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& A. G. STRAWBRIDGE.

Air-Compressor and Water-Lifter.

No. 226,918. Patented April 27, 1880

FIG. 1.

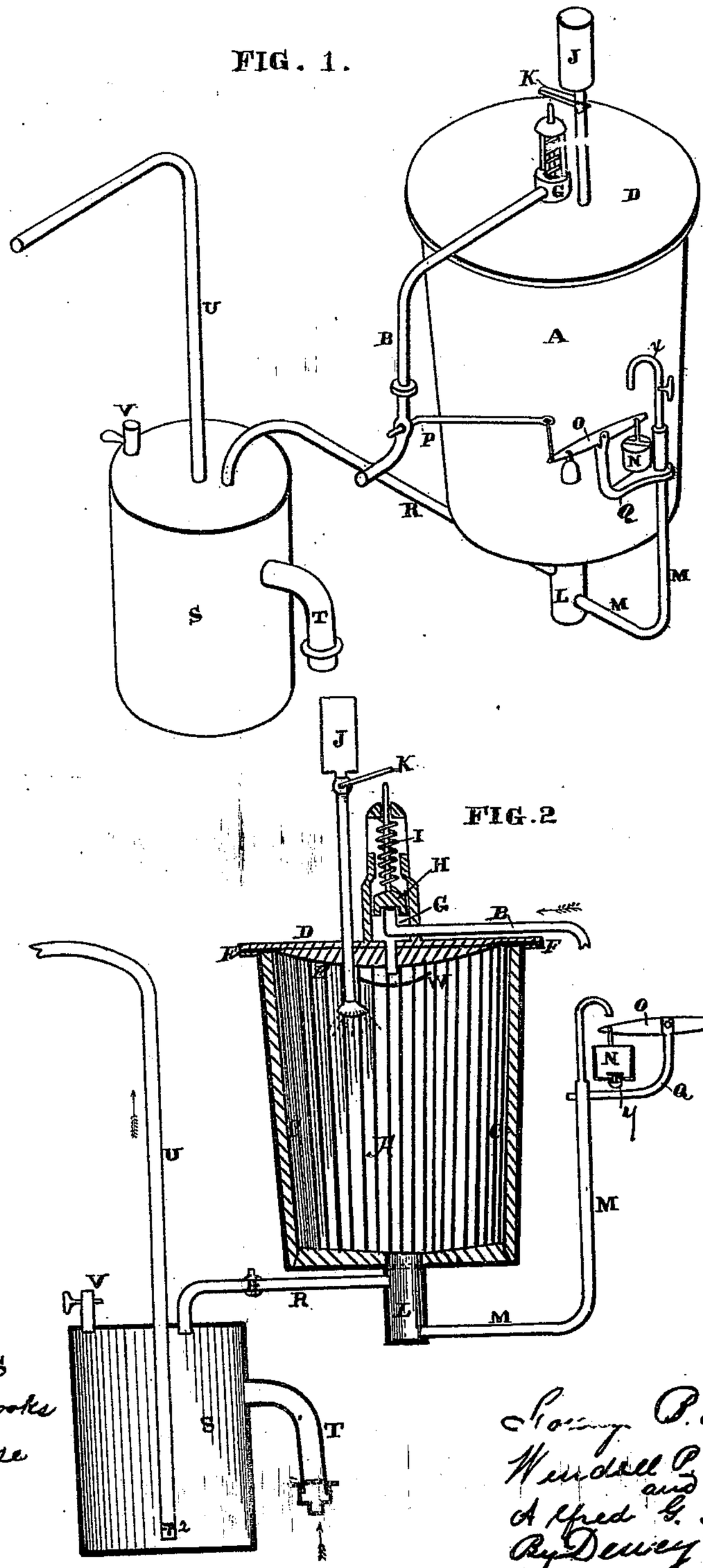

FIG. 3.

FIG. 2

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LORENZO B. LAWRENCE AND WENDELL P. HAMMON, OF OAKLAND, CAL.,
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AIR-COMPRESSOR AND WATER-LIFTER.

SPECIFICATION forming part of Letters Patent No. 226,918, dated April 27, 1880.

Application filed June 25, 1879.

To all whom it may concern:

Be it known that we, LORENZO B. LAWRENCE and WENDELL P. HAMMON, of Oakland, county of Alameda, and State of California, and ALFRED G. STRAWBRIDGE, of Sharon, Pennsylvania, have invented an Improved Air-Compressor and Water-Lifter; and we hereby declare the following to be a full, clear, and exact description thereof.

Our invention relates to certain improvements in apparatus for raising water, in which we employ the heat and pressure of a body of steam to act upon a body of air within a tank or reservoir without the intervention of a piston or other mechanism, so that said air is compressed and expanded at the same time, and serves as a medium by which to transmit the pressure to a distant tank from which water is to be raised to any desired point. This is accomplished automatically by the aid of certain mechanism, consisting, first, of an automatically-acting supply and exhaust valve and a condensing-jet actuated by a valve.

Our invention further consists in an automatic steam-valve-operating device, whereby the water of condensation may be withdrawn from the air-tank and employed to move the valve, and at the same time it may be used in its partially heated condition to feed the boiler.

Referring to the accompanying drawings for a more complete explanation of our invention, Figure 1 is an exterior view of our apparatus. Fig. 2 is a vertical section of two tanks with their connecting-pipes. Fig. 3 is a view of the valve.

A is the compression or air tank, and B is a steam-pipe, which may be connected to a boiler, but which may also be fitted with a loose coupling, so that when the device is employed at the side of a railway, for the purpose of filling the water-tank of locomotives, the steam to operate it may be taken directly from the locomotive-boiler.

The tank A is lined with wood, and it is made in the ordinary way, slightly tapering, so that the wooden staves may be fitted in and the last one driven home, so as to make a tight fit.

In case it is desired to increase the capacity of the tank, a second one, of the same tapering shape, may be inverted upon the first one, and when the flanges of the two are united the ends of the wooden lining-staves will just meet and form a complete lining.

The top D of the tank is preferably flat; and in order to relieve it from the internal pressure and strengthen it, a wooden disk, E, is fitted to its interior, the face toward the tank being curved or hemispherical. Flanges F project over the edge of the tank, and when the top D is bolted on they serve as a packing-joint to render it steam-tight.

The bottom of the tank has also a wooden lining, and the use of wood in this peculiar connection is of great value, since when heated the wood holds its heat for a long time, and when the jet of water is thrown in to condense the steam it only momentarily cools the surface of the wood, or just long enough to condense the steam and fill the tank with air, after which it becomes hot again, so that when the steam is again admitted it will not be unduly condensed by contact with cold surfaces. This enables us to use a comparatively small quantity of water to condense the steam without unduly heating the water or cooling the tank.

It will be seen that an entire wooden tank might be used whenever the pressure is not too great for safety; but under great pressure a wood-lined iron tank is better. In some cases a very thin metallic lining may be placed inside the wood to facilitate the flowing off of the water; but it should be so thin that it will not affect the action of the wood lining.

A valve-chamber, G, receives the end of the steam-pipe B, which is turned upward within this chamber, as shown. The valve H is fitted to set over the end of the steam-pipe, and the valve has a face upon its upper side, which fits a corresponding seat within the valve-chamber, as shown. A spring, I, the tension of which may be adjusted to any desired pressure, serves to keep this valve away from the upper seat, holding it down upon the end of the steam-pipe when the pressure in the tank is off, and thus allowing air to enter freely from the outside. The spring also serves

to throw the valve down before the whole interior pressure is off, and it thus serves as an exhaust-valve.

The steam within the tank may be allowed to condense itself when speed is not particularly desired; but we prefer to employ a rose-injector, which is connected with a tank, J, and by means of a lever, K, a valve within this tank allows the water to escape. This lever K is of such a size or it is so weighted that in the absence of any other agency it will be depressed and keep open the valve to which it is attached, and it is situated just above the stem of the valve H, and when valve H is closed against the atmosphere, by rising, the lever K will close the water-valve; but when the valve H drops open the air-inlet allows the lever K to fall, and opens the water-valve, so that the sprinkler will discharge its contents and immediately condense the steam within the tank.

Beneath the tank A is a small receiver, L, into which the water of condensation flows, and a pipe, M, leads from the bottom of this receiver up to a point beside the tank and near the steam-admission pipe B. A small bucket, N, is suspended at one end of a lever, O, while a weight at the opposite end of the lever overbalances it, so that when empty the lever will not tilt and the bucket will hang close beneath the curved end *x* of the pipe M. One end of this lever O is connected with the valve P in the steam-pipe, so that the valve will be open in its normal position. The steam entering the tank through pipe B will exert a pressure upon the water in the receiver or well L at the bottom, and, forcing it up through the pipe M, will fill the bucket until it overbalances the weight and sinks, thus closing the steam-valve P. When the bucket rests upon the arm or support Q, a valve, *y*, in its bottom will be opened and the water will run out, so that the bucket can again rise and open the steam-valve.

A pipe, R, passes from the upper part of receiver L, at the bottom of the tank A, and enters the top of the tank S, which is situated at any point where it can receive a supply of water. If intended to be placed in a well or cistern, an ingress-pipe, T, having a suitable check-valve, will supply it with water. The discharge-pipe U extends from the bottom of tank S to the point where it is desired to discharge the water.

In some cases another pipe, similar to R, may extend from the tank A to tank S, and while the air passes through R in one direction it will be allowed to return through the other pipe when the condensation occurs in the tank A.

The operation of our apparatus will then be as follows: Steam being admitted by opening the throttle of the steam-pipe, it will force the valve H to its upper seat, thus closing communication with the atmosphere. The pressure of the steam is communicated to the air contained in the tank A, and it also heats it, so that its bulk is not diminished by the compression it undergoes in elevating the water; but it may even be increased by the rarefaction caused by the heat.

The steam is distributed as it enters the tank and thrown out horizontally by means of a spreader, W. This plate prevents the steam from being thrown to the bottom and mixed with the air, and by holding the steam in the upper part of the tank our experience shows that the steam mixes but very little with the air in the tank, but acts upon it as upon a piston, and through it transmits its power without actually leaving the tank A to any appreciable extent.

The pressure exerted upon the air by the steam is transmitted to the water in the tank S through the pipe R, which may be of any desired length, and the water is forced up pipe U. When the column of water has been forced to the desired point, and the air forced out of the tank A into the tank S, the steam-ingress valve or throttle will be closed by the action of the water of condensation, which, being forced up the pipe M from the receiver L by the pressure in chamber or tank A, will fill the bucket N, and the weight of this, acting upon the lever O, tilts it so as to close the valve P, as has been previously described.

Steam being thus cut off from the tank, the pressure decreases until the spring I can overcome the internal pressure, when it forces the valve H down to its lower seat, at the same time closing the end of the steam-pipe. The opening of this valve allows the lever K to drop, and the water from the tank J enters through a sprinkler, and, condensing the steam, allows a new supply of air to enter the tank, after which the operation is repeated by means of the weighted lever O again opening valve P, the water in bucket N escaping through *y*, and continues as long as steam is turned on from the boiler. A check-valve, Q, in pipe U sustains the back-pressure of the column being lifted while tank S is filling.

To recapitulate, the operation is as follows: The tank J being filled with cold water, the weighted lever K keeps the valve *k* nominally open, and the weight or lever O keeping valve P in steam-pipe B nominally open, steam is admitted from the generator to pipe B, which, escaping under valve H, instantly forces it to its upper seat, and the stem of valve H, striking lever K, shuts off the cold water from flowing into tank A. At the same moment the steam entering tank A exerts a pressure on the air contained therein, which is transmitted through pipe R into chamber S, and thence on the body of water contained therein, which is forced up pipe U for delivery. The same pressure of steam which is transmitted to chamber S acts upon a small body of water which remains in the pocket L in the bottom of tank A, forcing the water up pipe M and out of its open end into a bucket, N, on the

end of lever O until bucket N overbalances the weight on the lever, and thereby moves it and closes valve P in the steam-pipe B, shutting off the steam. Condensation then takes place in tank A until the spring I overcomes the steam-pressure and throws valve H to its lower seat, allowing steam to escape. This also moves the valve-stem downward, so that it ceases to support lever K, which, falling, opens valve *k*, and cold water from tank J is sprayed into tank A, completing the escape and condensation of the steam hurriedly. While the condensation is going on in tank A the bucket N is emptying itself of water through the medium of a valve, *y*, in its bottom, the stem of which strikes the support Q, when the bucket descends and opens the valve. As soon as the water in bucket N escapes the weight on lever O overbalances it, and it is raised, and the descent of the weighted end of lever O again opens valve P, steam passes into chamber A, and the operation is repeated.

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

1. In a water-elevator, the valve-chamber G, having the valve H, provided with the spring I, with its seat, as shown, in combination with the steam-pipe B, entering the valve-chamber, with its end beneath the valve, so that the valve rests upon it when the tank is open to the atmosphere, and is closed to the atmosphere by the direct pressure when it is admitted to the tank, substantially as herein described.

2. In a water-elevator, the tank A, with its steam-pipe B, valve-chamber G, valve H, with its stem, and spring I, in combination with tank J, a connecting-pipe, and weighted lever K, operating a valve, whereby the said valve is opened and water automatically admitted to tank A, substantially as and for the purpose described.

3. In a water-elevator, the tank A, with its steam-pipe B, chamber G, valve H, provided with stem and spring I, tank J, weighted lever K, provided with a valve, *k*, and connecting-pipe provided with a rose inside of tank A, in combination with a receiver or pocket, L, to collect the condensed and admitted water, substantially as herein set forth.

4. In a water-elevator, the tank A, provided with the receiver L, and a rose-jet pipe-valve, H, and chamber G, in combination with the pipe M, oscillating weighted lever O, self-emptying bucket N, pipe B, and the steam-valve P, provided with a lever connecting it with said lever O, as described.

In witness whereof we have hereunto set our hands.

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