Normalair compressed-air breathing apparatus

Normalair apparatus was originally designed and manufactured by the makers of breathing apparatus used by the Himalayan Expedition in 1953. As with other makes of compressed-air breathing apparatus, it comprised basically a cylinder of air, a respiratory system for reducing the air pressure and a face mask. Several new features were claimed for the apparatus, not the least of which was the single-stage demand regulator which operated on a 'tilt' valve principle. The firm Normalair subsequently amalgamated with the German firm Draegerwerk AG, and is now known as Draeger Normalair Ltd. Since the introduction of the apparatus—the first set being model 880—it has, like that of other manufacturers, been developed.

The Draeger/Normalair A100 compressed-air breathing apparatus was trialled and adopted by Sheffield Fire Brigade in the late 1950's. By the middle of the 1960's it had replaced the closed circuit oxygen BA sets and became the primary type of BA used.

Draeger/Normalair A100 compressed-air breathing apparatus

(1) Description of the set

The set (Fig. 1) consisted of a cylinder (1) mounted on a tough, light, thermo-plastics moulded backplate (2) supported on the back of the wearer by a synthetic fabric harness comprising adjustable padded shoulder straps and a waist-belt secured by a single buckle. The face mask (3) was secured by a head-harness (4) and incorporates a demand regulator (5), an expiratory valve/speech transmitter (6) and a Perspex visor.

The face mask was fitted with an inner mask (7) arranged to fit as closely as possible around the mouth and nose. The high-pressure air from the cylinder is supplied to the demand regulator and to the pressure gauge (8) by two flexible reinforced rubber hoses (9) having a working pressure of 207 bar. The hoses were connected to a 'Y' manifold at the top of the back plate; the longer hose passed over the right shoulder to the demand regulator and the other over the left shoulder to the pressure gauge. The gauge incorporated two built-in safety devices; the first was a relief valve which got rid of any excess pressure in the case and removed the risk of the face-piece blowing out, and the second was a shut-off valve which allowed air to pass for normal operation of the gauge, but shut off immediately if there was a flow. This valve was tested periodically in accordance with the maker's instructions by unscrewing the test screw provided.

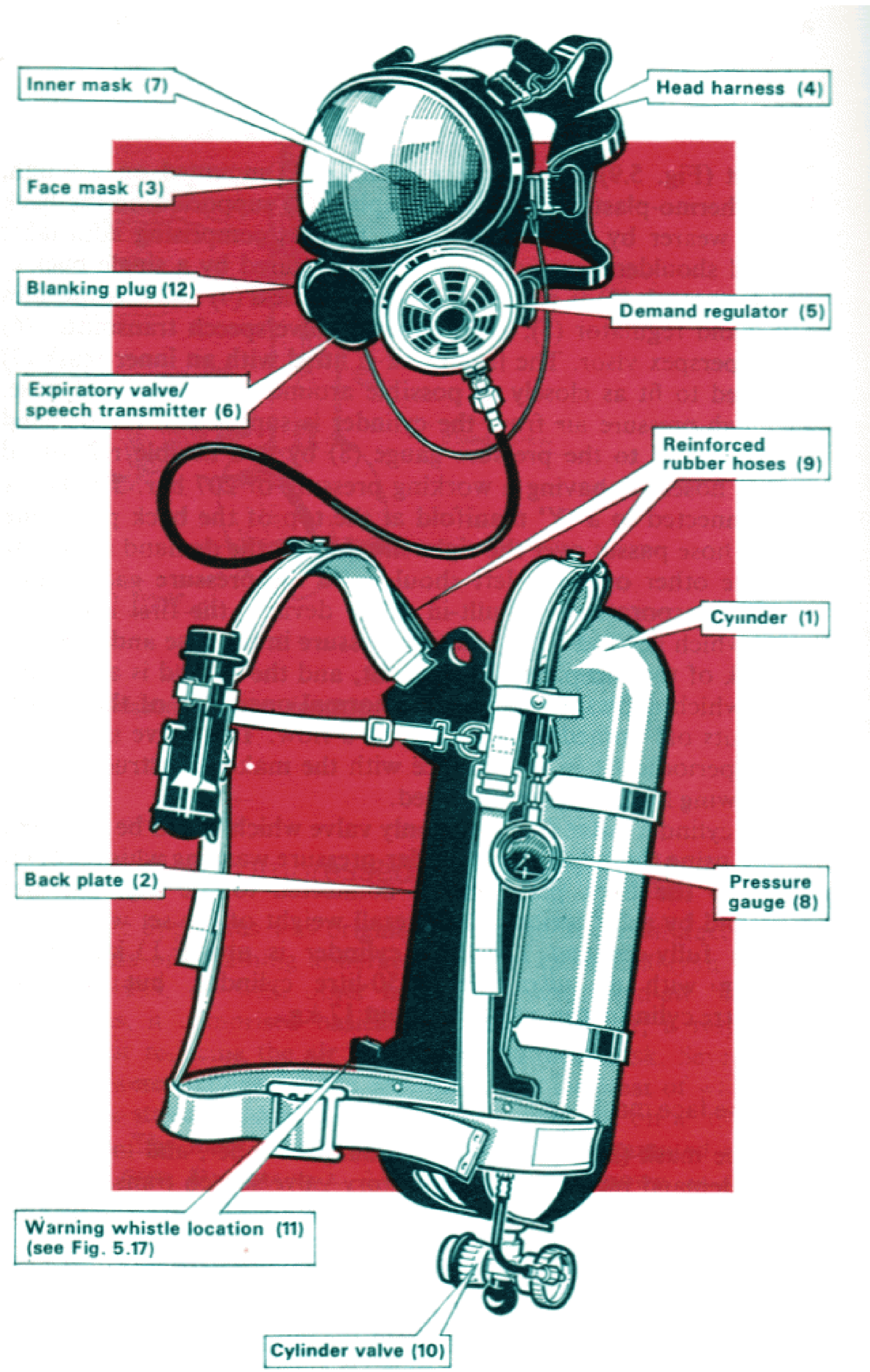

Fig.1 Draeger/Normalair A100 compressed-air breathing apparatus

The cylinder valve (10) was the only valve which had to be operated before using the set. A low-cylinder-pressure warning whistle (11) was fitted to the back plate and was connected to the high-pressure manifold by a 'T' union. The overall weight of the set when used with a fully-charged 1240-litre cylinder was about 13 kg, about 14.5 kg with an ultra-light 2250-litre cylinder, but with an 1800-litre steel cylinder, as used by SFB, the weight was about 17 kg.

(2) The face mask

The face mask (Fig. 1 (3)) was of moulded rubber, and in addition to the demand regulator (5), expiratory valve/speech transmitter (6) and the wide vision perspex visor, it incorporated breathing port adaptors made of moulded nylon; these were situated on each side and permitted the mask to be used for other purposes if required. However, when the mask was used with compressed-air sets, the demand regulator (5) was screwed into the left-hand adaptor and the other was fitted with a blanking plug (12). Fabric reinforced rubber bosses on the outside of the mask rim carried six metal quick-release buckles which secured the head-harness. The harness was a rubber moulding with six straps which were ribbed to prevent slipping.

A bonded air-cushion seal round the inside edge of the mask (Fig. 5.10 (1)) contained air at atmospheric pressure and formed a leak-proof seal on the face with only light tension on the adjusting straps. The air was sealed into the cushion by a bronze ball (2) and the cushion adjusted itself to the contours of the face when the mask was put on. Air-deflecting flanges assisted in demisting by directing inspired air over the perspex visor. Projections on the inner rims of the breathing port adaptors prevented any risk of the deflecting flanges interfering with the free passage of air.

Also shown in Fig. 2 is an exploded view of the expiratory valve/speech transmitter. This comprised a housing (3), washer (4), moulded nylon diaphragm (5) with the expiratory valve seating (6) in the centre and an expiratory rubber mushroom valve (7), which was located in a central hole in the valve seat. The diaphragm was sealed in the valve housing by the screwed valve cover (8).

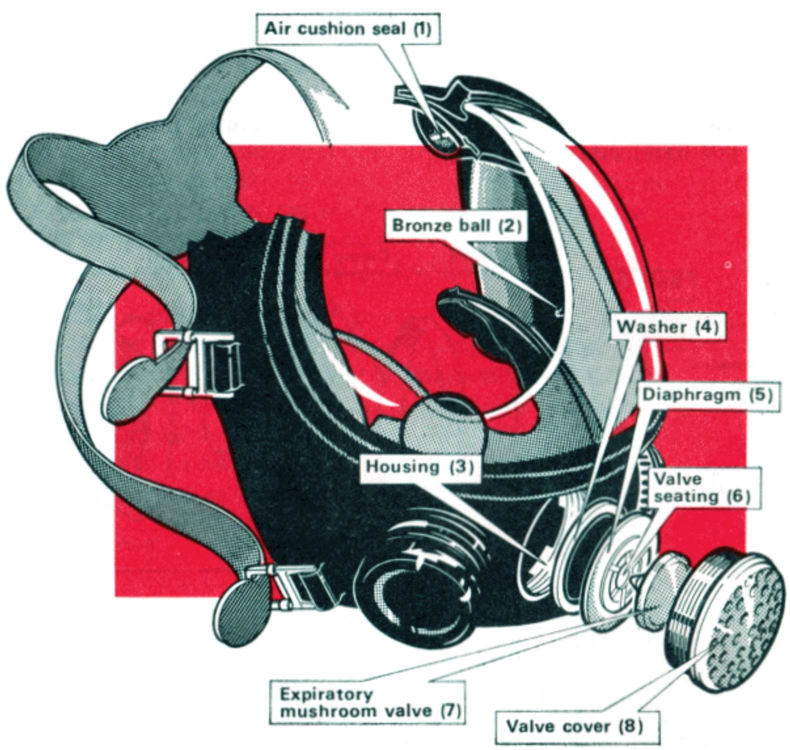

Fig. 2 Draeger/Normalair face mask showing air-cushion seal and the expiratory valve/speech transmitter

(3) The demand regulator

The demand regulator was a single-stage reducer consisting basically of a tilt valve and a diaphragm housed in a suitable casing. The regulator consisted of the regulator body (Fig. 3 (1)), the body covered (2), a diaphragm (3) of silicone rubber bonded to a central pressure plate, which carried a nylon blanking disc (4), clamp ring (5), tilt valve body (6), the tilt valve (7) and the tilt valve deflector (8). A hole through the tubular threaded projection (9) in the diaphragm case moulding formed an access port for breathing. This breathing port projection screwed into the breathing port adaptor on the left-hand side of the mask.

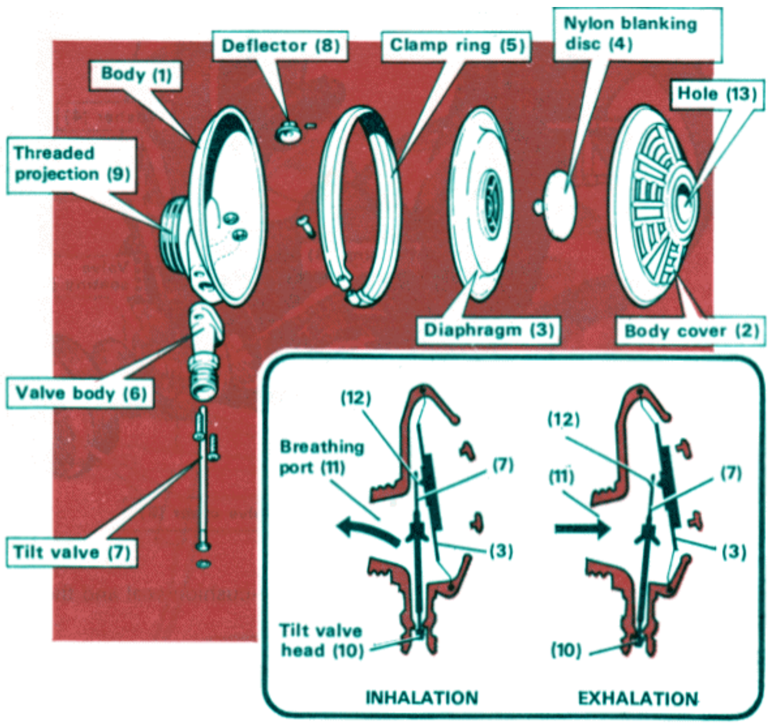

Fig. 3 Draeger/Normalair demand regulator. Inset: diagrammatic arrangement of the operation of the tilt valve

The regulator was simple in design and the arrangement of the tilt valve operation is shown in Fig. 3 (inset). The tilt valve spindle (7) projected through the housing and the deflector into the lower half of the diaphragm case, and the head of the tilt valve (10) was held in the closed position on its seating in the valve housing by the pressure of air from the cylinder. Inhalation through the breathing port (11) created a partial vacuum within the face mask which caused the diaphragm (3) to move inwards and press against the spindle at (12), so tilting the valve from its seating at (10) and permitting a flow of air from the cylinder. Exhalation caused the diaphragm (3) to move outwards away from the valve spindle (7), allowing the tilt valve to reseat and cut off the supply of air at (10).

The performance of the regulator was such that the wearer was supplied with whatever air he required. During light work and shallow breathing, the valve tilted slightly, allowing only a small volume of air to pass. Harder work and deeper breathing caused greater tilting of the valve and consequently the flow of air was increased. At normal rates of work, the suction effort is only about 12.5 mm of water gauge, and at the top peak of exertion is no more than 25 mm. This performance was inherent in the design and no adjustment was required.

As the demand regulator provided ample air for the highest possible rate of work, no by-pass was required. The regulator was so designed, however, that it could be manually operated, if required, by pressing on the diaphragm through the 25 mm diameter hole in the centre of the outer casing (Fig. 3 (13)). This action caused the diaphragm to press against the tilt valve spindle, lifting the valve from its seating as during inhalation, and allowing air into the system.

(4) Cylinder and manifold assembly

The cylinder, the neck of which was cradled by the curved bottom (Fig. 5.4 (1)) of the backplate, was secured in position by two stainless-steel straps (2) tightened by thumbscrews (3). The manifold assembly (4) was positioned on the backplate; it consisted of a nickel-plated copper pipe (5) to which was connected a short length of high-pressure flexible hose (6) terminating in a finger-tight cylinder valve connection at the lower end. At the upper end was a 'Y' manifold (7) to which the high-pressure hoses for the demand regulator and the pressure gauge were connected. Near the bottom of the pipe was a 'T' junction (8) to which the low-cylinder-pressure warning whistle (9) was fitted.

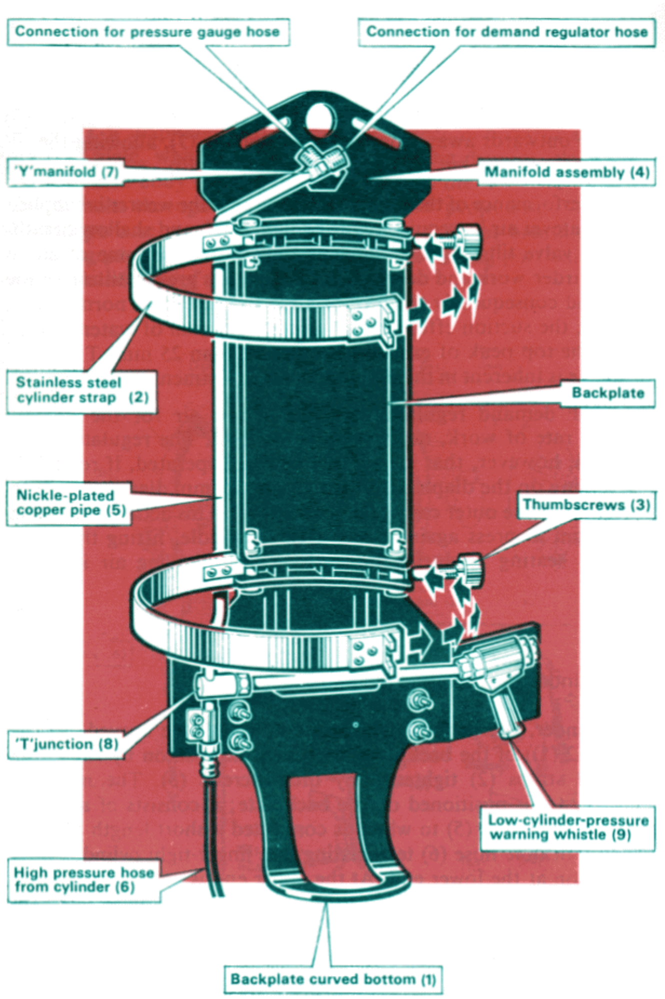

Fig. 4 Rear view of the Draeger/Normalair A100 backplate showing the manifold assembly

The set could be supplied for use with four types of cylinder: 1240 litres at 132 atmospheres, 1800 litres at 200 atmospheres and 2250 litres at 200 atmospheres, all of which were about 180 mm in diameter and were interchangeable when used with the standard strap. The fourth type of cylinder, however, i.e. 1200 litres at 200 atmospheres, was only 140 mm in diameter and smaller straps were required to secure it.