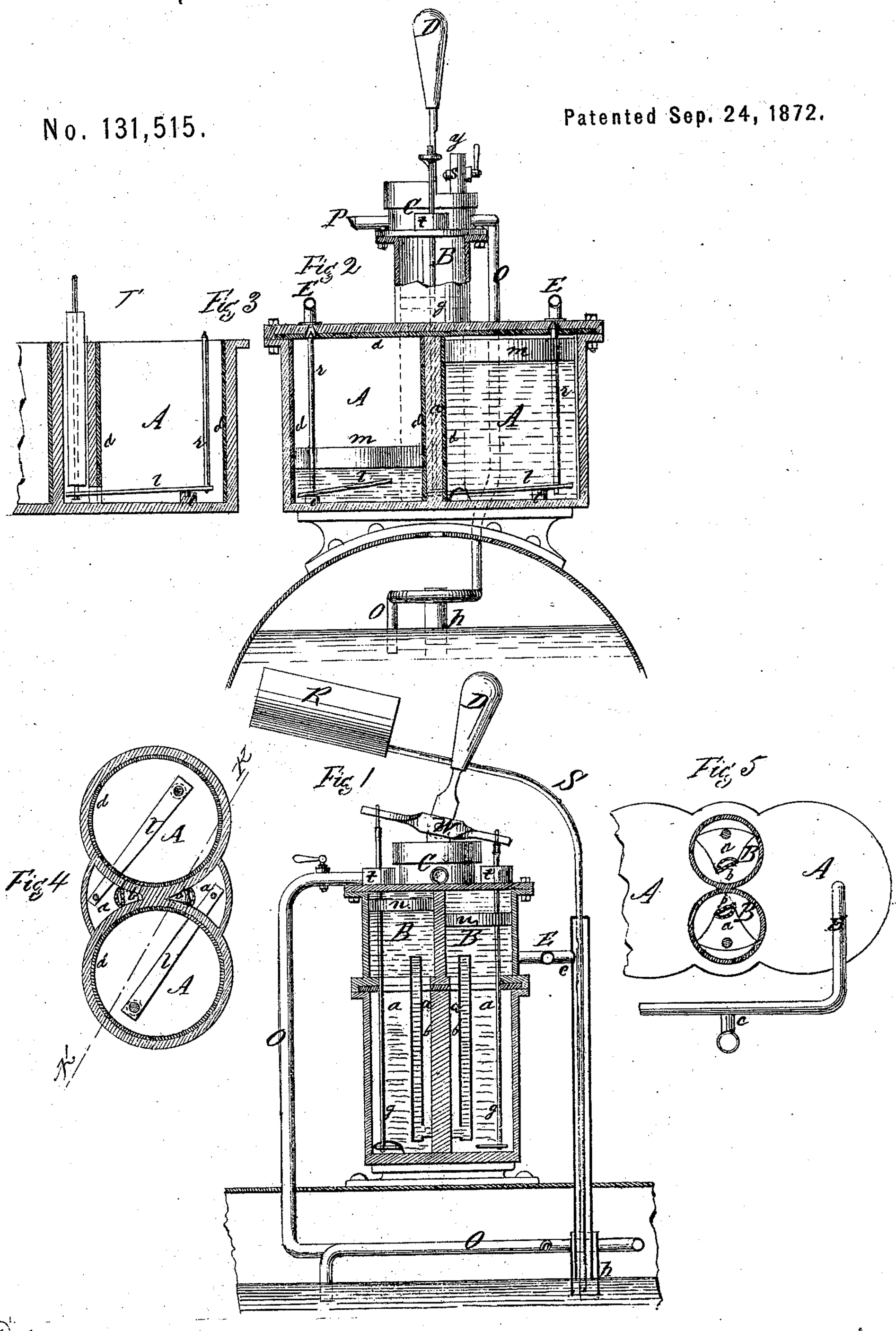
C. H. HALL.

Improvement in Steam Vacuum-Pumps.

No. 131,515. Patented Sep. 24, 1872.



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

IMPROVEMENT IN STEAM VACUUM-PUMPS.

Specification forming part of Letters Patent No. **131,515**, dated September 24, 1872.

CASE A.

To all whom it may concern:

Be it known that I, CHARLES H. HALL, of the city of New York, in the county and State of New York, have invented certain Improvements in Apparatus for Pumping Water, of which the following is a specification:

The invention described in the following specification relates to a new apparatus operated by steam, and designed to raise and force water, oils, acids and other liquids by pulsations, and in all respects to take the place of the steam-pump in mines, manufactories, ships' wells, &c. It may also be employed as a steam fire-engine, or, as is shown in the accompanying drawing, it may be used to supply a steam-boiler with water, in which position it works automatically.

In order to enable others skilled in the art to construct and operate my apparatus, I will proceed to describe the same, reference being had to the accompanying drawing which forms a part of this specification, like letters referring to similar parts, in which—

Figure 2 is a longitudinal vertical section of my apparatus in position upon a section of an ordinary steam-boiler, showing its operation while supplying a boiler with water. Fig. 1 is a vertical transverse section of the same. Fig. 3 is a vertical diagonal section through line K, Fig. 4, of one of the working-chambers and the passage leading to one of the vacuum-chambers above, showing their connection and operation. Fig. 4 is a horizontal section through both of the working-chambers. Fig. 5 is a horizontal section through the vacuum-chambers.

A A are two upright cylindrical chambers with a tight bottom and flanged open top, and which, together with passages *a a*, *x x*, and *b b* I cast or otherwise make in one piece. B B are two other chambers, also cast in one piece, with its lower flange made sufficiently large to cover the top of chambers A A, to which it is strongly bolted or riveted, and in such position above the same as to communicate with them properly through passages *a a*, *b b*, and *x x*, as is shown in Fig. 1. C is another casting, in one piece, with its lower flange bolted firmly to top of chambers B B, and communicating with the same through valve-openings in chamber C. In the upper portion of the last-mentioned castings are formed all the necessary check-valve seats and water-passages to and from the apparatus. *d* is a lining of non-conducting substance covering the inside of chambers, as is shown. For this purpose I employ any good non-conductor of heat, capable also of resisting the action of steam. E E are steam-pipes leading from chambers A A, and joining at *c*, connect with any steam-boiler, the inner terminations of said pipes forming valve-seats within the chamber; but in the case shown they lead downward through the shell of boiler and terminate at the water-line of said boiler in a cup, *h*, which stands within the same. Said cup is perforated at or near the bottom with several small holes, so that the water it contains will constantly remain at the same level as that within the boiler. *r r* are two rods, the upper ends of which are fitted to the valve-seats just before described, steam-tight, and terminate at their lower ends upon the short end of levers *l l*, respectively, and are so arranged as to move freely up and down, so as to operate as a perfect valve, as shown in Fig. 2. Levers *l l* operate upon fulcrums *i i*, and extend across the bottom of chambers A A and into passages *a a*, and in which the ends move freely up and down. *g g* are two other rods, which are attached to the long end of levers *l l* and within passages *a a*, and extending upward through said passages and also through chambers B B, pass through the top of said chambers by means of an opening just sufficient to allow the same to move up and down freely. *m m* are two floats, of cork, but may be any good non-conductor of heat, which I place in chambers A A so as to fit closely, yet work freely within the same. *n n* are two other floats, which I place in chamber B B, fastened to rods *g g*, near the top of said chambers, arranged to work freely within the same. P is a pipe, which leads from the well, tank, hydrant, or other source of supply to the apparatus. O is a water-pipe leading from my apparatus to the steam-boiler, which, after passing through the shell thereof extends longitudinally to and fro any desired number of times, and then ends below the water-line, as shown in Fig. 1. *y* is a pipe leading upward from chamber C to any desired tank or reservoir. Throttle-valves of ordinary construction are placed upon pipes O and *y*, operating as

hereinafter described. *t t* are cups formed upon the top of chambers B B and around rods *g g* at their upper terminations. W represents a beam pivoted at the center upon a pin with holes drilled near its ends through which the ends of rods *g g* work loosely, and so arranged that the ends of said beam in its vibrations will strike the shoulders on said rods alternately. D represents a weighted arm, fastened at right angles to beam W, so constructed that when said beam is in a horizontal position the weight above is perpendicular and counterpoised, but holds the end of the beam with force upon the shoulders of whichever of rods *g g* it may be inclined toward. R represents a strong, hollow, cylindrical chamber, placed upon the end of spring pipe S, so arranged that it will spring upward or downward according to the weight of water it contains. Pipe S leads from near the lower part of cylinder R, and passes through pipe E, and opens into cup *h* at a point lower down than the end of pipe E.

I will now proceed to describe the operation of my apparatus when being employed to supply a boiler with water, as shown, which explanation, with some slight modifications corresponding to different conditions, and obvious to any engineer, will apply to all the uses for which it may be employed. When it is in position upon a boiler, and connected therewith, as shown, steam enters through the open valve at the top of the rod *r* into the top of one of the chambers A, and exerting a pressure equal to the initial pressure within the boiler, it depresses the water in said chamber A with the float *m* lying on its surface, and the water thus being forced downward passes through passage *a* up into its corresponding chamber B above, and from thence, upward past the float *n*, it flows through its corresponding check-valve, not represented, into chamber C, and from thence downward, through pipe O, into the boiler. There being an open passage for the steam to enter, and another for the continuous outflow of water, the operation continues until the said chamber A is nearly emptied of water, and an equal bulk of steam has taken its place. This condition is shown in Fig. 2, where the water-line appears depressed to nearly the bottom of the chamber. Simultaneous with the last-described movement the steam also displaces the water in passage *b*, said water-line always keeping the same level as in the corresponding chamber A, and when it has reached a point a little below the position shown in Fig. 2, the steam instantly rushes from chamber A upward through the corresponding passage *x* into chamber B above, which, being full of cold water, condenses the same and produces a vacuum within. Into this vacuum nearly all the steam in the chamber A immediately rushes and is condensed. The pressure being thereby suddenly reduced and equalized between chambers A and B, the water in chamber B instantly sinks through passage *a*, flowing inward through the aperture *a* into chamber A, and simultaneous with the downflow of the water from chamber B, the float *n* within, attached to rod *g*, receives a strong influx of water above it from the inflow through pipe P, and acting upon the long end of lever *l* raises rod *r* and shuts off the further entrance of steam to the chamber A, the cold water rushing into chamber B through pipe P, and the proper check-valve fills the same, thus taking the place of the water which has gone to fill chamber A and passages *a*, *x*, and *b*, and this portion of the apparatus is again ready for the inflow of steam, as at first described. But the steam cannot enter said chamber A by reason of the weight of counterpoise D, resting upon the top of rod *g*, and acting through lever *l* holds the rod *a* firmly into its seat in the top of the chamber A, and will continue to so hold it until the pulsation takes place at the proper time in the opposite group of chambers A B and connected passages. When such effect occurs in the opposite side of the apparatus, the forces holding down the rod *g* on this side are overcome, and said rod *g* will be lifted up by buoyancy of the float *n* in chamber B, which will rise and lift the lever W, and also acting below, tilt the lever *l* and open the valve on rod *r*, and the steam will then enter and expel the water again, as first above particularly described. While the operation just described is going on in one of the groups of chambers and passages—to wit, the chambers A and B and passages *a*, *x*, and *b* on one side—the same alternately filling and emptying as they are successively brought under the influence of pressure and vacuum, the opposite group of chambers and passages A B, &c., are in an opposite condition, respectively—that is, while the water is being forced from one of the chambers A, and, finally, out through pipe O, it is at the same time being drawn into the other chamber A from the tank or well, through pipe P, and this operation continues indefinitely, a nearly continuous stream of water coming into the apparatus, and a corresponding stream flowing out, the arrangement of check-valves and passages in chamber C being suitable to accomplish this result. The purpose of the beam W and its counterpoise-weight D is merely to hold the steam-valve closed in the chamber A, toward which said weight may be inclined until the opposite chamber shall have become emptied of its contents, as before described, the pressure holding it down will be relieved, when the inclination of the counterpoise-lever will be reversed, and it will open and then hold down the opposite rod *g* until the water-line in the opposite chamber being emptied, shall have reached the discharging-point, and the steam shall have escaped therefrom. The purpose of cups *t t* being to avoid the necessity for stuffing-boxes, they should be kept full of water, the water serving as packing for the rods *g g*, a sufficient quantity being forced up into said cups during the outflow of water to prevent the entrance of air while a vacuum exists within the chamber below.

Floats *m m* are provided and arranged in chambers A A for the purpose of reducing the condensation of steam which would otherwise take place, were the surface of the water exposed to its influence. The sides and top of said chamber I also furnish with the non-conducting coating of rubber or analogous material, for the purpose of preventing the heat from being conducted away by direct contact with the metal of which the chambers are composed. Pipe *y* is provided and is furnished with a valve or cock, *s*, for the purpose of forcing water into any tank, reservoir, or fountain whenever it may be desirable to do so, instead of supplying the boiler as shown; or a hose with suitable nozzle may be attached to said pipe, when the apparatus may be employed as a steam fire-engine.

The operation of cup *h* within the boiler in combination with steam-pipe E is in the manner following: Said cup stands upon the flues of the boiler or in such position as that the desired water-line to be maintained in the boiler shall be between the ends of pipes E and S, which hang into the said cup, the one inside the other. Now, said cup being perforated with several small holes at or near the bottom, it is obvious that the true water-line in the boiler will constantly be shown within the cup regardless of the oscillations or foaming of the water, and the steam-pipe E hanging within, it is plain that, as the boiler becomes filled by the constant influx of water from the apparatus in the manner before described, the water-line will rise in the boiler and cup *h* until the lower end of pipe E is reached. When this point is reached by the water it is manifest that water instead of steam will rise in the pipe E, and the operation of the apparatus will cease until such time as the water-line will leave the end of said pipe exposed, when the water will again resume its flow into the boiler. The stop-cock or pipe O is provided to shut off the flow of the water to the boiler when it is desired to force the same elsewhere through pipe *y*. The object of the device contained in the combination of chamber R and pipe S is to provide a low-water alarm to operate in case the supply of water should fail in coming to the apparatus by reason of clogged valves or pipes leading thereto. Its operation is as follows: while the water-line in the boiler and cup is above the end of tube S the chamber R is full of water, and being arranged upon the arm of a flexible tube, S, it is necessarily depressed; but as soon as the water should reach a point below the end of the small tube before mentioned, the water in chamber R will flow into the boiler through said tube, and steam will take the place of said water in said chamber. This will cause the chamber to rise upward in consequence of the weight of water within being removed, and by applying that movement to springing an alarm, ringing a gong, or opening a whistle, or other obvious device, I provide a means by which all danger from low water may be averted, the operation of the apparatus before described being in itself a perfect high-water detecter, it never being possible for it to rise above the end of pipe E in cup *h*. Thus for all purposes I have an apparatus which takes the place of a steam-pump in raising or forcing water and other liquids. It is simple, compact, cheap, and durable, and superior to any ordinary pump, producing a more perfect vacuum and forcing water further with a given pressure—always ready for operation. It will raise muddy water without danger of wearing out the apparatus.

Some of the advantages due to certain portions of my invention may be separately enumerated as follows: First, by reason of the steam-connection E being contracted in area of cross-section, I am able to produce and maintain a partial vacuum in the chamber A when the steam is discharged up the passage *b*, pending the closing of the valve *r*, and thereby to induce the movement thereof by the other devices. Second, by reason of the piece *n* mounted so as to be strongly moved so soon as the vacuum is commenced to be formed in the chamber A and of the connection thereof to the valve *r*, I am able to close the valve immediately and save the steam which would otherwise be withdrawn through the contracted steam-passage. Third, by reason that the passage *x* which carries up the steam in its discharge from the chamber A is separated from the passage *a*, which communicates above and below, I am able to insure a prompt counter current, the water descending in *a* to make room for the steam above, so as to allow its very rapid discharge to be condensed. Fourth, by reason of the passage or channel *b* taking the steam from the chamber A at a high level, I am more certain that steam alone will be discharged during the violent action it produces, and that steam will continue to be discharged freely during the period of the re-filling with water of the chamber A.

I claim as my invention, and desire to secure by Letters Patent—

1. The steam-connections E having an area sufficient to supply steam for driving up the water, but not sufficient to maintain the pressure when the steam is suddenly discharged from the chamber A, so proportioned that there will be a sudden diminution of pressure when the steam commences to be condensed in the passages *a b*, and a rapid induction of water will be thereby commenced with the effect of instantly thereafter closing the steam passage entirely, as specified.

2. The valve *r* connected to and operated, as shown, by a movable piece, *n*, subject to the influence of the vacuum, so that on this forming of a vacuum or partial vacuum in the chamber A the piece *n* will be instantly moved and the valve *r* closed to forbid the further admission of steam until a change of conditions, as herein specified.

3. The separate or divided passages *a b x*, arranged as shown, so that as the steam is discharged from the chamber A at the moment of the exhaust and ascends through one passage or channel, a counter current of cold water descends through the other passage or channel *a*, as and for the purposes herein specified.

4. The descending passage *b*, arranged as shown, so that the steam discharged at the moment of the exhaust is drawn above the water-line in the chamber A, as and for the purposes herein set forth.

5. The double apparatus described, composed of the two sets of main chambers A A, with two sets of condensing-chambers B B, with the valve-chamber C, common to both, in combination, and operating together with their respective connections, alternately, as specified.

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Witnesses:
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