No. 766,465. PATENTED AUG. 2, 1904.

E. B. PETRIE & J. E. MARTIN.

MEANS FOR FORCING WATER FROM DIVING SUITS OR APPARATUS.

APPLICATION FILED OCT. 22, 1903.

NO MODEL. 3 SHEETS—SHEET 1.

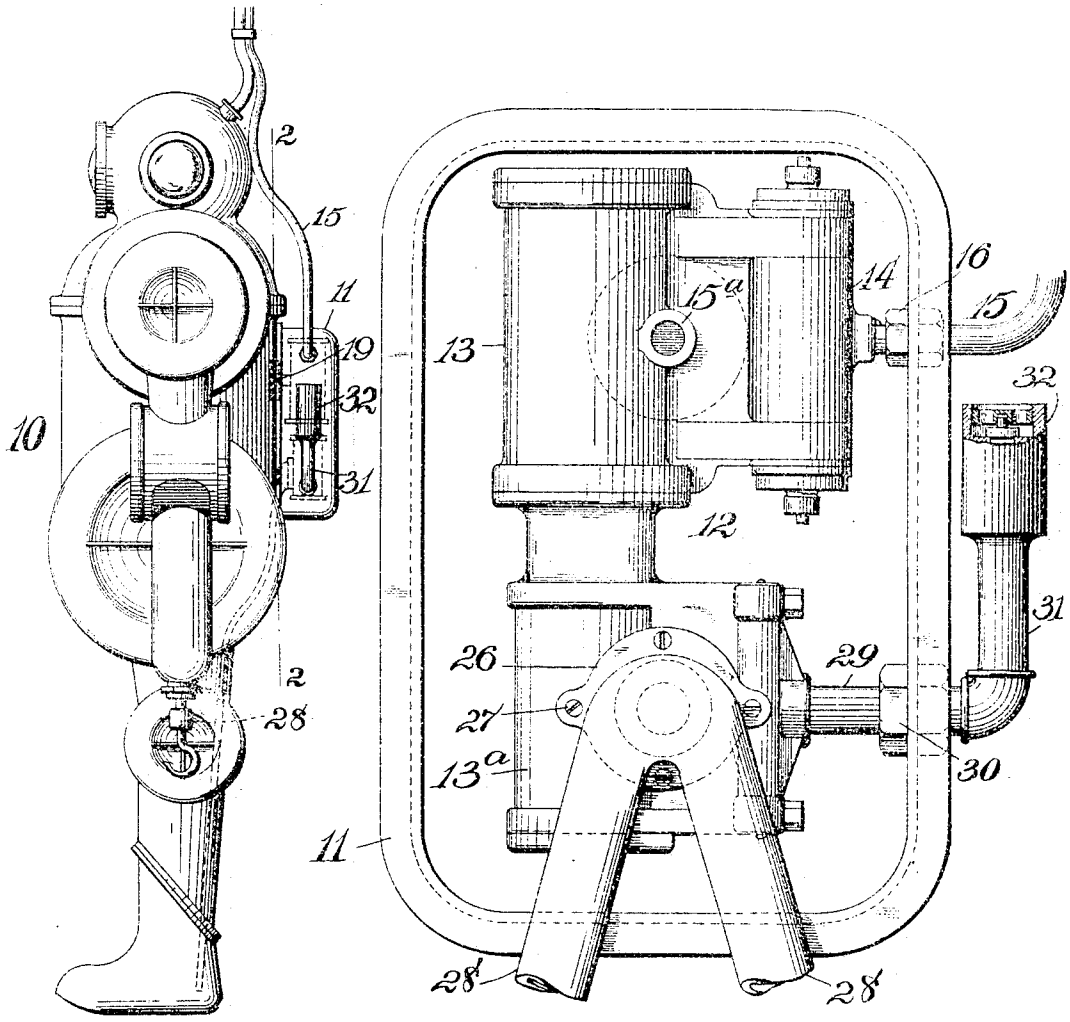

Fig. 1.

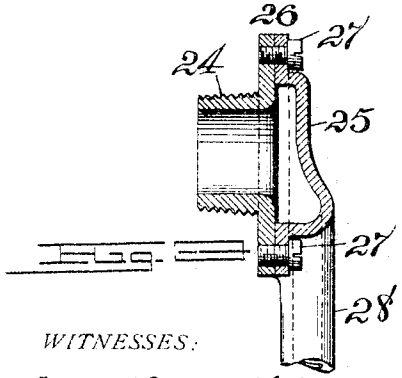

Fig. 2.

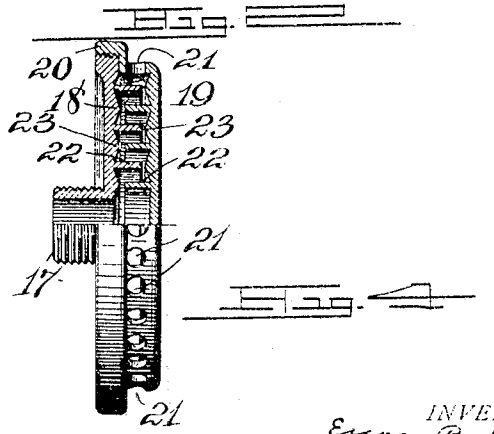

Fig. 3.

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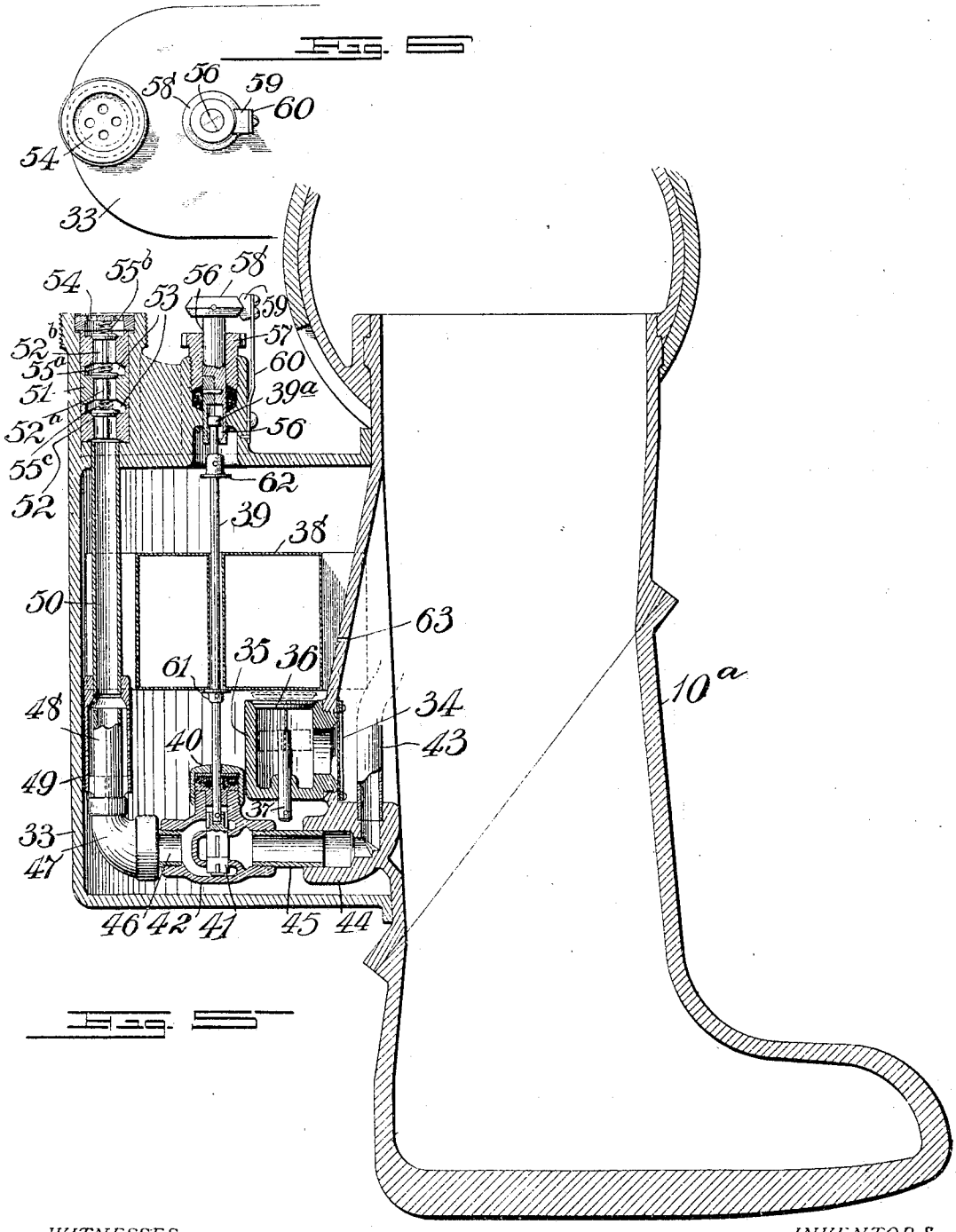
NO MODEL. 3 SHEETS—SHEET 2.



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NO MODEL. 3 SHEETS—SHEET 3.

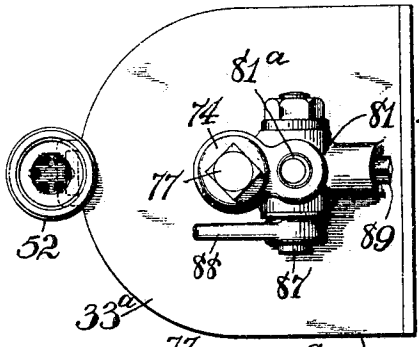

Fig.

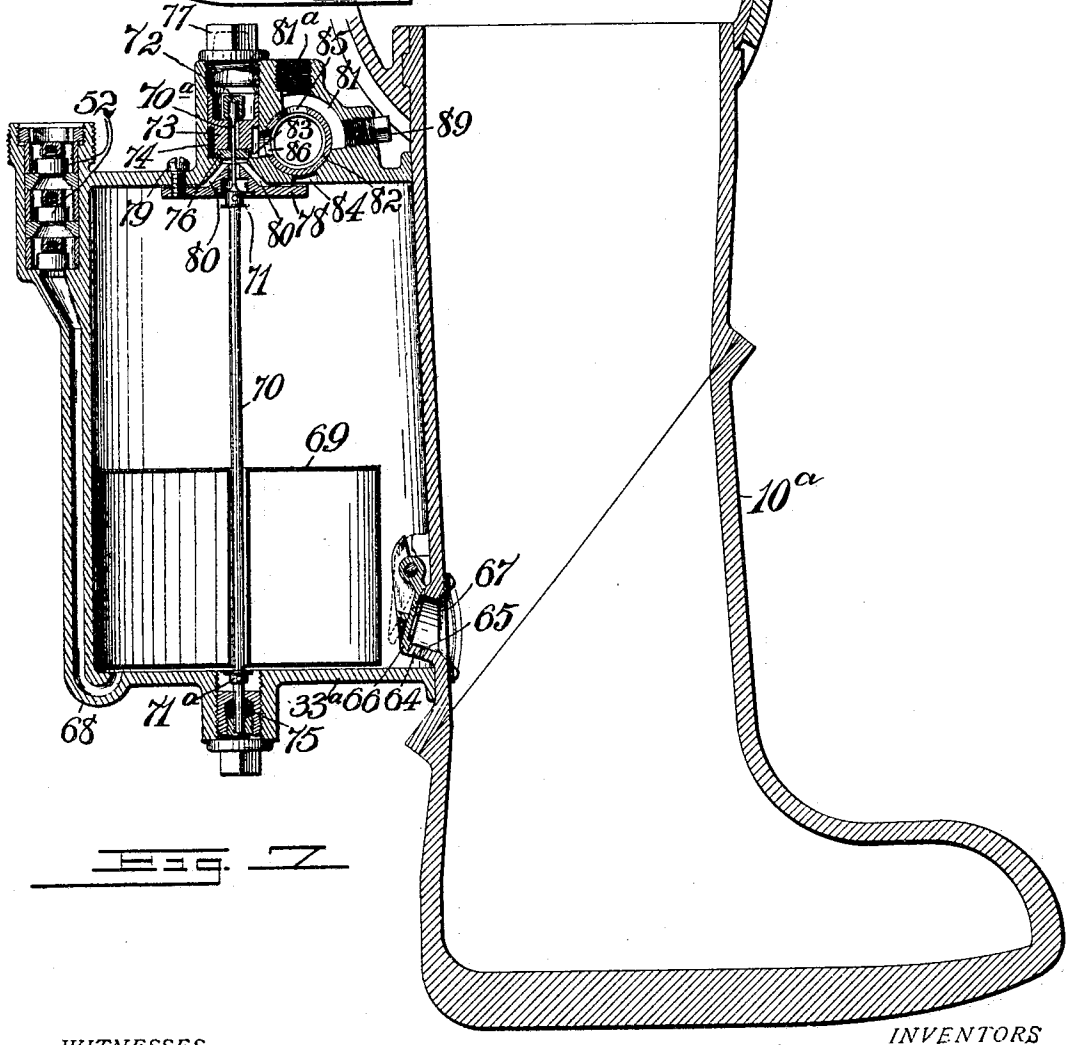

Fig. 7

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No. 766,465. Patented August 2, 1904.

UNITED STATES PATENT OFFICE.

ENOS B. PETRIE, OF NEW YORK, N. Y., AND JOSEPH E. MARTIN, OF NEWARK, NEW JERSEY, ASSIGNORS TO PETRIE DEEP SEA DIVING COMPANY, OF NEWARK, NEW JERSEY, A CORPORATION OF NEW JERSEY.

MEANS FOR FORCING WATER FROM DIVING SUITS OR APPARATUS.

SPECIFICATION forming part of Letters Patent No. 766,465, dated August 2, 1904.

Application filed October 22, 1903. Serial No. 178,032. (No model.)

To all whom it may concern:

Be it known that we, ENOS B. PETRIE, of New York, in the county of Kings and State of New York, and JOSEPH E. MARTIN, of Newark, in the county of Essex and State of New Jersey, have invented a new and Improved Means for Forcing Water from Diving Suits or Apparatus, of which the following is a full, clear, and exact description.

Our invention relates to improvements in devices for forcing water from diving suits or apparatus.

We have shown our invention as adapted for use in connection with a diving apparatus such as illustrated in Letters Patent of the United States No. 735,809, dated August 11, 1903; but the attachment may be used in connection with other deep-sea apparatus. Its obvious use, however, is in connection with apparatus adapted for deep-sea work, where the water-pressure outside the apparatus is sufficiently heavy to force water through the joints.

The object of our invention is to produce a simple and positive apparatus which can be operated by compressed air to remove water from the diving suit or apparatus, which will be set in motion and stopped automatically by the rise and fall of water in the suit or apparatus, and which also has auxiliary means for controlling it, said means being hand-operated.

Our invention is also intended to produce a device which will be very compact and simple, so as to be carried conveniently upon a suit or apparatus without impeding the work of the diver.

With these ends in view our invention consists of certain features of construction and combinations of parts, which will be hereinafter described and claimed.

Reference is to be had to the accompanying drawings, forming a part of this specification, in which similar figures of reference indicate corresponding parts in all the views.

Figure 1 is a side elevation of a diving apparatus or suit having our improved attachment connected therewith. Fig. 2 is an enlarged detail sectional elevation on the line 2 2 of Fig. 1, showing particularly the pump and its connections. Fig. 3 is a detail sectional view of the pipe connections for the intake of the pump. Fig. 4 is a detail view, partly in section, of the air-expanding device connected with the exhaust of the pump. Fig. 5 is a sectional elevation of a modified form of our invention, which shows especially the application of an air-lift to the lower part or leg of the suit or apparatus. Fig. 6 is a plan view of the device shown in Fig. 5. Fig. 7 is a sectional elevation of another modification of the invention, showing means for utilizing direct air-pressure for expelling water; and Fig. 8 is a plan view of the apparatus shown in Fig. 7.

The diving apparatus 10 is like that shown in the patent above referred to; but, so far as this invention is concerned, it may be any diving apparatus, and it has attached to it, preferably at the back, so as to be as much out of the way as possible, a casing 11, in which the pump is secured, this casing being attached to the body of the suit so as to open into the same, and it contains a pump 12, which is not shown in detail, as it may be any usual type of air-driven pump. It may, in fact, be any power-pump; but we prefer to use the air-driven pump, because the air used to work the pump may be exhausted directly into the suit or apparatus 10, and so supply wholly or in part the diver with air, the accumulation of which is prevented by the proportions of the return air-tube from the suit to the surface. As shown, the pump has the ordinary air and pump cylinders 13 and 13ª, and the cylinder 13 is provided with the usual valve-chamber 14, which is supplied by a pipe 15, extending through a suitable gland 16 in the casing 11, and the pipe 15 may be conveniently led up with the ordinary air-pipe, as

shown in Fig. 1, to its source of air-supply above the water. The exhaust 15ª of the cylinder 13 is adapted to connect with the threaded pipe 17, which has preferably a wide flange 18, forming one wall of the exhaust-chamber to be described presently, and the outer wall 19 of the casing has a flange 20, which is threaded, so as to screw onto the periphery of the wall 18. The casing formed by the two walls 18 and 19 is preferably of a generally circular shape and has numerous air-holes 21 around its periphery.

On the opposite walls 18 and 19 are disposed concentric inwardly-extending flanges 22, the flange of each wall extending to a point near but not touching the opposed wall, and to further assist in expanding and directing the exhaust-air each wall is preferably provided with a circular boss 23, which comes opposite each flange 22. It will thus be seen that when the exhaust-chamber just described is attached to the engine-exhaust 15ª the air will be repeatedly baffled by the concentric flanges 22 and bosses 23 and following a zigzag course will nave time to expand, so as to finally pass out through the holes 21 at a temperature sufficiently high to be easily borne by the diver.

It will be observed that if the air were permitted to exhaust in a blast directly against the diver it would chill him by its sudden expansion, and at the same time the exhaust-port would be likely to freeze up. Several modifications of the exhaust-chamber as to shape will naturally suggest themselves—as, for instance, it is not necessarily, though preferably, circular in section, and it may be made in more or less parts, as desired.

The intake of the pump-cylinder 13ª is through a pipe 24, having its outer end merging into a casing 25, the two parts having meeting flanges, (shown at 26,) and the flanges are connected by screws 27. The casing 25 is preferably flattened, so as to occupy as little space between the pump and the diver's body as possible; but it may be shaped differently and the casing may be made in a single piece, if preferred. The capacity of the pipe 24 and of the pump-intake is twice that of the pipes 28, which connect with the casing 25 and pipe 24 and which run down into each leg of the diving-suit, as shown by dotted lines in Fig. 1.

The discharge of the pump is through a pipe 29, which extends outward through a gland 30 in the casing 11 and has an upturned bend 31, terminating in a valve-casing 32, having a series of check-valves and delivering into the open water. Ordinarily the pump is not in operation; but if water rises in the suit so as to be uncomfortable or dangerous to the diver he signals by the usual means to have the pump started, and this is immediately done by turning on the air-supply through the pipe 15. The pump exhausts as described and in operation lifts the water through the pipes 28 and discharges it through the pipes 29 and 31. It will be seen that the pump may be without making it unduly large of sufficient capacity to quickly lower the water in the diving apparatus.

As shown in Figs. 5 and 6, the device is in the form of an air-lift attached to the leg 10ª of the diving suit or apparatus, but in any event to the lower part of the suit. The casing 33 is attached to the rear part of the leg, this position being chosen as the diver generally wears rubber boots, and therefore if the water rises over the tops of his boots he will immediately know that the apparatus has not started automatically and will start the same manually by the mechanism hereinafter clearly described. The water from the suit or leg 10ª enters, preferably, through a strainer 34, but in any event through the valve-casing 35, the inlet of which is in the leg 10ª and the outlet of which is in the casing 33. In the top of the valve-casing 35 is a check 36, which is preferably provided with laterally-extending wings, as shown by dotted lines in the drawings, and the stem 37 of which runs down through the bottom of the valve-casing for a guide. In the main casing 33 is a float 38, which is guided on a stem 39, moving between two tappets hereinafter referred to. The stem 39 extends downward through a friction-packing 40, which will normally hold the stem raised, and the stem connects at its lower end with an ordinary balanced air-valve 41, the construction of which is not shown in detail, because any suitable air-valve can be used. This valve is held in the customary valve-casing 42, which forms part of the air-passage, the inlet being through a pipe 43, connecting with any suitable source of compressed-air supply. The air-pipe 43 connects, by means of the elbow 44 and pipe or nipple 45, with the valve-casing 42, and the latter has at its outlet the nipple 45, connecting with an elbow 47, and this connects with the discharge-nozzle 48, vertically arranged, as shown.

Obviously the particular arrangement of the air-pipes is immaterial, the only necessary thing being to provide a suitable connection with the valve-casing 42. The nozzle 48 is surrounded by a hood 49, a space being left at the bottom for the inlet of water, and the upper end of the hood is reduced and connected with the discharge-pipe 50, the inlet of the discharge being spaced apart from the upper end of the nozzle 48, so that the water can rise over the top of the nozzle and enter the pipe 50. The pipe 50 connects at its upper end with the discharge check-valve casing 51, in which are seated a series of check-valves 52, 52ª, and 52ᵇ, which can be of any approved type and which are separated by the chambers 53. A spider 54 at the top of

the casing 51 serves to retain the upper check-valve in place. We have shown a series of three of these check-valves; but a greater or less number can be used. The particular feature of them is that they are pressed to their seats by springs 55, 55[a], and 55[b] of gradually-increasing tension, so that the air and water will lift the lower check 52 and be held in the lower chamber 53 until with increased pressure the second valve is lifted, and so on until the last is raised, and in each case there will be a check behind the valve which is lifted, so that while the checks operate readily there is a multiple system to make it positive that no water shall rush in from outside the casing 33.

The stem 39, which is operated by the float 38, has a head 39[a] at its upper end moving in the chamber at the lower end of the stem 56, which extends upward through a suitable gland 57 and terminates in a flanged handle 58, having, preferably, a convex face, which should be conical in section, though this is not absolutely necessary, and the face of the handle is engaged by the spring-clutch 59, which fits against it and which is carried by a spring 60, attached to a convenient support, which in the present instance is a part of the casing 33. The float 38, hereinbefore mentioned, moves between the tappets 61 and 62, so as to open and close the air-valve by its rise and fall, as described below. Attention is also called to the fact that there is a perforation 63 in the partition between the casing 33 and leg 10[a], which perforation provides for the equalizing of pressure in the two parts after the discharge of water has taken place and the supply of air has been closed off by the valve 41, which is necessary to allow the casing 33 to again fill with water.

The operation of the apparatus is as follows: When water in the leg 10[a] or in the diving apparatus to which the casing 33 is attached rises to the level of the valve-casing 35, it flows into the latter and lifts the check 36, so as to flood the casing 33, and it gradually lifts the float 38 until the latter strikes the tappet 62 and raises the valve-stem 39, thus opening the air-valve 41. While the water has been lifting the float it will also have passed into the hood 49 and above the nozzle 48, the water rising, in fact, into the pipe 50. The apparatus is now ready to operate like the ordinary air-lift—that is to say, the air passing in from the pipe 43 will bubble up through the water in the pipe 50 and a bubble of air will carry with it a globule of water, the two passing up by the lower check-valve 52 into the chamber 53, and as the bubbles and water globules continue to come the second check and finally the third are lifted and the water and air pass out together. As the water begins to lower the stem 39 will retain its position because of the friction-packing 40 until the water has dropped sufficiently to permit the float 38 to strike the lower tappet 61, and the weight of the float will cause the stem 39 to be pushed down, so as to close the air-valve 41. In case the apparatus does not start automatically for any reason the diver will know it by the rise of water on his legs, and he can then reach down and with his hand or with some manually-operated device grasp the flanged handle 58 and lift it from engagement with the clutch 59. In this way he raises the stem 56 and the apparatus begins to work, as already described. After this he will return the flanged handle to its closed position, where it will be engaged by the clutch 59, and this will bring the parts into the right position to provide for the clearance necessary for the automatic operation of the device.

In Figs. 7 and 8 we have shown another modification adapted to operate by direct pressure in the supplemental casing 33[a], which is attached to the lower part or leg 10[a] of the apparatus. The casing 33[a], like the casing 33, serves as a trap, and it connects with the part 10[a] through the opening 64, this being provided with a perforation 65 in its wall to permit the equalizing of pressure in the parts 10[a] and 33[a]. The opening 64 is closed on the casing side by an ordinary clack-valve 66, and the opening is also, preferably, covered by a strainer 67. The casing 33[a] has a discharge 68, which may be a separate pipe or may be formed in the wall of the casing, as shown, and at the upper end of the discharge is a series of check-valves 52, like those already described.

In the casing 33[a] is a float 69, which moves freely on the vertical stem 70, having abutments or tappets 71 and 71[a] near the top and bottom, and the upper end of the stem 70 merges in an extension 70[a], which has at its upper end a valve 72, which is adapted to seat itself on the central opening of the piston 73, which moves in the chamber 74 at the top of the casing 33[a]. The lower end of the stem 70 moves in a suitable friction 75. At the lower end of the piston 73 is a disk 76. The top of the chamber 74 is closed, as illustrated, by a nut 77, and beneath the chamber in the upper part of the casing 33[a] is a spreader 78, which is perforated in the center and which is held in place by a screw 79 or equivalent fastening. An air-space 80 is left between the cone of the spreader 78 and the top wall of the adjacent casing to permit the flow of air downward into the casing 33[a], as hereinafter described. The object of the spreader 78 is to cause the air as it issues from the chamber 74 to be deflected to the sides of the casing 33[a], so that it will not interfere with the action of the float 69.

At one side of the chamber 74 is a valve-

casing 81, in which turns the cylindrical hollow two-way valve 82, and the casing 81 has at the top a suitable air connection 81^a, to which an air-pipe may be attached. The valve-casing 81 has an outlet 83, leading to the chamber 74, and a second outlet 84, leading to the chamber 33^a. The hollow valve 82 has also ports 85 and 86, adapted to connect with the chamber in the valve-casing 81 and with the port 83 and also adapted to connect the chamber in the casing 81 directly with the casing 33^a through the outlet or port 84. The stem 87 of the valve 82 projects outward from the casing 81 (see Fig. 8) and has a suitable handle 88. The plug 89 is merely to close the hole made to facilitate the boring of the port or outlet 83.

The operation of the apparatus, as shown in Figs. 7 and 8, is as follows: The water which rises in the leg 10^a flows in past the clack-valve 66 and gradually fills the casing 33^a. As it does so the float 69 rises until it strikes the tappet or abutment 71, and this by means of the extension-stem 70^a lifts the valve 72 from its seat and permits the air which has been retained in the chamber 74 to pass down around the stem 70^a through the space 80 to the casing 33^a. The release of the air in the chamber 74 permits the piston 73 to rise under the pressure of air coming in through the opening 81^a and through the valve 82, so that as soon as the piston 73 is lifted the air passes freely in through the valve 82 and ports 86 and 83, thence down through the space 80 of the spreader 78, so as to supply the requisite pressure for the casing 33^a, and this pressure acting on the water in the casing will force the water out through the discharge 68 and by the check-valves 52. When the float 69 drops, owing to the fall of water, it strikes the lower tappet 71^a, pulls down the stem 70, and also closes the valve 72, which permits the accumulated pressure to force down the piston 73 and close the air-inlet to the casing 33^a, the piston 73 thereby closing all air-supply to the casing 33^a. The handle 88 is only used in case of emergency. If the diver feels that the water is rising and that the apparatus is not working automatically, he tips the handle over, so as to bring the port 86 opposite the chamber of the casing 81 and so as to bring the port 85 opposite the port 84, and thus a direct air-pressure comes into the casing 33^a and expels the water.

In the foregoing description we have shown three simple and positive methods of expelling the water, and obviously many of these details might be changed without departing from the principle of our invention.

Having thus fully described our invention, we claim as new and desire to secure by Letters Patent—

1. The combination with a diving suit or apparatus, of means connected with the legs and operating to expel the water from the said suit.

2. The combination with a diving suit or apparatus, of an auxiliary casing outside the suit and supported thereon, and means located in the auxiliary casing for discharging water from the suit.

3. The combination with a diving suit or apparatus, of a pump located thereon, and a connection by which the pump lifts and discharges the water from the apparatus.

4. The combination with a diving suit or apparatus, of a pump located thereon and having intake-pipes connecting with the lower extremities of the apparatus, and a discharge-pipe delivering outside the apparatus.

5. The combination with a diving suit or apparatus, of a pump located on the body portion thereof, the said pump having intake-pipes extending to the lower portions of the diving apparatus, and a discharge-pipe delivering externally of the apparatus.

6. The combination with a diving suit or apparatus, of a pump located on the back of the said apparatus, the pump having intake-pipes extending into the legs of the apparatus, and a discharge-pipe delivering externally of the apparatus.

7. The combination with a diving suit or apparatus, of a casing located on the body portion thereof, a pump contained in the casing, an intake for the pump connecting with the interior of the apparatus, and a discharge for the pump delivering externally of the apparatus.

8. The combination with a diving suit or apparatus, of a pump located thereon, said pump having connections to discharge water from the apparatus and having its exhaust delivering into the said diving apparatus.

9. The combination with a diving suit or apparatus, of a casing located thereon, an air-pump in the said casing, pipe connections by which the pump discharges water from the lower part of the apparatus to a point externally of the apparatus, and means for exhausting the air from the pump into the said suit or apparatus.

10. In an apparatus of the kind described, the combination with the pump, of an expander connected to the exhaust of the pump, said expander having overlapping baffle-plates or flanges to retard the discharge of air.

11. The exhaust-expander comprising a casing having an inlet and discharge, and a series of overlapping baffle-plates or flanges located between the intake and discharge.

12. The herein-described expander having an intake and discharge, and a series of concentric flanges or baffle-plates projecting inwardly from opposite walls of the expander so as to give a zigzag course to the fluid passing through the expander.

13. The herein-described expander com-

prising a casing having an inlet and discharge, concentric plates or flanges projecting inwardly from the opposite walls of the casing, and concentric bosses opposite the inner edges of the said baffle-plates or flanges.

14. The herein-described expander comprising a two-part casing, one part having an essentially central intake and the second part having a peripheral discharge, and concentric overlapping flanges projecting inwardly from the two walls of the casing.

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