the one in the branch *b* opens. Hence the exhaled air which has passed into the mixing-bellows B is compelled to flow into the purifying-chamber C through the opening *d* in its top, Fig. 2, and through the same. This purifying-chamber C is constructed with partitions *e e*, and is partly filled with barium hydrate or some other suitable solution which readily absorbs carbonic acid. The exhaled air, in flowing through this purifying-chamber, as indicated by arrows, flows through this barium hydrate or other solution, whereby the carbonic acid is absorbed, and only the nitrogen of the exhaled air and a certain part of oxygen not used by breathing pass in at the branch *b*.

E E are reservoirs (one or more) containing oxygen, and which connect with each other by tubes *f f*. These reservoirs are firmly secured to the case A. Pure oxygen is forced into these reservoirs E E through the opening F to a pressure of about sixty atmospheres. The opening F is then closed by a screw-cap or other suitable means. From these reservoirs E the oxygen flows into a tube, *g*, Figs. 1 and 2, which leads into the space G, and which tube is closed by a valve, *h*, Fig. 1. The space G is covered by a diaphragm, *i*, in the diaphragm-chamber H. This space G connects with the mixing-bellows B by a tube, *j*, which leads into the space *c* surrounding the purifying-chamber C.

The diaphragm-chamber H is perforated, as at *k k*, so that the diaphragm *i* is pressed inward by the water flowing in through these openings *k k* when the diver is under water. The diaphragm *i*, in being pressed in, presses on the arm *l*, Fig. 1, which arm presses the valve *h* inward, and thus has a tendency to allow the oxygen in the reservoir E to escape.

Ordinarily the pressure of oxygen from the inside of the tube *g* on the valve *h* counterbalances the pressure of the arm *l* from the outside; but when the diver begins to inhale a partial vacuum is formed in the space *c*, as well as the tube *j* and space G. Thus, the pressure in the space G being diminished, the diaphragm *i* is pressed inward, and the arm *l*, pressing the valve *h* inward, allows some oxygen to escape at the moment of inhalation, but at no other time.

As the pressure of oxygen in the reservoir varies, the pressure of the diaphragm *i* can be regulated by the set-screw I acting on spring *m*. This set-screw I also serves to adjust the diaphragm *i* for greater or less depths of water, for if the diver has to work in deep water the pressure of the water on the diaphragm *i* is increased, and by turning the screw in the proper direction the pressure of the spring *m*, to which it is connected, is lessened, while if the diver ascends and the apparatus is thus carried nearer the surface the pressure of the water on the diaphragm *i* diminishes, and the pressure of the spring *m* can be increased. By this means perfect equilibrium can always be maintained.

The oxygen, on escaping through the valve *h*, passes into the space G and through the tube *j* into the space *c* surrounding the purifying-chamber, and thence into the mixing-bellows B. From thence it passes, together with the exhaled air, into the purifying-chamber through the opening *d*. It then passes through this purifying-chamber C, and passes into the opening *b*, together with the nitrogen coming from the exhaled air. Thus a mixture of oxygen and nitrogen corresponding to the ordinary atmosphere is formed, and is inhaled by the diver through the pipe D.

Before beginning to operate the machine a certain quantity of nitrogen is also introduced into the mixing-bellows B through the valve *n*. The mixture in the bellows B is caused to flow out at the moment of inhalation by the pressure of the water on the top and sides of bellows. This pressure must, however, not be too great, and in order to counterbalance it I provide a pressure-bellows, J. If, now, the bellows B is pressed down too low, it causes the rack *o*, Fig. 2, to ascend, being connected to it by means of the chain or rope *p*. This causes the cog-wheel *q* to revolve and the secondary rack *r* to descend in the direction of the arrow. By this means the bellows J, containing air or gas, is compressed, thus counterbalancing the pressure of water on the bellows B.

The pressure-bellows J can be adjusted for various pressures by the set-screw K, so that the diver can descend with the apparatus into greater or less depths of water.

From the diaphragm-chamber H, Fig. 2, leads a tube, *s*, into a secondary chamber, L, conveying oxygen into the same. From this chamber L the oxygen flows through the tube *t*, and can be fed to a lamp, which may thus be used under water. The products of combustion can be led into the breathing-pipe D, and thence through the mixing-bellows and purifying-chamber, the same as the exhalations of the diver. When no lamp is required the tube *s* is closed by stop-cocks *u u*.

The whole apparatus is made of a form and size convenient to carry, and is strapped on the back of the diver, who thus carries the apparatus and means of breathing with him under water wherever he goes. This apparatus is not only useful for working under water; but if a person has to descend into a well or coal-mine, which, as is well known, are often filled with carbonic-acid and other noxious gases, he will find the apparatus just as effective.

What I claim as new, and desire to secure by Letters Patent, is—

1. The combination, in a diving apparatus, of reservoirs E, (one or more,) containing oxygen, diaphragm-chamber H, containing a diaphragm for regulating the outflow of oxygen, tube *j* for conveying the oxygen to a mixing-bellows, B, bellows-chamber containing a mixing-bellows, B, purifier C for freeing the air to be inhaled of its noxious qualities, and breath-