(No Model.) 2 Sheets—Sheet 1.

C. C. WORTHINGTON.

COMBINED WATER PUMP AND AIR COMPRESSOR.

No. 330,540. Patented Nov. 17, 1885.

Fig. 1.

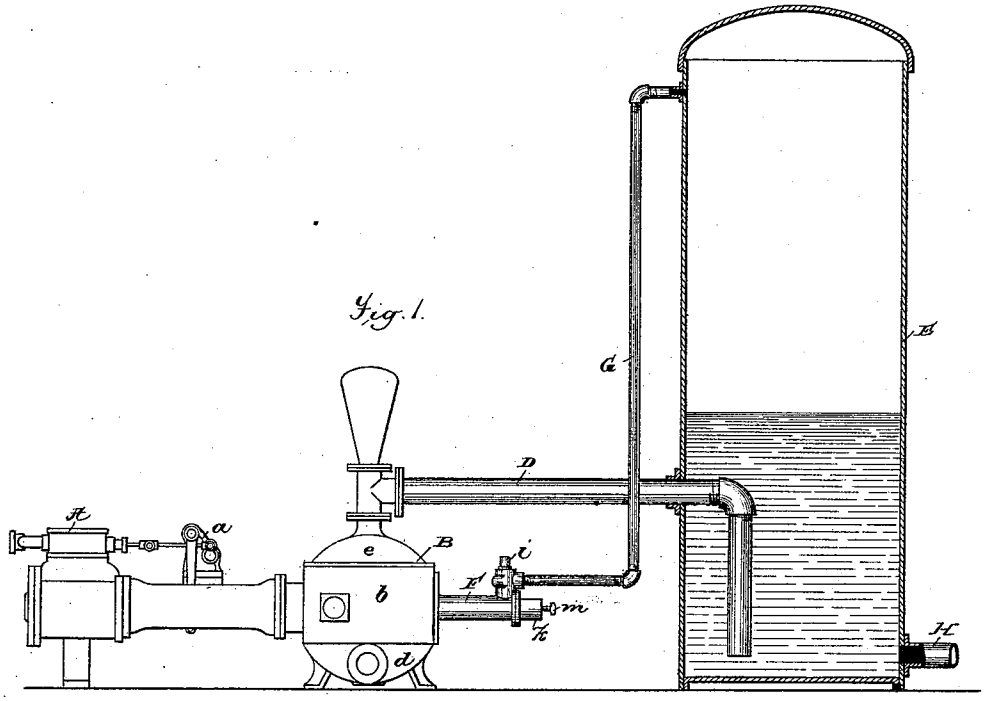
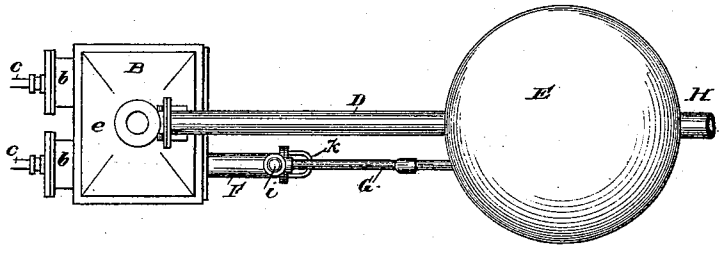


Fig. 2.



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(No Model.) 2 Sheets—Sheet 2.

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Fig. 3.

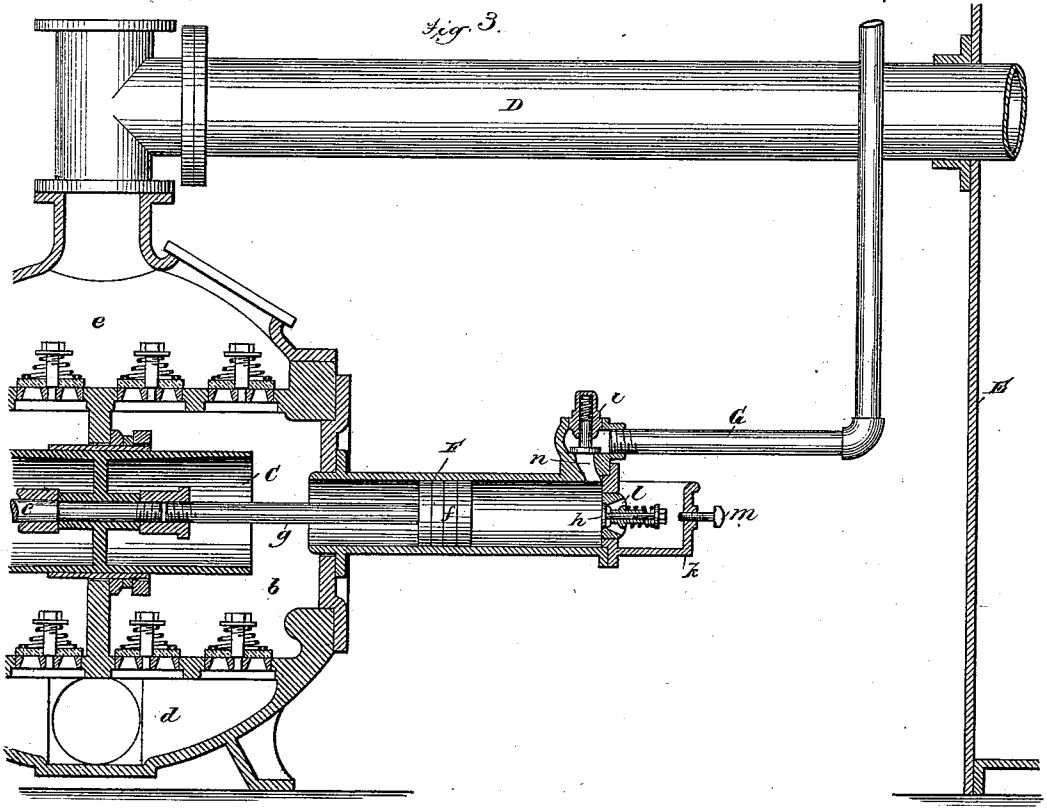
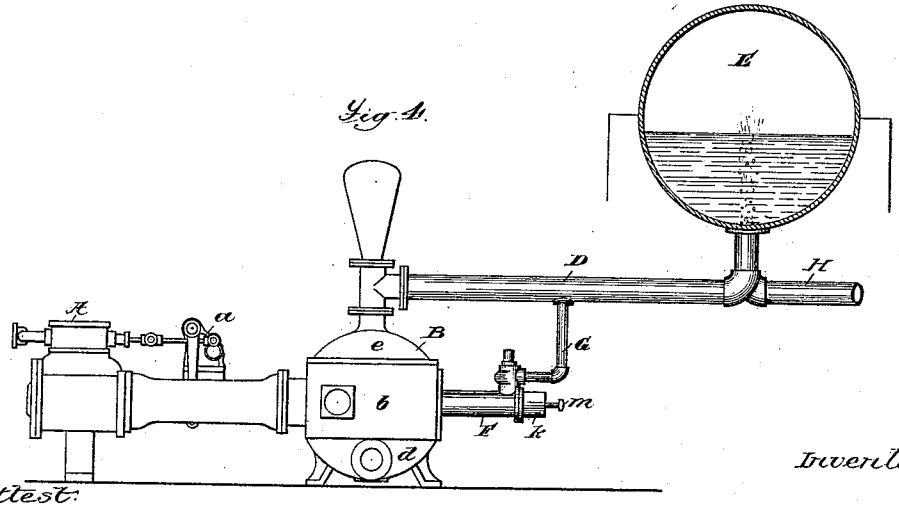


Fig. 4.



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UNITED STATES PATENT OFFICE.

CHARLES C. WORTHINGTON, OF IRVINGTON, NEW YORK.

COMBINED WATER-PUMP AND AIR-COMPRESSOR.

SPECIFICATION forming part of Letters Patent No. 330,540, dated November 17, 1885.

Application filed July 25, 1885. Serial No. 172,649. (No model.)

To all whom it may concern:

Be it known that I, CHARLES C. WORTHINGTON, a citizen of the United States, residing at Irvington, county of Westchester, and State of New York, have invented certain new and useful Improvements in Combined Water-Pump and Air-Compressor, fully described and represented in the following specification and the accompanying drawings, forming a part of the same.

This invention relates to a combined water-pump and air-compressor, which is especially designed for use in connection with hydraulic elevators and other similar apparatus. In operating this class of apparatus it is common to have the water supplied either from a considerable height, so that its fall is sufficient to produce the necessary pressure, or from a tank or reservoir in which it is maintained under the constant pressure of a volume of compressed air. In this latter case the air, which is confined in the tank or reservoir above the water, is constantly absorbed and carried off by the water, so that in order to maintain the proper pressure upon the water it is necessary to have the supply of air in the tank constantly replenished. This has heretofore been accomplished in a variety of ways. In some cases a special air-compressing pump has been provided for the purpose. In other cases the necessary air has been supplied by means of an air-compressing pump, which was operated from a cross-head upon the piston-rod of the water-pump, in the same manner as the air-pump of an ordinary condenser. In still other cases the pump by which the water was supplied to the tank has been arranged to force water into the tank upon one stroke and air upon the next, or to receive water for a part of its stroke and air for the remainder, so as to force a volume of mixed air and water into the tank. All of these arrangements have, however, proved more or less objectionable in practice, the first because of the additional machinery and, consequently, extra expense involved, the second because of the extra labor thrown upon the pump just at the end of its stroke, and the third because it caused the pump to operate in an irregular and spasmodic manner.

It is the object of the present invention to overcome these objectionable features, and to provide a combined water-pump and air-compressor by which the water can be supplied to the tank, and at the same time a sufficient amount of air introduced to maintain the proper pressure upon the water without putting extra labor upon the pump at the end of the stroke or giving to it a spasmodic or irregular action.

As a full understanding of the invention can be best imparted by a detailed description of the apparatus in which it is embodied, such description will now be given, reference being had to the accompanying drawings, in which—

Figure 1 is a side elevation of a duplex pump, showing the invention applied thereto, the tank into which the water and air are forced being shown in section. Fig. 2 is a partial plan view of the same. Fig. 3 is an enlarged sectional elevation of one of the water-cylinders and the air-compressor; and Fig. 4 is a view similar to Fig. 1, showing a slight modification, which will be hereinafter referred to.

Referring to said drawings, it is to be understood that the water-pump therein illustrated is of the ordinary direct-acting duplex type, A being the steam end of the pump, which consists of two steam-cylinders having the usual valve-gear, *a*, by which the valve of each cylinder is operated by the piston-rod of the other after the manner of this class of pumps, and B the water end of the pump, which consists of two water-cylinders, *b b*, provided with the usual double-acting pistons or plungers, C, the rods *c* of which are connected directly to the pistons of the steam-cylinders. The water end B of the pump is provided with the usual suction-chamber, *d*, which communicates with the water-cylinders *b*, and with the usual force-chamber, *e*, into which the water is forced from the cylinders *b*, and from which it is discharged through the discharge-pipe D into a tank or reservoir, E, against the pressure of a volume of compressed air confined in the upper part of the tank.

The parts thus far mentioned are of the ordinary and well-known construction, and will consequently be understood by any one familiar with this class of pumps without a more detailed description.

The outer end of one of the water-cylinders *b* is provided with an extension, F, forming a

small cylinder, the outer end of which is closed, while the inner end opens into the cylinder *b*. The cylinder F is provided with an ordinary piston, *f*, the rod *g* of which is secured to the piston or plunger C of the pump, as shown in Fig. 3. The cylinder F is provided at its outer end with valve-openings *l n*, which are controlled by ordinary suction and force valves, *h i*, which open inwardly and outwardly, respectively, and are provided with springs or other suitable means by which they are normally held to their seats, the opening *l*, which is controlled by the valve *h*, being arranged to communicate with the open air, while the opening *n*, controlled by the valve *i*, communicates with a pipe, G, which leads to the upper portion of the tank E.

The operation of the combined water-pump and air-compressor thus constructed is as follows: The pump being set in motion, the water will be drawn from the suction-chamber *d* into the water-cylinders *b*, from which it will be forced into the force-chamber *e*, and discharged through the pipe D into the tank E, against the pressure of the volume of air confined in the upper portion of the tank, in the usual manner. The water thus forced into the tank will then be drawn off through the pipe H and conducted to the place of use under the pressure due to the volume of air compressed in the upper part of the tank. As before stated, the air contained in the upper part of the tank E is gradually absorbed and carried off by the water as the latter is drawn from the tank, so that if no means were provided to maintain the supply of air in the tank it would be gradually diminished and its pressure thus destroyed, so that the water would issue from the tank under less than the proper degree of pressure. This result is avoided by the operation of the cylinder and piston F *f*. As the plunger C makes its stroke toward the steam end of the pump, a quantity of air is drawn into the cylinder F by its piston *f*, and upon the return-stroke of the plunger C the air thus drawn into the cylinder F is compressed by the piston *f*, and forced past the valve *i*, and through the pipe G into the upper portion of the tank E, thus constantly supplying air to the tank to compensate for the air absorbed and carried out by the water, and maintaining the water under the proper degree of pressure.

It will be observed that by this arrangement no extra labor is thrown upon the pump at the end of its strokes in either direction, the resistance at the end of the strokes in each direction being just equal to the pressure of the water against the full area of the plungers C, and no more. By this arrangement, also, no air is allowed to enter the water-cylinders, and consequently smooth and quiet action of the pump is secured. By this arrangement, also, no trouble is experienced from the heating or lack of proper lubrication of the air-compressing cylinder F, as the water from the cylinder *b* follows the piston *f*, so as to enter the air-cylinder and keep it properly cooled and lubricated.

In order that all the air drawn into the cylinder F may be compressed and forced out into the tank E, it is often desirable that a quantity of water should be admitted in this cylinder in front of the piston *f* to fill the clearance between the piston and the head of the cylinder. For this purpose a small trough or receptacle, *k*, may be provided at the end of the cylinder, into which a small quantity of water can be poured, so that as the valve *h* is opened to admit air to the cylinder upon the suction-stroke of the piston *f* a small quantity of water will be allowed to flow past the valve into the cylinder.

If at any time it should be desired to stop the forcing of air into the tank E, it can readily be accomplished by simply fastening the valve *h* in its opened position. This can readily be done by means of a screw, as *m*, arranged to be turned inward, so as to abut against the end of the valve-rod and move and hold the valve away from its seat; or, if preferred, the same result can be accomplished by locating the valve *h* in a pipe, through which the air is allowed to enter the cylinder, said pipe being provided with a cock by which the supply of air can be shut off, if desired.

As shown in Figs. 1, 2, and 3, the pipe G leads from the cylinder F directly to the top of the tank. This arrangement, however, is not necessary. If preferred, the pipe G may enter the pipe D instead of the tank, as shown in Fig. 4. In this case the air will be mingled with the water before the latter enters the tank, and will simply rise through the water and accumulate in the top of the tank.

Although, as herein shown, only one of the water-cylinders *b* is provided with an air-compressing cylinder, it is of course to be understood that both of the water-cylinders may be provided with these air-compressing cylinders if in any case it should be found necessary or desirable to do so.

Although the invention is herein shown as applied to a direct-acting duplex pump it will readily be understood that it is not limited in its application to a pump of that type, but may be applied to a single pump, or to a pump that is not direct acting with equally good results. It will also be seen that the invention is not limited in its application to supplying air and water to the same tank in order to maintain the water under pressure, but may be used in any case where it is desired to pump water and at the same time compress air for any purpose.

While a simple way is shown in the illustration of connecting the piston-rod of the compressor with the plunger C, any other convenient connection may be employed for conveying the reciprocating motion of the pump to the compressor-piston *f*.

What I claim is—

1. A combined water-pump and air-compressor consisting of a water-cylinder and its

piston or plunger and an air-cylinder and its piston or plunger, the two cylinders being so arranged that one end of the latter communicates with one end of the former, substantially as described.

2. The combination, with a water-cylinder and its piston or plunger, of an air-cylinder arranged at the end of and opening into the water-cylinder and having its piston or plunger connected to the piston or plunger or piston or plunger rod of the water-cylinder, substantially as described.

3. The combination, with a duplex pump, as A B, of an air-cylinder, as F, arranged at the end of and opening into one of the water-cylinders, and having its piston or plunger connected to one of the pistons or plungers or piston or plunger rods of the water-cylinders, substantially as described.

4. A combined water-pump and air-compressor consisting of water-cylinder having a moving piston or plunger, and an air-cylinder and its piston or plunger, the two being so arranged that the water-pressure in the pump is communicated to one side of the piston or plunger of the air-cylinder, substantially as described.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

CHARLES C. WORTHINGTON.

Witnesses:

W. A. P. BICKNELL,

T. H. PALMER.