E. ROBERTS.

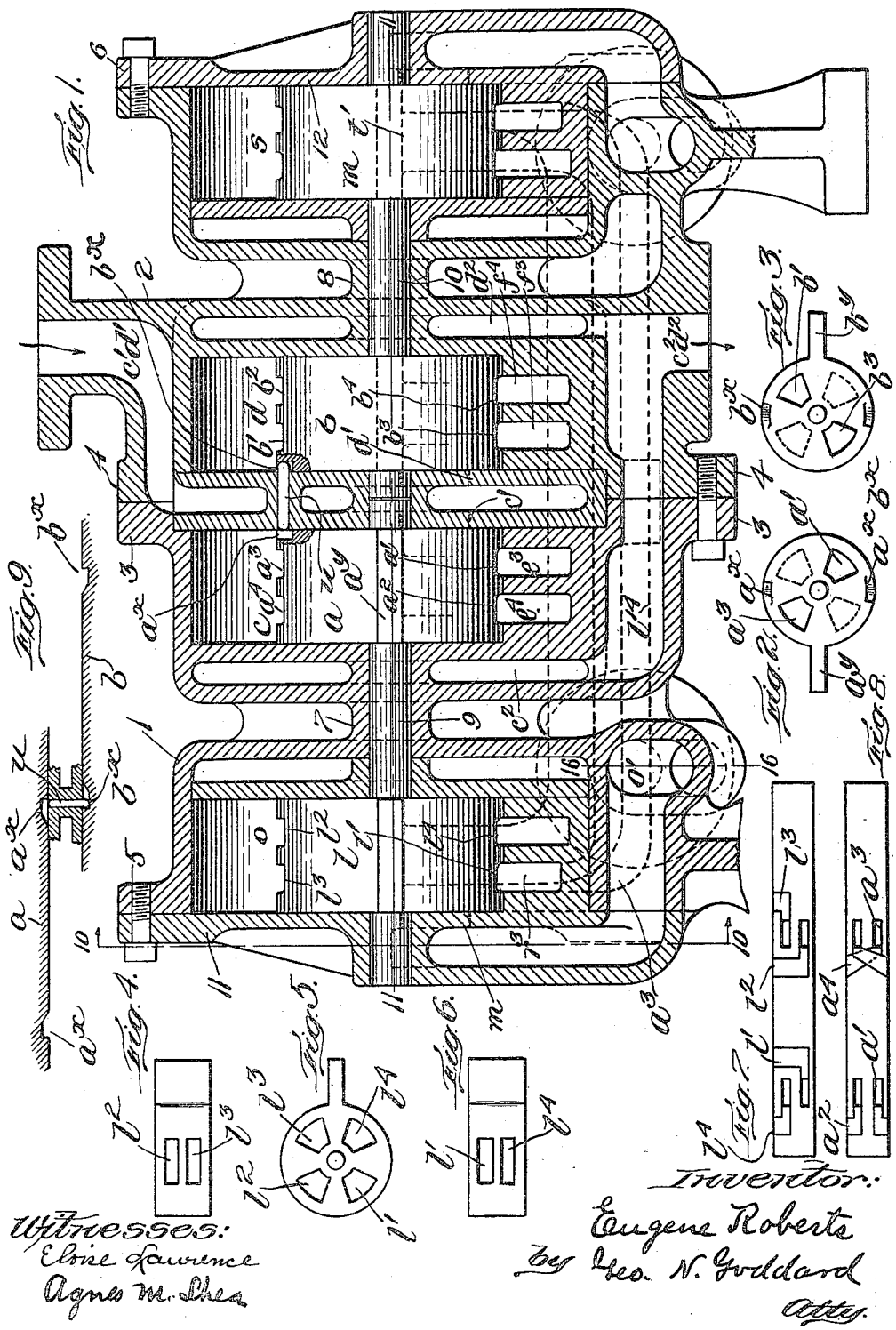
STEAM PUMP.

APPLICATION FILED JAN. 30, 1915.

1,225,274.

Patented May 8, 1917.

4 SHEETS—SHEET 1.



THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

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4 SHEETS—SHEET 2.

Fig. 10.

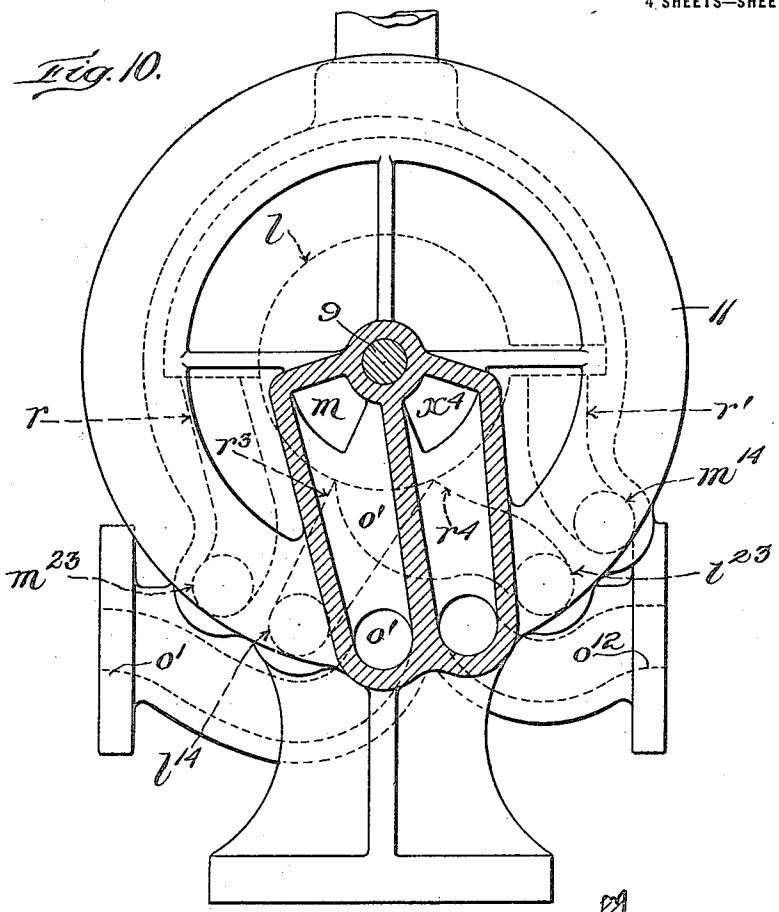
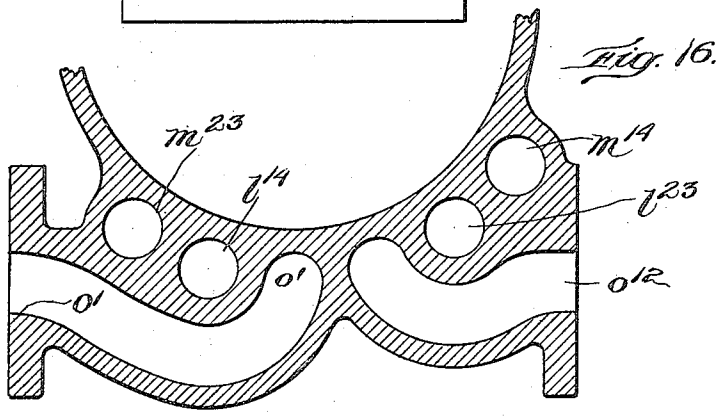


Fig. 16.



Witnesses:
Eloise Laurence
Agnes M. Shea

Inventor:
Eugene Roberts
by Geo. N. Goddard
Atty

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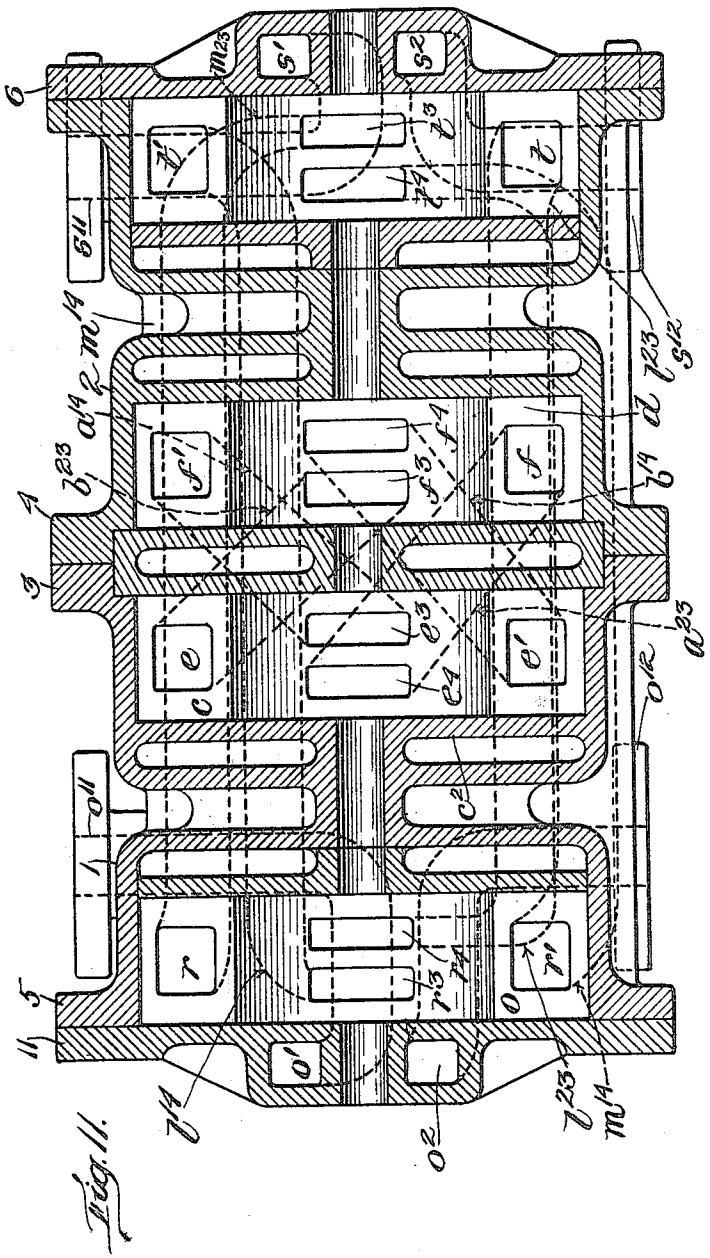


Fig. 11.

Witnesses:
Eloise Lawrence
Agnes M. Shea.

Inventor:
Eugene Roberts
By Geo. N. Goddard
Atty.

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4 SHEETS—SHEET 4.

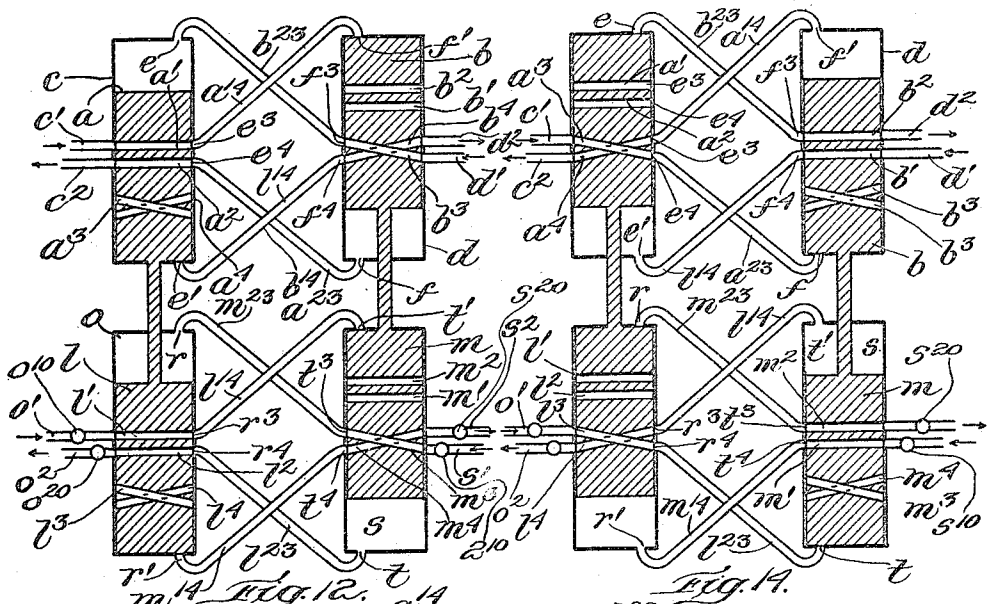


Fig. 12.

Fig. 14.

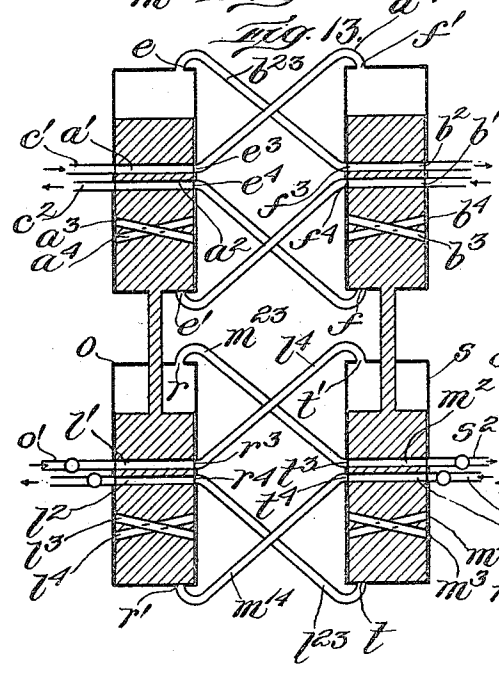


Fig. 13.

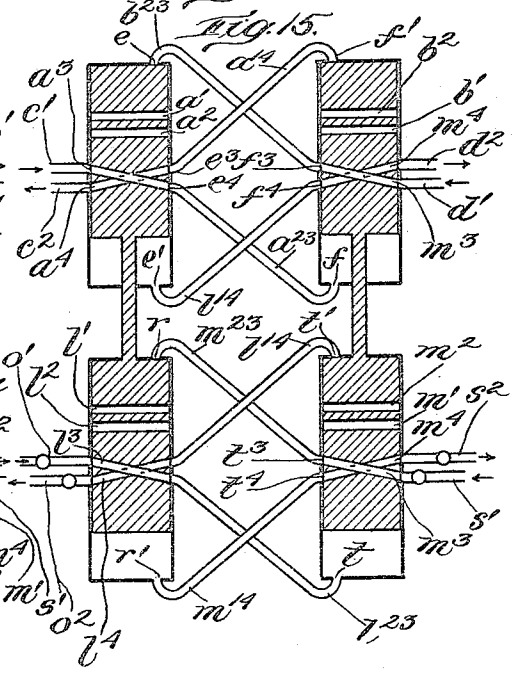


Fig. 15.

Witnesses:
Eloise Lawrence
Agnes M. Shea.

Inventor:
Eugene Roberts
by Geo. N. Goddard
Atty.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

EUGENE ROBERTS, OF SALT LAKE CITY, UTAH, ASSIGNOR TO SUGAR CENTRIFUGAL DISCHARGER COMPANY, OF SALT LAKE CITY, UTAH, A CORPORATION OF UTAH.

STEAM-PUMP.

1,225,274. Specification of Letters Patent. Patented May 8, 1917.

Application filed January 30, 1915. Serial No. 5,304.

To all whom it may concern:

Be it known that I, EUGENE ROBERTS, citizen of the United States, and resident of Salt Lake City, Utah, have invented certain new and useful Improvements in Steam-Pumps, of which the following is a specification.

This invention comprises an improvement in steam pumps and is intended to simplify the mechanism of such apparatus and provide a compact and economical construction which shall have complete reliability.

To this end the invention comprises in its simple form a pair of separately movable steam pistons, and a pair of separately movable water pistons, so combined that each steam piston is connected with one of the water pistons, and so constructed and arranged with relation to the steam and water passages that each steam piston itself forms a controlling valve for admitting and exhausting steam from the other steam piston chamber, while each water piston similarly controls the admission and exit of water in the other water piston chamber.

The construction completely eliminates all special valve mechanism, since the in-flow and out-flow of fluid to each piston chamber is entirely controlled through ports or passages formed in the piston of the companion chamber. The only valves used are the check valves of the water inlets and off-takes, and these are used merely to prevent the back-flow of water and not as a part of the regulating or controlling mechanism.

In the accompanying drawings, I have illustrated a simple and convenient form of embodying the principles of this invention in which the pistons are given an oscillatory movement, but it will be understood that the invention is not confined to that form of pump.

Figure 1 is a central vertical section through the casing showing the positions of the pistons at one stage in the operation, that is, the water piston at the left hand end in position to admit water to the farther side of the water chamber at the right hand end, and with the left hand steam piston in position to admit steam to the farther side of the right hand steam chamber.

Figs. 2 and 3 are side elevations showing opposite faces of a steam piston.

Figs. 4 and 6 are edge-wise views of opposite sides of a water piston.

Fig. 5 is a side elevation showing one face of the water piston.

Figs. 7 and 8 are flat developments showing the ports or passages of the water and the steam pistons respectively.

Fig. 9 is an enlarged detail view in cross section illustrating the locking pin.

Figs. 10 and 11 are sectional views of the casing on the planes indicated by section lines 10—10 and 11—11.

Figs. 12 to 15 are diagrammatic views illustrating the four consecutive phases of the piston action.

Fig. 16 is a transverse vertical section through the lower portion of the casing intersecting the inlet and outlet passages of a pump chamber.

According to the form of the invention illustrated, I construct a substantially cylindrical casing formed in two parts, 1 and 2, arranged to be coupled together by means of coupling flanges 3 and 4. The complete casing contains two middle sector chambers *c* and *d* and the outside or end chambers *o* and *s* which are of similar shape. As shown, each member of the casing contains a pair of adjacent chambers or piston cylinders united by a connecting web or neck 7 and 8 in which are inserted oscillatory shafts 9 and 10 whose inner ends substantially abut together in a bearing formed at the middle of the chamber and whose outer ends are supported in bearings formed in the end heads 11 and 12 respectively. Near the opposite ends of each oscillatory shaft 9 and 10 are secured the pistons which comprise a cylindrical hub portion with a single radially projecting vane or wing which traverses its appropriate chamber in the casing alternately from one end to the other by an oscillatory movement.

I will first describe the action of the steam pistons which alternately oscillate the respective shafts. It will be understood that each steam piston is formed with ports or passages in its hub portion so arranged with reference to steam passages in the casing that in one position of the piston a given passage affords communication between the steam inlet of the casing and the then inlet side of the piston chamber containing the companion piston, while another passage in the first piston establishes communication between the outlet end of the chamber of the companion piston with the steam outlet or

exhaust passage in the casing. In other words, each piston while at rest at the end of its stroke serves to admit live steam into one end of the piston chamber containing the companion piston and to exhaust the steam from the other end of said chamber so that each piston in turn acts as the controlling inlet and exhaust valve for its companion piston.

When each piston is in place, the central part of its containing chamber will be filled by the hub of the piston, leaving an approximately semi-annular space for the steam chamber or the water chamber, as the case may be, whose cross section is filled by the wing or blade of the piston.

I will first describe the passages and ports in the casing. Referring now particularly to Fig. 11, it will be seen that one end face of the semi-circular steam chamber c is provided with a port e having communication through a cored passage in the casing with the port f^3 formed in the bottom of the central semi-circular recess which receives the hub. The opposite end of the chamber c is provided with a similar port e' communicating with the port f^4 in the companion chamber. In the same manner, the companion chamber d has in one end wall a port f communicating with the port e^4 in the central bottom portion of the chamber c, and the opposite end wall of chamber d has a port f' communicating with the port e^3 of chamber c. For convenience in tracing the flow, it may be said that odd index numerals used with the reference letters denote passages or ports for the admission of live steam to the piston chamber, while reference letters with even index numerals denote passages for conducting exhaust steam away from the piston chamber to the off-take. The two steam chambers have a common inlet passage c' d' formed in the top of the casing leading to the space between the two steam piston chambers, and having lateral branches or passages c' d' leading, as will be hereinafter explained, through passages or ports formed in the respective piston hubs to the ports e^3 f^3 respectively.

There is also a common outlet passage or exhaust $c^2 d^2$ provided with branches c^2 and d^2 in communication respectively with the exhaust ports e^4 f^4 through passages in the respective pistons a and b.

In Figs. 2 and 3 are shown opposite faces of the piston member a which is exactly like piston member b. Each flat side of the piston hubs is provided with a port forming one terminus of the inlet passages a' a^3 disposed diametrically across the center, the other termini of these passages a' a^3 being formed in the peripheral surface or edge face of the piston hub. These peripheral ports are also diametrically opposite each other and slightly offset circumferentially from the location of their corresponding ports in the lateral face of the piston. It will thus be seen that each piston plug or hub is provided with two inlet passages, that is, passages for the steam flowing toward piston chamber d, the inlet end of which is in the flat face, and the outlet end of which is in the circumferential face of the hub, both termini of one inlet passage being located approximately 180 degrees from the termini of the other inlet passage so that each inlet passage will form a connection for communication alternately at opposite ends of the stroke between the inlet passage c' d' and the ports e^3 f^3 through which the steam passes respectively to the end ports e' f'.

The opposite side or flat face of the piston hub a is similarly provided with openings forming the end of outlet passages a^2 a^4 whose other ends terminate in ports formed in the peripheral surface of the plug along side of the ports already described, and arranged 180 degrees from each other. The actual lead of all the passages formed in the two steam pistons is best shown in the flat development comprising Fig. 8 of the drawings.

According to the position of the parts shown in Fig. 1, the piston a is in position so that its inlet port a' bridges over or connects the inlet passage c' with the peripheral port e^3, whence the steam is conducted (Fig. 11) to port f' against which the blade of piston b is now resting, with the result that the in-flowing steam begins to push or rotate the piston, say approximately 180 degrees, until it covers port f in the opposite end of the steam chamber. At the same time, the exhaust steam is passing out through port f into passage a^{23}, thence through port e^4 and piston passage a^2 to the outlet branch c^2 on its way to the off-take passage c^2 d^2. The course of the steam communications while this movement of piston b is taking place is diametrically illustrated in Fig. 12.

Attention is called to the fact that all the passages in the casing which serve to connect the opposite end ports of each piston chamber with the passages through the piston plugs carry the fluid in opposite directions at different stages in the operation so that the inlet ports at one stage of the operation become the outlet ports of the same passages in the next stage in the operation. Fig. 13 illustrates diagrammatically the second stage in the operation at a point where the second steam piston b has advanced from position against port f' to position against port f, in which position it remains at rest to admit the steam into the port e' of steam chamber c while allowing the exhaust steam from said chamber to pass out through port e and passages 23 and b^2 to the exhaust pipe

c^2 d^2. This admission of steam into one end of chamber c and its exhaust out of the other end causes the piston a to traverse its piston chamber until it reaches the position shown in diagrammatic Fig. 14.

The third stage is shown in Fig. 14 in which piston a once more remains at rest while admitting steam from the inlet passage c' through inlet passage a^3 of the piston a into connecting passage a^{23} to port f. At the same time, the exhaust steam escapes through port f', passage a^{14} and a^4 to the exhaust pipe c^2 d^2.

The last described traverse of the piston b brings it into a position of rest, indicated in Fig. 15, where it allows the admission of steam through the port e into chamber c and the escape of the exhaust steam through port e' to the off-take, thus causing the piston once more to traverse the chamber until it comes to rest in the initial position indicated in Fig. 12, after which the same cycle is repeated.

The operation of the water pistons constituting the force pump are governed in a precisely similar manner to that already described in respect to the steam pistons. The left hand piston chamber o is provided at its opposite ends with ports r and r' which by means of passages m^{23} m^{14} lead respectively to the ports t^3, t^4 formed in the peripheral surface of the casing which receives the hub of the right hand water piston m. Similarly, water piston chamber s is provided at its opposite ends with ports t t' leading respectively to ports r^4 r^3 formed in the peripheral bearing surface at the bottom of water chamber o.

By referring to Figs. 4, 5 and 6 of the drawings, which show one lateral face and the two opposite peripheral faces of one of the water pistons, it will be seen that all the lateral ports of the water piston are formed on one side face only, there being four such ports having communication respectively with two pairs of peripheral ports formed 180 degrees apart in the periphery of the piston hub or plug. The development of these water piston ports or passages is shown in Fig. 7, and their connections are shown in the lower half of each of the diagrammatic views shown in Figs. 12 to 15 of the drawings. The reason for forming all the lateral ports of the water plugs on the same side is that both inlet and outlet passages for the water chambers are formed in the outer or end heads of the casing, as indicated at o' o^2 and s' s^2, that is passages continuing by curved passages, as indicated in Fig. 11, respectively to the inlet port o^{11} and the outlet port o^{12} near one end of the casing, and to the inlet port s^{11} and outlet port s^{12} near the opposite end of the casing.

It will, of course, be understood in following the flow of the water that the movement imparted to the two water pistons in alternation is due to the rotation of their respective driving shafts by their respective steam pistons, and is not due, as in the case of the steam pistons, to the pressure of the fluid introduced or admitted into the water chambers. With the parts in the position indicated in Figs. 1 and 12 wherein, as already explained, the steam piston b is about to begin its traverse from position overlying port f' to position overlying port f, the water in the chamber s will be expelled or forced through port t, passages l^{23} and l^2 to the outlet or discharge pipe o^2. At the same time, water is being admitted behind the piston m through the opposite end port t' which has communication with the water inlet passage o' through the passage l', port r^3 and passage l^{14}.

When the first stage of the movement is completed and the piston m comes to rest at the end of its traverse overlying port f, it is then in position to allow water to be expelled from chamber o through port r, passage m^{23}, port t^3, passage m^2 through the outlet passage s^2. At the same time a fresh supply of water for the pump chamber o is being admitted from water inlet s' through passage m', port t^4, passage m^{14} and port r' behind the advancing piston l.

Figs. 14 and 15 illustrate the next two stages which complete the four-stage cycle of the operations.

It would, of course, interfere with the efficiency and reliability of the operation of this pump should the two sets of pistons which mutually and alternately control each other's movements be so displaced from their relative positions, either by leakage or otherwise, as to leave the piston which is temporarily acting as a controlling valve away from its proper controlling position at the end of its stroke. That is, should it happen that both sets of pistons should assume an intermediate position in their respective chambers at the same time, the device would be dead-locked.

To prevent the possibility of such relative displacement, I have provided an automatic controlling means which acts to prevent the movement of the stationary piston away from its proper controlling position at the end of its stroke until the companion piston has reached or nearly reached the end of its traverse. The means devised for this purpose consists of a slide pin u arranged in an axial direction in the wall separating the two middle or steam chambers c and d and also slightly nearer the central axis than the peripheries of the hub portions of the pistons a and b, as shown in Fig. 1. On their adjacent faces, the pistons a and b are provided with a pair of notches a^x and b^x, the notches in each piston plug being disposed diametrically opposite each other so as to

be in position to engage the projecting end of the pin when the piston is at either end of its stroke. The pin u is of a length so that when one end lies flush with the adjacent surface of its containing wall, the other end projects a short distance into one of the piston notches formed to receive it. Each notch has one of its faces inclined so that the rotation of the piston away from its end position has a cam-like action upon the projecting end of the pin to push the pin longitudinally so that it would project on the opposite side. Obviously, this longitudinal movement of the pin can not take place until the companion piston has nearly reached the end of its traverse so as to bring its notch opposite the end of the pin. In other words, the pin cannot be released from holding engagement by any jar or otherwise until the companion piston reaches the end of its stroke and presents its receiving notch in position to receive the pin so that the moving piston always acts to positively prevent or lock the pin against shifting movement until the traverse is finished. As previously explained, when the traverse of the moving piston is completed, it has then reached a position to control the in-flow of steam to start the other piston in operation, and the initial movement of the other piston necessarily forces the pin into locking engagement with the piston that has just completed its traverse and is now controlling the companion piston.

The notches $a^{\times}$ and $b^{\times}$ in the piston plugs should extend through an arc slightly greater than the arc occupied by the inlet and outlet ports formed in the plugs so as to give a slight lead or overlap in the movements of the two coöperating pistons. Moreover, if the piston is intended to have, as in this case, an arc movement equaling 180 degrees, the piston chambers should extend through slightly more than 180 degrees to afford a slight clearance at each end of the stroke in order to prevent pounding or rebound.

The check valves referred to as indicated in the diagrammatic views are simple conventional check valves such as are used in any water pump, one being located in the water inlet passage, as indicated at o^{10}, and the other in the water outlet passage, as indicated at o^{20}. The corresponding check valves at s^{10} and s^{20} are located respectively in the inlet and off-take pipes of the companion water chamber. As they would most generally be located in the water pipe connections entirely outside of the casing and would form no part of the actuating mechanism of the pump itself, I have deemed it sufficient to indicate their respective positions in the diagrammatic view where the direction of flow of the water is indicated.

While for convenience I have referred to steam as the motive fluid for operating the power pistons, yet it will be understood that any other expansible motive fluid, such as compressed air or the like, may be used to drive the power pistons. Similarly the pump pistons may serve to pump other fluid bodies besides water.

What I claim is:

1. The combination of a pair of pump pistons mounted in their respective pump chambers, a pair of steam pistons mounted in their respective steam chambers, each of said steam pistons being operatively connected with one of the pump pistons, a casing inclosing the said chambers and provided with steam passages and water passages affording communication between the chambers of each pair and the supply and exhaust passages of the casing, the respective piston members being provided with ports or passages by which the inflow and out-flow of water and of steam is regulated in a predetermined order, substantially as described.

2. A steam pump embracing in combination a casing provided with a series of steam chambers and of water chambers of approximately semiannular contour arranged side by side, a series of piston members movably mounted in said chambers, the casing being provided with steam inlet and steam outlet passages having communication with the two intermediate chambers alternately through passages formed in the movable piston members mounted in said intermediate chambers, the casing also being provided with water inlet and outlet passages having alternately communication with the end chambers through passages formed in the respective end piston members, substantially as described.

3. The combination of a pair of coöperating oscillatory piston members mounted in a pair of containing steam chambers, a casing provided with passages for the admission and exhaust of steam, said passages having alternately communication with each steam chamber through passages formed in the piston of the companion steam chamber, a pair of pump pistons mounted in water chambers, said pump pistons being operatively connected with the respective steam pistons to cause them to move to and fro in order to alternately admit and expel water from the pump chambers, substantially as described.

4. The combination of a casing containing a pair of approximately semiannular steam chambers, oscillatory piston members mounted therein, each piston member being formed to control in alternation the admission and exhaust of steam from the companion steam chamber, a shaft secured to each piston member, pump pistons secured to the respective shafts and mounted to os-

cillate in their respective pump chambers and acting in alternation to admit and expel water from their respective pump chambers, substantially as described.

5. The combination of a casing containing a pair of steam chambers arranged side by side, a pair of steam pistons mounted in the respective steam chambers, each steam piston being formed when at rest at the end of its stroke to control in alternation the admission and exhaust of steam from the companion piston chamber, and means for automatically preventing each piston from moving away from its position of control until the companion piston has come to rest, and a pair of pump pistons mounted in their respective pump chambers and operatively connected with the respective steam pistons to cause them to alternately expel the water content from their respective pump chambers, substantially as described.

6. The combination of the casing provided with a pair of steam chambers, a pair of separately movable pistons mounted therein, each piston being constructed to form a valve controlling the flow of steam into and out of the companion piston chamber when it is at the end of its stroke, and a locking member movable alternately into engagement with the respective pistons to hold one in position at the end of its stroke until the other piston has reached the end of its traverse, and a pair of separately movable pump pistons mounted in their respective pump chambers and operatively secured to the respective steam pistons, substantially as described.

7. The combination of a casing provided with a pair of steam chambers, a pair of oscillatory pistons mounted in the respective steam chambers, each piston comprising a substantially cylindrical hub and a radially projecting vane, each being formed with passages through which the flow of steam into and out of the companion steam chamber through coördinated passages in the casing is effected, each hub portion being provided with recesses or notches on opposite sides of the center, a slide pin mounted between the two chambers to engage the side face of the moving piston and a notch in the controlling piston during each stage of the operation, a centrally mounted shaft secured to each steam piston, and a pump piston secured to each shaft and mounted in a containing pump chamber, substantially as described.

8. A steam pump comprising an oscillatory steam piston and an oscillatory pump piston coupled together and mounted to traverse parallel chambers arranged side by side, a couple of coöperating steam and pump pistons similarly arranged in their containing steam and pump chambers respectively and inclosing a casing provided with passages affording communication for the flow of steam between the steam chambers and the water chambers, each of the coupled pistons being formed to control the flow of water and steam to and from the chambers of their corresponding pistons of the other couple in alternation, substantially as described.

9. A four-cycle steam pump embracing a casing containing four piston chambers, two for steam and two for water, a double-acting piston mounted in each chamber, each steam piston being coupled to the adjacent water piston to actuate the same, each of the coupled pistons being constructed and arranged to form controlling valves for the in-flowing and out-flowing steam and water which passes through the respective piston chambers of the other couple, substantially as described.

10. A valveless pump embracing a coöperating pair of power pistons arranged to be alternately acted upon by a suitable motive fluid under pressure, a pump piston operatively connected with each power piston, an inclosing casing provided with ports and passages operatively related to coöperating ports and passages in the respective pistons so that the motive fluid and the fluid being pumped, is admitted to and expelled from the respective piston chambers in alternation, substantially as described.

In witness whereof, I have subscribed the above specification.

EUGENE ROBERTS.

In the presence of—
GEORGE F. KENNY,
CHARLES ORDWAY.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."