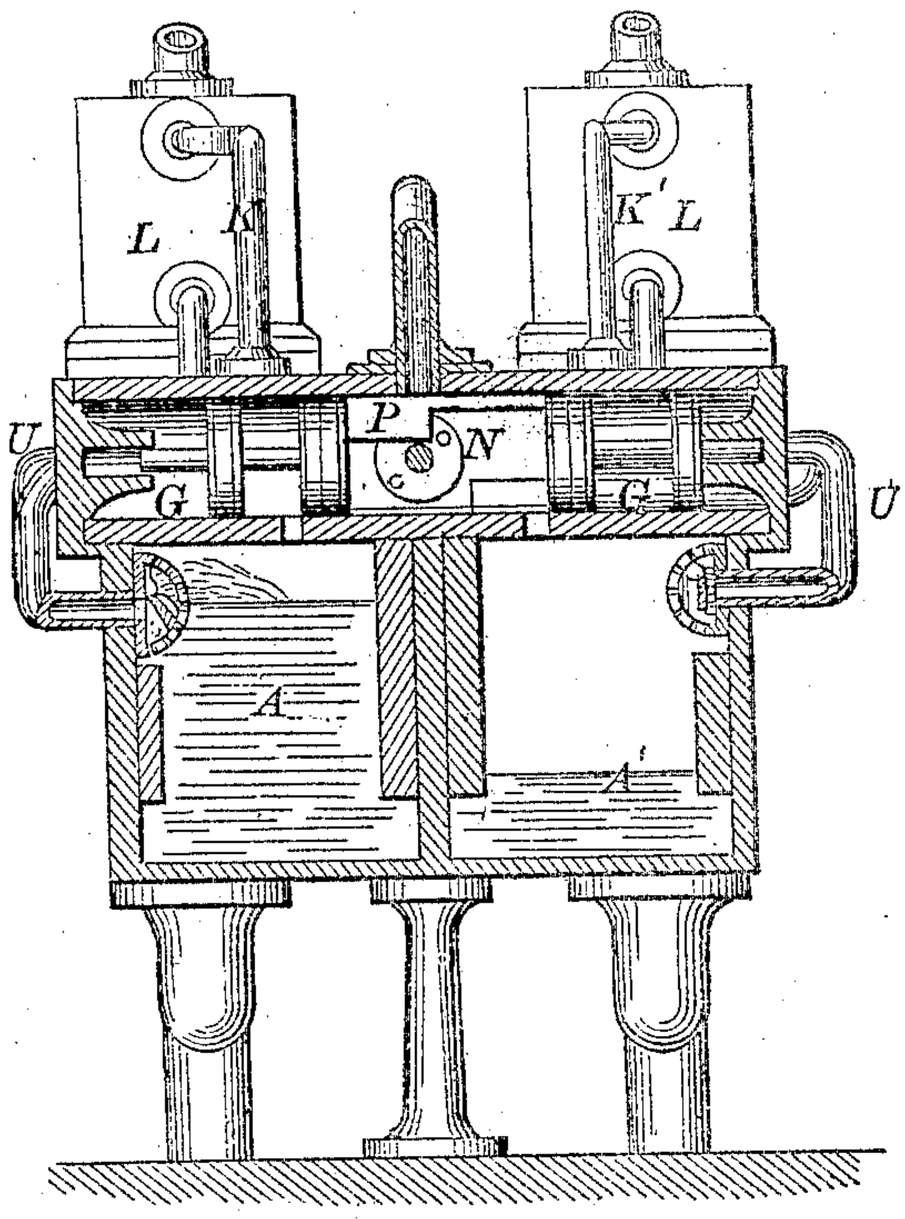
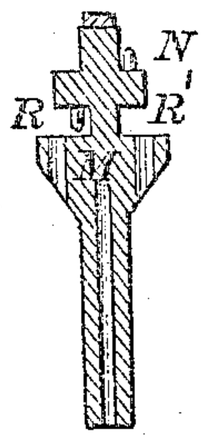
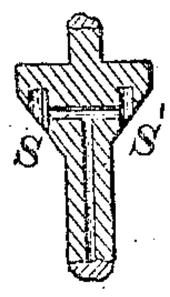
G. I. WASHBURN.

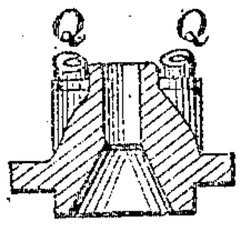
FEED WATER APPARATUS.

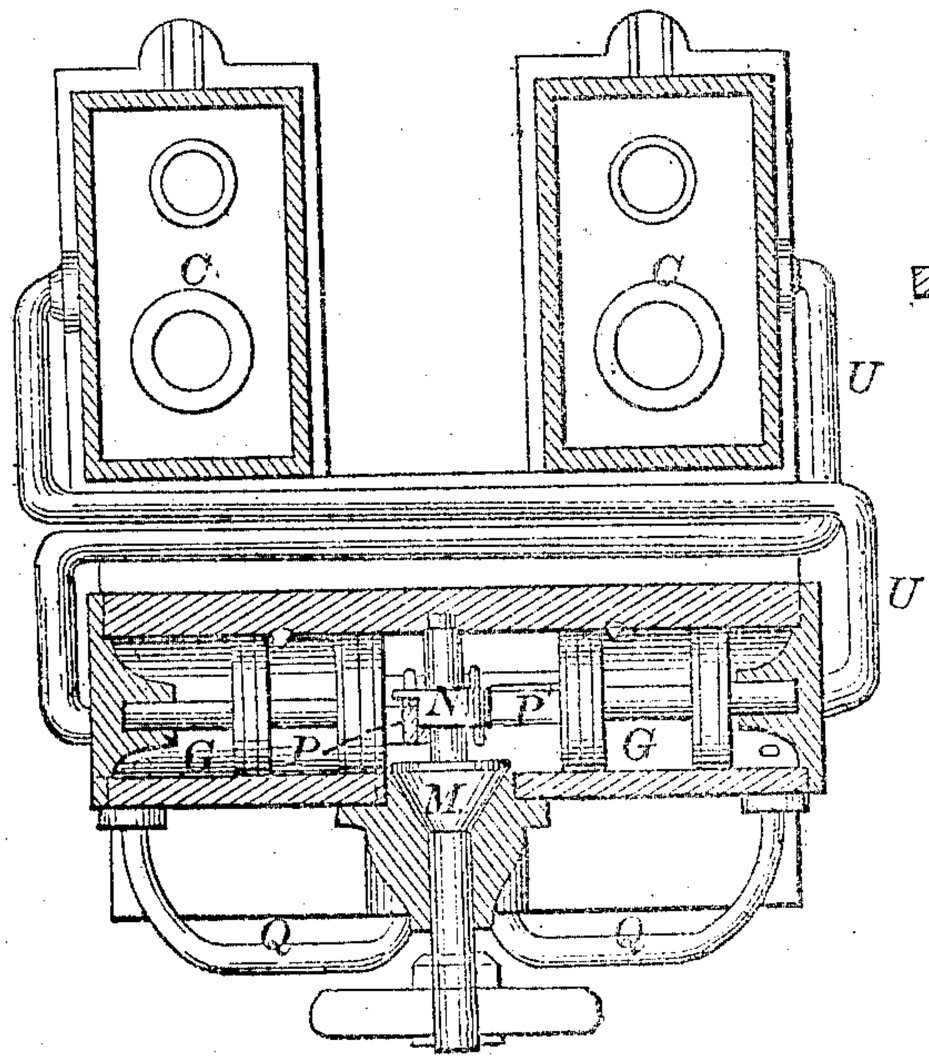
No. 49,941. PATENTED SEPT. 12, 1865.











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UNITED STATES PATENT OFFICE.

GEO. I. WASHBURN, OF WORCESTER, MASSACHUSETTS.

IMPROVEMENT IN FEED-WATER APPARATUS.

Specification forming part of Letters Patent No. **49,941**, dated September 12, 1865.

To all whom it may concern:

Be it known that I, GEORGE I. WASHBURN, of the city and county of Worcester, and State of Massachusetts, have invented a new and useful Improvement in Condensers and Feed-Water Pumps; and I hereby declare the following to be a full and exact description of the same, reference being had to the accompanying drawings, making part of this specification, in which—

Figure 1 is a side elevation of the apparatus, showing the boiler in section. Fig. 2 is a plan or top view. Fig. 3 is a vertical section on the line *x x*, Fig. 2. Fig. 4 is a vertical section on the line *x x*, Fig. 1, showing the valve in elevation. Fig. 5 is a horizontal section on the line *y y*, Fig. 1, showing the valves in plan. Fig. 6 is a face view of the conical valve. Fig. 7 is a longitudinal section of the conical valve on the line *x x* in Fig. 6. Fig. 8 is a longitudinal section of the conical valve on the line *y y*, Fig. 6. Fig. 9 is a face view of the conical valve-seat. Fig. 10 is a section of the valve-seat.

Similar letters of reference indicate corresponding parts in the several figures.

The invention consists of a steam-pump and condenser, and is shown as a feed-water apparatus located above the boiler water-level, and acting by the condensation of steam in the chamber which has been partially emptied of water to raise water through the supply-pipe, and then, by closing the said supply-orifice and opening the passages leading to the boiler, to supply the latter with feed-water by means of its greater elevation above the water in the boiler.

To enable others skilled in the art to which my invention relates to understand and use the same, I will proceed to describe its construction and operation.

It will be perceived by examination of the drawings that the devices are duplicated nearly all through, and that the sides act alternately to produce an approximately continuous effect, as in my former patent of January 26, 1864, on which this is an improvement.

A A′ are two water-chambers, connecting by passages B B′ with two valve-chambers, C C′. The latter chambers connect by valves D with the water-supply in a well or otherwise, and by valves E and pipes F with the boiler, for the purpose of carrying thereto a supply of feed-water.

The valve-chamber G is traversed by a reciprocating piston-valve, consisting of four disks, H H′ H″ H‴, attached by stems or plates in a manner to be further described hereinafter, so as to cause them to keep their determinate relative distances, the projecting stems at the outer ends working in socketed bearings I I′. The motions of this valve are obtained by means of live steam direct from the boiler, received into the chamber G through the pipe J, in a manner to be explained under that section of this specification treating of the operation. The opening from the pipe J into the chamber is always between the disks H′ and H″, and that portion of the valve-chamber is always full of steam and in direct and unobstructed communication with the boiler. Pipes K K′ start from the valve-chamber from points always between the disks H H′ and disks H″ H″, respectively, and said pipes, after passing through cold-water chambers L in a coil, enter and terminate in the valve-chambers C C′ respectively. The effect of this arrangement of spaces between the disks of the piston-valve and the openings K K and those leading to the condenser-pipe is that each chamber A A′ is in connection with the boiler-steam or its appropriate condenser at all times, and as soon as the communication with one is closed it is opened to the other, and these connections are alternate, unless it is desired to use the steam expansively, in which case there is a small interval between the closing of the induction-passage K and the opening of the communication to the condenser.

M is a rotating valve, having a wheel, N, upon its stem, the wheel being provided with four teeth, O O O O, two on each side. Plates P P′ connect the disks H′ and H″, so as to make the motion of all the disks simultaneous, the four rigidly-connected disks forming one piston-valve.

It will be observed that the plates P P′ have shoulders upon them which project so far into the chamber as to strike against the teeth O, and by each motion of the reciprocating valve to communicate one-fourth of a revolution to the rotating valve, which completes its revolution by two impulses each way, derived from the plates P P′ of the piston-valve. The shoul-

der of each plate P acts upon its respective two teeth O which project on that side of the wheel N. The valve M has four orifices in it which communicate by pipes Q Q′ with the ends of the chamber G beyond and outside of the end disks, H H‴, of the reciprocating valve. The orifices of the ports R R′ in the rotary valve are constantly open to the live steam in the central part of the chamber G, and by the intermittent action of the valve the said steam is admitted alternately to the ends of the valve-chamber G against the outer faces of the disks H H‴ respectively and alternately, while the other end of the said chamber G is at the same time thrown open by the pipe Q, communicating with it to the orifice S in the rotary valve and by the axial opening T with the outer air, allowing its contents to be discharged and removing any impediment arising from the presence of air or steam to the free motion of the piston-valve.

V is a fly-wheel on the end of the rotary-valve stem, and is intended to prolong the motion of the said valve after its sudden impulse, derived from the pressure of the steam on the end disks of the piston-valve and communicated through the shoulders of the plate P or P′ to the pin on the wheel N. This continued motion carries the rotating valve past the space between its ports, and the leaping motion of the piston-valve near the end of its stroke is due to the pointed shape of the steam ports in the rotating valve. The rotating valve, having arrived at the other port, admits the steam to the other end of the chamber G, and the steam causes the return motion of the piston-valve operating on the wheel of the rotating valve by the other plate P or P′, as before described.

The circumstances that tend to carry the rotating valve over the space between its ports are the momentum of the piston-valve and that of the valve itself, aided by the fly-wheel V. A spring may be so arranged as to be compressed by the direct steam-pressure and recoil during that part of the motion of the valve when it is moving between the ports.

U U are pipes which lead from the valve-chamber C or C′ on one side of the apparatus at W to the water-chamber A or A′ on the opposite side to that from which it started. These pipes take cold water from the valve-chambers and inject it in a comminuted stream through a sprinkler, Y, into the upper part of the chamber A or A′ for the purpose of condensing the steam. The openings of said pipes U into the said chamber A or A′ are guarded by valves to prevent reflux of water or steam into the tubes U U.

The valve-guarded opening Y is to let in a small amount of air when desired to transmit it to the boiler. *a a* are non-conducting linings to the chambers A A′.

The arrangement of the pipes U U may be used simultaneously with K K, or as an alternative under change of conditions, rendering one or the other more suitable and efficient.

The operation is as follows: I describe the operation on one side, as the two sides are duplicates and work alternately to produce an approximately-continuous effect, as has been stated. The chamber A being full, or nearly so, of water, steam is admitted from the boiler through the pipe J, which passes between the disks H′ and H″ and through the opening K into the chamber. The water is now between two equal pressures—viz., the pressure of the steam upon the water in chamber A and the pressure through the feed-water pipe F above the check-valve E. The pump being located above the boiler, the water will now commence to pass by way of the pipe F to the boiler with a force proportioned to its height above the boiler and until the water has been lowered to the desired extent, when the piston-valve is by the pressure of the steam moved so as to cover the port K and cut off the chamber from the direct action of the boiler-steam, and open a communication by means of the pipe K with the valve-chamber C, permitting the steam which has displaced the water in A to pass upward into the pipe K, and allowing the water in the chamber C to fall until it stands at an even height with that in chamber A, driving the steam and whatever air may be therein from the latter, which follows the tortuous windings of the pipe K, and the steam becomes condensed, leaving a vacuum more or less perfect in the upper part of chamber C, which is filled by the rising of the check-valve D and the entrance of water from the supply-pipe D′ under atmospheric pressure. The chamber being now again filled with water, the piston-valve is shifted so as again to admit the pressure of boiler-steam through the port K upon the water in the chamber, when it is again emptied of a part of its water, and the operation above described is repeated.

The entrance of the boiler-steam at the end of the valve-chamber G is effected by means of the point or smaller part of the steam-port R or R′, which is in connection with the end of pipe Q or Q′, and causes the piston-valve to begin to move away from the said end of valve-chamber G, and as this motion proceeds the plate P comes in contact with the pin O on wheel N and causes the valve M to rotate so as to bring the larger part of port R over the end of pipe Q or Q′, thus giving more steam to the said end of the valve-chamber G, which accelerates the motion of the valve-piston and acts directly upon it until the port R has passed from over the end of said pipe, when the remaining part of the stroke of each valve is made by their previously-accumulated momentum, the momentum of the rotating valve being the greater from the weight of the fly-wheel V.

In the course of the above-described motion the chamber A or A′, as the case may be, was shut off from the steam and opened to the pipe K and the valve M rotated one-quarter of a complete revolution, which opens that end of the valve-chamber G from which the valve-pis-

ton moved to the exhaust-pipe T through the medium of pipe Q or Q′ and the port S or S′, and now the said motion of piston and rotating valves being complete, the boiler-steam proceeds through the port R or R′ and pipe Q or Q′ to the other end of the valve-chamber G, toward which the piston-valve moved and from which it now commences to be forced by the incoming steam, and this return motion of the piston valve will cause the rotating valve to rotate in the same direction as before for one-quarter of one revolution, when the first-described motion of the valves will ensue, and so on.

The pipes V, which pass from the chambers C and C′ to the water-chambers A′ and A respectively on the opposite sides, are used for throwing a spray of cold water into the latter-mentioned chambers as soon as the port K leading to them is closed, and for the purpose of more quickly condensing the steam the water in this case proceeds from the chamber under pressure into the one where a vacuum is forming.

Any air which finds its way into the chambers, from the well or otherwise, passes either directly or eventually to the upper part of chamber C or C′, and is from thence discharged on the opening of the check-valve E and driven to the boiler.

The bodies of water in the chambers A A′, by the series of operations which have been described, are moved up and down, but are not materially changed. As the feed-water passes out by the pipe F the water falls in the chamber A or A′, and as the steam is shut off and the opening of the pipe K or K′ is uncovered, making the upper connection between the chambers A and C or A′ and C′, the water in the upper chamber sinks to an equilibrium with that in the lower, which rises proportionately. The only water immediately exposed to the steam is that in the upper part of the chambers A A′, while the worm of the condenser-pipes K K′ is purposely exposed in the chambers L to the cold water on its way from the well to the boiler, that the steam may not raise the temperature of the water in the chambers C C′, and thereby affect the vacuum. When the water in the boiler rises above the mouth of the pipe J, which supplies the line or boiler steam, by which the described motions are produced, the boiler will cease to supply the steam from the condensation of which the supply of water is derived, and the apparatus will cease to pump until the water in the boiler falls so far as to supply steam through the pipe J.

Two plans are shown for condensing the steam in the chambers—one by a spray of water from the valve-chamber of the opposite side and the other by a pipe, K, which has a coil in the feed-water chamber L. These may be used together or separately, but the latter will produce the least ebullition and spray and the most perfect vacuum, which is desirable where the water-supply is at a considerable depth.

The apparatus is shown as a boiler-feeder; but it may be adapted to other purposes, such as a steam-pump, or even for a fire-engine.

By the proper proportioning of the widths and relative distances of the disks on the piston-valve and the ports in connection therewith the steam in chamber A and A′ temporarily cut off from the boiler and condenser may be used expansively, but not in connection with the pipes U and the spray-condensers when used as a feed apparatus for steam-boilers.

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

1. The piston-valve reciprocating in the chamber, as described, in combination with the openings K and their alternate induction and eduction connections, substantially as described.

2. The rotary steam-valve, with its steam-ports R R′ and exhaust-ports S S′, communicating alternately by the pipes Q Q′ with the ends of the piston-chamber G.

3. The combination of the shouldered plates P P′ with the wheel N and the pins on the faces of the latter, by means of which devices the reciprocating motion of the piston-valve produces the rotary motion of the valve M.

4. The arrangement of the pipes and passages for connecting the water-chamber A A′ with the water-supply from below and the steam from above without allowing either to pass through the chamber, so as to obtain a rising and falling column of water in said chambers, the upper or surface portion of said body of water always remaining in the chamber exposed to the influence of the incoming steam.

5. The arrangement of the chambers A C and A′ C′, communicating respectively by the pipes K and K′ and the orifices in the chamber G, by which an equilibrium in the height of water in the connected chambers is periodically established by the weight of the column of water driving the steam from the lower chambers and condensing it during its passage by the described means of communication toward the chambers C C′.

6. The arrangement of the pipes V V, which connect the chambers C′ A and C A′ respectively, carrying a body of water from a chamber under pressure and discharging it in spray in a steam-chamber disconnected with the steam-induction, as and for the purposes described.

7. Conducting the condenser-pipe K through a body of water exterior to that in the chambers, so as to avoid impairing the vacuum therein when this is used in combination with the chambers A A′ C C′, substantially as described and represented.

8. The arrangement of the valves and ports by which air which may be in the chambers

is expelled at each stroke and driven toward the boiler, substantially as described.

9. In connection with pumps which draw their water by the vacuum caused by the condensation of steam and expel it by the direct action of steam, the method described of regulating the supply of steam to the apparatus by placing the steam-pipe, with its open end downward, in the steam-boiler at the water-line of the boiler or in a chamber attached to the boiler, substantially as described and represented.

GEO. I. WASHBURN.

Witnesses:
WM. T. HARLOW,
T. L. NELSON.