W. H. & W. L. BLAKE.

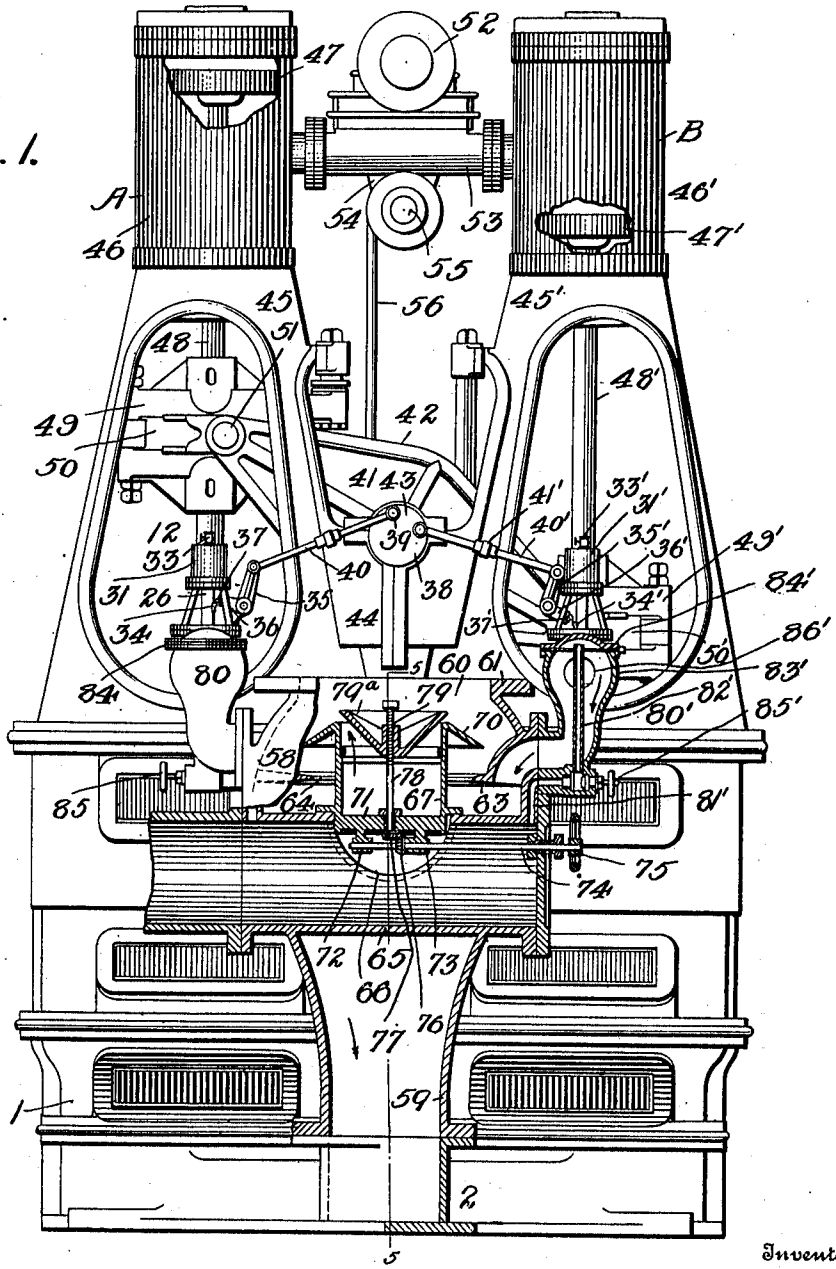
CONDENSER PUMP.

APPLICATION FILED FEB. 20, 1909.

988,431. Patented Apr. 4, 1911.

4 SHEETS—SHEET 1.

Fig. 1.



Witnesses

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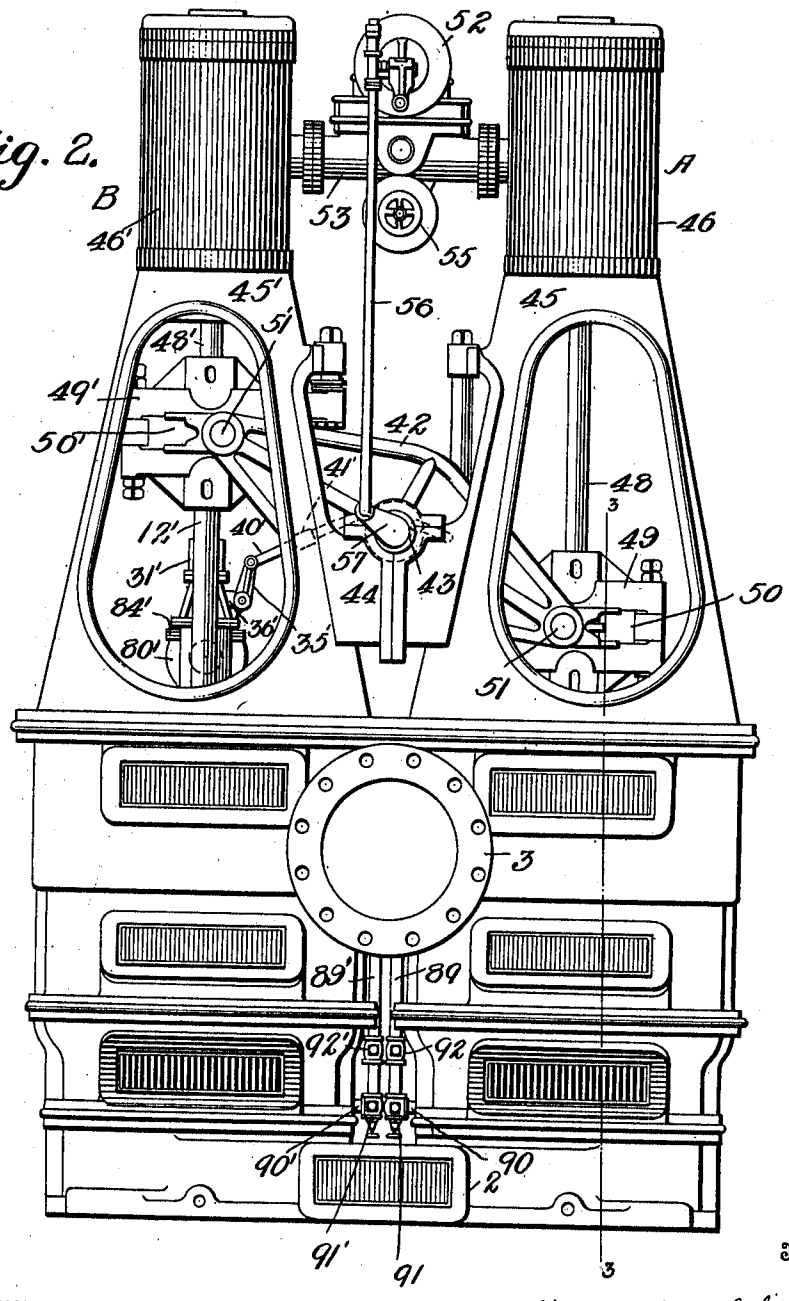
4 SHEETS—SHEET 2.

Fig. 2.



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4 SHEETS—SHEET 3.

Fig. 3.

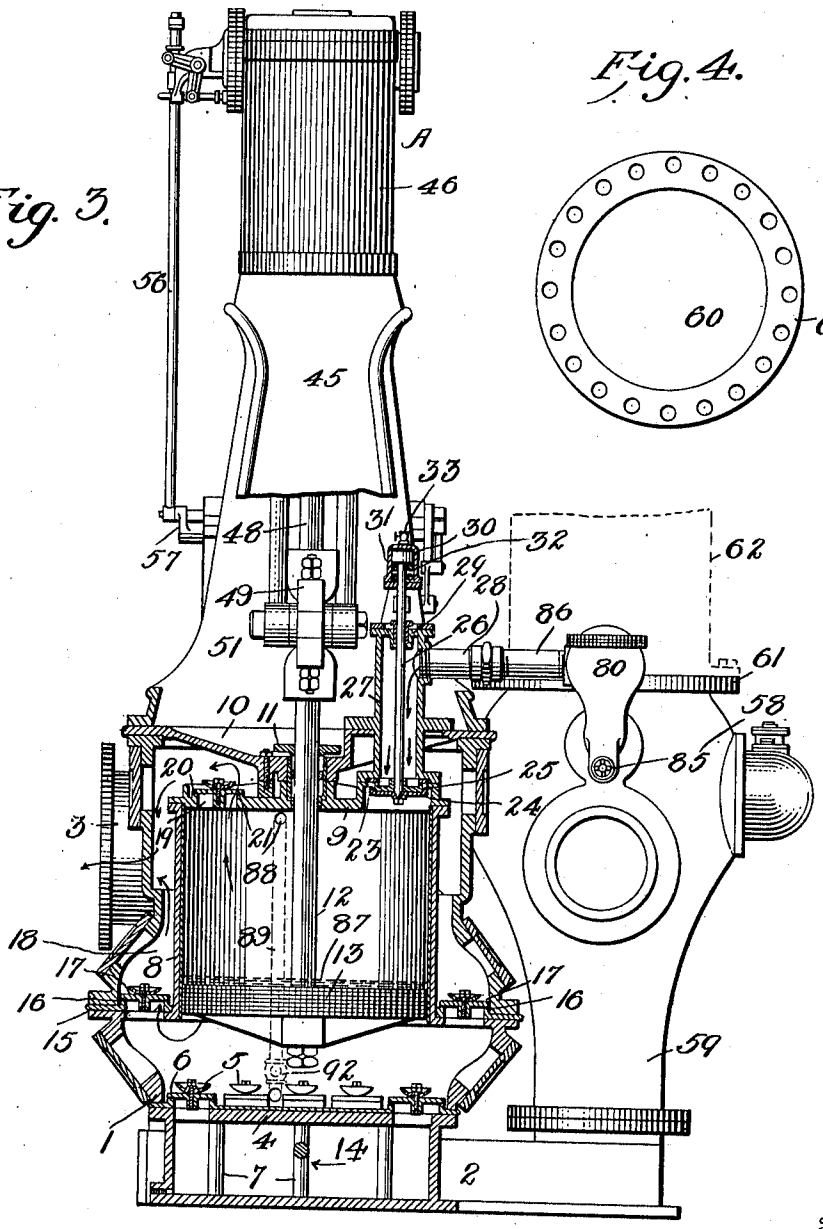

Fig. 4.

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4 SHEETS—SHEET 4.

Fig. 5.

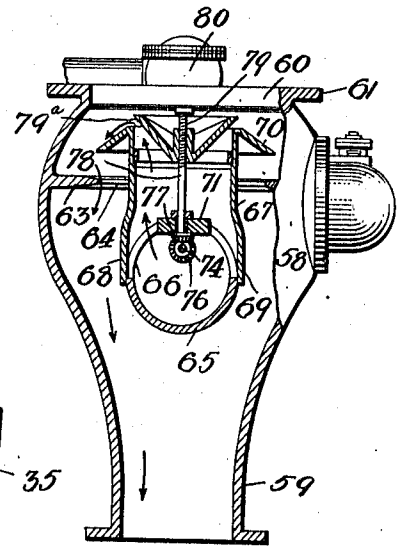


Fig. 7.

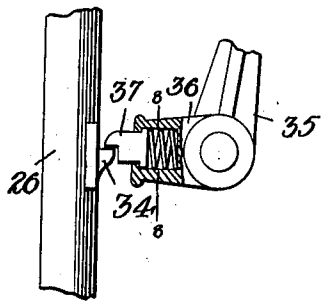


Fig. 8.

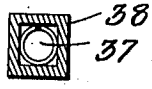
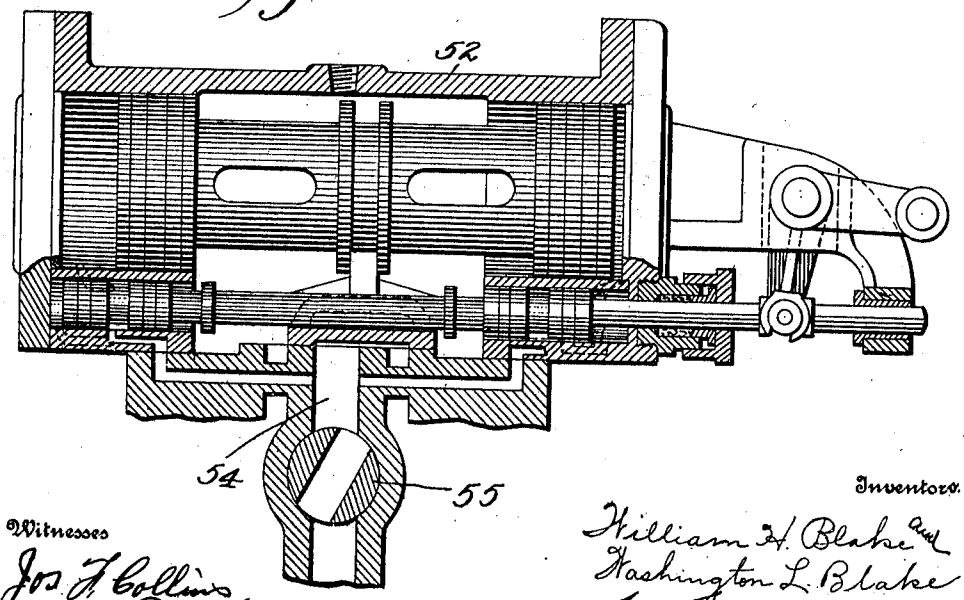


Fig. 6.



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UNITED STATES PATENT OFFICE.

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CONDENSER-PUMP.

988,431. Specification of Letters Patent. Patented Apr. 4, 1911.

Application filed February 20, 1909. Serial No. 479,291.

To all whom it may concern:

Be it known that we, WILLIAM H. BLAKE and WASHINGTON L. BLAKE, citizens of the United States, residents of Fitchburg, in the county of Worcester and State of Massachusetts, have invented certain new and useful Improvements in Condenser-Pumps, of which the following is a specification.

This invention relates to the general class of condenser pumps but it is particularly applicable to, and is here shown in connection with, a twin vertical direct double acting high vacuum air and water pump for condensers.

The main object of the invention is to provide a pump that will give a maximum vacuum such as required for steam turbine-engines and the like.

Another object of the invention is to so construct the air check valve, that water delivered from any suitable point to seal the piston and fill the clearance space above the piston will be received by said check valve, to seal the same notwithstanding the valve is closed when the piston raises the filling water up to the valve.

Another object is to provide means whereby any vapor drawn into the air suction pipe of the pump will be promptly condensed.

These and other objects and advantages as well as the novel details of construction of this invention will be specifically described hereinafter, it being understood that changes in form, proportion and minor details of construction may be resorted to without departing from the spirit of the invention or sacrificing any of its advantages.

In the drawings, Figure 1 is a rear elevational view of a pump constructed in accordance with our invention and a condenser, parts of the condenser being broken away to show the interior construction thereof; Fig. 2 is a front view of the same; Fig. 3 is a sectional view on the line 3—3 of Fig. 2, the condenser being shown in elevation; Fig. 4 is a plan view of the condenser inlet; Fig. 5 is a sectional view on the line 5—5 of Fig. 1 through the condenser only; Fig. 6 is a vertical longitudinal sectional view through a portion of the steam chest to the slide valve for admitting steam into cylinders of the pump; Fig. 7 is an enlarged detailed view of a part of one of the valve actuators for the dry air cylinders; and Fig. 8 is a cross-sectional view on the line 8—8 of Fig. 7.

The pump herein shown is provided with a jet condenser and it will be so described, although it is obvious that it may also be utilized with a condenser of the surface type.

In the form of our invention herein illustrated, we provide a casing 1 having an intake 2 and an outlet or discharge 3. By reference to Fig. 3, it will be observed that the casing 1 is provided with a perforate suction valve deck 4 having a plurality of valve seats 6 to receive the valve disks 5 and said deck is additionally supported by posts 7. Above the deck 4 is a cylinder 8 having a head 9 which is attached to the top 10.

11 is a lantern gland in which works the rod 12 of a piston 13.

The lower end of the cylinder 8 is open and communicates with a chamber 14 formed within the casing 1.

15 is a valve plate provided with valve seats 16 to receive the valves 17, whereby water may pass from the suction chamber of cylinder 8 into a discharge chamber 18 of the outside casing 1, whence it passes out through discharge port 3 as will be explained hereinafter. The cylinder head 9 is also provided with air discharge valves, or port openings 19 having valve seats 20 surrounding them and which receive valves 21. Surrounding the valve deck 20 is a flange 22 adapted to confine water within its walls so as to form a liquid seal for the valves 21. In the head 9 of the cylinder 8 is a port 23 normally closed by a spring retained inwardly opening valve 24 provided with a disk having an annular lip or flange 25 spaced from the periphery of said valve 24 so as to confine water within its wall and form a liquid seal for said valve. As water is brought within reach of the valve only by the up stroke of the piston 13, and when the

valve 24 is closed, said valve is constructed as described, for the purpose of adapting it to trap sealing water without opening or passing the water through the port which it controls. The valve 24 and the disk for the flange 25 are both supported on the reciprocatory rod 26 which is movable in the elongated port 27 communicating with the interior of the cylinder 8, and with the condenser through a pipe 28. The end of the port 27 is provided with a gland 29 through which the stem or rod 26 projects and at the end of said rod 26 distant from the valve 24 is piston 30 working in a cylinder 31 in which is a spring 32 interposed between one face of the piston 30 and the cylinder 31, said spring 32 being an expansion spring so as to have a tendency to normally keep the valve 24 seated. The cylinder 31 is provided with a pet cock 33 of the usual type whereby air may be drawn into the cylinder on the down stroke of the piston 30 and forced out on the upward stroke, the opening governed by the pet cock determining the return speed of said piston 30. The valve stem or rod 26 is provided with a shoulder or projection 34 adapted to be intermittently engaged by the valve actuating device comprising a bell-crank 35, one arm 36 of which is hollow to receive a reciprocatory member comprising a tooth 37 polygonal in cross section and adapted to slide in said arm 36, the normal tendency of said tooth 37 being to project beyond the end of the arm 36 on account of the interposition of an expansion spring between the rear end of said tooth and the bottom of the opening of the recess in the arm 36. The remaining arm of the bell-crank is connected to a wrist plate 38 at 39 by a link rod 40. The link rod 40 may comprise members connected together by a turn buckle 41 so as to regulate the throw of bell-crank 35. The wrist plate 39 is carried on the walking beam 42 supported by the rock shaft 43 of the pump. The shaft 43 is supported in bearing blocks 44 which in turn are carried by the standards 45 forming part of the superstructure of the pump and which support the pump engine cylinders.

If all the parts are properly assembled and steam is admitted into the steam chest 52 (to be described), the engine pistons will begin to reciprocate one on instroke, the other on outstroke. If the piston 13 is moving on instroke that is so as to draw water from the bottom of the casing up through the openings closed by the valve, the air will be forced out of the cylinder 8 between the inner face of the piston 13 and the inner face of the head 9. In order to be sure that every particle of the air will be forced from the cylinder 8, we provide a film of water 87 so that as the piston moves toward the head 9, the water will be forced into every crevice or recess and displace any air which may be therein. The continued movement of the piston will force a slight quantity of liquid through the opening 19 so that at the extreme limit of the in or upward stroke of the piston 13 there will be absolutely no air in the cylinder 8. During the movement of the piston just described, the valve 24 will remain seated. During the time that the piston 13 is moving toward the cylinder head 9 it is drawing water from the condenser through the openings surrounded by the valve seats 5 so that the suction chamber of cylinder 8 becomes filled with water and when the pump is working under perfect conditions, the cylinder 8 will be filled by drawn in water on account of the instroke of the piston 13 (or its complementary piston on the other side of the pump). When piston 13 begins its outstroke however, that is away from the head 9, water which has accumulated in the cylinder 8 will be forced through the openings closed by the valve 17 and into the chamber 18. The outstroke of the piston 13 will be effective in creating a vacuum in the cylinder 8 and said vacuum will have a tendency to more tightly seat the valves 21 but unseat the valve 24. The valve 24 will not become unseated by the "pull" of the piston 13 however, because it will be restrained from any movement by the spring 32.

When the piston has moved a definite distance, for example, about one quarter of its stroke, so that there is a considerable vacuum in cylinder 8 before opening, and there will be no tendency to back-flow from said cylinder through valve port 23, the shaft 43 will have been rocked sufficiently to cause the tooth 37 to contact with the shoulder 34 and impart an opening movement to the rod 26 so as to pull in approximately dry air through the pipe 86 leading from the jet condenser 80 to be described. When the piston 13 reaches the limit of its downward stroke, the valve will be tripped and be quickly closed by the spring 32. On the next inward stroke of the piston, the air previously taken in will be forced out through the openings 19 into the chamber 18 to commingle with the water which may be in said chamber 18. When the chamber 18 becomes full, the water and air therein will pass from the outlet 3 into the hot well or other receptacle provided therefor.

The pet cocks 33 and 33′ will be regulated so as to merely provide cushioning air to prevent hammering of the valves. There is a particular advantage in having the valve 24 positively actuated, in that no vacuum is lost in overcoming the friction of the valve and compressing the seating spring. There is also an advantage in delaying the opening until the piston has executed a portion

of its stroke in that a considerable vacuum, quite sufficient to overbalance any existing on the condenser side of the valve, has been developed before the valve is unseated. A further advantage accrues from the fact that the valve closes quickly under the action of the spring, in that its closing may thus be timed to take place at the exact end of the piston's downward stroke and avoid loss due either to premature closing or commencement of the closing movement, before the piston completes its full stroke, or to tardy completion of closing, after the piston starts upward. These considerations are of especial import in raising the efficiency of a condenser pump sufficient to serve a turbine.

Up to the present point, we have described but a single cylinder and its appurtenances. It is to be understood however, that the two sides of the pump are duplicates in construction but as shown the reciprocations of the pump pistons will be such that when one piston 13′ is moving in a direction to draw in water, the remaining piston 13 on the opposite side of the pump will be moving to expel water and as one of the pistons 13 will be moving to draw in air, the opposite piston will be moving to expel air.

In order to avoid confusion as to what portion of the pump is shown by the drawings, we shall designate the two pump engine cylinders as A and B. All that portion of the pump on the A side will be designated by the reference numerals unprimed while all the mechanism on the B side which is a duplicate of that on the A side will be indicated by a reference numeral similar to that designating a part on the A side except that it will be primed, thus 26 on the A side will be 26′ on the B side.

The standard 45 supports a steam cylinder 46 in which is a piston 47 actuated by a motive fluid, as for example, steam, said piston 47 being provided with the usual piston rod 48 which is connected to the lower piston rods 12 of the piston 13 by a scotch yoke 49. The slide block 50 of the scotch yoke is connected to one end of the walking beam 42 at 51. The steam chest and valve for the two cylinders 46 or 46′ is designated by the reference numeral 52 but it is therein shown as being of approximately the same construction as the structure shown in the application of Wm. H. Blake No. 432,516 filed May 12, 1908. The steam chest 52 may be in communication with any suitable source of supply through the intake port 53 and it may exhaust through an exhaust port 54 in which is a throttle valve 55 as will be explained hereinafter. The admission of steam through the intake 53 is mechanically controlled by the rod 56 connected to a slide in the chest 52 and to a crank 57 on a shaft 43.

As heretofore explained, the chamber 14 extends entirely across the casing 1 and water therefrom may be drawn up by either of the pistons carried by the rods 12 or 12′. The inlet 2 is in communication with a condenser herein shown as of a jet type and the casing is shown as of an elongated globular form, its greatest diameter being near the top as at 58 while its restricted lower portion 59 is in communication with the inlet port 2. The inlet for the condenser casing is indicated at 60 (see Figs. 4 and 5), said opening being surrounded by the flange 61 to receive a pipe or other conductor 62 in communication with the exhaust of an engine as will be readily understood. The condenser is provided with an inward projecting flange 63 surrounding an opening 64 approximately concentric with the inlet opening of said condenser and below the flange or shelf 63 as a horizontally supported pipe 65 having an opening 66 in which a vertical casing 67 is adapted to be seated and said casing is secured to said pipe by the flanges 68 and 69 respectively, whereby a water tight joint is made between the casing 67 and pipe 65. The casing 65 is provided at the upper extremity of its periphery with a truncated conical flange 70 which is superposed above the shelf 63 and whose inclination is such that moisture will be shed from the flange 70 on to the shelf or flange 63. Supported by the casing 67 is a bar or bridge piece 71 having bearings 72 and 73 for a shaft 74 which extends beyond the end of the pipe 65 and which is provided with a hand wheel 75 whereby said shaft 74 may be turned. The shaft 74 carries a beveled gear 76 in mesh with a beveled gear 77 on a rotating valve stem 78, said valve stem 78 being provided with threads 79 to engage corresponding threads of an inverted conical regulating valve 79^a which is within the casing 67 and surrounded by the flange 70. At diametrically opposite points on the condenser are jet condensers 80 and 80′ one of which is a counter-part of the other so we will describe only one of them. By reference to Fig. 1 it will be seen that the jet condenser 80′ is in communication with the injector pipe 65 through the medium of a port 81′ which communicates with an upstanding tube 82′ leading into the globular casing 83′ said tube 82′ having its discharge end above a perforate plate 84′ whereby the water from the pipe 82′ will be caused to pass back into the casing of the injector 80 and on to the outside of the pipe 65 in the form of a cascade precipitating any steam passing through the inlet 60 and up through the dry air intake. The amount of water passing through the pipe 82′ during a given time may be regulated by the hand valve 85′. The jet condensers 80 and

80′ are in communication with the ports 27 and 27′ through the unions or pipe connections 86 and 86′.

It will be obvious that practically all of the steam will be condensed when it is understood that the water coming through the pipe 65 at a comparatively low temperature will pass up through the casing 67 and out through the upper end thereof, its volume of discharge being governed by the valve 79ª. It may be caused to spray from the casing 67 to commingle with the steam and condense it. Some of the water will shed off the flange 70 so that the steam will have to pass therethrough and from the flange 70 the water will pass on to the shelf 63 to form a curtain through which the steam must pass before it can enter the restricted portion 59 of the condenser. During all this time the vapor is being transformed to a liquid before permitting liquid and the air from leakage or other sources to pass up into the condensers 80 and 80′. The steam or vapor after being condensed together with the injection water from the pipe 65 passes down to the inlet 2 while the air is permitted to pass up into the condensers 80 and 80′. If the steam or vapor passes into said condensers, condensing water falling from the plates 84 or 84′ will condense the same and permit only air to pass into the pipes 86 or 86′. Under some conditions, the jet condensers 80 and 80′ might be dispensed with, particularly if the water passing through the pipe 65 is cold enough to condense all of the steam before it passes down beyond the shelf 63. However, ordinarily we prefer to use the condensers 80 and 80′ in addition to the main condenser heretofore described.

The cylinders 8 and 8′ are provided with water inlets 88 and 88′ respectively. These inlets are in communication with pipes 89 and 89′ which in turn are in communication with the casing 1 at 90 and 90′. The pipes 89 and 89′ are provided with valves 91 and 91′ whereby the amount of water drawn through the pipes may be governed. The pipes are also provided with check valves 92 and 92′, which close on the upstroke of the pistons and open on the downstroke thereof. These pipes are provided for the purpose of replenishing liquid supply 87, for as the pistons 13 or 13′, as the case may be, move in an upward direction some of the water will be forced out of the openings 19 endeavoring to force out all of the air but on the down stroke of the piston a sufficient amount of water will be permitted to enter the cylinder 8 to compensate for that previously dissipated through the openings 19. In the event that there is not a sufficient amount of injection water to fill the cylinders, the pistons 13 are liable to jump or kick. The shock and vibration caused by this action not only tends to injure the pump by opening joints, loosening connections, driving out valve seats and breaking valve stems, but is detrimental to the efficiency of the machine because it causes excessive valve slam and water slip consequently loss in piston displacement. We overcome this tendency to jump however, by throttling the exhaust steam from the two cylinders 46 or 46′ by placing a throttle valve 55 in the exhaust port 54 of the steam chest 52. By thus loading the pistons 47 and 47′ by throttling the exhaust, the excessive slam or jump of the pistons 13 or 13′ will be avoided. This objection of jumping or water slam is present in the device of pumps now generally in use.

We claim:—

1. In a condenser pump, the combination of the pumping cylinder, the air inlet for said cylinder, the piston working in said cylinder, means for supplying water above the piston to fill the clearance in the cylinder at the end of the compression stroke and a valve for closing the air inlet, constructed with a water receptacle for trapping sealing water, having communication with the cylinder when the valve is closed.

2. In a condenser pump, the combination of the cylinder having an air inlet port, the piston working in said cylinder, means for supplying water above the piston for the purpose of filling the clearance at the end of the compression stroke and a check valve for the air inlet port, opening inwardly to the cylinder and having a flange surrounding its seat, within the cylinder, whereby it receives sealing water at the end of the compression stroke of the piston while the check valve is closed.

3. In a condenser pump, the combination of a suitable prime mover, a pumping piston actuated by said prime mover, a cylinder for said piston, an air inlet valve for said cylinder, means for constantly loading said valve in the direction of closing, and means for positively unseating said valve and thereafter releasing it to the action of its closing means, consisting of a lever engaging the valve in the direction of unseating but moving out of engagement therewith by continuation of its throw, and a rock shaft actuated by the prime mover and having connection with said lever.

4. A twin vertical direct acting condenser pump comprising a pair of steam cylinders, pistons working in said cylinders, a walking beam connected with said pistons and insuring reciprocal action thereof, pump cylinders beneath the steam cylinders having pistons connected with the respective steam pistons, air inlet valves for the pump cylinders, closing springs for said air inlet valves

normally tending to seat them, levers engaging the respective air inlet valves in the direction to unseat them and moving to positions to release said valves by continuing their throw, and a wrist-plate carried by the shaft of the walking beam, having pitman connection with the valve levers; parts being timed to unseat the valves after commencement of the suction strokes of their respective pump pistons and to release said valves to the action of their seating springs at the completion of their suction stroke.

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In presence of—
WILTON M. GRANT,
JAS. A. SHEA.