(No Model.)

2 Sheets—Sheet 1.

A. H. DODD.

STEAM VACUUM PUMP.

No. 452,749. Patented May 19, 1891.

Fig. 1.

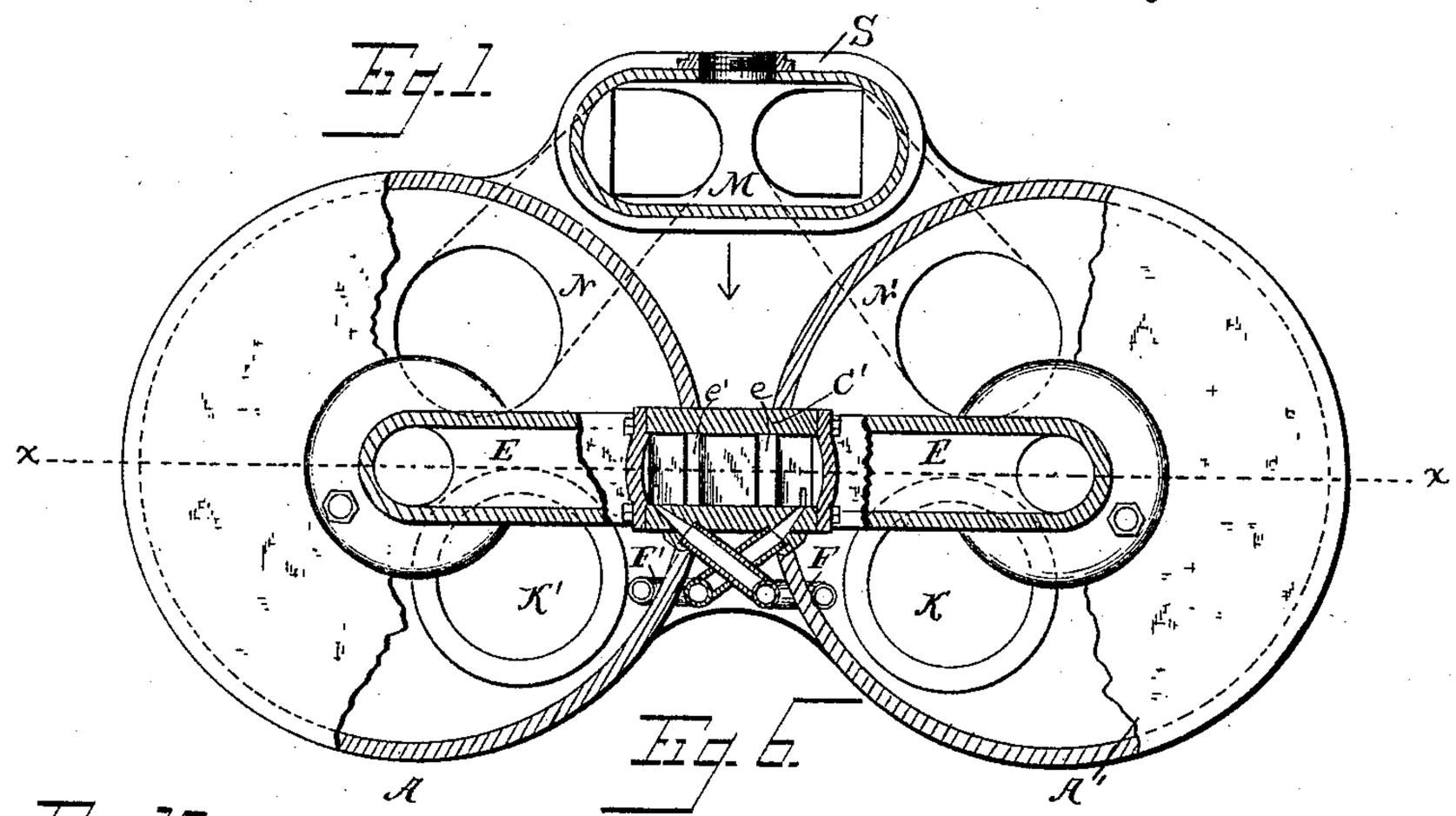


Fig. 10.

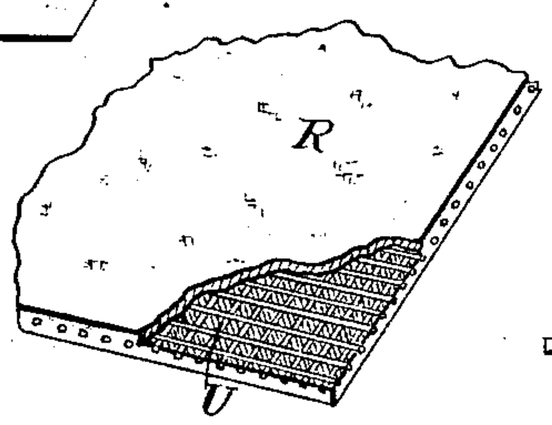


Fig. 6.

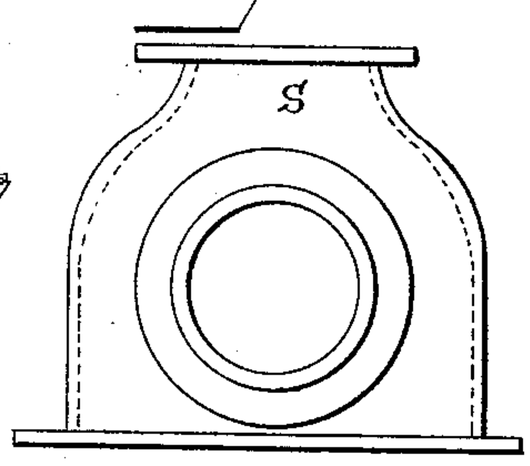


Fig. 7.

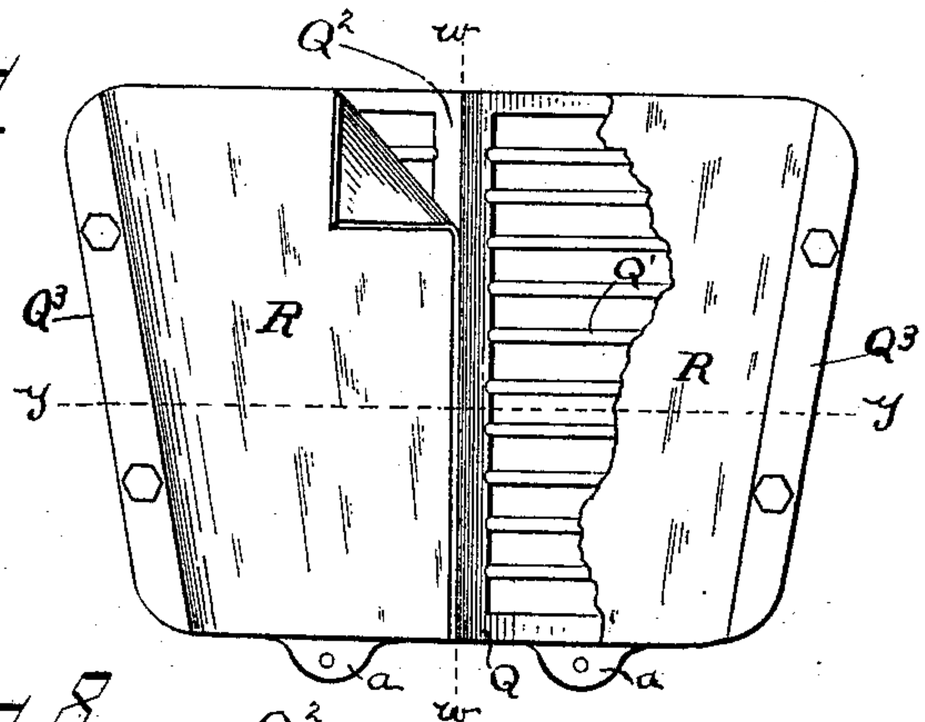


Fig. 8.

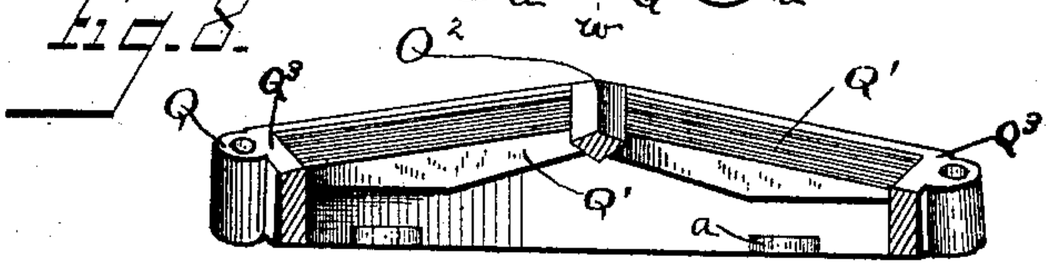
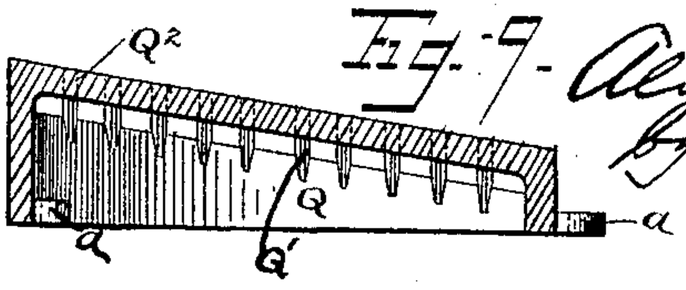


Fig. 9.



Witnesses

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(No Model.) 2 Sheets—Sheet 2.

A. H. DODD.

STEAM VACUUM PUMP.

No. 452,749. Patented May 19, 1891.

Fig. 3.

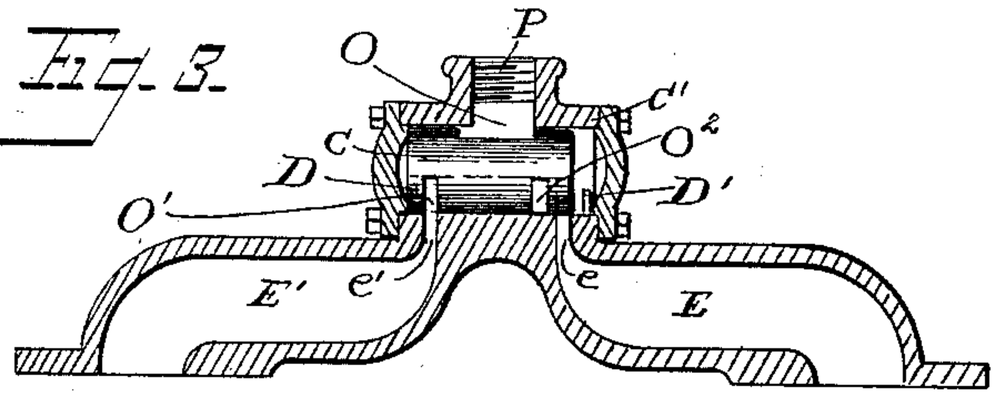


Fig. 2.

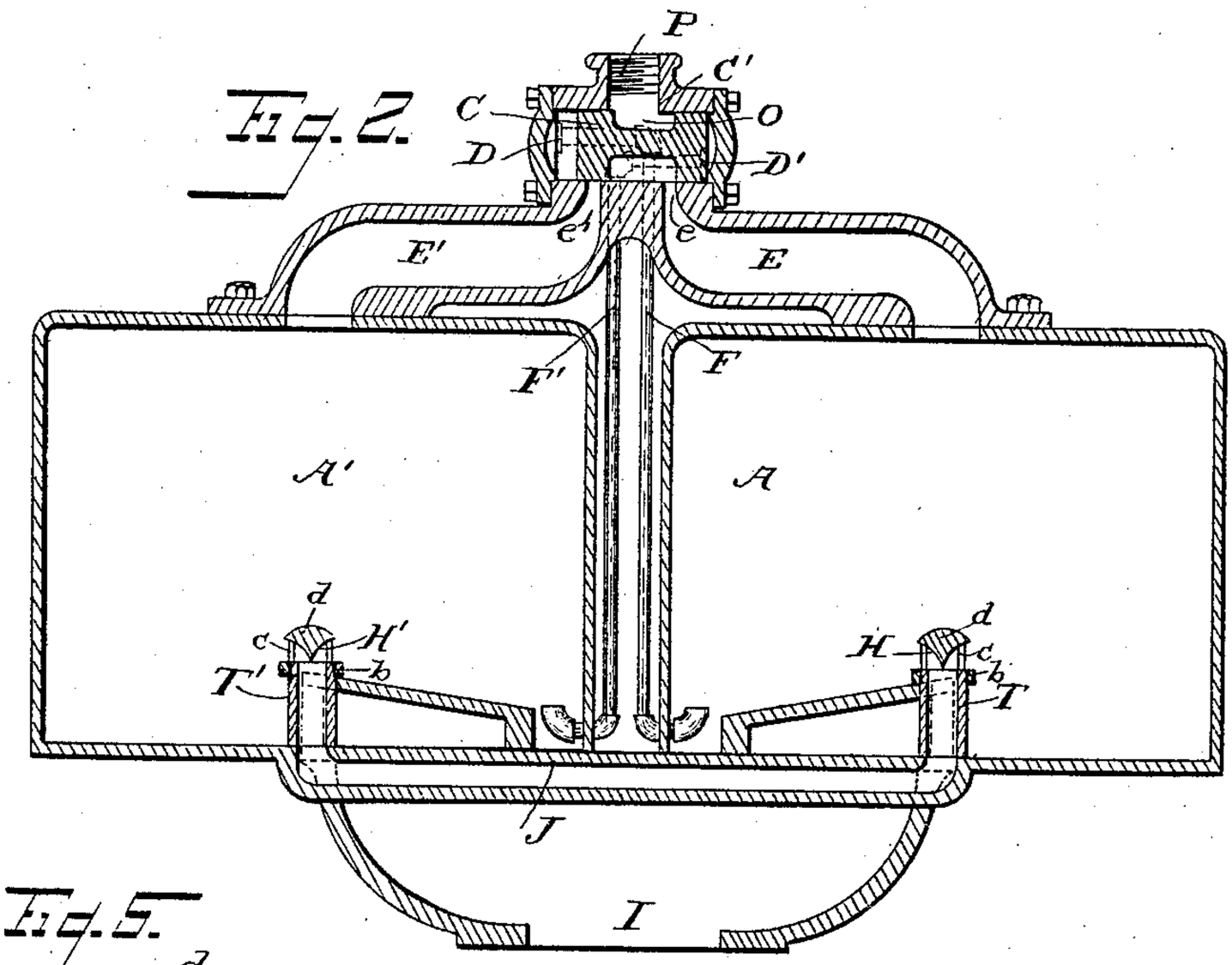


Fig. 5.

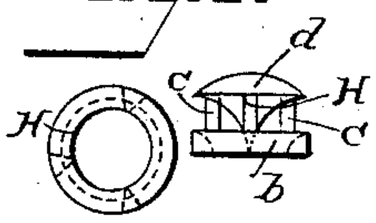
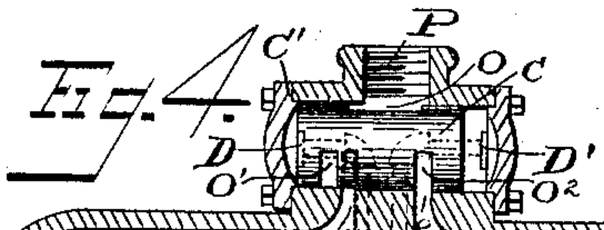


Fig. 4.



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UNITED STATES PATENT OFFICE.

ALVIN H. DODD, OF GREELEY, COLORADO.

STEAM VACUUM-PUMP.

SPECIFICATION forming part of Letters Patent No. 452,749, dated May 19, 1891.

Application filed September 20, 1890. Serial No. 365,651. (No model.)

To all whom it may concern:

Be it known that I, ALVIN H. DODD, a citizen of the United States, residing at Greeley, in the county of Weld and State of Colorado, have invented certain new and useful Improvements in Steam Vacuum-Pumps; and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

My invention relates to steam vacuum-pumps, more particularly to the double-acting pumps wherein a vacuum is created in one cylinder to draw water into the cylinder while steam is forcing water from the other cylinder, the two chambers acting in alternation to receive and discharge water.

The invention has for its object to provide for shifting the valve that controls the admission of steam to the cylinders in alternation by the pressure of air between the valve and its casing, the air being compressed by the weight of water in the pump-cylinder and pressure of steam on the water, a reduction of pressure on the other end of the valve taking place at or about the same time that the air is compressed at the other point; also, to provide for utilizing the water which serves to compress the air for causing a jet of water in the pump-cylinder to assist in condensing the steam to form a vacuum, said water being forced out of its pipe by the rebound or expansion of the air back of the valve on a sufficient reduction of pressure at the mouth of the pipe where it lies within the pump-cylinder; also, to provide improved means for passing water from one pump-cylinder to the other during the discharge of one cylinder, so as to further condense steam in the other cylinder to complete the vacuum therein; also, to provide an improved valve and valve-seat particularly well adapted for the water-induction port to the cylinders from the suction-pipe.

To the accomplishment of the foregoing objects, whereby the advantages in operation hereinafter appearing are obtained, the invention will be herein fully described, and then definitely specified in the claims, reference being had to the accompanying drawings, forming a part hereof, and in which—

Figure 1 is a plan of a double-acting steam vacuum-pump with parts broken away and others in horizontal section, the steam-inlet valve being removed from its casing. Fig. 2 is a vertical section on line *x x* of Fig. 1, looking in the direction of the arrow, with parts in full lines. Fig. 3 is a vertical section through the valve-casing and the conduits which lead therefrom to the two cylinders and showing in full lines one form of steam-inlet valve. Fig. 4 is a similar view showing a slight modification in the arrangement of parts to adapt having the pipe which leads the water from the pump-cylinder to compress the air back of the piston open directly to the piston above the cylinder from which the water is taken instead of to the end farthest removed therefrom. Fig. 5 is a side and also a top view of the spray-nozzle to the pipe connecting the two pump-cylinders for the purpose of completing the vacuum. Fig. 6 is a front view of the discharge-chamber detached from the other parts. Fig. 7 is a plan of the improved valve-seat, showing the valve proper in position, one flap thereof being broken away. Fig. 8 is a vertical section through the same on the line *y y* with the valve removed. Fig. 9 is a vertical section at right angles to Fig. 8 on the line *w w* with the valve removed. Fig. 10 is a perspective of a part of the valve proper with portion broken away to show its interior construction.

In the drawings, the letters A and A′ designate the two pump or vacuum cylinders, which are connected together at their upper ends by the usual neck or conduits E and E′, bolted to the cylinders in the usual way. To the top of this neck is bolted the valve-casing C′, having its heads bolted to the ends of the cylinder composing its sides and provided with the steam-supply port P, which will connect with a boiler or other source of supply, there also being the usual inlet-ports *e* and *e′* opening from the valve-chamber to the conduits E and E′. The pump is also

provided with the discharge-chamber M, connecting with the pump or vacuum cylinders through passage-ways N and N′, controlled by valves, as usual, and provided with the final discharge-opening S. The suction-pipe I at the base of the cylinders communicates with both cylinders through openings in the bottoms of the cylinders.

The parts so far generally described are or may be of an approved and well-known construction and are adapted to have my invention applied thereto.

Within the valve-casing I locate a valve, (designated by the letter C and illustrated as a reciprocating valve, but which may be of any suitable form and construction, although the preferred form is shown in Fig. 2 of the drawings and is what is known as a "spool-valve.") It will be observed that the interior of the valve-casing is longer than the valve, so as to allow a longitudinal play or reciprocation of the valve, and also that the heads of the casing on the inside are concave, as it is preferred to always have a space between the ends of the valve and the heads of the casing, which will constitute a chamber for a fluid to actuate the valve. In the side of the casing are formed two ports D and D′, one near each end and preferably extending down to or into the bottom of the casing, although they may terminate above the bottom. These ports have opening into them two pipes F and F′, one leading from each of the two vacuum-cylinders A and A′. The preferred arrangement of these pipes is to have each one connect the vacuum-cylinder into which it opens with the end of the valve-casing farthest removed therefrom, as illustrated in Fig. 2 of the drawings, which can be effected by having the pipes cross each other, as illustrated in Figs. 1 and 2, so that the pipe F, which opens into cylinder A, will have communication with the port D over the cylinder A′, and the pipe F′, which opens into the cylinder A′, will have communication with the port D′ over the cylinder A. The pipes F and F′ preferably have their lower ends turned up, as shown, so that water discharging therefrom will be directed upward. By thus arranging the ports and pipes, when water is admitted into the pump-cylinders to a point above the lower end of the pipes F and F′ it will rise in said pipes, and as the water continues to rise in the cylinders the weight thereof will force up the water in the pipes and compress the air in the pipes above the water therein and between it and the end of the steam-inlet valve, so that at a certain point or with a sufficient volume of water in the cylinder the air will be compressed in the space between the end of the valve and valve-casing to an extent sufficient to shift the valve, to open the opposite port leading to the vacuum-cylinder, and to hold the valve in that position until the air at that end of the valve is in turn compressed sufficiently to overcome the pressure from the other end, when the valve will be shifted back to open the other port and be held there in turn until the pressure at that end overcomes the pressure which holds the valve at that point, and so the action will continue from one cylinder and from one end to the other of the valve in alternation so long as the pump is working, whereby the steam is alternately admitted and cut off from the two cylinders, it being admitted to one while cut off from the other, and the shifting and holding of the valve to its shifted position being by the compression of the air, as stated. The mode of this operation so far described in general terms will more particularly appear in the operation to be hereinafter described. The water in the pipes F and F′ also serves to produce or to assist in producing a vacuum in the pump-cylinders. It will thus be observed that a single pipe for each pump or vacuum cylinder is made to serve the twofold purpose of a channel for the water to compress the air to shift the valve and for condensing the steam to create a vacuum in the pump or vacuum cylinders.

Instead of employing a spool-valve, such as illustrated in Fig. 2, I may employ a hollow valve, such as illustrated in Fig. 3, wherein the valve is formed with a chamber or channel O for the steam coming from the supply-pipe P, and with ports O′ and O^2 communicating therewith and opening through the side of the valve, so as to communicate with the ports *e* and *e′* as the valve is shifted from one end to the other of its casing, the admission of air to the ends of the valve being the same as that described for the spool-valve.

The openings in the bottom of the two pump-cylinders for the induction of water from the suction-pipe (indicated by the letters K and K′) are controlled by a valve of a particular construction, which freely admits the water and seats itself, so as to reduce to a minimum the blow of the valve against its seat, thus perceptibly lessening the vibration of parts and the clacking of the valves commonly experienced in steam vacuum-pumps. In constructing the valve I provide a raised seat, which may consist of a frame Q, having a grated top, which may be formed of a series of bars Q′, extending from a central rib or web Q^2 to the sides of the frame, which bars may be arched on their under faces to give strength to them. It is preferred to have two sides of this frame converge toward one end, and said sides incline from one end to the other, while the bars forming the grating incline upwardly from their outer ends inwardly to the central or intermediate rib Q^2. There is thus formed a seat for the valve proper, having its face inclining from one end to the other and also from a point intermediate of two of its sides toward both of said sides. This is a novel feature and may be employed without the bars Q^2, although it is preferred to use said bars to form a grated surface to the face of

the valve-seat. The frame of this seat is formed with perforated ears *a* for bolts to secure it in place.

The valve proper is designated by the letter R and may be composed of rubber, and is divided along the line of the rib Q^2 of the seat, and is hinged or secured in any suitable way to the sides of the frame—say to the lower sides or ends Q^3. By such construction I form a valve of two parts, which allow it to open in the center as well as along the outside edges, so that the water is admitted most freely through the induction-ports. This is important, and when such feature of construction is combined with the particular construction of valve-seat described a valve most satisfactory in its operation and possessing the advantages specified is produced.

In pumps of the kind to which this invention relates it is found very desirable to combine weight with flexibility, so that the valve will more quickly seat itself. It is also desirable to impart the maximum strength to the valve, as its quick successive seating and its movement under the influence of the vacuum causes great strain on the valve, and unless strong needs to be soon replaced by a new one. For the purpose of giving maximum strength and the desired weight, I mold the valve proper with a netting of wire U—say annealed wire—centrally within the same, as illustrated in Fig. 10. It will be observed that this metallic wire mesh or netting is in the center of the material composing the valve, and the material passes through the mesh, so that one homogeneous body is formed. This metallic netting imparts the necessary weight and will bend or yield with the movement of the rubber of which the valve may be made, and will resume its normal condition or position as the rubber resumes its flat shape after movement therefrom. This wire-netting also avoids the breaking of the rubber, which will occur where strips of material are inserted, as then the valve is more rigid where the strips are than elsewhere and the rubber will break along the edge of such strips; but by the construction described the whole area of the valve has the same firmness and flexibility, so that breaking of the valve is prevented and at the same time the requisite additional weight is given to it. A passage-way or channel J, formed underneath the pump-cylinders A and A′, effects a communication between the two cylinders, and is preferably located so as to open into the cylinders near the center of their bottoms, there being provided at such points upright pipes T and T′, extending up above the bottom of the cylinders and provided at their ends with spray-nozzles H and H′, formed of a ring *b*, supporting by posts *c* a cap *d*, having arched sides to its under face, so as to spray the water issuing from the pipes, the nozzles being secured to the pipes by screwing the rings onto the threaded ends of the pipes. The purpose of this spraying is to condense steam in the cylinders, so as to complete the vacuum therein.

The pump constructed as described operates as follows: The two cylinders A and A′ are filled or primed with water to a point above that where the lower ends of pipes F and F′ enter said cylinders. The valve C being in the position shown in Fig. 1, steam is admitted through the supply P to the valve-casing. It passes thence through the port *e* into the conduit E and into the cylinder A, where it exerts a pressure on the surface of the water, forcing some of it up into the pipe F, so as to compress the air above it and force it through the port D into the space in the casing back of the valve C, so that it exerts a sufficient pressure against the valve to keep it against the opposite end of the casing and to keep the port *e* open until cylinder A′ is filled with water. At the same time the pressure of the steam against the water in chamber A forces the water out through the eduction-port into the discharge-chamber M, from whence it passes off through the discharge-port S. As the water lowers in the chamber A and its weight and consequent pressure on the water in pipe F becomes less, the confined or compressed air in the space of the valve-casing at D expands and exerts its pressure downward on the water in pipe F to force some of it out and up into the body of cylinder A, and this jet of water coming in contact with the steam in cylinder A condenses it and produces a partial vacuum in that cylinder. This fall of the water in pipe F and lowering of the air-pressure in the pipe above the water therein reduces the pressure of the air against the end of the valve at D below that of the pressure of the air in pipe F′ and in the space back of the valve at the port D′, so that the excess of pressure at D′ by the weight of the water in cylinder A′ presses the valve over against the end of the casing next to the port D, thereby closing port *e*, cutting off steam from the conduit E and cylinder A, and opening the port *e*′ and allowing the steam to pass through conduit E′ into cylinder A′, where it exerts a pressure on the water therein, which pressure holds the water in pipe F′, so as to keep the air compressed at D′ sufficiently to hold the valve against the end of the casing at D. In the meanwhile—that is, during the period that the steam is entering cylinder A′ and forcing water therefrom—the water in cylinder A has continued to flow therefrom, and a jet of water from the spray-nozzle H, caused by the forcing of water from cylinder A′ through channel J, has still further condensed the steam in the cylinder A, so as to form a complete vacuum, by which the water has been sucked through the suction-pipe I into the cylinder and filled the same and completely destroying the vacuum. While this has been going on in the cylinder A the pressure of steam in cylinder A′ has been forcing the water therefrom, and consequently reducing the pressure of the water in pipe F′, so

that the water therein has fallen, which has resulted in lowering the pressure against the valve at D′. At the same time that the pressure is lowered the air exerts a reflex action and forces some water out of the pipe F′, and it coming in contact with the steam in cylinder A′ forms a partial vacuum therein. At this time the compression of the air in the valve-casing at D, occasioned by the weight of the water in cylinder A forcing the water up in pipe F, exerts a pressure against the end of the valve at that point greater than the resistance offered at the opposite end of the valve, so that the valve is shifted to the opposite end of its casing, whereby the port *e′* is closed and port *e* opened and steam admitted to cylinder A to force the water therefrom, the steam remaining in cylinder A′ from the formation of only an incomplete vacuum continuing to force the water therefrom until the spray from the nozzle H′ condenses all the steam, thereby forming a complete vacuum, whereupon the water is sucked through pipe I and the valve at K′ to fill the cylinder. The operation is then repeated and continues successively so long as the pump is worked.

It will be observed that it is not necessary to wait for the formation of a complete vacuum in either cylinder A and A′ before shifting the steam-inlet valve, as the valve is shifted while steam is still in the chamber exerting its force upon the water and expelling it, and that the shifting of the valve is effected by the pressure of the compressed air against one end of it and a reduction of pressure at the other end. It will also be observed that a single pipe leading from each vacuum-cylinder to the space in the casing between the valve and the end of the casing serves for both the water and air, which combine to effect the shifting of the valve, and that there is no steam passing from the vacuum-cylinder to the space at the end of the valve occupied by the compressed air.

The construction described insures the filling and the complete discharge of each cylinder or vacuum-chamber and avoids the constant pounding of the induction and discharge valves and concussion in the cylinders, forming a constant source of annoyance in pumps as heretofore constructed.

Instead of having the two pipes F and F′ crossed at their upper ends so as to discharge into the valve-casing at the end farthest removed from the cylinder into which the pipe opens at the other end, they may open into the end of the casing directly over the cylinder with which the other end communicates, as illustrated in Fig. 4 of the drawings—that is, pipe F will lead into port D′ and the pipe F′ into the port D. Under that modification the form of valve shown in that figure may be used and the construction of the connecting neck or conduits leading to the two cylinders and the inlet-ports *e* and *e′* will be as shown in the same figure. The valve will be moved, however, by the same means as in the other constructions and the action of the compressed air and the water in the pipes F and F′ will be the same as in such other constructions, the only difference being in the direction of movement of the valve to open and close the ports, the valve being shifted to the left of its casing to open the port into the cylinder A and to the right to close that port and open the port to cylinder A′, as will be apparent from an inspection of Fig. 4 of the drawings.

I have described what I consider to be the best construction and arrangement of the several parts to carry out my invention; but I do not wish to be understood as limiting myself thereto, as it is obvious that various changes can be made without departing from the spirit of my invention.

Having described my invention and set forth its merits, what I claim is—

1. The within method of shifting by compressed air the steam-valve of a steam vacuum-pump to admit steam to one cylinder and cut it off from the other, consisting in the employment of compressed air acting directly by its compression to shift the valve, the air being compressed by pressure from within the vacuum-cylinder, substantially as described.

2. The within method of shifting by compressed air the steam-valve of a steam vacuum-pump to admit steam to one cylinder and cut it off from the other, consisting in the employment of compressed air acting by its direct compression in contradistinction to compression and then expansion to shift the valve, substantially as described.

3. In a steam vacuum-pump, the combination, with the two vacuum-cylinders, a valve-casing and valve therein, and conduits leading from said casing to said cylinder, of a pipe or channel for each vacuum-cylinder opening at its lower end into said cylinder at a point to receive water from and return water to said cylinder and at its upper end opening into an inclosed space, forming a chamber at the end of the valve to receive an agent from said pipe to act on the valve, substantially as described.

4. In a steam vacuum-pump, the combination, with the two vacuum-cylinders, a valve-casing and valve therein, and conduit leading from said casing to said cylinders, of a pipe or channel for each vacuum-cylinder opening at its lower end into said cylinder at a point to receive water therefrom and at its upper end opening into an inclosed space at the end of the valve farthest removed from the cylinder into which the lower end of the pipe or channel opens, whereby an agent may be admitted into said space at one end of the valve to shift and hold the valve upon a reduction of pressure at the opposite end of the valve, substantially as and for the purposes set forth.

5. In a steam vacuum-pump, the combination, with the two vacuum-cylinders, a valve-casing and valve therein, and conduits leading from said casing to said cylinders, of a

pipe or channel for each vacuum-cylinder opening at its lower end into said cylinder and bent upwardly where it enters said cylinder at a point to receive water from the cylinder and afterward discharge it into the cylinder at the same point, and at its upper end opening into an inclosed space which forms a chamber to receive an agent through said pipe to act on said valve, substantially as and for the purposes set forth.

6. The valve for the induction-port, having its body divided between its exterior edges, whereby it may separate at the line of division to permit a free egress of the water, substantially as and for the purposes set forth.

7. The valve composed of the raised seat inclined from one end to the other and having a central rib or web, and a valve divided between its edges so as to open at that point and having its inner portion resting on said central web, substantially as and for the purposes set forth.

8. The valve having a raised seat inclining from one end to the other and from an intermediate point toward opposite sides, substantially as set forth.

9. The valve-seat inclining from a point between its edges toward two sides and provided with a valve separated between its outside edges and resting upon the oppositely-inclined faces of the seat, substantially as and for the purposes set forth.

10. The combination, with the vacuum-cylinders having the induction-ports in the bottom thereof, of the valve-seats to said ports composed of a raised frame setting horizontally on the bottoms of the cylinders over the ports and formed each with inclined seats and the valves resting on said seats, substantially as and for the purposes set forth.

In testimony whereof I affix my signature in presence of two witnesses.

ALVIN H. DODD.

Witnesses:

GEORGE H. WEST,

WILL S. GRASSIE.