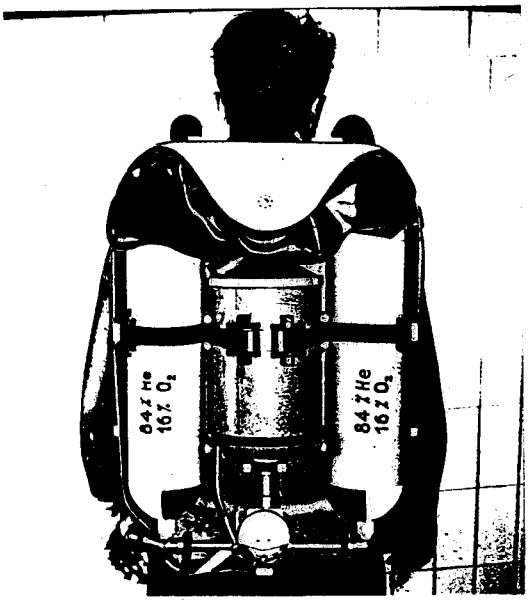
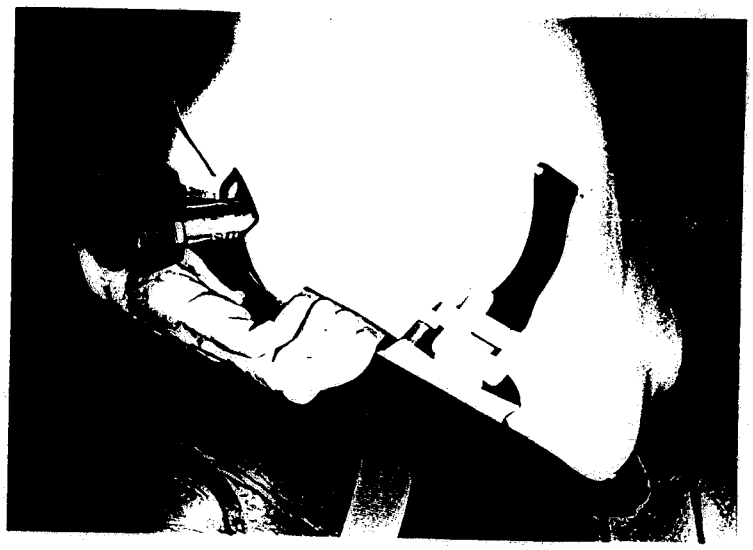
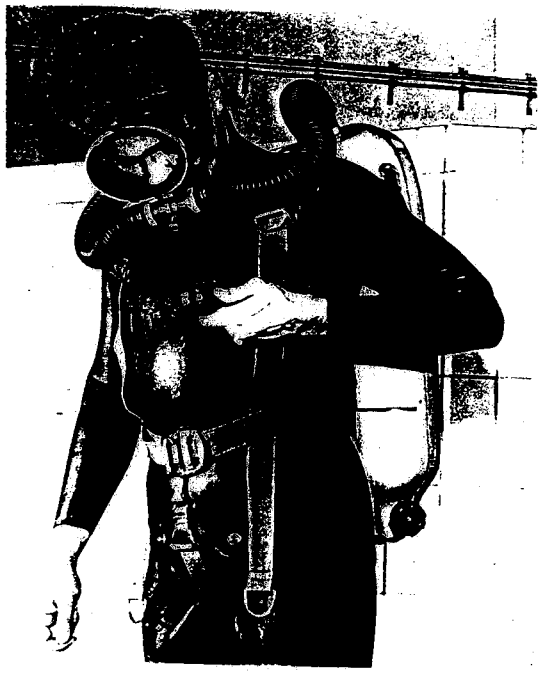
1.3 Construction

1.3.1 The lower shell contains all component parts.

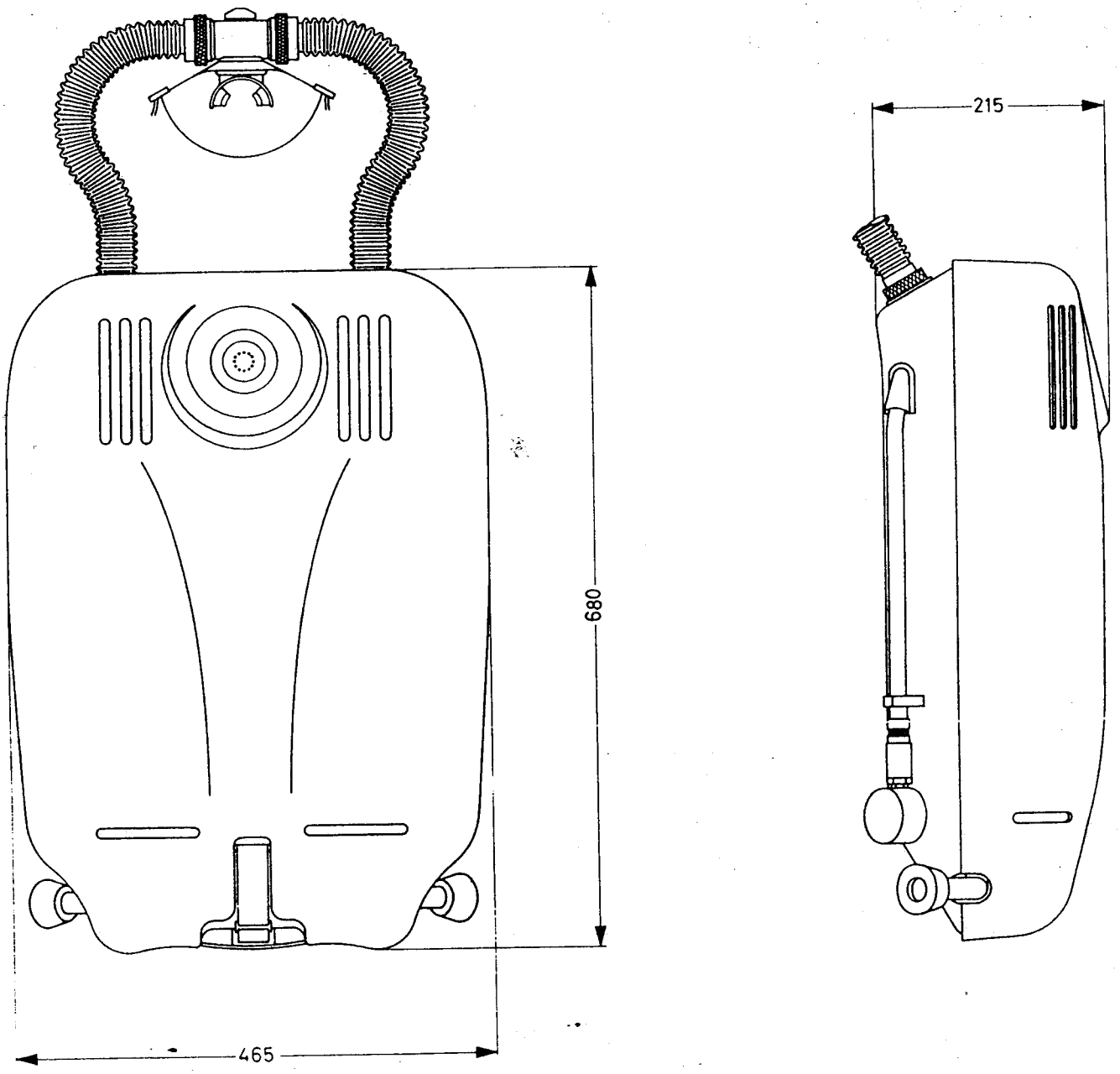




2.2.2 Checking the cylinder pressure.



2.2.3 FGG III ready for use.



Dimensions of the mixed gas swim-diving apparatus FGG III

Précis:

For use of the précis the detailed operating instructions for the FGG III should be known.

1. Charge the cylinders with the respective gas mixture (200 kp/cm^2).
2. Adjust and check the dosage corresponding to the gas mixture.
3. Insert the cylinders and secure them with the tightening straps. Tighten the cap nuts.
4. Connect the twin breathing tubes and provide the connection to the supplementary supply plant.
5. Check the dosage of the supplementary supply.
6. Fill the soda lime canister to the mark and shake it for the soda lime to settle. Put on the cover, insert the canister and secure it with the tightening strap.
7. Assemble the unit and open one cylinder.
8. Submerge the apparatus in water with the rotary slide valve closed and check it for leaks. Close the cylinder. Bubbles should only escape from the pressure relief valve.

9. Check the pressure gauge for correct function by briefly opening the cylinders.

10. Don the apparatus and fix the supply hose on the waist-belt by means of a hose clip. The unit is ready for use.

Technical description

Range of application

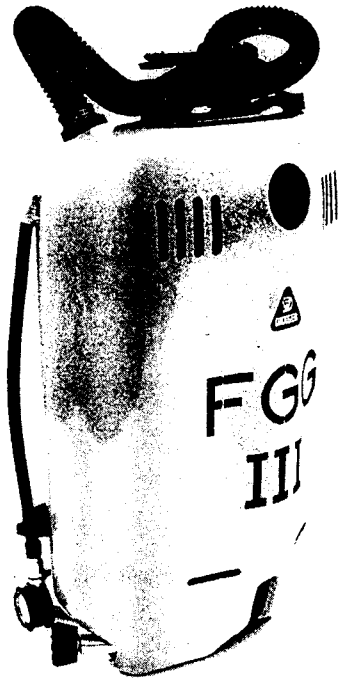
The FGG III is a newly designed self-contained swim-diving apparatus working on the semi-closed system with an oxygen-helium mixture. The fibreglass-reinforced polyester casing contains the twin breathing bags, the refillable soda lime canister, the pressure reducer dosage block and the two gas cylinders. According to the diving depth one of the three constant dosages can be selected. The apparatus can be used to a maximum diving depth of 200 m (658 feet). The duration can be prolonged by supplementary gas supply from a diving bell or from the surface.

1. Technical data

1.1. Construction

All component parts are housed in a strong fibreglass-reinforced protective casing.

The carrying harness is attached to the bottom and the twin breathing tubes to the top.



1.2.	Model No.	: T 10 500
1.3.	Dimensions	: Length : 680 mm Width : 456 mm Height : 215 mm
1.4.	Weight ready for use	: 28 kp
1.5.	Weight under water	: 0 kp (breathing bag filled)
1.6.	Duration of use	: maximum 3 hours with external supply. As a self-contained unit see Table.

1.7. Cylinder data : working pressure 200 kp/cm^2
Water capacity 4 litres
Maximum gas capacity 800 litres

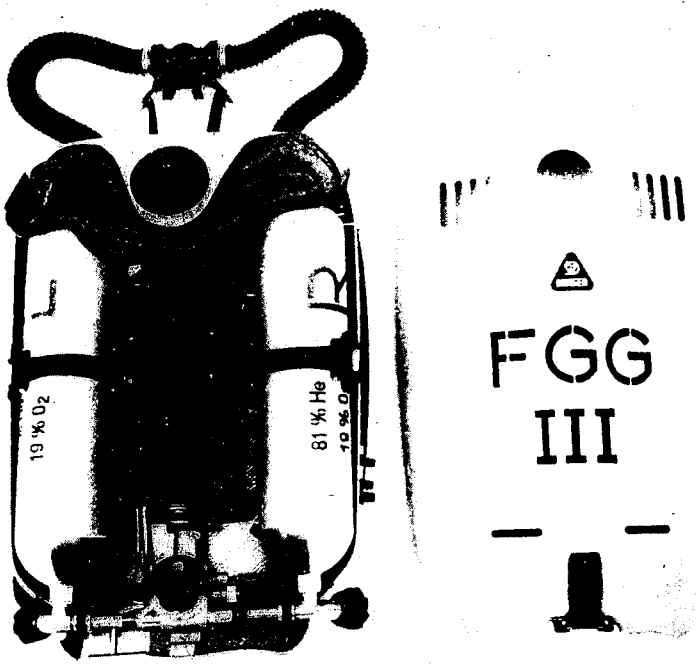
1.8. Soda lime canister : soda lime filling 3 kp -
granulation 4 - 6 mesh

1.9. Dosages and
diving depth : see Table

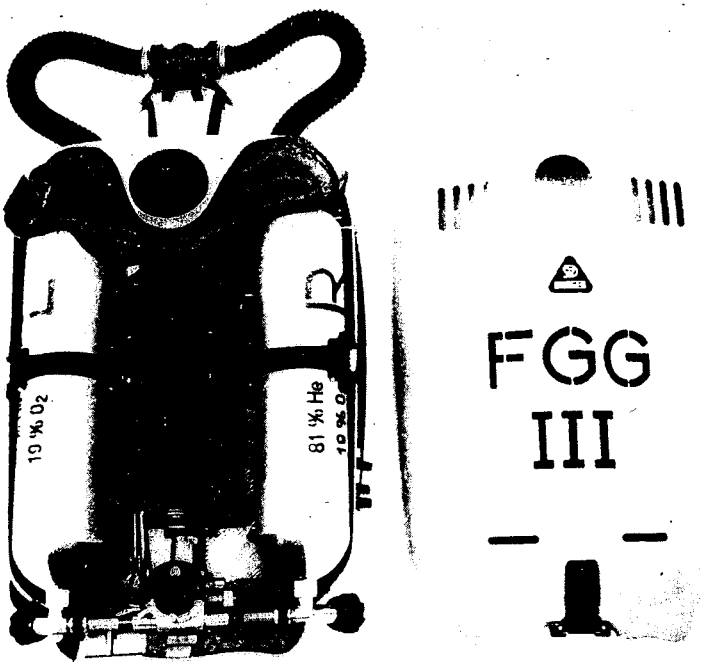
2. Construction

2.1. Protective casing

The high quality fibreglass-reinforced protective casing provides overall protection for the entire apparatus.
The cover is slotted in the upper part and connected to the lower shell by two strong hooks. At the bottom it is secured by a thick rubber tightening strap.

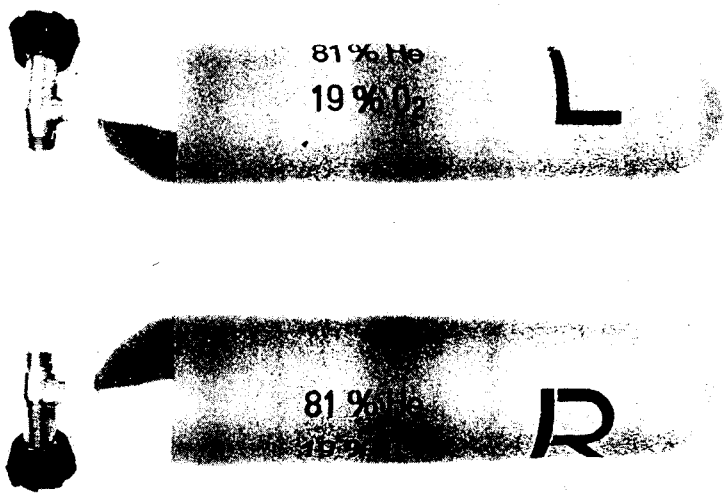


The soda lime canister, cylinders, breathing bag, pressure relief valve, pressure reducer, dosage block, harness, pressure gauge and supply hose are all connected to the protective casing. The twin breathing tubes connected either to a mouthpiece or full-vision mask are fitted to the inhalation resp. exhalation sockets on the top of the casing.



The soda lime canister, cylinders, breathing bag, pressure relief valve, pressure reducer, dosage block, harness, pressure gauge and supply hose are all connected to the protective casing. The twin breathing tubes connected either to a mouthpiece or full-vision mask are fitted to the inhalation resp. exhalation sockets on the top of the casing.

2.2. Cylinders



The two supply cylinders are respectively fitted with left- or right-angled valves. The connecting sockets and the cylinder valves are painted to indicate the respective gas mixture with the right side marked in green and the left side in red.

The charging pressure is 200 kp/cm^2 so that at a cylinder cubic capacity of 4 litres, 800 litres of gas is provided.

The cylinders are connected to the pressure reducer block by O-ring sealed finger tight connections the thread size being W 21.8 x 1/14" external. They are fully protected against corrosion. The cylinders are labeled with the ratio of mixture of the gases they contain.

They are retained in the protective casing by a rubber strap snap closure. As well as the oxygen-helium mixture these cylinders can be supplied containing compressed air.

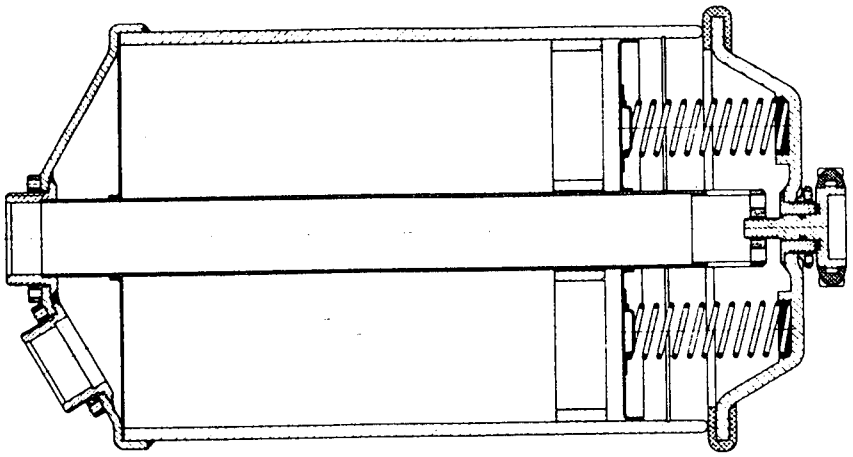
2.3. Soda lime canister

The fibreglass-reinforced polyester canister contains the central airway, a strong perforated plate and a spring loaded pressure plate. The cover is locked with a central securing screw.

The canister should be filled with approx. 3 kp of fresh soda lime, granulation 4 - 6 mesh.
The two perforated plates exclude the soda lime from the circuit, and the spring loaded top keeps the soda lime under slight tension.
The cover seals against a large gasket and is secured by the central screw fitting incorporating O-ring seals.

A

B

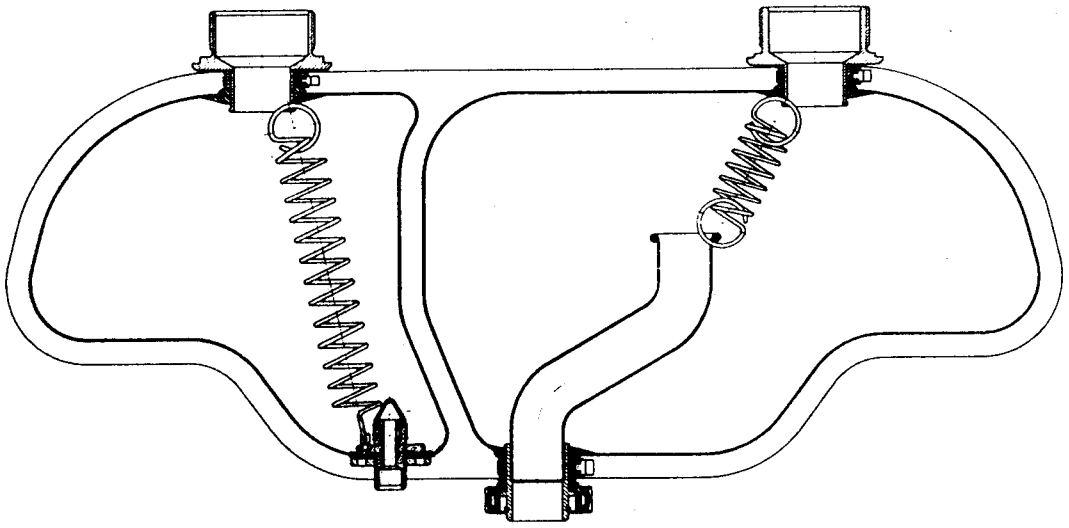


At point A the expired air enters through the central airway, passes through the soda lime for elimination of the CO_2 and flows back into the inhalation bag through socket B.

The canister is retained in the lower shell by two rubber tightening straps and connected to the breathing bag by O-ring sealed finger tight connections.

2.4. Breathing bag

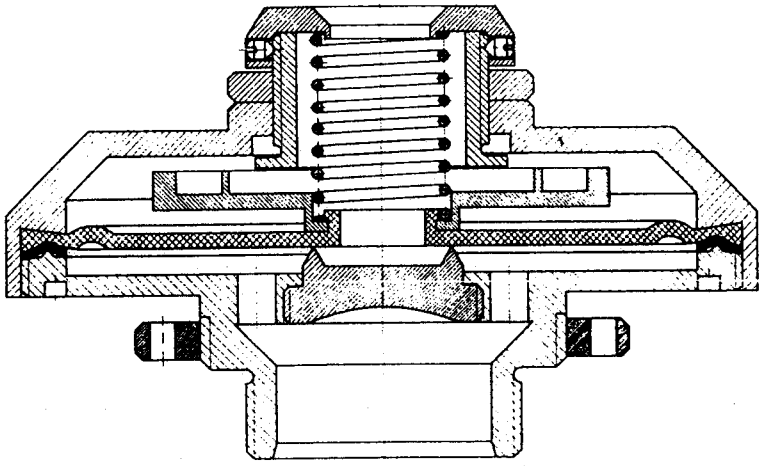
The breathing bag is made of highly durable neoprene reinforced fabric with the seams both stitched and welded. The separate inhalation and exhalation bags are paired together on a common plate.



The expired air passes into the exhalation bag which is connected to the pressure relief valve and the soda lime canister. The connection between breathing bag and soda lime canister is so designed that any water (condensate) in the exhalation bag is excluded from the canister. The swept volume of the bags is approx. 5.5 litres at a differential pressure of between +10 and -10 cm W.G. The inhaled air is drawn from the inhalation bag which is connected to the constant dosage device and the soda lime canister. The gas supply line from the dosage device connects to the bag with a fitting incorporating a non-return valve.

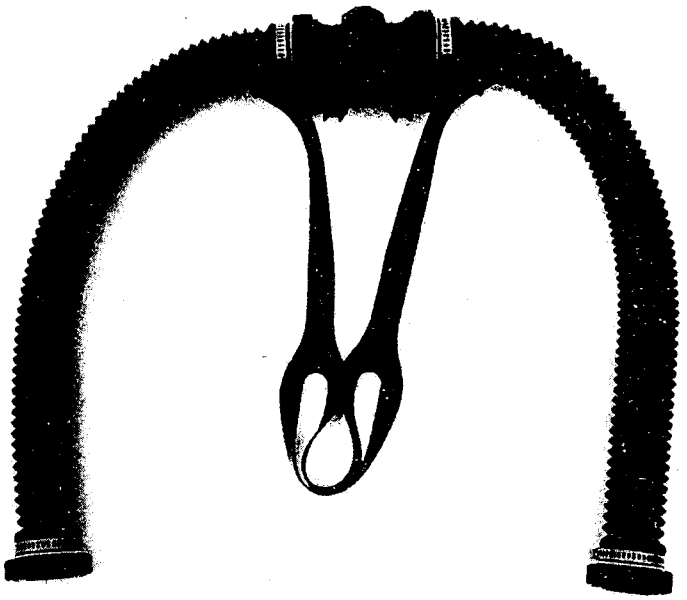
2.5. Pressure relief valve

The robust plastic pressure relief valve is sited high up and on the centre line of the apparatus. This is to minimize the change in breathing characteristic irrespective of the diver's position in the water.

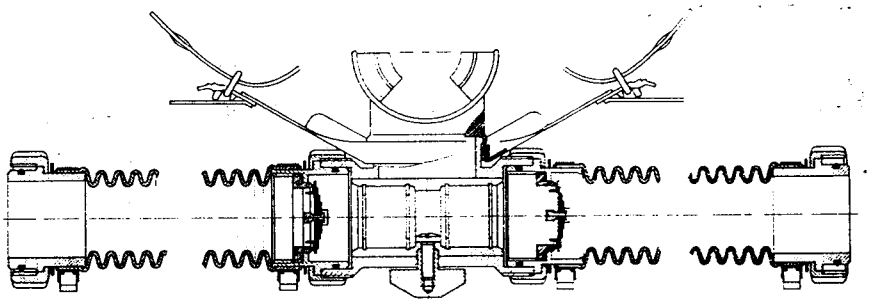


The opening pressure can be set to between 10 and 17 cm W.G. by a setscrew.

2.6. Twin breathing tubes



The flexible twin breathing tubes of high quality corrugated rubber are fitted with high-grade plastic connectors.
Via the mouthpiece or full-vision mask the diver is connected to the circuit of the apparatus.

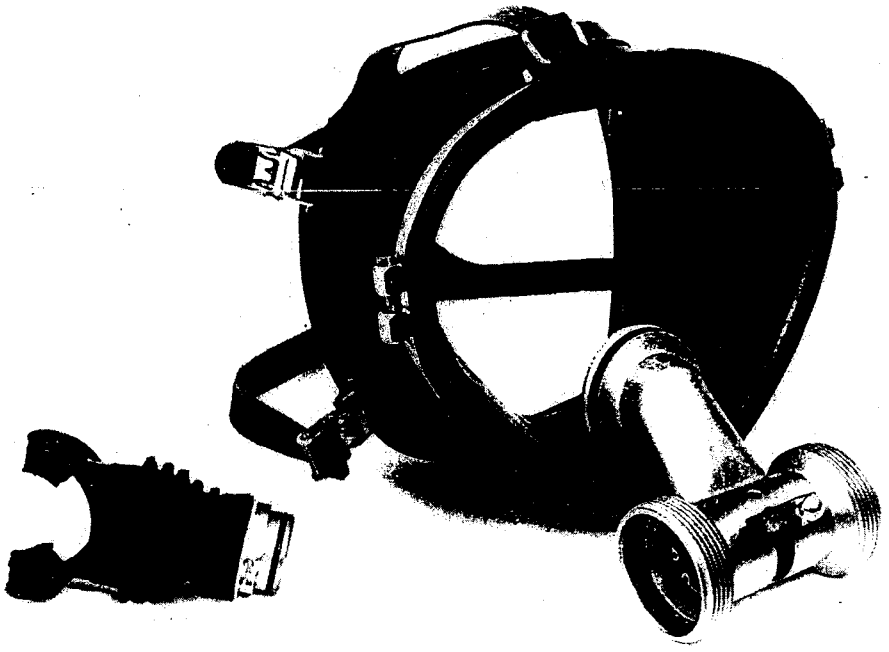


A rubber inhalation valve is embodied in the mouth-piece connector of one breathing tube and a similar

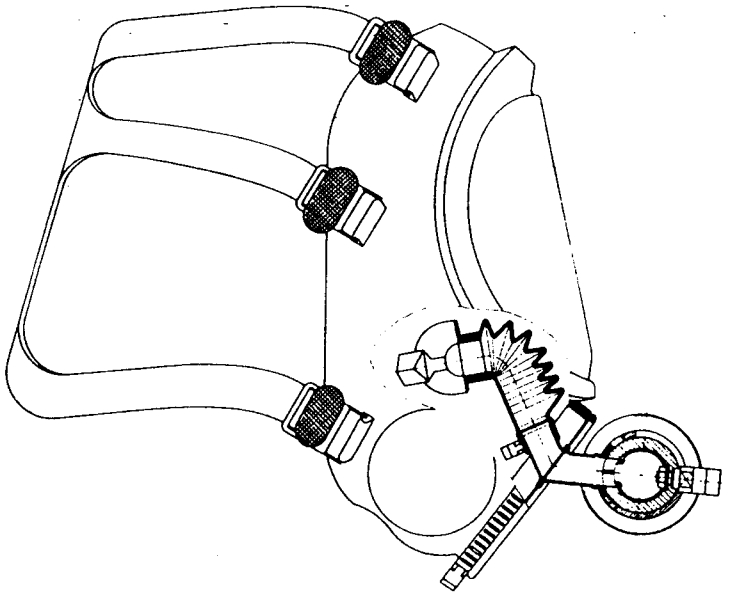
exhalation valve is in the connector of the other tube. These connectors and the connectors on the other ends of the tubes are so designed to prevent the respective tubes from being wrongly connected.

2.7. Full-vision mask

The apparatus can be used either with a mouthpiece or a full-vision mask.
Two models incorporating a mouthpiece are available.



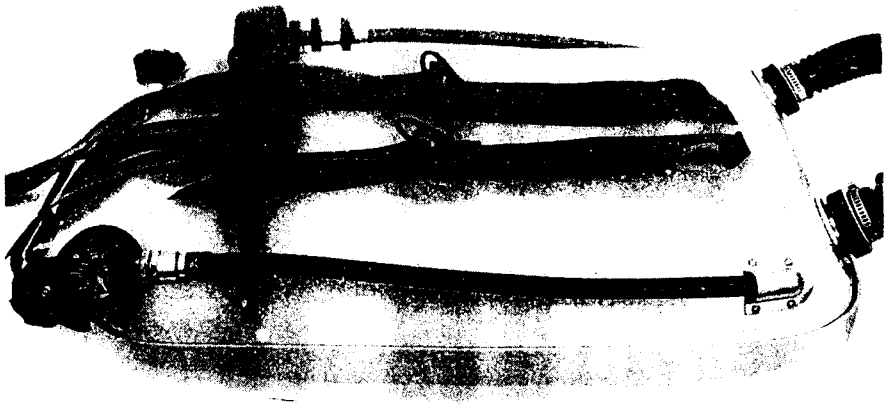
The DRAGER full-vison mask has the mouthpiece connector attached through the visor. The integral flexible mouthpiece is easily interchangeable. The rotary slide valve box is mounted on the outside of the mask to seal off the interior.



The DRAGER-NORMALAIR full-vision mask incorporates the rotary slide valve box with the highly flexible mouthpiece being attached.
This enables the diver to temporarily dislodge the mouthpiece when he wishes to talk.

O-ring sealed noninterchangeable finger tight connections provide the connection to the diving apparatus.

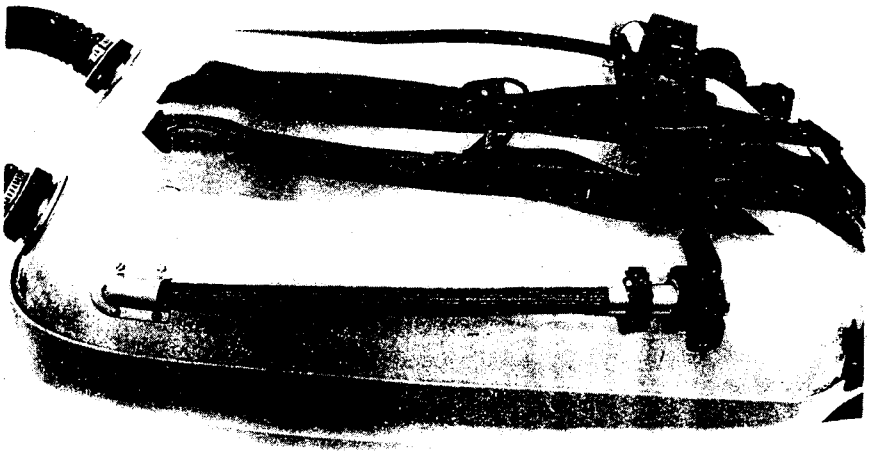
2.8. Hinged pressure gauge



A flexible high pressure line connects the pressure gauge to the apparatus at the top left-hand side of the casing and is clipped at the pressure gauge end by a special securing device.

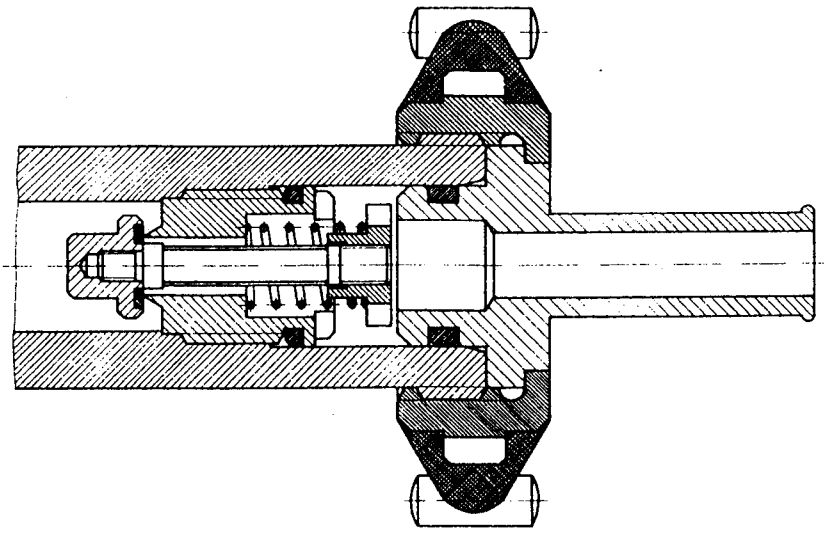
The gauge indicates the contents of the two cylinders. It is calibrated alternatively in kp/cm^2 or lb/sq inch. The minimum safe operating pressure of 45 kp/cm^2 or 639.9 lb/sqinch is clearly marked.

2.9. Hose connection



When diving with external supply the connection between supplementary supply unit and diving apparatus is made via a short connecting hose mounted on the right-hand side of the casing.

This hose has O-ring sealed manual fittings to which the supply hose is connected.

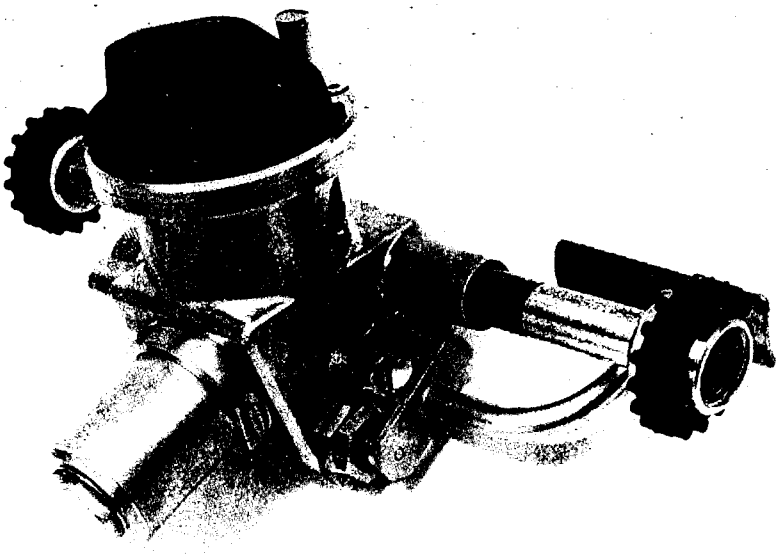


A non-return valve is sited in the connector (in later models it will be sited in the casing) to prevent water from penetrating into the circuit of the apparatus.

When the hose is not used the connector is sealed by a locking screw and securely clipped to the side of the casing.

2.10. Pressure reducer dosage block

In a special pressure reducer the high pressure gas is reduced to a constant working pressure and passed directly to the dosage block.



The unit incorporates the two connecting sockets with finger tight connections. The sockets are marked in red and green for correct insertion of the cylinders.

The block is attached to the lower shell with the connections for dosage and pressure gauge line and the bypass lever being located on the left-hand side. On the right-hand side a filling socket is provided for charging integral cylinders.

In addition a safety valve is provided for the working pressure. By means of a robust control grip with safety locking device the respective dosage corresponding to the gas mixture is preset.
The gas flow is reduced to a working pressure of 40 kp/cm^2 which remains constant irrespective of depth and work rate.

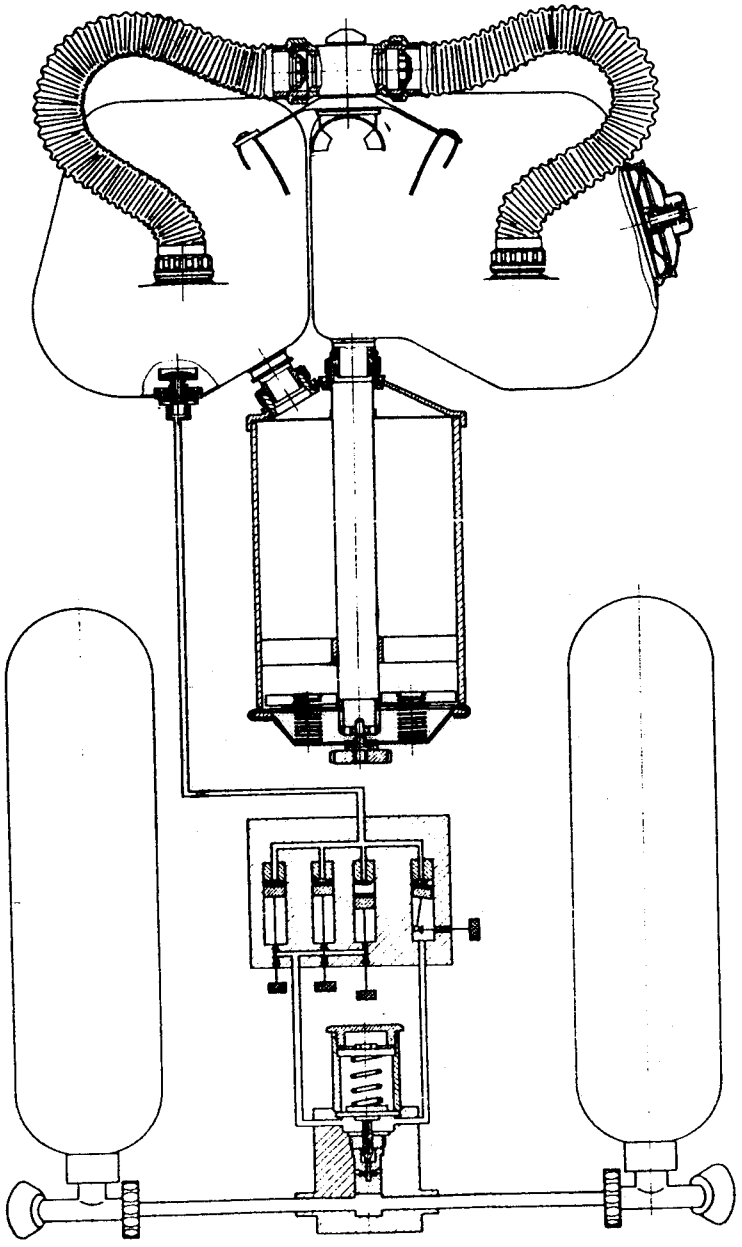
The flow control unit is preset to give three alternative flow settings which correspond to the gas mixture.

Independently of the dosages the constant working pressure is admitted to a bypass system. When operating a lever mounted on the lower side of the casing the circuit of the apparatus is supplied with a multiple of the constant flow.

The respective constant dosage values are indicated on page 25.

3. Operation

The FGG III is a self-contained mixed gas swim-diving apparatus working on the semi-closed system.



The diver uses a mouthpiece or a full-vision mask incorporating a mouthpiece. Two respiratory valves are sited in the mouthpiece connector to ensure a minimum dead space. The connector also embodies a hand operated rotary slide valve which is designed to keep water and ambient atmosphere out of the unit.

The expired air passes through the exhalation valve down the exhalation tube into the exhalation part of the twin breathing bags. Here any excess gas escapes via the adjustable pressure relief valve.
The pressure relief valve is connected directly into the bag and sited in the casing as near to the physiological centre of respiratory pressure as is practical. The gas passes into the refillable soda lime canister for elimination of the CO_2. It then passes out into the inhalation part of the twin breathing bags. Here the system is replenished by the constant flow supplied via a non-return valve from the pressure reducer dosage block of the apparatus or via the supply hose from the supplementary supply plant.

The inhaled gas is then taken from the inhalation bag via the inhalation tube, inhalation valve and mouthpiece.

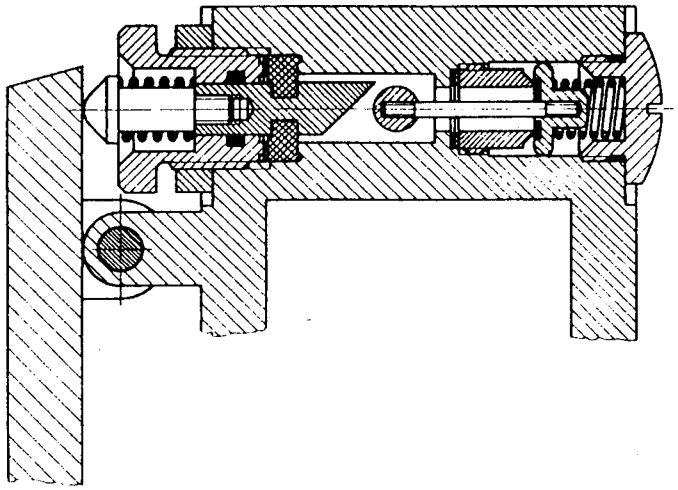
The gas is supplied via the pressure reducer dosage block. This is situated at the lower part of the casing and acts as a manifold lower anchoring point for the cylinders. The high pressure gas from the cylinders is reduced to a pressure of 40 kp/cm^2, this pressure remaining constant irrespective of diving depth and work rate.

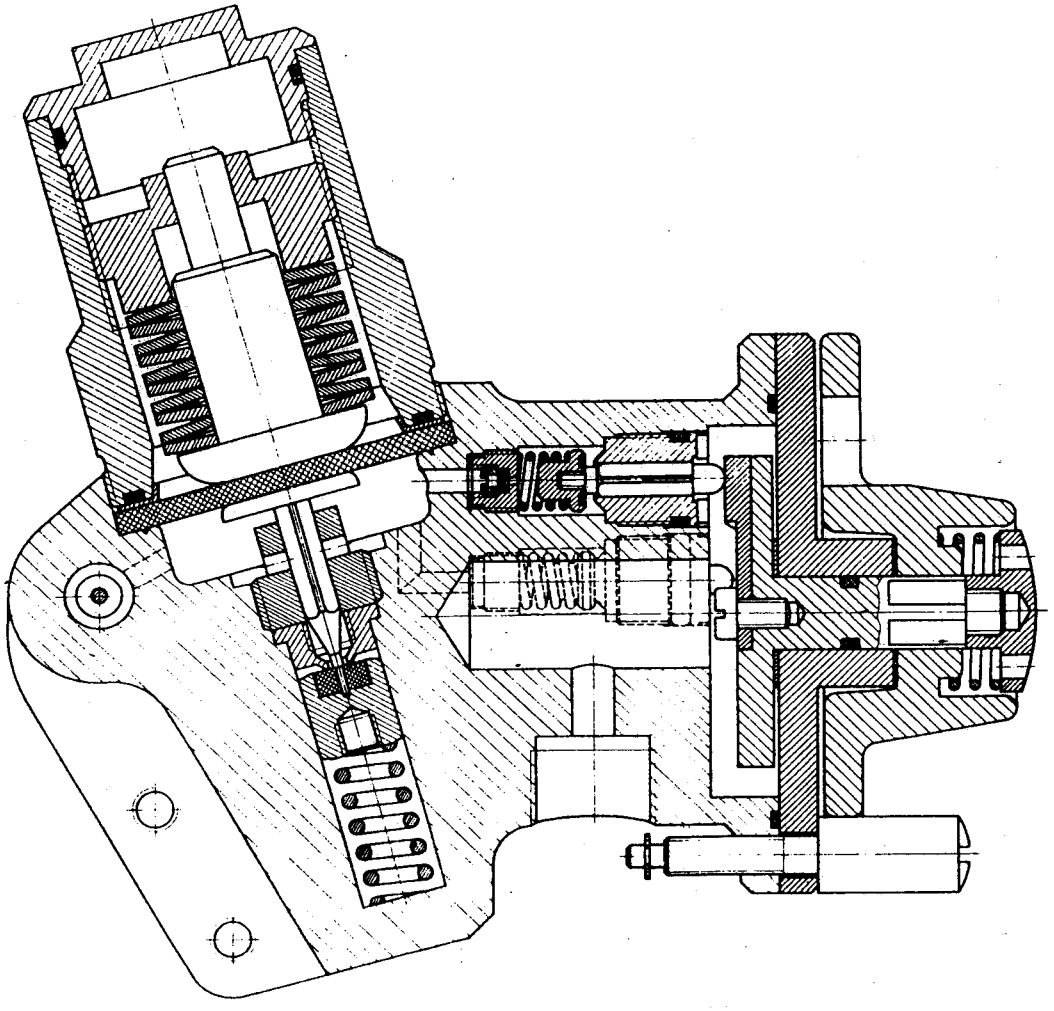
The gas at this reduced pressure now passes to a flow control unit which can be selected to give one of three pre-determined flows.

The required dosage is adjusted by a selector knob which is locked by a special screw to prevent alteration during diving.

This unit also incorporates a manual bypass valve the operating lever of which is at the bottom left-hand side of the casing. When operated the bypass valve will pass up a multiple of the constant dosage.

The working principle of the unit is shown in the following diagram.





When diving with external supply the apparatus cylinders and the pressure reducer dosage block serve as an emergency outfit only the necessary supply cylinders being installed in a diving chamber.

The supplementary supply plant in the chamber is fitted with the same pressure reducer dosage system as the diving apparatus. A robust pressure hose provides the connection to the diver.

The following formula is used to determine the O_2 partial pressure for the different rates of consumption:

$$X = \frac{(F \cdot p - V)}{(F - V)} \cdot T$$

X= O_2 partial pressure (atm.abs.)

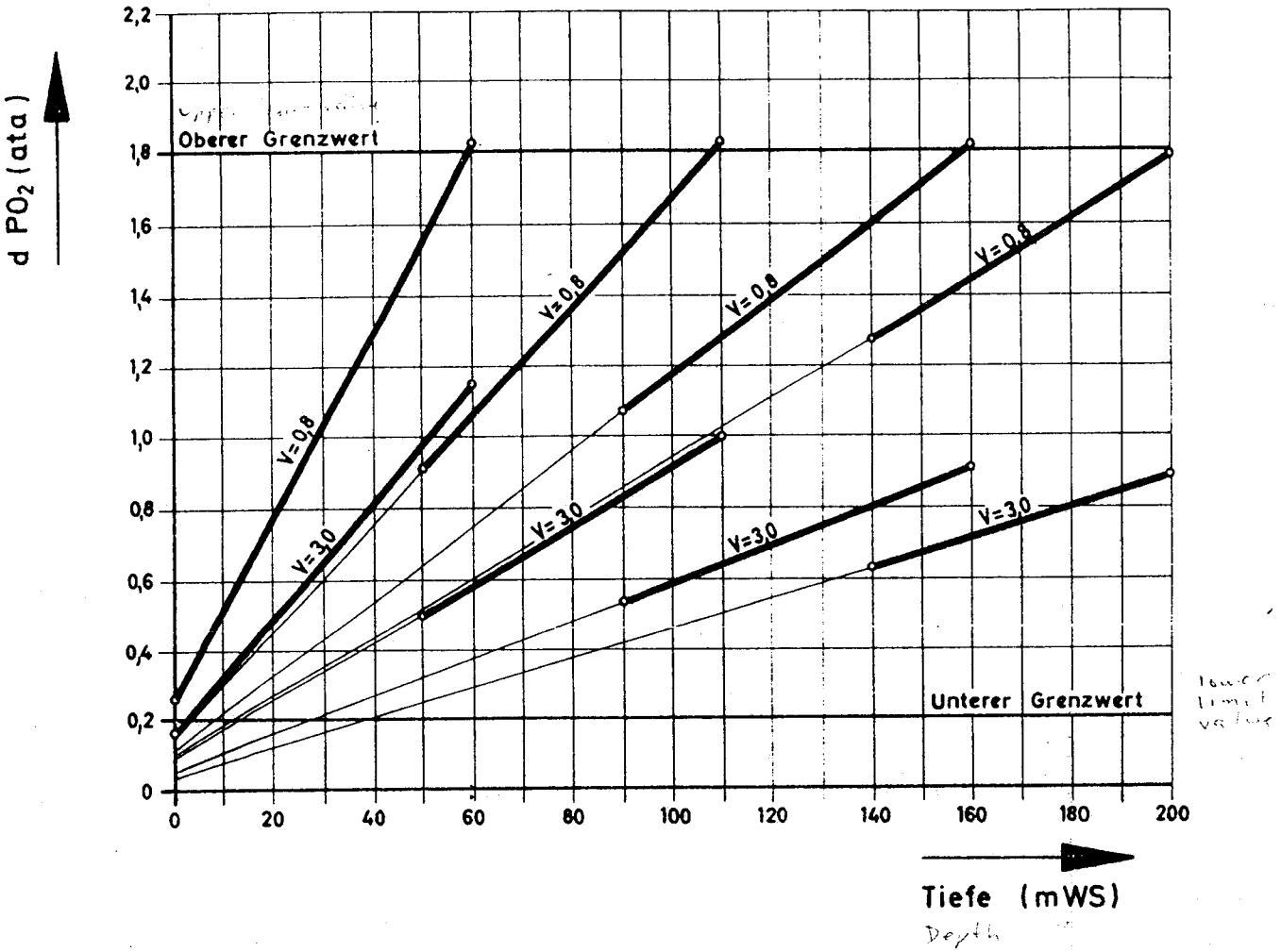
F= dosage (l/min)

p= O_2% in gas mixture

V= O_2 consumption (l/min)

T= absolute hydrostatic pressure

In the following Table the different O_2 partial pressure values are indicated.



Gemisch 0

29 % O_2, 71 % N_2

Dosierung 20 l/min

Tiefe (m)	d PO_2 (ata)	
	V = 0,8	V = 3,0
0	0,260	0,165
60	1,823	1,153

Gemisch I

17,5 % O_2; 82,5 % He

Dosierung 30 l/min

Tiefe (m)	d PO_2 (ata)	
	V = 0,8	V = 3,0
50	0,914	0,50
110	1,829	1,00

Gemisch II

12,5 % O_2, 87,5 % He

Dosierung 40 l/min

Tiefe (m)	d PO_2 (ata)	
	V = 0,8	V = 3,0
90	1,071	0,541
160	1,821	0,919

Gemisch III

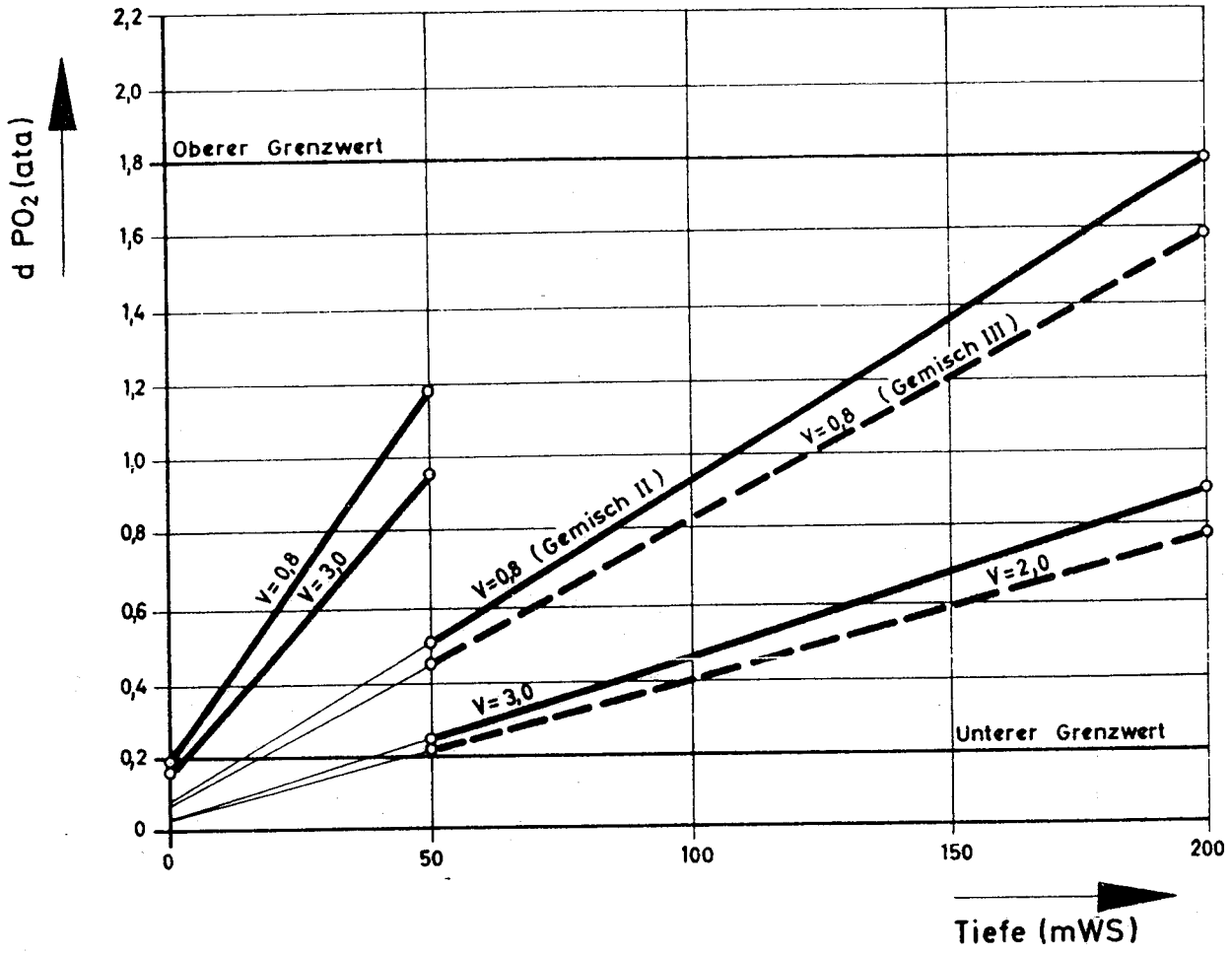
10 % O_2, 90 % He

Dosierung 50 l/min

Tiefe (m)	d PO_2 (ata)	
	V = 0,8	V = 3,0
140	1,280	0,638
200	1,793	0,894

Bemerkung: Gemisch 0 kann bei Stellung III des Dosierungsblocks verwendet werden

In the following Table the different O_2 partial pressure values are indicated.



Gemisch I

21 % O_2 , 79 % N_2

Dosierung 50 l/min

Tiefe	d PO_2 (ata)	
(m)	V=0,8	V=3,0
0	0,197	0,160
50	1,183	0,957

Gemisch II

10 % O_2 ,90 % He

Dosierung 50 l/min

Tiefe	d PO_2 (ata)	
(m)	V=0,8	V=3,0
50	0,512	0,255
200	1,793	0,894

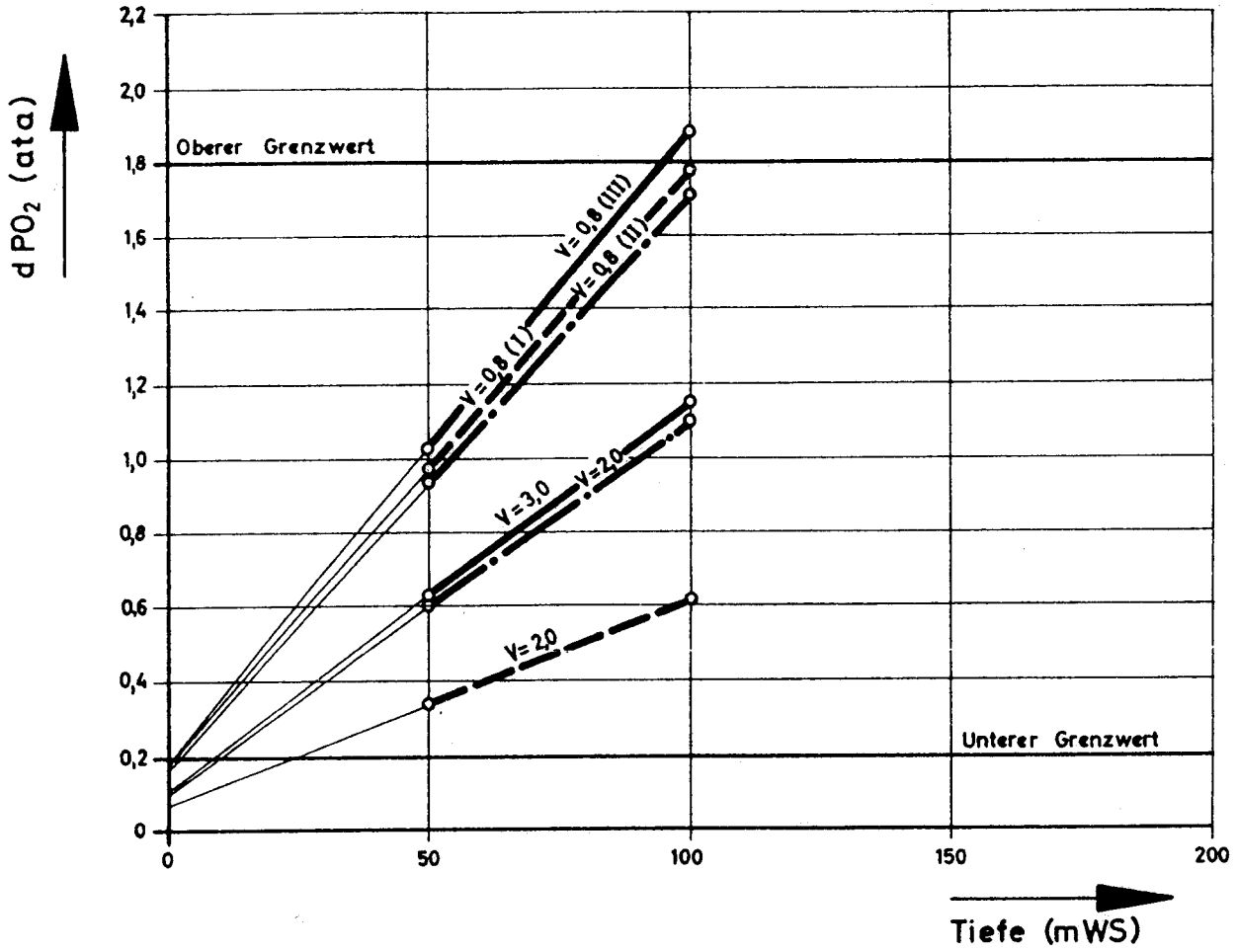
Gemisch III

10 % O_2 ,90 % He

Dosierung 30 l/min

Tiefe	d PO_2 (ata)	
(m)	V=0,8	V=2,0
50	0,453	0,222
200	1,582	0,778

In the following Table the different O_2 partial pressure values are indicated.



Gemisch I

22 % O_2 , 78 % He

Dosierung 11,5 l/min

Tiefe (m)	d PO_2 (ata)	
	V=0,8	V=2,0
50	0,970	0,335
100	1,779	0,614

Gemisch II

19 % O_2 , 81 % He

Dosierung 20 l/min

Tiefe (m)	d PO_2 (ata)	
	V=0,8	V=2,0
50	0,938	0,6
100	1,719	1,1

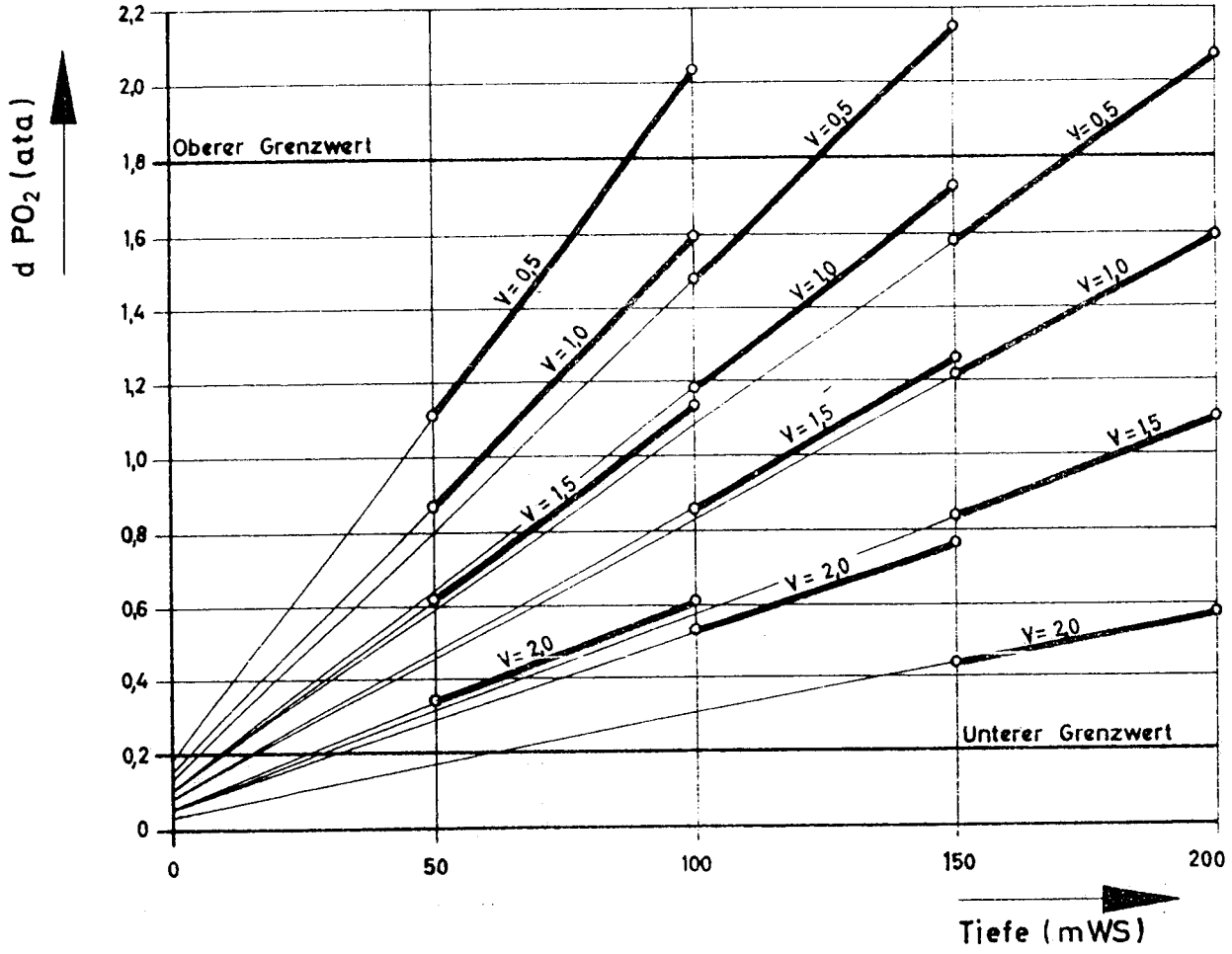
Gemisch III

19 % O_2 , 81 % He

Dosierung 35 l/min

Tiefe (m)	d PO_2 (ata)	
	V=0,8	V=3,0
50	1,026	0,628
100	1,882	1,152

In the following Table the different O_2 partial pressure values are indicated.



Gemisch I

22 % O_2 , 78 % He

Dosierung 11,5 l/min

Tiefe	d PO_2 (ata)			
(m)	V=0,5	V=1,0	V=1,5	V=2,0
0	0,185	0,146	0,103	0,056
50	1,11	0,87	0,62	0,34
100	2,03	1,6	1,13	0,615

Gemisch II

16 % O_2 , 84 % He

Dosierung 17 l/min

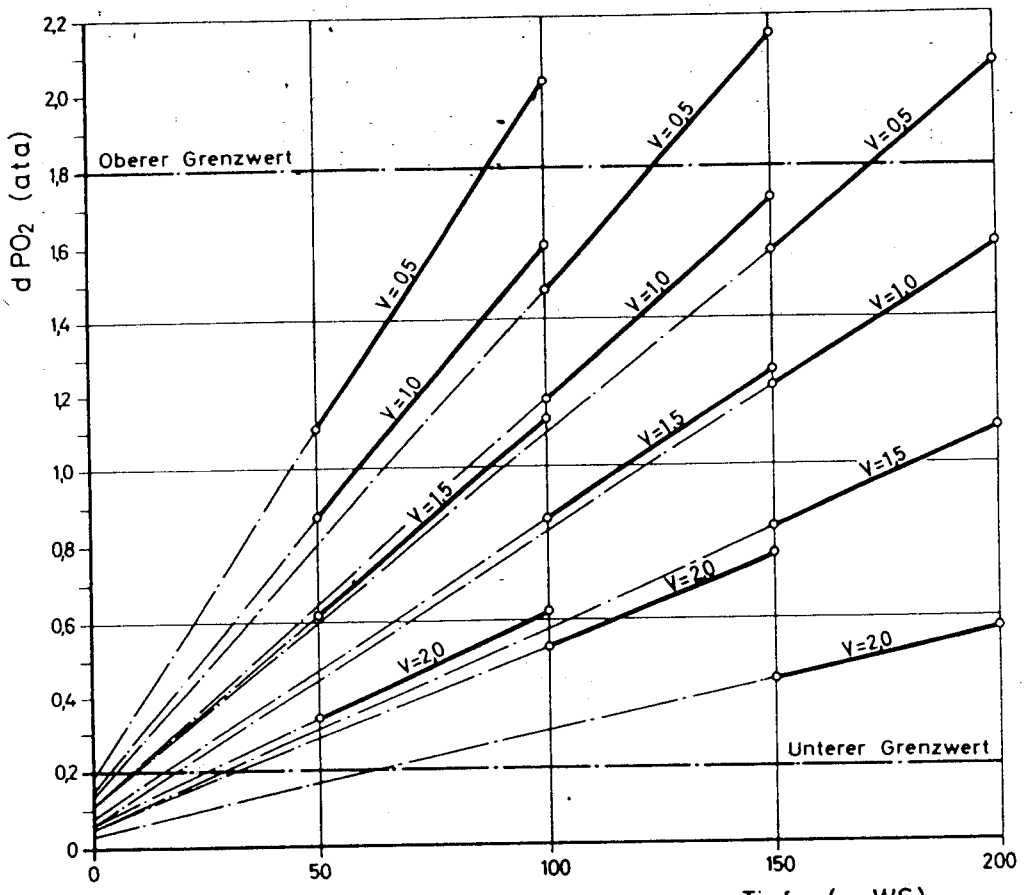
Tiefe	d PO_2 (ata)			
(m)	V=0,5	V=1,0	V=1,5	V=2,0
0	0,134	0,107	0,08	0,05
100	1,48	1,18	0,865	0,53
150	2,15	1,72	1,26	0,77

Gemisch III

12 % O_2 , 88 % He

Dosierung 21 l/min

Tiefe	d PO_2 (ata)			
(m)	V=0,5	V=1,0	V=1,5	V=2,0
0	0,1	0,08	0,05	0,03
150	1,58	1,215	0,84	0,44
200	2,07	1,6	1,1	0,575



Tiefe (m)	d PO_2 (ata)			
	V=0,5	V=1,0	V=1,5	V=2,0
0	0,185	0,146	0,103	0,056
50	1,11	0,87	0,62	0,34
100	2,03	1,6	1,13	0,615

Tiefe (m)	d PO_2 (ata)			
	V=0,5	V=1,0	V=1,5	V=2,0
0	0,134	0,107	0,08	0,05
100	1,48	1,18	0,865	0,53
150	2,15	1,72	1,26	0,77

Tiefe (m)	d PO_2 (ata)			
	V=0,5	V=1,0	V=1,5	V=2,0
0	0,1	0,08	0,05	0,03
150	1,58	1,215	0,84	0,44
200	2,07	1,6	1,1	0,575

Bild 15 0_2-Partialdrücke FGGIII in Abhängigkeit vom Sauerstoffverbrauch

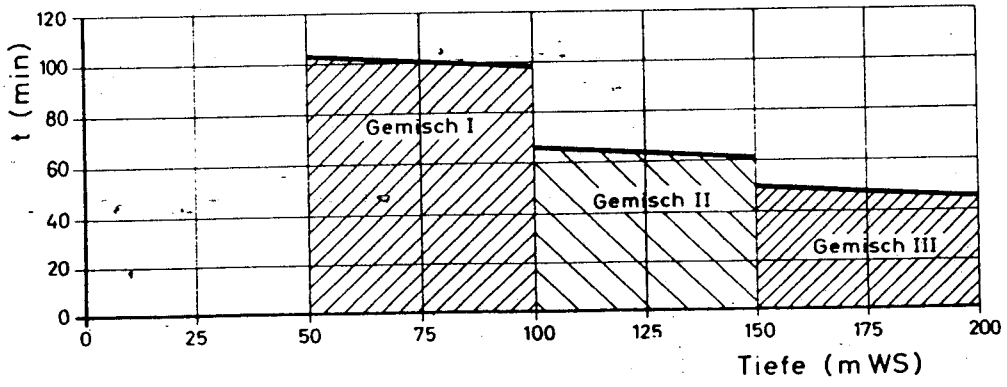


Bild 16 Theoretische Gebrauchszeiten FGG III ohne Fremdgasversorgung

4. Use

4.1. Prepare the apparatus for use.

4.1.1. Fill the apparatus cylinders.

Check the O_2 concentration of the gas mixture in the apparatus cylinders and of the external supply.

The water content of the gas mixture must not exceed 50 mg/Nm^3.

4.1.2. Insert the cylinders in the lower shell.

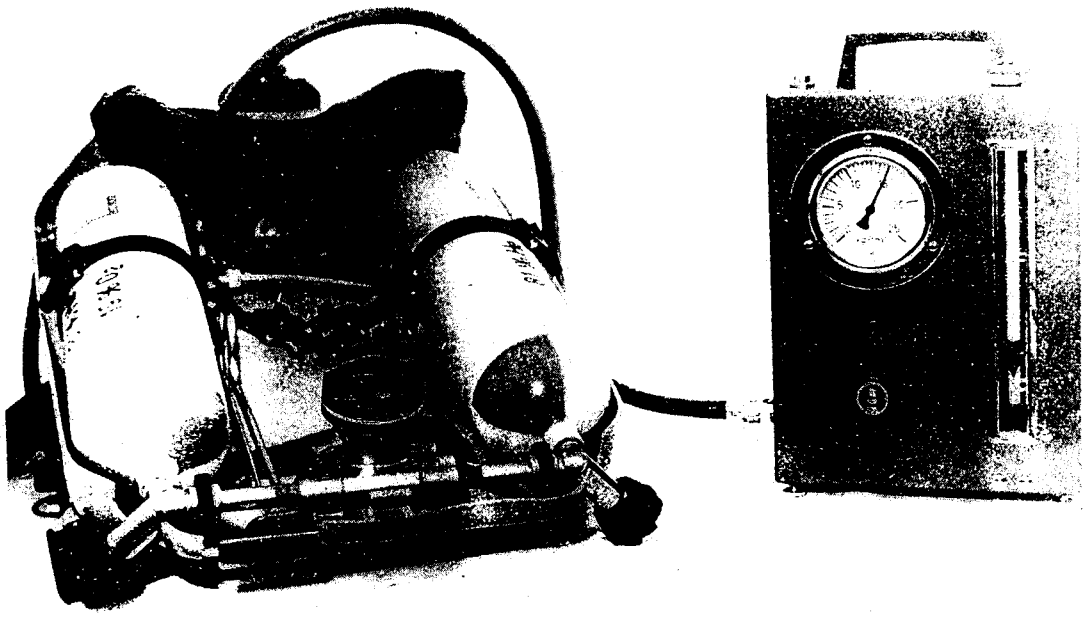
Screw up the cap nuts of the pressure reducer dosage block and the cylinder valves first.

After that secure the cylinders with the rubber straps.

4.1.3. Select the required dosage by unscrewing the locking screw and turning the knob until the required figure appears in the aperture. Lock the knob by refitting the locking screw.

Caution: The selector knob should not be left between two settings and it should not be operated when the system is pressurized.

4.1.4. Dosage test



Disconnect the supply pipe from the breathing bag and connect it to the test set.

Open one cylinder and check the dosage fall between the respective marks on the flowmeter.

These marks are set to give a permissible tolerance of ± 10% related to the final value.

When closing the fine regulating valve in clockwise direction the pressure in the dosage outlet is increased according to the diving depth. The respective pressure is read off from the gauge of the unit.

With the diving depth adjusted on the gauge the dosage is checked again.

The flow should not fall outside the limits at any cylinder pressure between 50 and 200 kp/cm^2.
Shut off both cylinders and remove the test set.

4.1.5. Connect the gas supply line to the breathing bag.

4.1.6. Diving with external supply

Connection to a supplementary mixed gas supply plant

Remove the connector from the fixing device and re-insert the locking screw. Connect the supply hose to the connector and check it for leaks.

Dosage test

Make the dosage test as described in item 4.1.4. with the apparatus cylinders closed as the gas mixture is supplied from the supplementary supply plant.

4.1.7. Filling the soda lime canister

Fill the canister with approx. 3 kg of unused soda lime (granulation 4 - 6 mesh).
The canister should be shaken or tapped for approx. 15 seconds for the soda lime to settle before the cover is fitted.

The cover should be tightened by the central securing screw. If the canister is not being fitted to an apparatus immediately - fit connector blanks, otherwise the soda lime will deteriorate.

4.1.8. Insert the soda lime canister and secure it in the lower shell with the two tightening straps. Tighten the O-ring sealed manual screwings of the twin breathing bags.

4.1.9. Check that the respiratory valves in the breathing tubes function correctly by alternatively blowing and sucking on each tube. Damaged valves must be replaced.

4.1.10. Connect the inhalation and exhalation side of the tubes with respiratory valves to the full-vision mask or mouthpiece and the other ends to the respective casing connections. The threads are so designed that faulse connection is excluded.

Tighten all connections.

4.1.11. Leak test of the complete apparatus.

Seal off the mouthpiece and set the pressure relief valve to maximum pressure by securing it fully in. Pressurize the circuit by opening one cylinder valve until the pressure relief valve opens.

Submerge the unit in water and close the cylinder. Check it for leaks with particular attention to the breathing circuit and soda lime canister connections.

Re-adjust the pressure relief valve and secure it with the counter nut.

4.1.12. Put on the cover and secure it.

Take care that the breathing bag is not trapped.

4.1.13. Don the apparatus and tighten the harness.

If necessary fit additional weights at breast-height. To reduce the total weight remove the weights under the breathing bag.

4.1.14. Check the cylinder pressure and the bypass valve for correct function by opening the cylinder valves and operating the bypass.

Fit the mouthpiece or mask.

Open the rotary slide valve - the apparatus is ready for use.

4.2. Diving

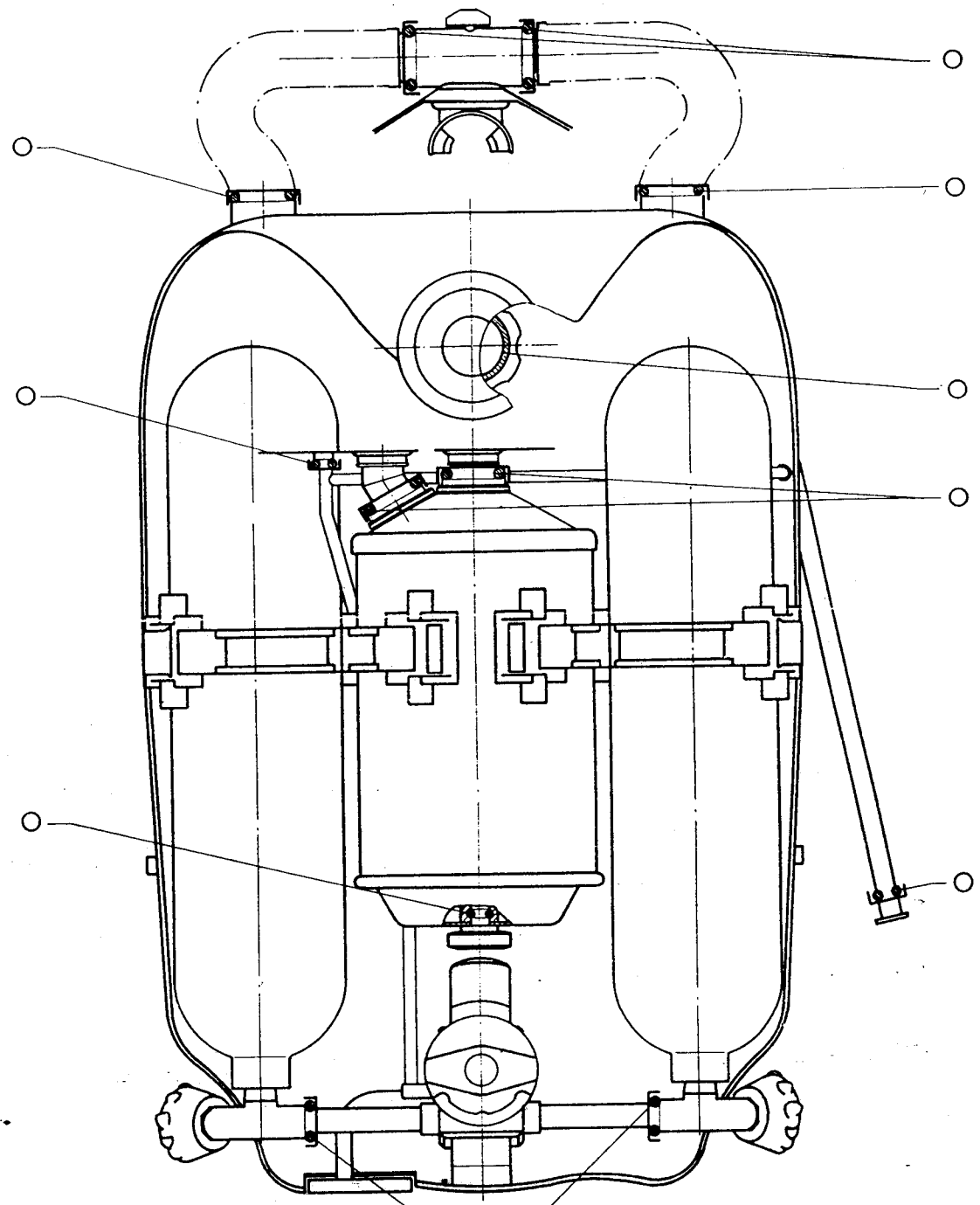
When diving take care that a minimum residual pressure of 40 kp/cm^2 is not exceeded, otherwise the gas supply will be considerably reduced.
The escape of any excess gas from the pressure relief valve can be heard.

5. Maintenance

5.1. After use care

As soon as possible after diving the unit should be thoroughly rinsed with clean fresh water.
Empty the soda lime canister, rinse in clean water and allow to dry out. (Keep it away from excessive heat).
Check all seals and gaskets for damage and renew as necessary.
Degrease the O-rings according to the following lubrication diagram.
Replace damaged rings.

Schmierplan FGG III
Lubricationplan



○ An diesen Stellen mit O-Ring Fett „Dow Corning 55 M Grease" schmieren

○ These places should be greased with „Dow Corning 55M Grease"

Check all connections for correct function.

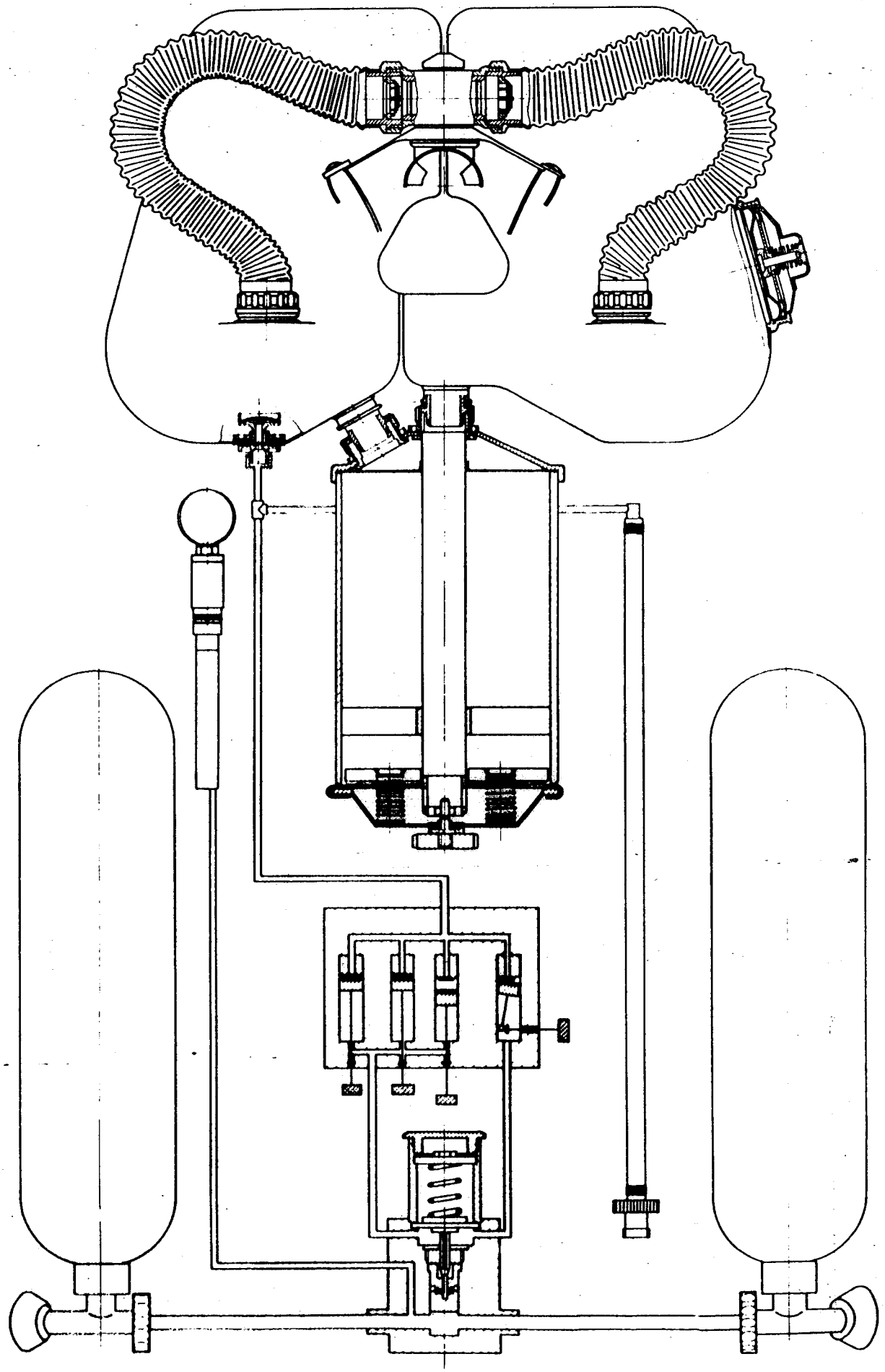
5.2. Periodic inspection

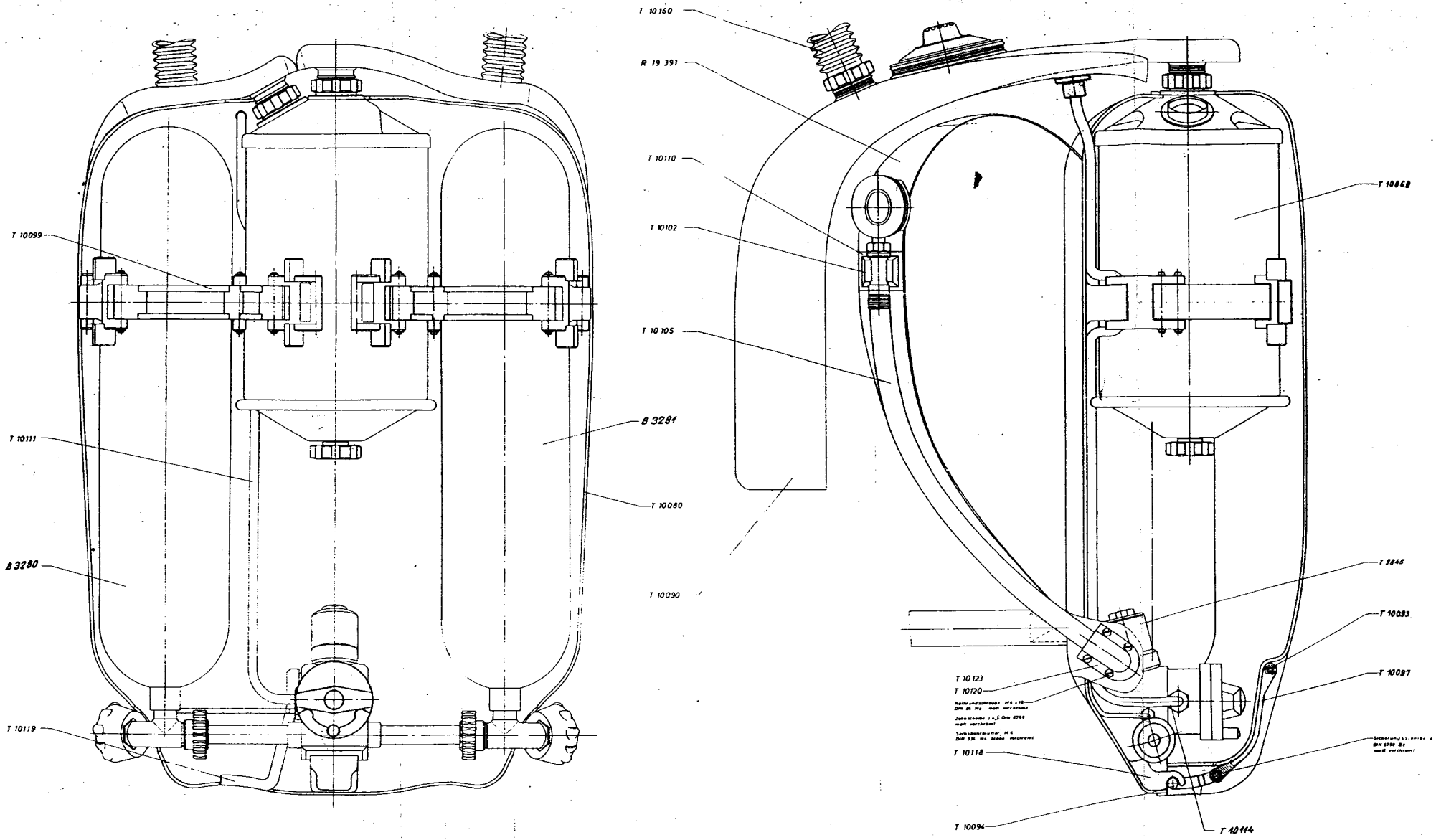
At intervals of two years the pressure reducer dosage block should be returned to the manufacturer for overhauling.

Recertification and date stamping of the cylinders must be carried out according to the current regulations of the country.

Funktionsschema

FGG III





Fertiggasgemisch – Tauchgerät FGG III

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