

Submarine Products Limited

Diving Handbook

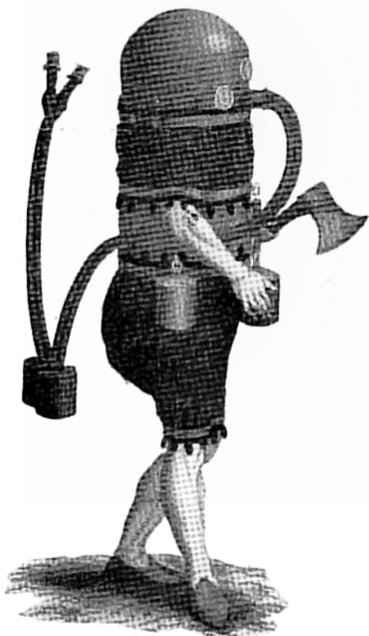
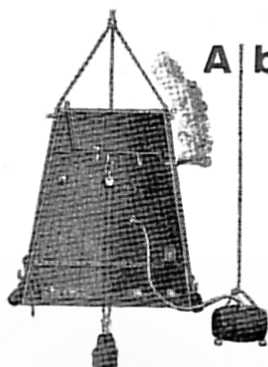
SUBMARINE PRODUCTS LTD . HEXHAM . NORTHUMBERLAND

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A brief history of diving



Man has always been fascinated by what lies under the sea ; one of the earliest references to diving is in Homer's Iliad written about 3000 years ago. There are many other stories of the exploits of unassisted divers in history—the forerunners of the modern snorkel diver.

There were also early attempts at assisting divers to stay under water. Aristotle mentions that divers breathed under water from a metal vessel which was lowered to them. It did not fill with water but retained the air in it. Very probably this was a small diving bell which a naked diver could bob up into for a breath of air when necessary. Also Alexander the Great is reputed to have made a descent in a machine which kept him dry and enabled him to see.

Many diving bells were made in the 17th and 18th century but the first really successful one was designed by Edmund Halley (of comet fame) in 1717. It was made of wood, 8 feet high and 5 feet diameter at the bottom, with heavy lead weights to keep it down. Fresh air was lowered to the bell in weighted barrels. This arrangement was so effective that Halley with 4 others once remained at a depth of 60 feet for 1½ hours.

The next major improvement to the diving bell took place at Hexham, Northumberland in 1778, when the famous engineer John Smeaton used one to repair the foundations of the bridge over the River Tyne. Instead of barrels he used a force

pump to supply the air and thus laid the foundations for the immense amount of submerged dock and harbour work that was to be carried out in the next 50 years.

Meanwhile numerous inventors had been striving to make a diving suit to enable a man to walk and work freely underwater. The inadequacy of early air pumps made their task nearly impossible, but Klingert made an ingenious helmet suit in 1798. The diver had a cast iron helmet with glass windows, sealed below the knees with leather breeches. His air supply was contained in a large chamber, lowered with him, and connected to him by air pipes. When he reached the bottom he could walk around for some distance.

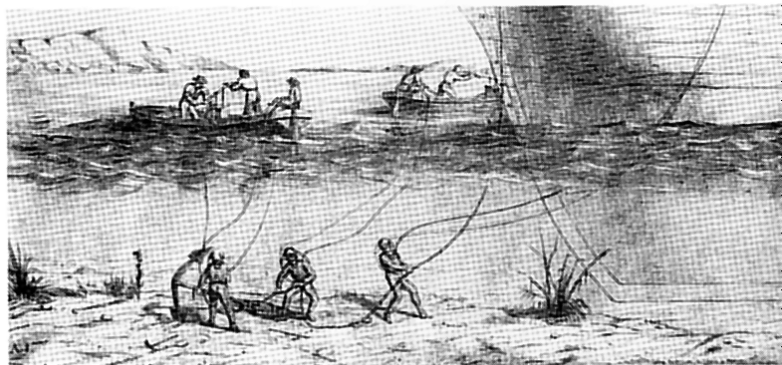
In 1837 Augustus Siebe perfected the first really practicable deep sea diving suit. It consisted of a copper helmet, rubberised canvas suit and powerful air pump ; in fact virtually the same equipment as is used today by modern salvage divers.

In 1860 two Frenchmen, Rouquayrol and Denayrouze made the first truly self-contained diving set by fitting a compressed air cylinder and an automatic pressure regulator to a helmet diving suit.

The next significant innovation was the closed circuit oxygen set used by frogmen of World War 2. In these, pure oxygen was breathed in and out through a carbon dioxide absorbent. Compactness and lack of bubbles made them ideal for military use, but this sort of equipment is not suitable for amateurs as oxygen is a poison when used at depths greater than 33 feet.

Up to now all diving apparatus had severe limitations and divers had to be highly trained specialists. However in France in 1943 Cousteau and Gagnan perfected the first practicable open-circuit breathing set. In this, pure air was breathed from a cylinder on the back and afterwards exhaled to the sea. It suffered from none of the drawbacks of the closed circuit oxygen set, and could be used by anyone with a little training.

This type of equipment developed and improved over the last 20 years has made modern diving possible. Submarine Products Ltd., are proud of the part they have played in its development.



The equipment you are going to need

You have decided to take up diving. What equipment are you going to need?

To breathe—you need a breathing set.

This is the most important piece of equipment, for without it you cannot even start to dive properly.

The complete set is made up of:

1. a regulator—to supply air automatically to you as you need it.
2. a harness—to hold the set securely on your back.
3. one or more cylinders—to hold the compressed air you need.
4. a manifold (if you use more than one cylinder it links them together.)
5. a contents gauge and tube—to tell you how much air you have left.

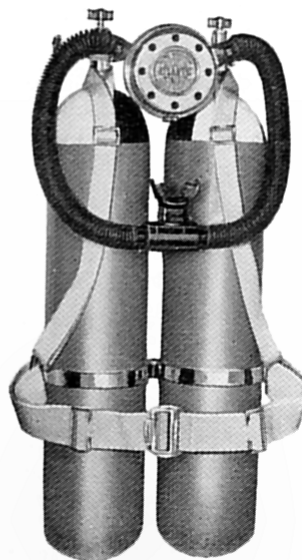
With this assembly you can breathe naturally underwater. A contents gauge is essential. You must always know how much air you have in your cylinders.

To see—you need a mask.

The human eye cannot see clearly unless it is in contact with air. You will have noticed this if you



four



have ever put your head underwater and opened your eyes ; everything is blurred. So to put air between your eyes and the water you must wear a mask.

The mask covers eyes and nose, and by blowing into the interior of the mask you can introduce air to counteract the effect of pressure crushing it against your face as you descend.

The mask is your window on the underwater world. Choose it carefully. A good well-fitting mask can last for years. Here is a tip on how to decide which model is best for you.

Place it on the face without putting the strap on. Breathe in through your nose. Take your hand away. The mask should stay put. If it falls off, or you hear air leaking, or can keep inhaling, the mask is a bad fit and it will leak underwater.

SWIMMERS GOGGLES MUST NOT BE USED FOR DIVING.

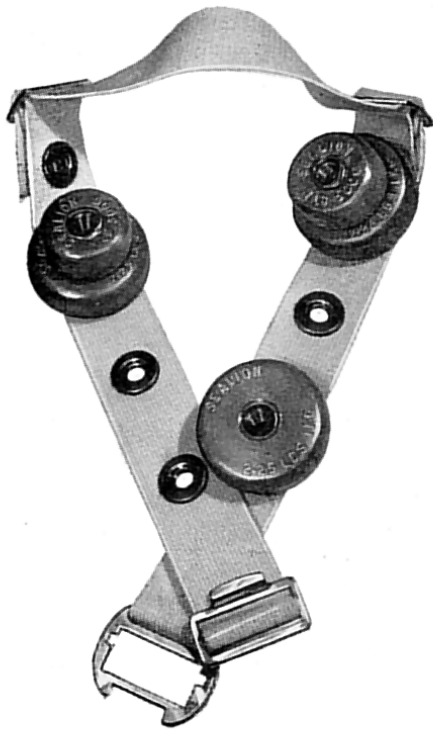
To swim—you need a pair of fins.

Now you can breathe and see underwater, you will want to move about. Surface-style swimming, largely dependent on arm movements, is not much use below the surface, and unaided leg kicks do not supply much thrust.

Swim fins will give you the thrust you need to move about effortlessly— after all you don't want to waste precious air getting there.

A vast range of swim fins is available in all sizes, colours and qualities. But you, as a serious diver, should select your swim fins with care.

Choose a shoe-type fin that fits your foot really comfortably, making allowance for your diving suit. The blade should be large and rigid and the rubber strong enough to withstand walks along the shore.



To submerge—you need a weight belt.

Most people are buoyant. As you probably know, it takes quite a lot of effort to swim even a short way below the surface. When you are wearing a breathing set and a diving suit you will find it even more difficult to submerge. Your aim is to become neutrally buoyant. To do this you will need ballast, and pieces of lead attached to a belt is the most practical way of carrying it. The phrase "neutrally buoyant" means you neither sink nor float you just hang in the water.

To achieve this state of suspension needs careful regulation of the amount of lead you carry. It is a matter of individual adjustment.

This adjustment can be tedious with standard "thread through" weight belts as you have to take the entire belt off to remove or add a weight. It is simplicity itself with the SEALION patented weight belt with screw-on weights.

Any weight belt **must** have a reliable quick release so it can be jettisoned in an emergency.

For comfort—you need a diving suit.

In almost every ocean and sea and certainly in every lake you will need to wear a diving suit to keep you warm. However hot it is on the surface, once you get down to 30 or 40 feet even the warmest water becomes uncomfortably cold.

There are two types of diving suits available—the “wet” and the “dry.”

A “wet” suit is made of foam neoprene—a rot-proof synthetic rubber with excellent heat insulating properties. The suit is called “wet” because it is not completely watertight. The small amount of water that seeps in soon reaches your body temperature and is not uncomfortable. Make sure your suit is a snug fit and it will keep you very warm indeed—even in really cold waters.

Neoprene suits are now available nylon-lined and though these are more expensive they are well worth the extra money in terms of durability and ease of dressing.

A “dry” suit is completely watertight. It in itself doesn't keep you warm, but under it you can wear as many jumpers as you like and it will keep you and them quite dry.

Which should you choose?

Most divers prefer a “wet” suit. It is more comfortable, easy to put on and no problem to maintain or repair. However, a “dry” suit is better for diving in very cold or dirty water.



ACCESSORIES

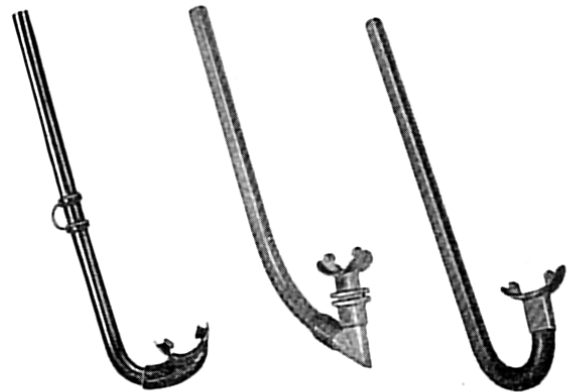
You are now equipped for diving, but there are many accessories on the market that will increase your safety and pleasure.

The Knife.

This could be a life-saver! A good knife with a sharp stainless steel blade could be invaluable in an emergency. Tarzan knives and daggers are carried in a convenient leg sheath so in a crisis they are always to hand. The sheath will also hold your snorkel.

The Snorkel.

Though you can have enormous fun swimming on the surface with a snorkel and mask, just looking at passing fish—the snorkel is also an important part of the divers' kit.



If by chance you run out of air far from shore or your boat, you will find it much easier to replace your regulator mouthpiece with your snorkel and swim gently back to base.

The Depth Gauge.

What the speedometer is to the motorist, the depth gauge is to the diver. The Tarzan Palimetre goes further than merely indicating your depth. It has a second pointer which shows you the maximum depth you have reached and how long you can stay down without decompressing. You can also tie it to a cord and lower it to the bottom as a depth recorder—it registers to 240 feet.

The Underwater Watch.

The knowledge of time is vital to the diver. You must know how long you have been down and be able to time decompression stops should they be necessary.

The Compass.

The basis of any submarine navigation. It is wise to know where you are going and where the shore is. Take a bearing before diving and you should have no trouble returning to base.

Lighting.

A torch is useful when you are working in or around submerged objects, specially in deep water where there is virtually no light, or if you are diving at night. It won't help you to take photographs—you need a really powerful light for photography—nor will it be much use in dirty water, as the particles of dirt merely push the light backwards towards you.



The basic rules of diving

Before diving there are certain facts you should know.

Modern diving equipment is safe and simple to use, but as in many other exciting sports, you must know and understand the rules—and even more important—stick to them.

It would be foolish to say you can never get into difficulties underwater. But by knowing what you are doing and never being careless you can ensure safe and trouble free diving.

Be at home in the water.

You don't need to be a Channel swimmer to dive but you should be proficient enough to swim with diving equipment for reasonable lengths of time without strain.

It is best to start with fins, snorkel and mask and get the feel of breathing through a mouthpiece before using a complete breathing set.

If you are not a competent swimmer take lessons and learn life-saving techniques too. Your local swimming baths will give you details of clubs and classes.

Water pressure and how it affects you.

As you descend certain physical changes occur. On dry land your body is subject to a pressure of 14.7 p.s.i. (i.e. 1 atmosphere), due to the weight of the air above you. In the water the pressure increases rapidly as you descend. In fact one atmosphere every 33 feet. So if you are down 99 feet you have 4 ats. on your body—3 ats. due to the water and 1 at. to the air above.

Every diver must understand pressure and its effects. These range from a squeeze in a loose-fitting "dry" suit to leaks in a watch.

Probably the most noticeable effect will be pain in the ears which you will soon learn to eliminate as described in a later chapter. This occurs between

the surface and 33 feet because between these depths the total or absolute pressure on the body has doubled. Further descents of 33 feet produce diminishing percentage increases in pressure. In other respects the human body is virtually unaffected by increase in water pressure.

Increasing water pressure also affects breathing. The regulator of your breathing set supplies you with air at the same pressure as the water around you. If you are at 99 feet, this air will be at 4 ats. absolute, i.e. four times as dense as on the surface.

As your lungs take about the same volume of air with each breath it follows that the quantity of air you have in your cylinders will only last $\frac{1}{4}$ of the time it would on the surface. So the deeper you go, the less diving time your bottles will give you.

This dense air requires more effort to push to and from the lungs and thus is more difficult to inhale than surface air.

Air and its limitations.

As we have said, the human body is virtually unharmed by water pressure, but there are certain parts of it that can be affected under certain conditions. These are the cavities normally filled by air—the mouth and lungs, stomach and intestines, ears and sinuses.

In practice the only ones to cause the diver any trouble are the ears and sinuses. The sinus passages providing they are open are filled with compressed air from the breathing circuit. If, however, they are obstructed by a cold, air cannot get in and the pressure on them causes intense pain. **YOU SHOULD NEVER DIVE WITH A HEAD COLD OR SINUS INFECTION.**

In the case of the ears, compressed air has to come to the inside of the ear drum from the throat via the eustachian tube—a narrow passage not

designed for the large pressure changes in diving. As you descend, water pressure acts on the outside of the eardrum causing pain, unless it is balanced by air coming through the eustachian tube. If air cannot get through, you have to help. This is called "clearing the ears."

Begin by ascending until the pain disappears. Then swallow and work your jaws until your ears "pop." If this fails, push your mask hard against your nose and blow smartly. Best of all, wear a Compensator mask, which has bosses let in to allow you to grip your nose and blow really hard.

If you still cannot clear your ears, come up and forget about diving for the day. If necessary see your doctor.

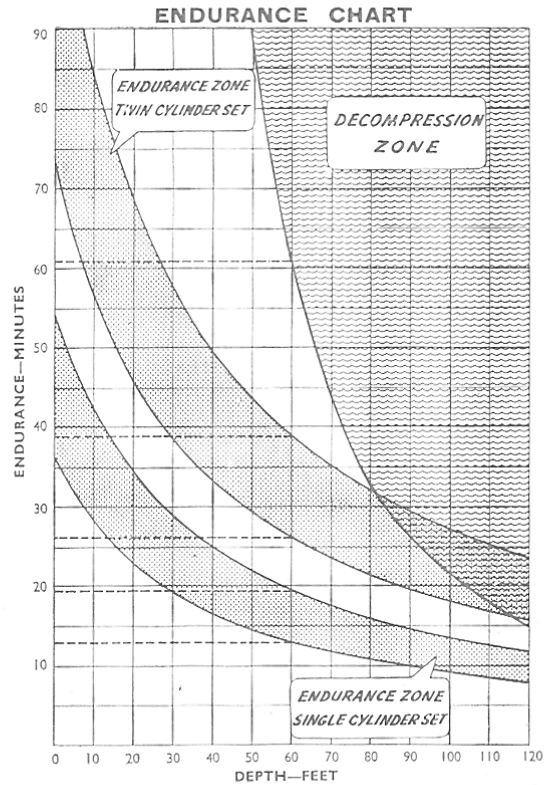
EAR PLUGS MUST NEVER BE WORN.

They prevent water pressure reaching the eardrums and could cause them to burst outwards.

Up to now we have talked only about descending. Ascending has problems of its own. The golden rule is **NEVER HOLD YOUR BREATH WHILE ASCENDING.** We have shown you already that the density of the air you breathe increases as you descend. Conversely, it decreases as you come up. This means that the volume of air in your lungs grows, the nearer you get to the surface. If you were to take a lungful of air at 33 feet and ascend holding your breath, the volume would have doubled and your lungs would have burst by the time you reached the surface. If you come up leisurely, normal breathing will take care of the increased volume of air. If you are in a hurry, exhale as you rise, but don't ascend faster than 25 feet a minute.

The "Bends" and decompression.

Nitrogen in the air you breathe is absorbed by the blood and body tissues. How much is absorbed depends upon how deep you dive and how long you stay down. After a deep dive if you come up slowly following a decompression table, this nitrogen escapes from the bloodstream to the lungs and you exhale it naturally. If, however, you



come up quickly or don't follow a decompression table when you should, the nitrogen dissolved in your system escapes as best it can—often as bubbles in the bloodstream and tissues.

This can cause extreme pain and actual damage to muscles and to the nervous system. The only cure is recompression. The patient must either be put immediately into a decompression chamber or re-immersed in the sea to his previous depth and follow an extended decompression timetable before re-surfacing.

The average sporting diver cannot easily get into a situation where decompression is necessary because the endurance of his equipment at greater depths is strictly limited. The chart illustrated shows a probable dive duration at given depths with both single and twin cylinder sets. This of course, will vary with individuals.

	Depth of Dive		Duration of Dive in Minutes		Duration of Decompression Stop at 10 Feet in Minutes
	Metres	Feet	Without Stop	With Stop	
For intermediate depths and times, always use the next larger depths and times	16	55	70	90	3
	20	65	50	65	9
	24	78	37	50	6
	28	92	28	40	6
	32	105	22	30	8
	36	118	17	25	8
	40	130	15	20	3
	42	138	13	16	4
	45	148	10	14	8
	50	165	8	12	8
	55	180	6	10	7
	60	200	ATTENTION DANGER		

For longer dives consult standard decompression tables.

On the right of the chart is the decompression zone and you will see with a single set you have no decompression worries. With a twin set you must be careful at depths of 80 feet and over. If you are using a triple set or dive more than once in a day, decompression may be necessary.

Tarzan suits have a patented abbreviated decompression table stuck to the left sleeve of each jacket, a really practical system for safety. This is reproduced above.

The symptoms of the bends which can occur several hours after surfacing are as follows:

1. Itching of the skin near a joint, perhaps accompanied by swelling and a rash.
2. Increasing numbing pains in the joints leading to paralysis in the limbs.
3. Headache and dizziness and pains in the chest.

Before embarking on any deep diving operation, it is sheer common sense to know the whereabouts of the nearest decompression chamber and the availability of a doctor.

Nitrogen narcosis.

At depths below 130 feet the nitrogen dissolved in your body will start having a strange effect on you. First you will feel lazy and unable to concentrate, followed by feelings of drunkenness and gaiety.

In itself nitrogen narcosis is harmless and disappears immediately you ascend, but it can become dangerous in an environment where you need all your wits about you—just as it is dangerous to drive a car when drunk.

You can best avoid the possibility of this effect by never diving below 130 feet.

Oxygen poisoning.

Pure oxygen is a poison when breathed at absolute pressure greater than 2 ats. This is why Naval frogmen never dive below 33 feet using a closed circuit oxygen set. Consequently, the cylinders of your breathing set must never be filled with oxygen.

15 diving rules you should know

1. Be a good swimmer first.

Your breathing set will not make up for lack of swimming ability. Respect the ocean and seek local advice on tides and currents etc.

2. Receive competent diving instruction.

Learn to dive properly by joining a Club, or better still, taking a course of instruction at a certified diving school.

3. Never hold your breath while ascending.

Ascend the last 35 feet slowly. Take at least 90 seconds.

4. Know your decompression rules.

Study the decompression chart and tables. Remember if you dive twice in any 12 hour period you must add the length of your first dive to that of the second to time your decompression. If decompression stops are needed make sure you leave enough air in your cylinders for them.

5. Don't exceed 130 feet.

The dangers of nitrogen narcosis are very real.

6. Check your contents gauge frequently.

Never be in a position of having to come to the surface because the air is short.

7. Beginners don't exceed 25 feet.

Don't run before you can walk. You can practise all necessary diving evolutions at this depth.

8. Never dive alone.

Always have another qualified diver with you either within sight underwater, or on the surface ready to come in.

9. Always dive with a life jacket.

10. Always use a suit in cold water.

Extreme cold will cause serious loss of body heat which can lead to unconsciousness.

11. Avoid undue exertion.

Don't exhaust yourself and your air supply unnecessarily.

12. Always put your weight belt on last.

This makes sure it will come off if you have to release it in an emergency.

13. Never dive if you don't feel well.

14. Do not dive after eating.

Allow at least two hours after anything but a snack meal.

15. Know first aid and lifesaving techniques.

We hope you will never need them, but every diver should know what to do in an emergency or in case of accidents.

Assembling your equipment

The single cylinder set.

Your new equipment has arrived, packed separately for protection in three boxes. What is the best way to put it together? The cylinder is charged and you should first remove the piece of adhesive tape that holds the washer in position on the cylinder valves. Take the harness and unscrew the thumbscrew on the clamp band. Lower the band over the cylinder from the valve end and thread the cylinder valve through the small loop between the two shoulder straps.

Looking from above and with the cylinder valve washer facing away from you, the thumbscrew on the clamp band should be on the left of the cylinder. The strap from the band should come straight up the back of the bottle. Adjust it so that the band is about half way down the cylinder. Now tighten the band.

The next step is to put on the demand regulator. Undo the tap screw on the yoke on the underside of the regulator. Fit it over the cylinder valve, making sure that the regulator valve seating fits snugly into the recess in the cylinder valve, and that you haven't lost the washer in the process. It is important that the regulator is the right way up. The hoses must point upwards and away from the cylinder. Tighten the screw firmly.

At the back of the regulator you will see a cap nut with a screwdriver slot. This covers the pressure gauge take-off. Unscrew it and replace it with the high pressure tube. At the other end screw in the pressure gauge. Finger-tightness is all that is needed. Do not use grips.

Now turn on the air. Listen for any leaks, or better still push it underwater to see that you have made all the joints correctly.

Check the pressure gauge reading and breathe

in and out through the mouthpiece several times.

Now put the set on. Pick it up by the left shoulder strap and put your left arm through it. Now put your right arm through the right shoulder strap. Couple up the waist strap till it feels comfortably tight. (There are adjusting buckles on all straps). Pull the breathing hoses over your head and put the mouthpiece in your mouth. The flange should be under your lips with your teeth grasping the bite projections.

The correct position for the set is with the demand regulator between your shoulder blades.

The twin cylinder set.

The method of assembling the twin cylinder set is similar to that of the single cylinder set. Put all the parts on a table. Lay the two cylinders side by side with their valve seatings facing each other. Slip the loops at the ends of the shoulder straps of the harness over the cylinder valves. Now push the manifold over the cylinder valves with the block facing downwards towards the base of the cylinders. You may have to rotate the cylinders to get the valves through the yokes. Don't forget to remove the adhesive tape first.

Tighten up the tap screws lightly. Now slide the clamp band of the harness over the bottom of the cylinder to about half way up and tighten. Tighten up the manifold tap screws, and you are ready for the regulator.

Remove the tape from the manifold block and fit the regulator to the manifold as described in the single cylinder set.

The triple cylinder set.

The triple cylinder set has a fixed centre cylinder with manifold and harness. The two outer cylinders should be mounted as described above.

The first dive

In the last chapter we described your breathing set, how to assemble it, and the correct way to put it on.

Here is a check list that you should learn by heart and use for each and every dive.

1. Check air pressure in the cylinders by means of the pressure gauge.
2. Check that the harness is properly fixed to the cylinder. The length of the straps should be such that the regulator sits comfortably between the shoulder blades.
3. Make sure the regulator is clamped on to the cylinder valve so that the two breathing hoses are pointing upwards. Open the cylinder valve and breathe in deeply for the mouthpiece to check the output.
4. Put on your breathing set.
5. Moisten both sides of your mask glass with saliva and rinse it with water. (This is the best "anti-dim" there is). Put on your mask and then your swim fins.
5. Check all accessories (knife, depth gauge, snorkel etc.). The snorkel will be very useful when you reach the surface after your dive and want to swim back to base.

Buoyancy adjustment.

You are now ready to get into the water and adjust your ballast. You can do this in about 5 feet of water.

Just add weights to your weight belt until you have a very slight tendency to sink. Be careful to breathe naturally while you are doing this as excess air in the lungs makes you more buoyant. You must also remember that if you are wearing a diving suit some air will be trapped in it and will not be entirely eliminated until you have gone down 10 feet or so.

Don't be afraid to start your dive a little heavy.

A cylinder holds about 3 lbs. of air, so you will be that much lighter at the end of the dive.

Another point to remember is the loss of buoyancy due to the foam rubber of a "wet" suit being compressed as you descend. Subtract 2 lbs. of lead for every 30 feet.

The first steps.

Choose clear water preferably with a gradually shelving rocky bottom. You can dive from a swimming pool, a beach or from a boat anchored in 15—20 feet of water. In the latter case use the anchor chain for a slow descent.

To begin with, you should be nearly motionless. Then try revolving slowly with very flexible movements.

Descend gradually. As soon as you feel any air pressure, equalise your ears by swallowing, or blow through your nose while holding it through the bosses of your compensator mask. You should then hear a slight crackle and feel no more discomfort. Do not continue to descend if your ears will not stand it. It is quite possible that your ears will not clear on your first dive. However, this need not worry you. It is quite a common occurrence. It often takes three or four dives before the Eustachian tubes clear properly. You can train the Eustachian tubes to clear themselves by holding your nose and blowing—on dry land. Ear plugs should never be worn. The ear drum may burst due to internal pressure.

Take great care on your first dive and do not go below 25 feet.

Evolutions.

All movements should be slow and unhurried to avoid becoming breathless.

Try any movements you like. It won't affect your ease of breathing. Simple movements of the feet with the legs as relaxed as possible will give

easy propulsion. It is unnecessary and useless to thrash your arms about. They should be stretched down along the body line to minimise "braking."

Underwater navigation is very difficult unless you carry a compass. It is very easy to go round in circles. Until you are trained, you should avoid diving "in the blue", i.e. far from the bottom and



the surface at a point where nothing but a blue liquid mass can be seen with no point of reference. You can always identify the vertical by your air bubbles.

Ascent.

When the air in the cylinder is down to 30 ats., it is time to come up.

Rise rapidly as far as the first decompression stop (to 10 feet if you do not have to make a decompression stop). Slow down as you near the surface and whatever the duration of the dive, make a short stop at 10 feet.

The decompression stops must be carefully followed. Every diver should be able to read and understand the simplified diving decompression tables. If you make several successive dives in 12 hours the duration of these dives must be added together to determine your decompression stops. This rule is fundamental and you must stick to it. While ascending, breathe normally so that the lungs are not blocked. Expanding air in the lungs could have very serious consequences.

Listen for propeller noises, which are easy to hear, and look carefully all round you before surfacing. Keep your mask on when you reach the surface, and if the boat or the shore are at a distance, use your snorkel as soon as the air in the bottles is exhausted.

FUNDAMENTAL DIVING EXERCISES

Here are several very useful exercises for you to practice. They will familiarise you with the breathing set and accessories.

Clearing the mask.

Wearing your breathing set in a moderate depth of water, say 10 feet, stand upright and take a deep breath. Allow a little water to enter the mask by raising its edge. Breathe out gently through the nose while bending over backwards and holding the mask with the hand until the glass is approximately horizontal. The air you have breathed into

it pushes the water out of the bottom. Repeat this exercise three or four times, allowing a little more water to enter each time. Now take off the mask, put it on again, and clear it of water as before. It is good practice also to breathe when the mask is off. Hold your nose between finger and thumb if you are worried by water entering it.

Clearing the mouthpiece.

With your breathing set in place and at a depth of 10 feet, take the mouthpiece out and put it back again. This is simple! Breathe in deeply before you take the mouthpiece out. Go over on to your back—the air will escape rapidly from the mouthpiece. Put it back into your mouth. At the same time turn your head toward the exhaust hose (to the right), and blow strongly to empty it of water. In an emergency two divers can breathe from one set by passing the mouthpiece one to the other.

Removing and replacing your set underwater.

Wearing a breathing set, dive to a bottom 8—10 feet deep, and take off the breathing set. Leave it on the bottom, come up to the surface then dive down again and put the equipment back on. This is really a simple exercise!

When the breathing set is on the bottom, if the mouthpiece is lower than the regulator, no air will escape from the apparatus even if the cylinder valve is open. Take the mouthpiece and raise it above the regulator—it discharges air. Allow it to discharge for two or three seconds. Put the mouthpiece in your mouth and blow vigorously to empty the exhaust hose of water. There is now plenty of time for the set to be put on again. A little thought will show you how to proceed. A good solution is to put the breathing set on over your head. The extra stretch of the spiral breathing hoses allow this.

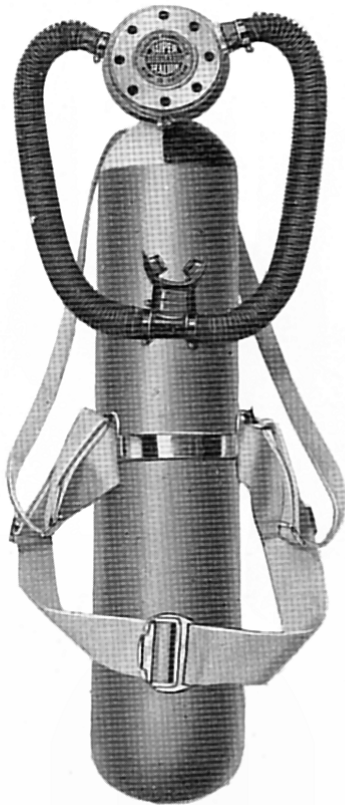
Free ascent.

This is an exercise for divers who have made a dozen or so dives, and for those who have dived in a group. Leave the breathing set with a fellow diver

on the bottom at a depth of 30 feet. Come to the surface taking care not to stop the lungs and to exhale while ascending. This is called a "free ascent." It will be found that enough air is always available during the ascent, and that it can get you out of a tight spot.



Understand your breathing set



The demand regulator.

This is the heart of the breathing set. Its function is to give you all the air you want, when you want it, regardless of depth.

When you breathe in, the diaphragm inside the regulator moves and operates a high pressure valve assembly through a system of levers. Air flows from the cylinder to the breathing circuit just as long as you continue to inhale. As soon as you stop, the diaphragm returns to its normal position and the valve shuts.

When you breathe out, your exhaled air goes out through the exhaust hose through a valve to the sea. As you descend, water pressure acts on the diaphragm allowing more air to enter the breathing circuit to balance the increase in pressure.

Submarine Products Ltd. make two models.

The ATLANTIC regulator features an adjustable venturi system which is set to give the maximum air with the minimum resistance at all depths. Each one is individually pressure chamber tested at depths of 33 feet, 100 feet, and 165 feet. A nylon non-return valve mouthpiece stops any danger of flooded hoses.

The SUPER SEALION regulator is available both with and without the nylon non-return valve mouthpiece. This regulator is similar in construction to the ATLANTIC but does not have the venturi feature. Consequently, it does not have quite the same ease of breathing at greater depths. All regulators have contents gauge take-off points.

Cylinders.

The air you need underwater is carried in one or more cylinders. Specially designed for diving, they are slim and streamlined with a capacity of 1100 litres. The working pressure is 140 ats. (2000 p.s.i.) and they are zinc-coated and stove-enamelled for protection against corrosion. Each

cylinder holds about 3 lbs. of air, and floats in sea water when full. The cylinder valve is glandless and cannot leak round the stem.

Cylinders must be charged with clean, dry, compressed air. NOT OXYGEN. They are made to Home Office specification "T," so this can be done at any depot of the British Oxygen Company, who will also undertake re-testing when it falls due.

Harness.

The type of harness depends on how many cylinders you wish to carry.

The single cylinder harness is designed to prevent the cylinder rolling on your back. It is important that it should be correctly fixed with the shoulder straps coming from the back of the cylinder as shown in the illustration. A simple fool-proof quick-release buckle is fitted, and a jock-strap is available as an extra if desired. All straps are of rot-proof nylon coloured yellow for easy visibility underwater.

The twin cylinder harness is similar in construction, except that the shoulder straps are fixed round the cylinder necks.

Manifold.

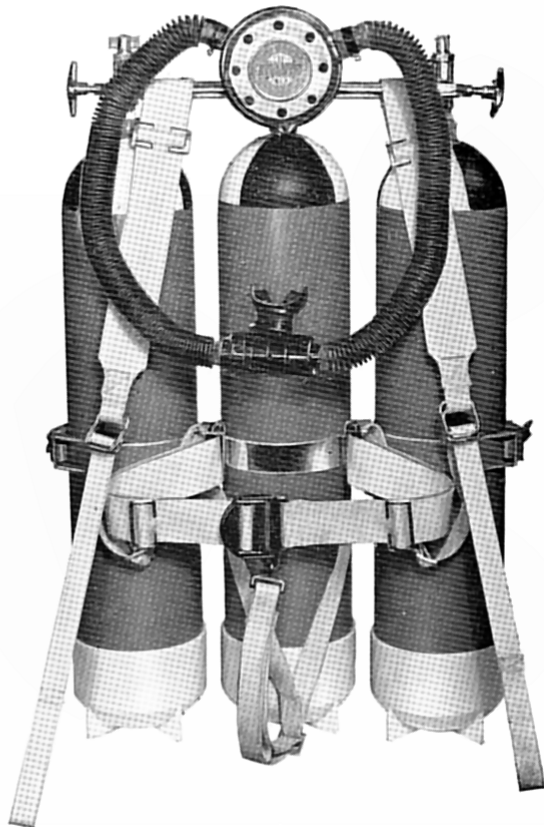
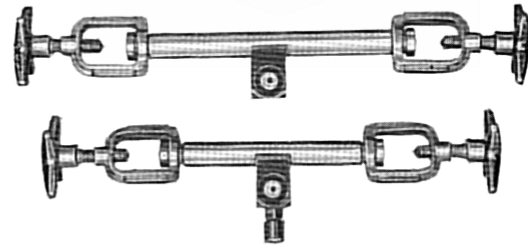
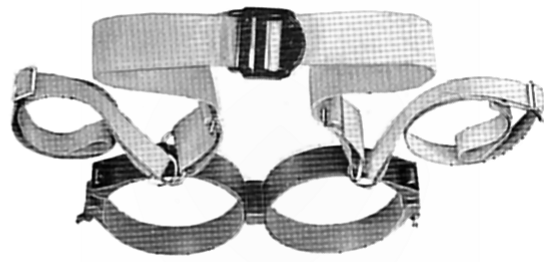
The manifold is needed for a twin cylinder set to connect the two cylinder valves. Normally it is recommended that the manifold block should be pointing downwards so that the demand regulator fits more neatly between the shoulder blades. Manifolds are also available with pressure gauge take-offs.

Triple cylinder set.

This model has the manifold and harness mounted permanently to the centre cylinder. Two standard cylinders fit either side of it allowing the economic conversion of a twin to a triple.

The harness has three particular features which are necessary for this larger and heavier breathing set.

1. A jock-strap to keep the set firmly down on the back.



2. A special quick-release buckle which has provision for automatically releasing the jock-strap as well as the waistband.

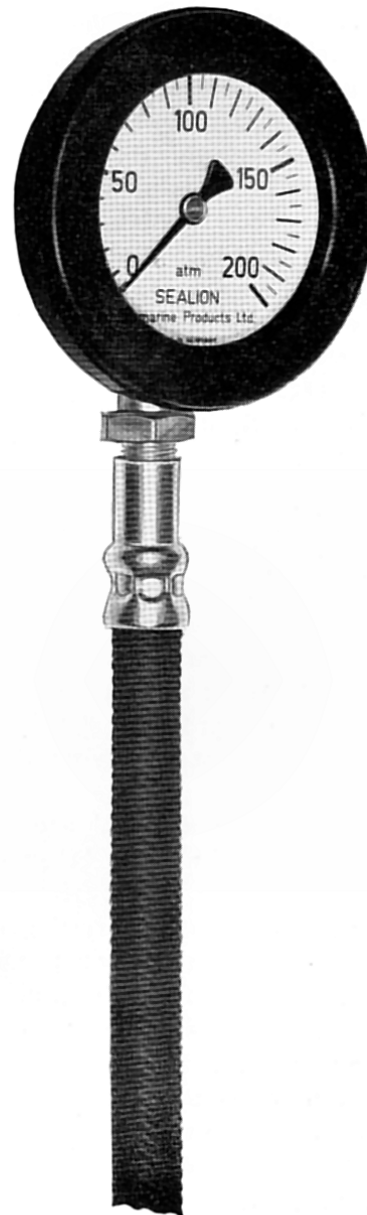
3. The shoulder straps have rapid adjusters which can be operated in position. You merely let them out to the full extent, pulling the loops one at a time when the set will come up the back until it is in the most comfortable position. If the loops on the buckles are lifted, they release the straps and the set can be easily lowered.

Cylinder contents gauges.

These indispensable fittings allow the diver to know **at all times** just how much air he has in his cylinders and consequently approximately how much longer he can stay underwater.

The dial pressure gauge is a very robust Bourdon-type gauge, which is filled with glycerine to protect and lubricate the internal mechanism. It is very accurate and easy to read with a maximum reading of 200 ats. It may be used for checking cylinder pressure when charging. A rubber protection ring insures it against knocks. A bubble is visible in the glycerine. This is intentional to allow for expansion and contraction.

The gauge is connected with the pressure gauge take-off either on the demand regulator or on the manifold by a flexible high pressure tube which has "finger tight" connections each end.



Care of equipment

Careful maintenance of your breathing set is well worth while. Not only will it extend its useful life, but you will feel much happier diving with equipment that you **know** has been carefully looked after.

Regulator.

This should be thoroughly rinsed in fresh water after each dive. Hold your thumb over the air inlet to prevent water getting in. Let a good quantity of water go down the mouthpiece and out through the exhaust valve. The non-return valve mouthpiece will prevent it going into the inlet hose.

It is wise to do a periodical check for leaks in the hoses. Put the regulator on the cylinder but don't open the valve. Breathe in. You should not be able to breathe any air at all. If you can, check carefully along the hose for a small hole or crack. If you can't find a hole and the hoseclips are tight, the exhaust valve or diaphragm may be to blame.

In event of this or any other trouble, it is wise to return the regulator for a guaranteed factory overhaul. An annual factory inspection is always a good idea. Home repairs are not advised as most divers do not have the proper equipment to carry them out or facilities to test the regulator afterwards.

Cylinders.

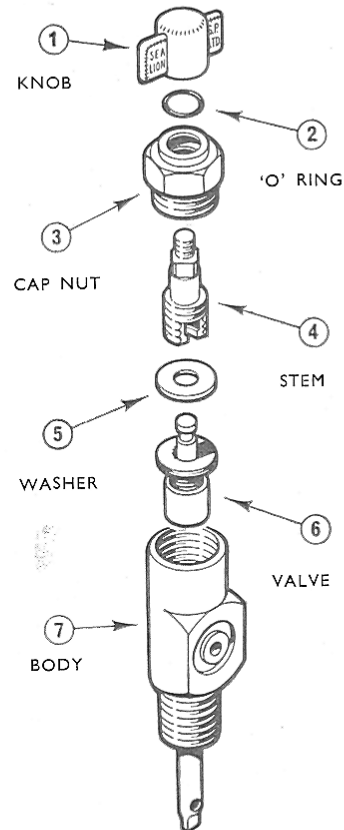
Cylinders are made of steel and therefore subject to corrosion. This can be external or internal. Externally they are protected by zinc coating and stove enamelling, and rusting is unlikely except for serious scratches. You should touch them up with good enamel paint if this happens.

Internally, rusting can go on without being noticed. Fortunately, it is only caused by filling with damp, badly filtered air, or leaving the cylinder valve open. If precautions are taken against this, then you have nothing to worry about.

Cylinder Valve.

This is particularly liable to accidental damage,

so it is fitted with a knob designed to break before the valve spindle is bent or broken. A new knob can easily be fitted if necessary by a few light taps with a hammer.



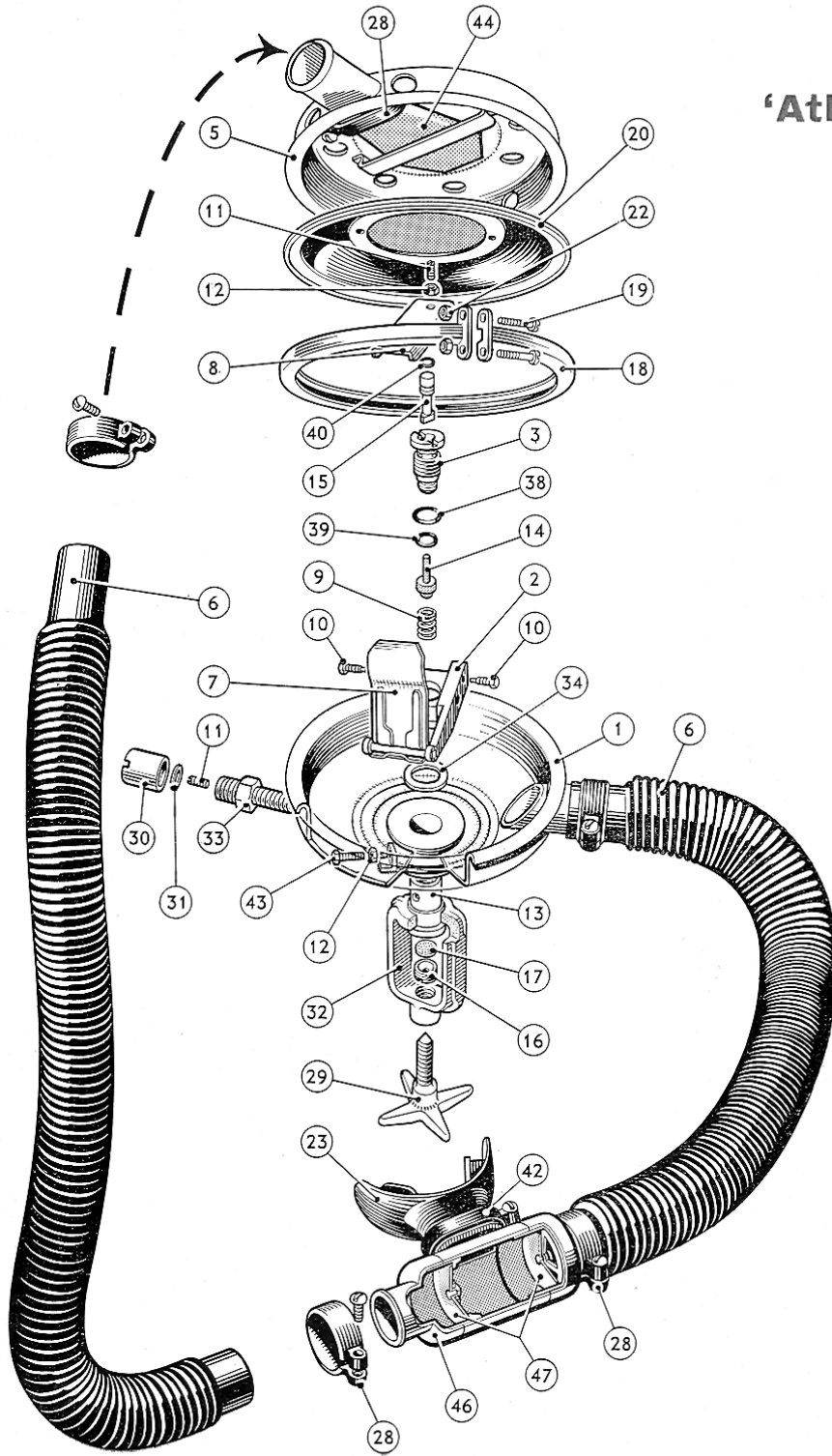
Harnesses.

These are made of rot-proof nylon and chrome brass. They will benefit by being washed in fresh water, and the clamp screws lightly greased.

Storage.

When equipment is to be stored for any length of time, it should first be washed in fresh water and allowed to dry thoroughly. Dust over rubber parts with French chalk. It is a good idea to put some in the regulator mouthpiece and blow it down through the exhaust valve to stop it sticking. Cylinders should have some compressed air left in them.

'Atlantic' Regulator



Item
No. Description

- 1 Main Body.
- 2 Lever Bracket.
- 3 H.P. Valve Seat.
- 5 Cover.
- 6 Breathing Hose.
- 7 Primary Lever.
- 8 Secondary Lever.
- 9 Spring.
- 10 Pivot Screw.
- 11 Adjusting Screw.
- 12 Lock Nut.
- 13 Yoke Stem.
- 14 H.P. Valve.
- 15 H.P. Valve Guide.
- 16 Filter Retainer.
- 17 Filter.
- 18 Clamp Ring.
- 19 Clamp Ring Set Screw.
- 20 Diaphragm.
- 22 Clamp Ring Nut.
- 23 Mouthpiece.
- 28 Hose Clip and Screw.
- 29 Yoke Thumbscrew.
- 30 P.G. Take Off Blanking Nut.
- 31 Sealing Ring for Blanking Nut.
- 32 Yoke.
- 33 Pressure Gauge Take Off.
- 34 Lever Bracket Washer.
- 38 Low Pressure "O" Ring.
- 39 High Pressure "O" Ring.
- 40 H.P. Valve Guide "O" Ring.
- 42 Mouthpiece Clip.
- 43 Venturi Adjusting Screw.
- 44 Exhaust Valve.
- 46 Mouthpiece Tube.
- 47 Non-Return Valves.