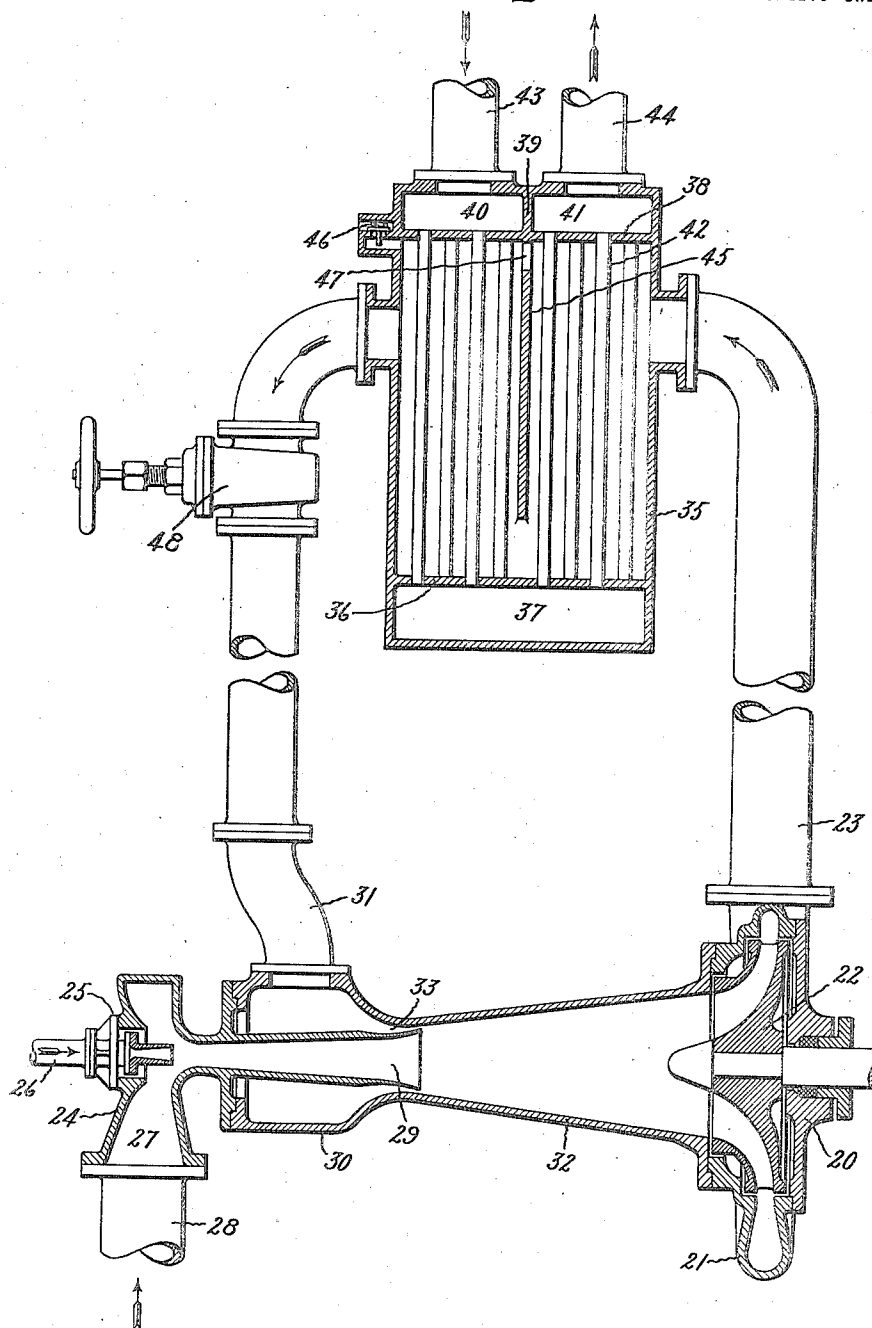


AIR PUMP.

1,267,897.

2 SHEETS—SHEET 2.

Fig. 3.



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UNITED STATES PATENT OFFICE.

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AIR-PUMP.

1,267,897.

Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, GUSTAV PAGEL, a subject of the King of Prussia, residing at Berlin, Germany, have invented certain new and useful Improvements in Air-Pumps, of which the following is a specification.

The present invention relates to air pumps for drawing off air or air and vapors from condensers or similar devices, and has for its object to provide an improved apparatus for this purpose.

In carrying out my invention, I employ a suitable pump, as a centrifugal air pump of the water throwing type, or a helical pump, and arrange on the suction side thereof a fluid ejector, preferably a steam ejector, or a water ejector, or a combination of the two, in such a manner that the diverging portion of the discharge nozzle which forms the compression chamber is directly in front of and extends up to the inlet of the pump. In my preferred structure I use a water throwing pump in combination with a steam ejector and so arrange them that the water for the pump acts as a cooling medium for condensing the steam used in the ejector. This gives a particularly economical and efficient arrangement and one capable of maintaining a high vacuum.

For a consideration of what I believe to be novel and my invention, attention is directed to the accompanying description and claims appended thereto.

In the accompanying drawings, Figure 1 is a sectional view through one form of apparatus embodying my invention; Fig. 2 is a section taken on line 2—2, Fig. 1; and Fig. 3 is a view, partly in section, of a second form or embodiment of my invention.

Referring first to Figs. 1 and 2, 4 indicates a water throwing air pump of suitable construction and comprising the usual casing 5 and shaft 6 carrying the impeller 7. It receives its supply of water through conduit 8 and discharges the water and entrained air, or air and vapors, through the discharge conduit 9. 10 indicates a steam ejector comprising the steam nozzle 11, the suction chamber 12 into which the air or vapors to be pumped are drawn by the suction action of the ejector, and the discharge nozzle 13 in the diverging portion 13^a of which the velocity of the steam and air or air and vapors is converted more or less into pressure. The diverging portion 13^a constitutes in sub-

stance a compression chamber. It is formed at its outer end with V-shaped indentations or passages 14 and surrounding it is a wall 15 forming a chamber 16 into which conduit 8 leads, and from which water is fed to the impeller 7 through the indentations. Steam is supplied to the ejector through pipe 17 and the suction chamber 12 is connected to the condenser or other apparatus from which the air or vapors is to be drawn by pipe 18.

In operation, steam is admitted through pipe 17 and is discharged from the nozzle 11 at a high velocity into the discharge nozzle 13 drawing with it air and vapors from the chamber 12. In the diverging portion 13^a of the discharge nozzle the velocity of the mixture of steam, air and vapors is to a greater or less extent converted into pressure. At the same time water for the throwing pump is being supplied through conduit 8 to the chamber 16 and then by way of the indentations or passages 14 to the impeller. This water in flowing around the nozzle 13 condenses all or the greater portion of the steam therein and thus materially decreases the volume of material to be handled by the water throwing pump. The operation of this type of pump is well understood. The vanes of the impeller as they pass by the ends of the indentations 14 in the nozzle 13 cut off successive slugs of water between which the air and vapors from the ejector are entrapped and compressed, and the whole is discharged through conduit 9. This conduit will preferably be connected with a suitable separator for separating the air from the water. The water may then be used again in the pump or it may be used for feed water.

Referring now to the modification shown in Fig. 3, 20 indicates a centrifugal pump having the casing 21, impeller 22 and discharge conduit 23. In this instance I have shown the pump in connection with both a steam and a water ejector, the steam ejector being in advance of the water ejector, as regards the direction of flow, and discharging into the diverging portion of discharge nozzle of the water ejector. The discharge nozzle of the water ejector extends up to the inlet of the pump and is connected directly thereto. 24 indicates the steam ejector having the steam nozzle 25 which receives steam through pipe 26. 27 is the suction chamber

connected by conduit 28 to a condenser or other apparatus from which the air or air and vapor are to be drawn, and 29 is the discharge nozzle. The water ejector comprises a casing 30 which receives water by way of conduit 31 and from which the water is discharged through the diverging portion of the discharge nozzle or compression chamber 32 directly to the pump casing. The discharge nozzle 29 of the steam ejector projects through the casing 30 of the water ejector and terminates at substantially the narrowest point, *i. e.* the throat, of the discharge nozzle 32. Between the end of nozzle 29 and the throat of nozzle 32 is an annular space 33 through which the water from chamber 30 is forced in passing through nozzle 32 to the pump. In other words, the nozzle 29 forms the suction pipe of the water ejector. In operation the steam jet discharged from steam nozzle 25 sucks up the air and vapors through conduit 28 and discharges them into the nozzle 29 from which they are drawn by the action of the water ejector, the flow of the water from chamber 30 through space 33 around the end of nozzle 29 creating a suction therein as is well understood. In other words, the steam ejector and the water ejector work in series. The water of the water ejector acts to condense the steam from the steam ejector so that the pump 20 has a much less volume to handle.

In this arrangement the discharge conduit 23 of the pump is shown as connected to an air separator and cooling device. It comprises a casing 35 having a horizontal partition 36 at its lower end forming a chamber 37 and a horizontal partition 38 and a vertical partition 39 at its upper end forming two chambers 40 and 41. The chambers 40 and 41 and chamber 37 are connected by a plurality of pipes 42. 43 and 44 are admission and discharge conduits connected to chambers 40 and 41 respectively and through which cooling water is admitted. This water enters chamber 40, flows down through the left-hand group of tubes 42 to chamber 37 thence up through the right-hand group of tubes 42 to chamber 41 and out through conduit 44. 45 is a baffle plate for directing the water and air and vapors discharged from conduit 23 in a tortuous path over the cooling tubes 42. It also acts to abruptly break the direction of flow of the water and this assists in the separation of the air and vapors therefrom. The air and vapors separate from the water in chamber 35, and rising to the upper portion thereof escape through the relief valve 46. 47 is an opening through the upper portion of baffle plate 45 to permit of the passage of air to the relief valve. The water in passing over the tubes 42 is cooled and flows to the conduit 31 and is again used in the water ejector.

Its passage through conduit 31 may be controlled by a valve 48. The cooling water used in the cooler and air separator may be the feed water for a boiler, thus effecting an economy in heat.

In accordance with the provisions of the patent statutes, I have described the principle of operation of my invention, together with the apparatus which I now consider to represent the best embodiment thereof; but I desire to have it understood that the apparatus shown is only illustrative, and that the invention can be carried out by other means.

What I claim as new and desire to secure by Letters Patent of the United States, is,—

1. In an apparatus of the character described, the combination of a pump and a fluid ejector arranged on the suction side thereof with the diverging portion of its discharge nozzle extending up to and connected directly with the inlet of the pump.

2. The combination with a centrifugal pump, of an ejector apparatus arranged on the suction side thereof, said ejector apparatus having a diverging discharge nozzle which extends up to and discharges directly into the inlet of the pump.

3. In an apparatus of the character described, the combination of a centrifugal water throwing pump, a steam ejector arranged on the suction side thereof with its discharge nozzle extending up to and discharging directly into the inlet of the pump, said nozzle being formed with indentations, and means for feeding throwing water through said indentations to the pump.

4. In an apparatus of the character described, the combination of a centrifugal pump, a discharge nozzle extending up to and connected directly to the inlet of the pump, a steam nozzle discharging into said first named nozzle, and means for supplying water around the discharge nozzle to said pump.

5. In an apparatus of the character described, the combination of a centrifugal water throwing pump, a steam ejector arranged on the suction side thereof with its discharge nozzle extending up to and discharging directly into the inlet of the pump, said nozzle having V-shaped indentations therein which extend down to the pump inlet, a casing surrounding said nozzle, and means for supplying throwing water to said casing from which it flows through said indentations to the impeller of the pump.

6. In a water throwing pump, the combination of a casing having an inlet, an impeller located in the casing, an elastic fluid ejector having a diverging discharge nozzle, said nozzle extending up to and discharging directly into the inlet of the pump, and means for supplying water to the pump.

7. In an apparatus of the character described, the combination of a centrifugal

5 pump having an inlet and an outlet, a steam ejector arranged on the suction side thereof with its discharge nozzle adjacent to and discharging directly into the inlet of the pump, and means independent of the ejector and connected directly with the inlet of the pump for supplying water thereto.

8. In an apparatus of the character described, the combination of a centrifugal pump having an inlet and an outlet, a conduit connected to the inlet of the pump for supplying water thereto, and an ejector com-

prising a nozzle through which pumping fluid is admitted and a discharge nozzle, arranged on the suction side of the pump, said discharge nozzle being separate from said conduit and extending up to and discharging directly into the inlet of the pump.

In witness whereof, I have hereunto set my hand this 4 day of March, 1915.

GUSTAV PAGEL.

Witnesses:

PAUL HOSEL,
ALFRED PABBY.