B. Rouquayrol,

Compressing Air,

No. 53,385. Patented Mar. 20, 1866.

Fig. 1.

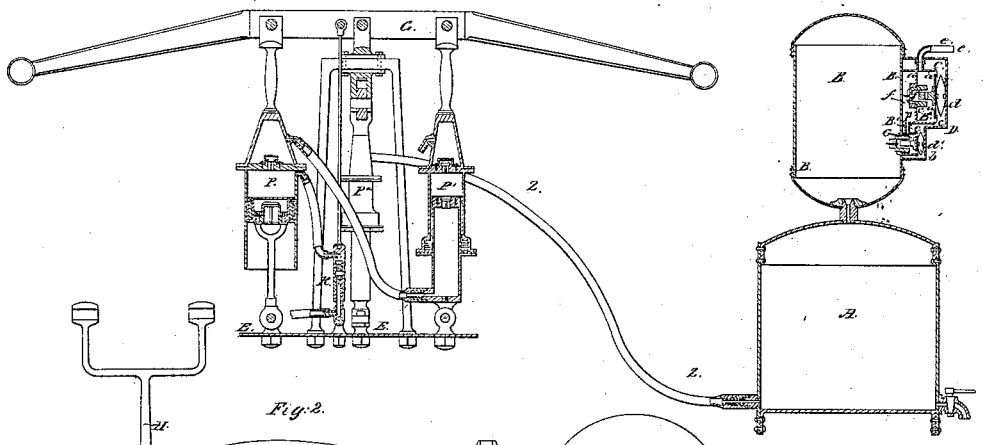

Fig. 2.

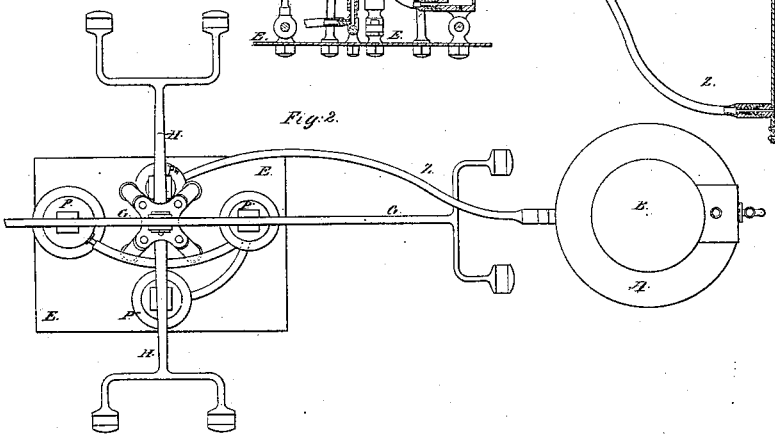

Fig. 3.

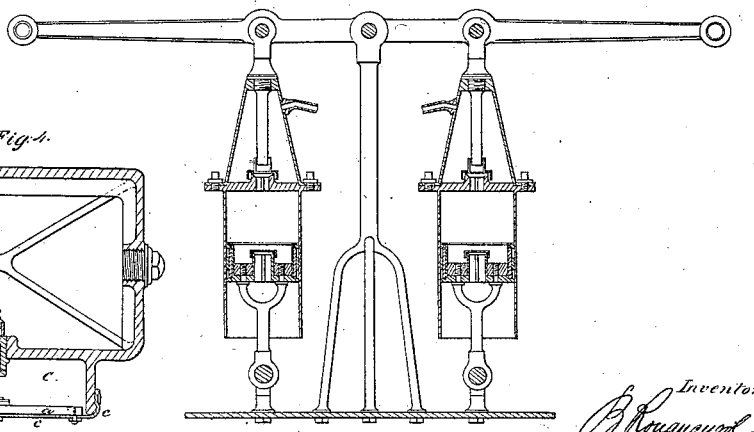

Fig. 4.

Witnesses:

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BENOIST ROUQUAYROL, OF PARIS, FRANCE.

IMPROVEMENT IN APPARATUS FOR SUPPLYING A CONTINUOUS FLOW OF AIR.

Specification forming part of Letters Patent No. **53,385**, dated March 20, 1866.

To all whom it may concern:

Be it known that I, BENOIST ROUQUAYROL, of Paris, in the Empire of France, have invented certain new and useful improvements in apparatus for supplying air to persons employed under water, or in places where noxious gas, air, or vapor prevails; and I hereby declare that the following is a full, clear, and exact description of the same, reference being had to the accompanying drawings.

The invention relates to apparatus for supplying air to persons employed under water or in places where noxious gas, air, or vapor prevails.

The apparatus constructed according to these improvements comprises a reservoir of compressed air and an air-chamber and pumps for supplying the same. The air-chamber is provided with a plate or lid of less diameter than itself, on which is a piece of elastic material, which connects it with the sides of the chamber, and thus forms a second chamber over or at the side of the former. The two are caused to communicate by a valve, which is opened by a rod when pressure is exerted on the plate, and allows the air to flow out. This contrivance I call an "air-box," and the outflow of air may be regulated by combining two such contrivances or air-boxes and causing them to communicate with each other by a tube or other connection through which air flows from one box to the other. The boxes may be surrounded by a casing and springs used for pressing on the plates. A tube leads from the air-vessel to supply the workman, who may wear a mouth-piece consisting of a strip of caoutchouc held between the lips and teeth. The action of the air-valve is preferably so regulated that the same air may be breathed twice.

The pumping apparatus consists of a series of two, three, four, or more pumps, cylinders, or barrels which communicate with each other, so that air drawn into and compressed in the first or largest flows therefrom into the next in size, in which it is more compressed, and so on from one to the other, and as the cylinders differ in capacity it becomes more and more compressed in its passage through the series, and it thence flows into the air-reservoir. The pumps are preferably so arranged in respect of dimensions as to raise the pressure in a regularly-increasing geometrical progression. Water is pumped in to cover or overlay the pistons and form a hydraulic joint, whereby the air, after having entered the series of pumps, is prevented from escaping till it has passed through them all. The pistons are attached to a plate and are fixtures, and the cylinders or pump-bodies are worked up and down by a brake, a beam, or other means. The pistons may be solid, or they may be hollow with a valve at top.

Having thus set forth the nature of the invention, I proceed, with reference to the drawings, to describe more particularly in what manner it may be carried into effect.

Figure 1 is an elevation, partly in section, and Fig. 2 a plan, of the apparatus.

A is a vessel or chamber forming a reservoir of compressed air. This reservoir communicates with a series of pumps, P P′ P″ P‴, and also with an air-chamber, B, which is provided with one or more contrivances, herein called "air-boxes," through which the air is delivered from the chamber to supply the diver or workman. Fig. 4 is a detached view of a chamber, B, with one such air-box. This air-box is constructed by forming the chamber with a recess, C, nearly closed by a plate, *a b*, which, being of less diameter than the recess, does not quite extend to the sides thereof. On this plate is fastened a disk or piece of caoutchouc, *c*, which extends to and over the edge of the recess, and is attached thereto so as to close it, whereby a second chamber, C, is formed at the top of the chamber B, with which it communicates by an orifice, *o*, opened and closed by a valve, *f′*, worked by a rod, *f*—that is to say, when pressure is exerted on the plate *a b* such pressure, being transmitted by this rod *f*, opens the valve *f′* and allows air to flow from B to C. The arrangements C *a b c o f f′*, combined as above described, form the contrivance which I call the "air-box." When the chamber is furnished with one such box, as in Fig. 4, the outflow of air will be continuous, but not regular. Now, to render such outflow regular the air-chamber is provided with two air-boxes, B′ B², employed in combination, as in Figs. 1 and 2. These boxes, each of which is constructed substantially like the air-box Fig. 4, are at the side of the chamber, and communicate with each other by means of a passage, *p*.

e is a pipe opening at one end into the box

B^2 and leading therefrom to the mouth-piece or inhaling apparatus of the diver or other workman.

D is a casing over the boxes.

d d' are springs which press on the movable plates *a b*.

Air is pumped into the reservoir A by the pumping apparatus P P′ P″ P‴ through the pipe Z, and passes from A into the chamber B, and thence through the box B′ and passage *p* to the box B^2, whence it is conveyed through the pipe *e* to the respiratory organs of the diver or workman.

The chambers A and B may be fixed rigidly together, as in Figs. 1 and 2, or they may be apart and placed in communication by a flexible or other pipe, which connects them together. The air-chamber may sometimes be carried on the workman's back.

I now proceed to describe the pumping apparatus.

P P′ P″ P‴ are four pumps for compressing the air and supplying it to the reservoir A. These pumps communicate with each other by pipes or passages. Each pump consists of a traveling cylinder and stationary piston—that is to say, the cylinders or bodies of the pumps have a reciprocating up-and-down motion communicated to them by a brake, G H, worked by any motive power, and they are fitted with pistons fixed to a base-plate, E. Each cylinder differs in diameter or working capacity from the others, and atmospheric air is admitted into and compressed in each of these cylinders in turn, beginning with the largest, and so on to the smallest—that is to say, the air is first drawn into and compressed in the largest pump P, and thence passes into and is compressed in the next in size, P′. It thence passes into and is compressed in P″, (which is the smallest but one,) and, lastly, it passes into and is compressed in the smallest of the series P‴, whence it follows that the pressure of the air is raised to a greater degree in each pump in succession. From the smallest pump P‴ the compressed air passes through the pipe Z into the reservoir A. The cylinders should be so arranged as to their dimensions or capacities that the elevation of pressure of the air shall be in a regularly-increasing geometrical progression—say, for example, at a ratio of two and one-half—viz., thus, if raised to two and one-half atmospheres in pump P, it will reach six atmospheres in P′, fifteen in P″, and forty in P‴.

Of course the pumping apparatus may be constructed with more or less than four cylinders, and may be arranged for other series, ratios, or progressive rates of increase of pressure than as above.

R is a pump, which is worked by the brake, and forces water into the cylinders P P′ P″ P‴, so as to keep the upper surface of each piston constantly covered or overlaid by a layer of water, which forms a hydraulic joint or packing and prevents the air in the pumps from leaking out. The water is pumped in, a little at a time, at each stroke of the brake.

Fig. 3 is a sectional elevation of a smaller or two-cylinder pump, constructed on the same principle as the pumping apparatus, Figs. 1 and 2, except that its two cylinders are of equal diameter. This pump is intended for supplying a small air-chamber at low pressure, and it may be made of small dimensions, so that the pump, air-chamber, and connecting-pipe may be packed in a box for convenience of carriage.

The pistons are kept under a layer of water, as in the apparatus, Figs. 1 and 2.

Having now described the nature of the said invention and in what manner the same may be performed, I claim—

The air-chamber provided with what I call an "air-box" or "air-boxes," the parts of which are arranged and combined as hereinbefore described, and this I claim whether a single air-box be used, as in Fig. 4, or two air-boxes in combination, for obtaining a regular outflow, as in Figs. 1 and 2.

In testimony whereof I have signed my name to this specification before two subscribing witnesses.

B. ROUQUAYROL.

Witnesses:

E. SHERMAN GOULD,

C. SMART.