circuit apparatus with a disposable soda lime CO₂-absorbent canister .
- It has been NIOSH-certified four times (1995) as both a 3- and 4-hr apparatus and a **standard- and positive-pressure apparatus**.
- The BG 4 has a constant flow of O₂ of at least 1.5 L/min ATPD plus a volume-activated demand valve.
- The relief valve is also volume-activated and purges exhaled air before it enters the CO₂-absorbent canister.
- The face mask is the same as that used with the BG-174A..

- The user exhales into the face mask, through the exhalation check valve and breathing hose, through the CO₂-absorbent canister, and into the spring-loaded breathing bag.
- Upon inhalation, the user draws air from the breathing bag, through the heat-absorbent canister, the inhalation hose and check valve, and back to the face mask.
- The heat-absorbent canister works by routing inhalation air around a chamber containing a large cylinder of ice inserted just before use, formed in a separate ice mold



Figure 10.—Draeger BG 4.

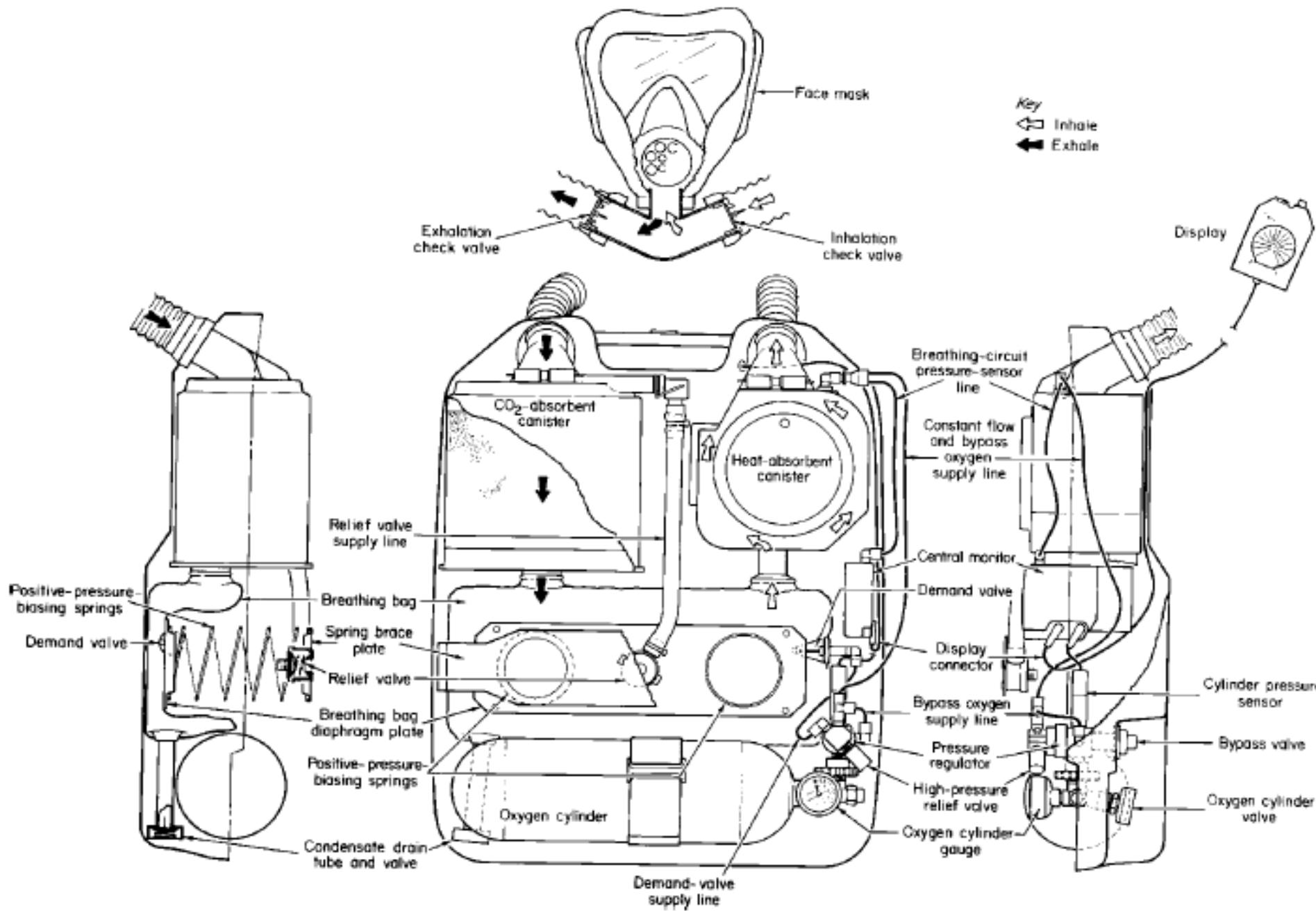


Figure 11.—Draeger BG 4 schematic.

Rescue stations

- The necessity of having well equipped rescue stations was deeply felt after a series of disastrous fires and explosions shook the Indian mining industry during the 1930's.
- The first mines rescue station in India was established in Kolar Gold Fields as early as Nov 1923.
- In the coal mining sector, the first coal mines rescue rules were promulgated in India in 1939 and two Central Rescue Stations were established in August 1941 at
 - Dhansar (Jharkhand)
 - Sitarampur (West Bengal)
- At present, 46 Rescue Stations in Coal Mining industry and 6 rescue stations in Metal Mining industry are functional in India.

- The **Coal Mines Rescue Rules** were modified in 1959 and made applicable to all the coal companies in India.
- The Coal Mines Rescue Rules 1959 were replaced by the **Mines Rescue Rules 1985** as per the recommendations of the Mitra Committee.

Functions of rescue stations as per The Mines Rescue Rules, 1985:

The functions include:

- Imparting initial training in rescue and recovery work.
- Imparting refresher training to rescue trained persons.
- Providing support by its own rescue teams and equipment in case of major accidents or long-lasting rescue and recovery operations.
- Carrying out the functions of rescue room in respect of the below ground mines where there is no rescue room.

Types of rescue stations

- There are mainly 3 types of rescue stations:
 1. Central rescue stations
 2. District rescue stations
 3. Rescue stations at mines
- The central rescue stations have wider objectives than the district rescue stations and rescue stations at mines.

The Central Rescue Stations:

- Established by the government in the centre of important coalfields depending on their geographical location.

The District Rescue Stations:

- Established to serve a group of mines in a defined mining region or district.
- They may also be established at isolated mines with gas outburst and explosion hazard and fully equipped for rescue work and training of rescue men.
- District rescue stations must be equipped with a rescue van or truck.
- The central and district rescue stations should be located so that the radius of action does not exceed 25 to 35 km. All stations must efficiently cooperate with one another in emergencies.

The Mine Rescue Stations:

- The mine rescue stations or mine rescue rooms are provided at mines employing 100 or more persons underground on any shift and maintaining rescue brigades.
- Neighboring mines belonging to a single large mining company or different mining companies may maintain a joint rescue station at a suitable place, provided the total no. of persons ordinarily employed below ground of all such mines does not exceed 5000.
- A mine rescue station is equipped with specified breathing apparatus, equipment and supplies which are maintained in good order and ready for immediate use by the mine rescue brigade.
- It comprises of
 - an apparatus room
 - a maintenance room
 - a lecture room and
 - a test room

A modern central or district rescue station contains the following:

- Offices
- An apparatus room
- A repair or maintenance shop with an O₂ pump and cleaning and drying facilities
- A dormitory for members of the resident rescue corps on continuous duty
- Wash-rooms
- A store
- A gas analysis laboratory
- A garage
- A driver's waiting room
- A recreation and a guest room

Station personnel

- The permanent personnel at every central or district rescue station usually comprise
 - one Superintendent (first Class): Custodian of the station
 - one or two Assistant Superintendents
 - at least two instructors (Second Class)
 - two mechanics and
 - a Rescue Brigade of not less than 18 rescue trained persons.

Station apparatus and equipment

- The mining regulations specify minimum no. of safety apparatus and equipment of the officially-approved type that should be kept and maintained at every rescue station.
- The equipment of a rescue station comprises the equipment stored at the station and a mine rescue van which is kept fully stocked and ready to use as a mobile rescue station during emergency.

A rescue station is equipped with

- Self-contained O₂ breathing apparatus and necessary equipment for testing such apparatus.
- A portable supply of liquid O₂, pressurized O₂, or O₂-generating chemical as applicable to the supplied breathing apparatus
- Tins of absorbent chemicals
- All-service gas masks
- Oxygen self-rescuers
- Gas detectors for CO and CH₄
- O₂ indicators
- Safety lamps (flame and electrical)
- Bird testers with O₂ cylinders

- Gas chromatograph for analysis of mine air samples
- Electric cap-lamp charging rack
- Resuscitators and inhalers
- First-aid materials
- Stretchers
- Portable mine rescue communication system or a sound-powered communication system
- A mobile inert gas generator
- A rescue cage/capsule
- Adequate no. of necessary replacement parts of all apparatus

Objectives of a Central Rescue Station

- Recommend formulation of mine rescue rules as well as rules for protection against toxic gases in auxiliary plants on the surface of the mines.
- To draw mutual-aid plans under which neighboring mines, after occurrence of a major mine disaster, assists each other on a reciprocal basis.
- To train directors or in charges of rescue operations, leaders/captains and apparatus mechanics or attendants in rescue and disaster techniques for mine rescue brigades, and also to conduct refresher training courses for them.
- To supervise the training of mine rescue brigade at mines and under certain circumstances, even train mine rescue brigades.

- To guide and supervise the conduct of rescue and recovery and reopening operations in mines.
- To maintain a permanent rescue corps in constant readiness where the rescue station is required to help in conducting rescue and recovery operations in mines falling within its radius of action.
- To store special types of equipment and apparatus for firefighting and mine rescue work.
- To supervise the working of district rescue stations.

- To inspect apparatus and equipment for mine rescue work maintained at mines and report defects and shortcomings to the management.
- To conduct approval tests and give expert opinion on new designs of equipment and apparatus for mine rescue work.
- To initiate development of new apparatus and equipment.
- To conduct approval tests of portable fire extinguishers for use in mines.
- To advise on all matters concerning mine rescue, protection against toxic gases, fire protection, and working of seams or deposits liable to spontaneous combustion.