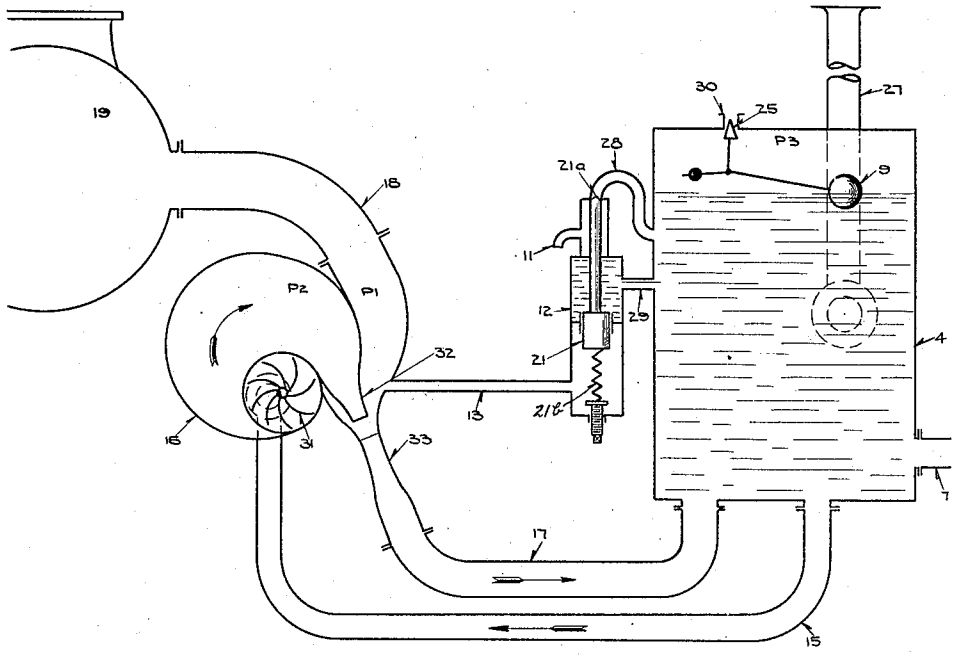
A. E. L. SCANES.

PUMP OR COMPRESSOR.

APPLICATION FILED FEB. 20, 1917.

1,327,294. Patented Jan. 6, 1920.



WITNESSES:

J. H. Kendig.

INVENTOR.

Arthur Edwin Leigh Scanes

BY Greene & McCallister

ATTORNEYS.

UNITED STATES PATENT OFFICE.

ARTHUR EDWIN LEIGH SCANES, OF ASHTON-ON-MERSEY, ENGLAND, ASSIGNOR TO THE BRITISH WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY LIMITED, A COMPANY OF GREAT BRITAIN.

PUMP OR COMPRESSOR.

1,327,294. Specification of Letters Patent. **Patented Jan. 6, 1920.**

Application filed February 20, 1917. Serial No. 149,934.

To all whom it may concern:

Be it known that I, ARTHUR EDWIN LEIGH SCANES, a subject of the King of Great Britain and Ireland, and a resident of Ashton-on-Mersey, in the county of Chester, England, have invented a new and useful Invention in Pumps or Compressors, of which the following is a specification.

This invention relates to fluid pumps or compressors of the kind utilizing a liquid in the form of a jet, spray or a succession of liquid pistons as the working medium. Pumps of this kind as at present constructed usually derive their working liquid from a tank, commonly known as a seal tank, which is maintained at approximately atmospheric pressure. Such pumps have the disadvantage that, as the weight of air or gases dealt with by the pump increases with a resulting increase in the absolute pressure at the pump suction, the quantity of working liquid drawn into the impeller or delivered by the nozzle of the pump is decreased. This will be apparent when it is remembered that the quantity of working liquid taken by the pump varies with the difference in pressure between the pressure existing at the suction of the pump and that at the receptacle from which the pump receives the working liquid.

It is one of the objects of this invention to produce a pump system wherein the difference in pressure between that existing in the tank and that in the pump suction is maintained substantially constant, so that the operation and performance of the pump will be uniform and consequently more efficient over a wide range of variations in the amount of fluid pumped. These and other objects, as may hereinafter appear, are obtained in construction illustrated in the drawing wherein—

The figure is a diagrammatic sectional view of a pump system arranged in accordance with the invention.

According to this invention, instead of an open seal tank, a closed seal tank is employed, and is provided with a restricted outlet which forms the only outlet for the gases or vapors compressed by the pump and liberated from the liquid in the tank. By suitably controlling the effective area of this outlet the difference in pressure between that in the seal tank and that in the air suction of the pump can be maintained substantially constant, thus insuring an efficient operation of the pump under wide variations in the amount of fluid pumped. For example, in the case of a pump adapted to eject gases and noncondensable vapors from a space which it is desired to evacuate, when very little gases or vapors are being delivered by the pump, atmospheric pressure may exist in the seal tank, while when gases or vapors are being delivered in such quantities that the absolute pressure in the pump is atmospheric, the pressure in the tank will be increased to one atmosphere above atmospheric pressure, so as to maintain a uniform difference in pressure between the seal tank and the pump suction.

One form of apparatus for accomplishing the above regulation of the pressure in the seal tank with respect to the pressure in the pump suction is disclosed in a copending application for patent filed May 3, 1916, Serial No. 95,151, which has now matured as Patent No. 1,268,498, June 4, 1918, wherein the outlet above referred to is controlled by a valve responsive to variations in the difference in pressures existing in the pump suction and the seal tank. This invention is substantially a modification of the invention disclosed in the above mentioned application, and the effective area of the fluid outlet of the seal tank is controlled by variations in the height of the water in the tank.

Referring to the figure which shows the complete pumping system, the pump 16 is of a well known form of rotary water extraction pump. As shown, water is taken from the tank 4 through the pipe 15 into the impeller 31 of the pump 16. Water is discharged from the impeller through the cone 32 into a collecting cone 33 entraining air from the condenser 19 arriving through the inlet pipe 18. The combined air and water mixture is then discharged through the pipe 17 into the tank 4 by reason of the high velocity of the water. The air separates out from the liquid in the tank and passes to the atmosphere through the outlet port 30, the area of which is adapted to be restricted by a valve 25 operated and controlled by a float 9 pivoted to the tank so that the float will be operated vertically to actuate the valve by variations of the water level within the tank.

It is the purpose of this invention to control the pressure within the tank so as to maintain a constant and predetermined difference in pressure between the pressure in the tank and the pressure in the pump suction or pipe 18 leading from the condenser 19. For this purpose a valve mechanism 12 is provided having a piston 21 disposed therein, which in its uppermost position holds a valve 21^a closed and thereby closes a passage 28 leading from the tank to the upper end of the valve mechanism. When this valve is in its lowest position, the passage 28 is fully open and liquid from the tank may then pass therefrom through the passage 11 to the overflow. The valve 21^a is preferably of the balanced type and is arranged within its casing so that fluid passing to the valve from the tank through the passage 29 exerts pressure upon the upper side of the valve tending to move it downward in opposition to the pressure of a spring 21^b and fluid pressure supplied to the lower face of the piston 21 through the passage 13 which communicates with the pump suction or pipe 18.

It has been found that the best results are obtained when the difference in pressure existing between the tank 4 and the pump suction is the equivalent of atmospheric pressure or practically 15 pounds and in order to maintain this difference in pressure, the fluid pressure beneath the piston 21 is supplemented by the adjustable spring 21^b adapted to hold the valve 21^a closed so long as the difference in pressure on opposite sides of the valve remains at approximately 15 pounds. It will be apparent, therefore, that before the valve 21^a will open there must exist a difference in pressure of more than 15 pounds between the pressure in the tank and the pressure in the pump suction. Therefore if the pressure in the pump suction should increase, the pressure in the tank will increase the same amount before any action of the valve 21^a occurs. However, if the pressure in the tank exceeds the predetermined difference in pressure, the valve 21^a will be caused to open by means of the greater pressure on the upper side thereof exerted by the fluid passing to the valve mechanism through the passage 29. When the valve 21 opens the passage 28 the fluid passes from the tank through the outlet 11, causing the water level in the tank to fall, carrying with it the valve float 9 and the valve 25, which increases the outlet area of the exhaust port 30. This action results in a reduction of pressure within the tank and water continues discharging from the tank until the combined spring and fluid pressure on the underside of the valve 21 again moves the valve into the closed position, stopping the flow of water from the tank. A "makeup" water supply port 7 is provided in the tank 4 through which water is supplied to the tank to take the place of the water that is lost in operation, so that the quantity of water in the system is maintained substantially constant.

In order that the operation of the apparatus may be clearly understood, it may first be supposed that the cover of the tank 4 is removed, when a plant of a well known character will be represented. Under normal conditions, the pressure P^1 in the pipe 18 is approximately zero, P^3 representing the pressure (atmospheric) at the surface of the water in the tank 4. Water flows from the tank 4 through the pipe 15 into the impeller 31 which imparts to it an absolute pressure P^2. The difference of pressure between P^2 and P^1 creates a flow of water through the cone 32. The water issuing at high velocity from the cone 32 entrains the air in the pipe 18 and discharges it into the tank 4, where the air escapes to the atmosphere. It will be obvious that the head opposing the water flowing from the impeller 31 is the pressure P^1 and it is also obvious that the quantity of water discharged by the impeller 31 will depend upon this head P^1. If a heavy leakage of air should occur in the condenser 19, the pressure P^1 would increase, consequently the head against the impeller 31 would be increased, and as in the case of centrifugal pumps, the quantity of water discharged by the impeller would decrease and therefore a less volume of air would be discharged by the water jet issuing from the cone 32.

If the cover of the tank 4 is replaced so as to convert it into a closed seal tank, the balanced valve 12 will be made operative and the pressure P^3 will be increased above atmospheric by approximately the same amount as the pressure P^1 is above zero. For example, when the plant is operating under normal conditions and P^1 equals $\frac{1}{10}$ of an atmosphere, the pressure P^3 will equal $1+\frac{1}{10}$ atmospheres. This is brought about by controlling the amount of water allowed to escape through the water outlet 11 of the valve device 12 and thereby controlling the effective area of the vent 30. If a heavy air leak occurs in the condenser 19, the pressure P^1 may rise to half an atmosphere, and the pressure P^3 will then rise to $1\frac{1}{2}$ atmospheres at which times the valve 12 will open to relieve the pressure within the tank. Although in such a case, the pressure head P^1 against the water jet has increased by 0.4 of one atmosphere, the pressure of the water at the inlet to the impeller 31 has also increased by 0.4 of an atmospere and consequently the total head against the impeller remains unaltered, therefore the same quantity of water will be discharged by the impeller and this will entrain approximately the same volume of air. The capacity of the pump is therefore, under the assumed conditions, greater

than if the tank 4 were open to the atmosphere.

When the plant is first started up and the pressure P^1 equals one atmosphere, the pressure P^3 will rise to two atmospheres before the valve 12 opens and permits water to escape from the tank through the outlet 11. As the vacuum increases and the pressure P^1 decreases correspondingly, the pressure P^3 will also decrease until normal conditions are obtained.

The impeller 31 of the pump 16 may be driven in any convenient or usual way, such as by a steam turbine or an electric motor.

In order to stabilize the pressure within the tank, a standpipe 27 is provided in order to accommodate any excess water which may accumulate in the tank before it is discharged at 11.

While I have described and illustrated but one embodiment of my invention, it will be apparent to those skilled in the art that various changes, modifications, additions and omissions may be made in the apparatus described and illustrated without departing from the spirit and scope of the invention as set forth by appended claims.

What I claim is:

1. In combination with a fluid-ejecting device with liquid as working medium and having a suction inlet for fluid, a seal tank having a gas and vapor outlet and connections whereby said device receives its actuating liquid from said tank and delivers liquid and gaseous fluids thereto, a valved water-over-flow for said tank, the operation of which is dependent upon the opposing pressures existing in the tank and at the fluid inlet of said ejecting device and means whereby the effective area of said gas and vapor outlet is automatically varied in accordance with the level of water in said tank.

2. In combination with a fluid-ejecting device with liquid as working medium and having a suction inlet for gas or air, a seal tank having a gas and vapor outlet and a water over-flow, connections whereby said device receives its actuating liquid from said tank and delivers liquid and gaseous fluids thereto, a make-up-water inlet to said tank, means controlling the effective area of said water-over-flow, the operation of which is dependent upon the difference in pressure between that in the seal tank and that at the air or gas inlet of said ejecting device, and means whereby the effective area of said gas and vapor outlet is dependent upon the water level in said tank.

3. In combination with an extraction pump, a sealed tank receiving liquid and entrained fluid from said pump, and delivering liquid to the liquid intake of said pump and provided with an atmospheric vent port, means responsive to variations in the liquid level within said tank for controlling the effective area of said vent, and means responsive to variations in the difference in pressure between the interior of the tank and a fluid passage of said pump for controlling the discharge of liquid from said tank.

4. In combination with an extraction pump, a sealed tank receiving liquid and entrained fluid from said pump, and delivering liquid to the liquid intake of said pump and provided with an atmospheric vent port, and means responsive to variations in the liquid level within said tank for controlling the effective area of said port.

In testimony whereof I have hereunto subscribed my name this 30th day of January, 1917.

ARTHUR EDWIN LEIGH SCANES.