C. H. HALL.

Improvement in Steam Vacuum-Pumps.

No. 131,517. Patented Sep. 24, 1872.

Fig. 1.

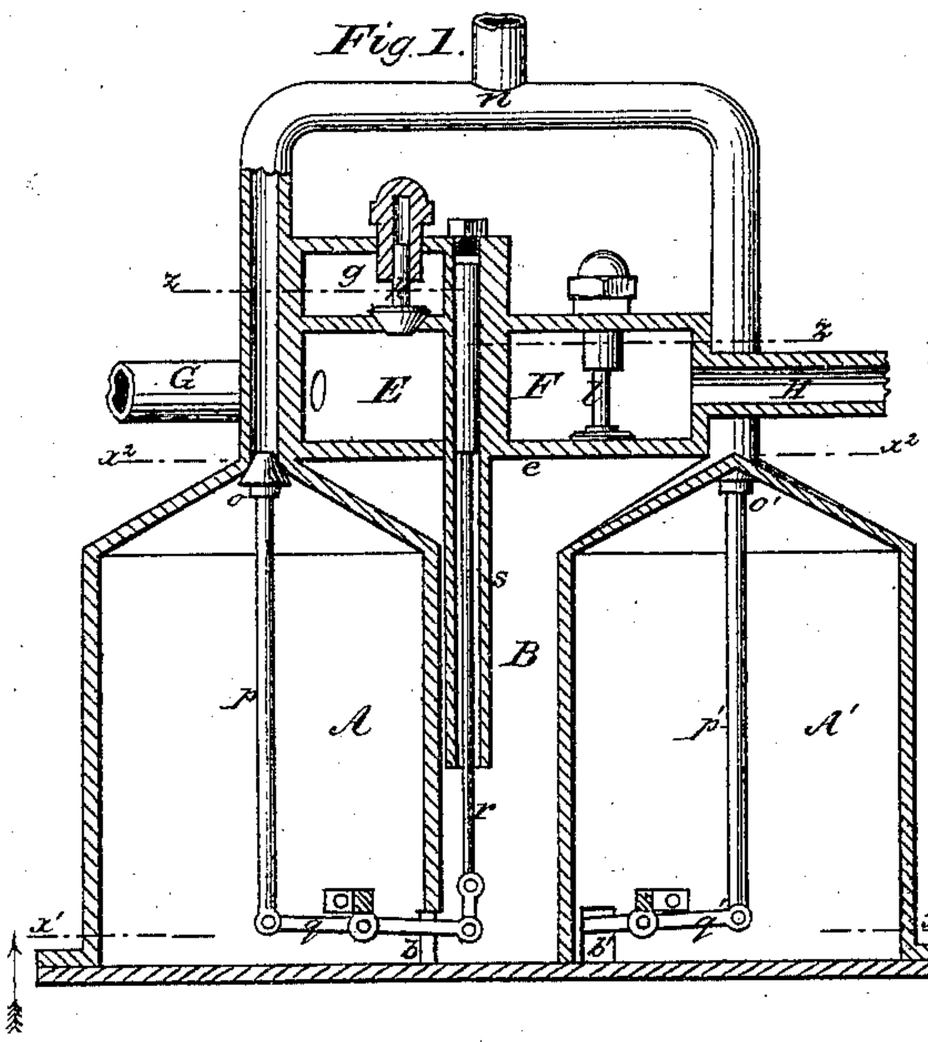

Fig. 2.

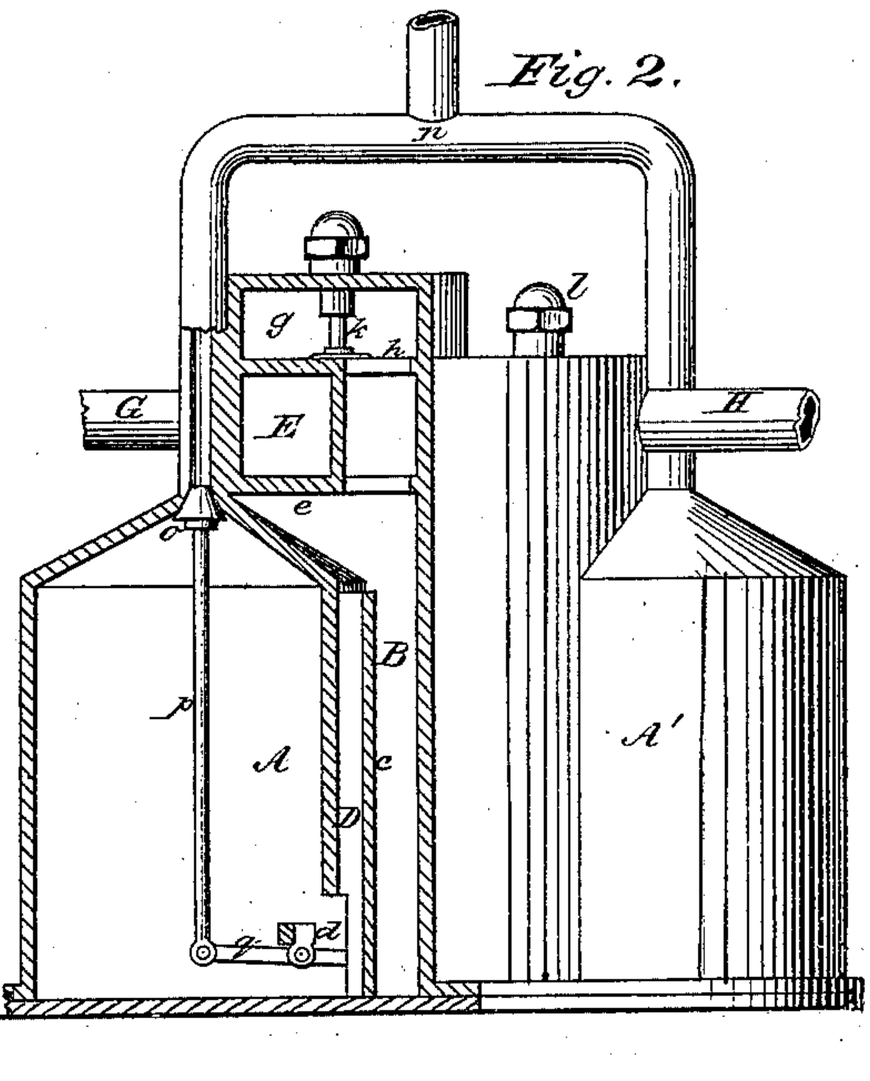

Fig. 3.

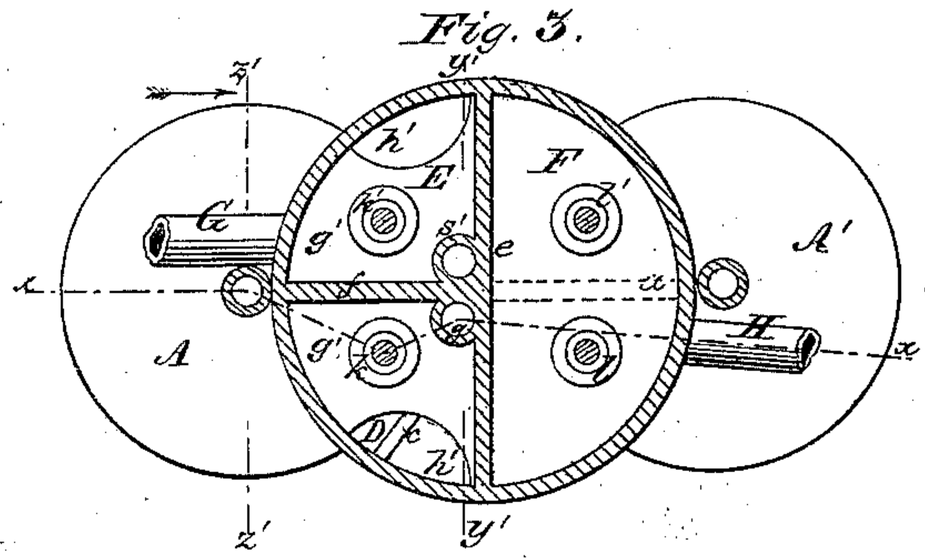

Fig. 4.

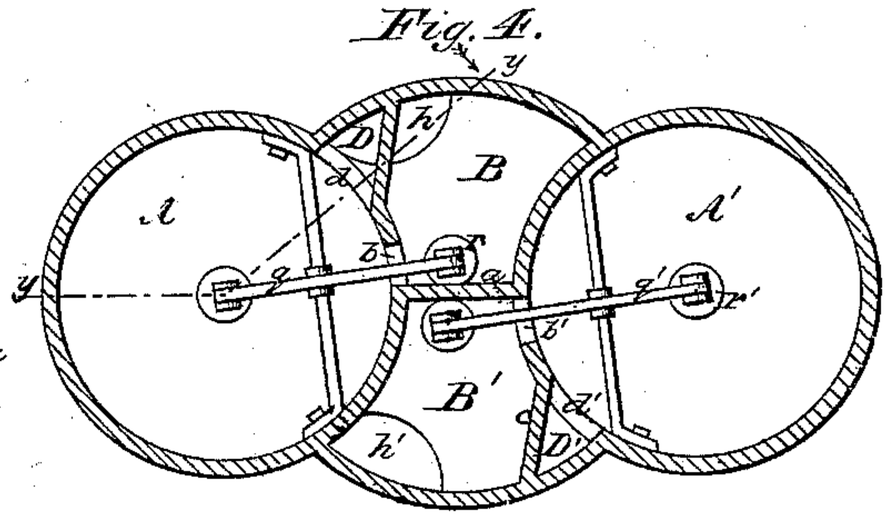

Fig. 6.

Fig. 5.

Fig. 7.

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UNITED STATES PATENT OFFICE.

CHARLES H. HALL, OF NEW YORK, N. Y.

IMPROVEMENT IN STEAM VACUUM-PUMPS.

Specification forming part of Letters Patent No. **131,517**, dated September 24, 1872.

CASE C.

To all whom it may concern:

Be it known that I, CHARLES H. HALL, of the city, county, and State of New York, have invented a new and Improved Vacuum-Pump; and I do hereby declare the following to be a full, clear, and exact description of what I consider the best means of carrying out the same, and which will enable those skilled in the art to make and use the same, reference being had to the accompanying drawing forming part of this specification, in which drawing—

Figure 1 represents a longitudinal vertical section of this invention, the line *y y*, Fig. 3, indicating the planes of section. Fig. 2 is a similar section of the same in the plane *y y*, Fig. 4. Fig. 3 is a horizontal section of the same in the planes *z z*, Fig. 1. Fig. 4 is a similar section of the same in the plane indicated by the line x^1 x^1, Fig. 1, and looking in the direction of the arrow opposite to that line. Fig. 5 is a transverse vertical section in the plane *z' z'*, Fig. 3. Fig. 6 is a similar section in the plane *y' y'*, Fig. 3, but with the valve-controlling pistons omitted. Fig. 7 is a horizontal section of the apparatus in the plane x^2 x^2, Fig. 1.

Similar letters indicate corresponding parts.

This invention relates to an apparatus for pumping water or other liquids by the action of steam, which is made to act on the liquid alternately by pressure and suction. The drawing represents the apparatus as double, and I prefer so to construct it; but it may be constructed and worked successfully singly, with slight modifications of the proportions, as will be understood. I employ in each half of the double apparatus represented a passage for steam in combination with two adjoining chambers—one, A, I term a working-chamber, the other, B, I term a receiving and condensing chamber—in such a manner that when the liquid in the working-chamber A is depressed below a certain level by the pressure of the steam on its surface the steam escapes through the steam-passage and condenses by coming in contact with the cold liquid in the adjoining chamber, and the first chamber is refilled by the suction of the vacuum produced by the condensation of the steam. With these chambers is combined a piston that serves to control the steam-valve of the first chamber. The first or working-chamber is provided with a conical top, which, with the provision I adopt for gently distributing the steam on its entrance, serves to reduce the condensation of the steam in said chamber. The double set of chambers are arranged together, as shown, there being a second set of similar construction to those described, both sets being connected to the same supply and discharge pipes in such a manner that nearly a continuous suction and discharge are produced. The alternate action or pulsation in the two sets of chambers is insured by a connecting-passage between the cylinders containing the valve-controlling pistons.

In the drawing, the letters A A′ designate two working-chambers, in which the pulsations of steam and water or other liquid take place, said chambers filling and discharging alternately, as will be hereinafter explained. They are made by preference in the form of cylinders, with conical tops, cast in one piece, and standing on their flat bottoms. Between the working-chambers A A′ are situated two intermediate chambers, B B′, which are separated from each other by a partition, *a*, (see Fig. 4,) and which communicate with the working-chambers A A′, respectively, through apertures *b b′*. (See Figs. 1, 4, and 5.) The chambers B B′ are provided with vertical partitions *c c′*, which separate the same from the escape-steam channels D D′, (see Figs. 2 and 4,) and these channels communicate at their bottom ends through apertures *d d′* with the working-chambers A A′. They are open at the top, communicating freely with the condensing-chambers B B′. Over the top of the chambers B B′ extends a horizontal partition, *e*, which separates the same from the first or primary receiving-chamber E and from the discharge-chamber F. The first receiving-chamber E receives the supply-pipe G. Above it are the second receiving-chambers, which are divided by a transverse partition, *f*, as shown, forming two receiving valve-chambers, *g g′*, (see Fig. 3,) which communicate through apertures *h h′* with the intermediate chambers B B′. The discharge-chamber F communicates with the discharge-pipe H, and it is provided with two valves, *l l′*, which control the communication, respectively, with each side of the partition *a* below, and thus serve as discharge-valves from the chambers B B′, as indicated in Figs. 3 and

1. Each of the receiving valve-chambers *g g'* is provided with a check-valve, *k k'*, so arranged that the liquid admitted through the supply-pipe G can open said valves and pass through the chambers *g g'* into the chambers B B', but the liquid flowing out of said chambers will close the valves *k k'* so that it cannot return to the supply-pipe. The check-valves *l l'* of the discharge-chamber F are so arranged that they allow the liquid to pass from the chambers B B' to the discharge-pipe, but prevent its return from the discharge-pipe to said chambers. The working-chambers A A' are supplied with steam through a common steam-pipe, *n*, which branches off so as to connect with said working-chambers, as shown in Figs. 1 and 2. The supply of steam to both chambers is governed by valves *o o'*, which close into the mouths of the respective branches of the steam-pipe, and which are supported by rods *p p'* and levers *q q'*, best seen in Figs. 1 and 4. Said levers are situated in the bottom part of the working-chambers A A' and they extend out through the apertures *b b'*, leading into condensing-chambers B B'. The outer ends of the levers *q q'* are pivoted to rods which extend up through cylinders *s s'*, and which carry the pistons *t t'*. The cylinders *s s'* connect near their top ends with each other through a passage, *u*. (See Fig. 6.) The cylinders *s s'* are closed at their top ends by screw-plugs *v v'*.

The operation of my apparatus is as follows: First, I place the apparatus in a suitable position with reference to the liquid to be pumped, taking care to keep the same within the elevation to which said liquid would be raised by the atmospheric pressure. I then connect the suction-pipe G with the tank, well, or reservoir containing the liquid, and provide said pipe with a suitable foot-valve, and the delivery-pipe H I connect with the receptacle into which the liquid is to be pumped. The steam-pipe *n* I connect with a suitable steam-generator, delivering steam at a suitable pressure, and then fill the apparatus with the liquid to be pumped, which may be done by pouring it into the chambers *g g'* through the hollow plugs or screw-caps covering the stems of the valves *k k'*, and after securing the caps again in their places the apparatus is ready to be started. By admitting steam through the pipe *n* one of the valves *o* or *o'* is depressed, and thereby, through the corresponding lever *g* or *g'* and its connections, the corresponding piston *t* or *t'* is raised. Suppose the valve *o* is depressed—then steam is admitted to the chamber A, pressing on the liquid contained in said chamber, and forcing the same out through the valve *l* and chamber F to the delivery-pipe. The steam, on entering the chamber A, is not only spread outward by the tapering valve O, and thus distributed gently, but also comes in contact with a contracted surface of liquid (the top of said chamber being conical) and thereby condensation is reduced to the lowest amount, and as the water-line is pressed downward, the hot liquid which is formed on the first entrance of the steam, spreads out over the increasing and undisturbed surface, and aids greatly to protect the steam from further condensation or diminution of pressure, until such pressure shall have forced the liquid from the chamber A and the level of the liquid has reached the top edge of the aperture *d*, which extends higher up than the aperture *b*, (see Figs. 1 and 2.) As soon as said aperture is uncovered by the liquid the steam instantly escapes from the chamber A, rushing upward through passage D, carrying the water in said passage with it, until it finally condenses in the upper portion of chamber B. As the steam has thus opened a clear passage for escape from the chamber A into the cold water or other liquid contained in the chamber B, condensation takes place and a vacuum is formed, which, by well-known laws, extends instantly back into the chamber A, the piston *t* is depressed by the suction of the vacuum, and the valve *o* is closed. This sudden movement of the piston *t*, in case of a double apparatus, as shown, is felt on the piston *t'* through the influence of the direct communication through the passage *u*, as will be shown further on. At the same time the check-valve *l* also closes and prevents the liquid from returning through the same, while the valve *g* opens and allows a fresh supply of liquid to enter and fill the chamber A through the same passages, by which the same has just been emptied. When said chamber is again filled the vacuum is neutralized, and the suction on piston *t* is consequently removed, the pressure of the steam on the valve *v* opens the same again, and the liquid from chamber A is again ejected, as previously described.

I have now clearly described the operation of my apparatus, when only one side or group of chambers is at work; but in order to comprehend the operation of the entire apparatus it will only be necessary to apply the foregoing description to the other group of chambers, and consider the operation within the same as alternating with that of the first-described group—that is, if liquid is being drawn into the chamber A, it is being forced from the chamber A', and vice versa, and thereby a constant stream is maintained both in suction and discharge.

To insure the alternate action of the two groups of chambers I have opened the passage *u* between the two cylinders *s s'*, Fig. 6. If the chamber is discharging, its steam-valve *o* is depressed, and acting on the lever *q* it raises the piston *t*, and the liquid contained in the upper part of the cylinder *s* is forced through passage *u* against the end of the piston *t'*, so as to depress the same, and, by its action upon the lever *q'*, to keep the steam-valve *o'* in the chamber A' firmly closed.

When the chamber A is empty, and the steam therefrom escapes through aperture *d* and channel D, and then condenses, as above described, the suction produced on the piston *t*

depresses the same, and the piston *t'* being relieved of the pressure on its upper side rises, thereby allowing the opening of the steam-valve *o'*, and thus admitting steam into the chamber A' to repeat the round of operations.

By these means alternate pulsations are produced in the chambers A and A', which continue indefinitely as long as the supply of liquid is kept up, and a pumping apparatus is produced which I propose shall supersede the ordinary steam-pump in a great many cases.

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

1. The combination of piston *t* and valve *o*, with chamber A and steam-pipe *n*, substantially as set forth.

2. The tapering top of chamber A, in combination with the reversely-tapered steam-valve *o*, arranged as shown, relatively thereto, and adapted to spread and diffuse the steam gently therein, as and for the purposes herein set forth.

3. The combination of chambers A B A' B', with supply-pipe G and chambers E *g g'* containing valves *k k'*, and with chamber F containing valves *l l'* and discharge-pipe H, substantially as herein shown and described.

4. The cylinders *s s'* containing pistons *t t'*, and connected by passage *u*, in combination with the steam-valves *o o'* and chambers A A', substantially as herein set forth.

5. The arrangement and combination of chambers A A' B B', passages *d* D *d'* D', valves *o o'*, pistons *t t'*, valves *k k' l l'*, and supply and discharge-pipes G H, all constructed and operated substantially in the manner herein shown and described.

C. H. HALL.

Witnesses:
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E. F. KASTENHUBER.