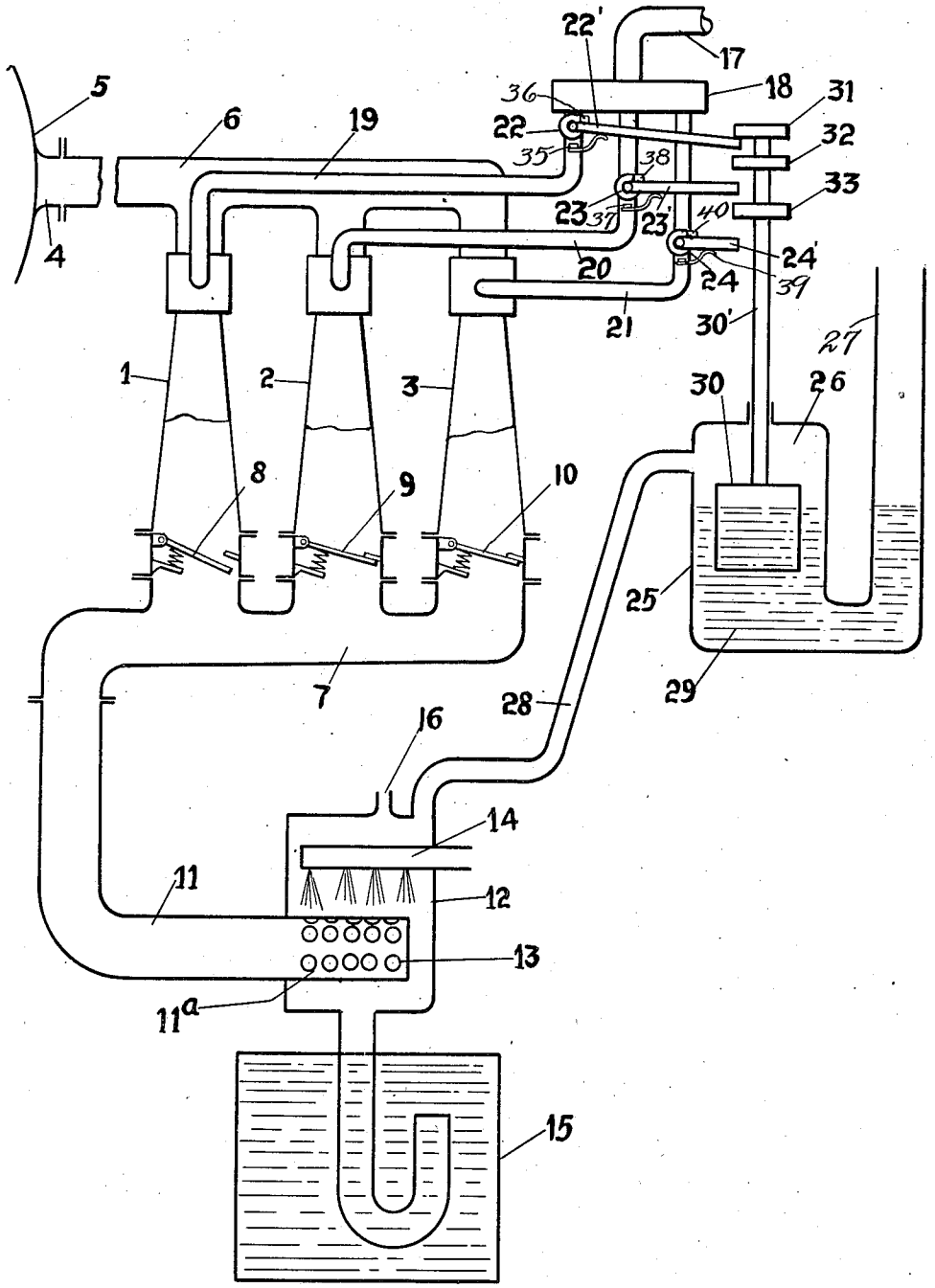
Feb. 19, 1924. 1,484,013

R. N. EHRHART

EJECTOR APPARATUS

Filed Aug. 21, 1918



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UNITED STATES PATENT OFFICE.

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EJECTOR APPARATUS.

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To all whom it may concern:

Be it known that I, RAYMOND N. EHRHART, a citizen of the United States, and a resident of Edgewood, in the county of Allegheny and State of Pennsylvania, have made a new and useful Invention in Ejector Apparatus, of which the following is a specification.

This invention relates to means for extracting non-condensable fluids from condensers or the like. Air pumps and particularly hydraulic air pumps employed for such purposes, are usually designed with a capacity sufficient to operate effectively under maximum extraction conditions and are constantly supplied with sufficient steam or motive fluid to effectively operate under full load or maximum extraction conditions.

If the quantity of fluid to be extracted is small, the steam or motive fluid supply should be reduced in order to conserve steam or motive fluid. An object of my invention is therefore to produce automatic means for controlling the delivery of steam or motive fluid to the air pump for condensers, or like apparatus in response to variations in the amount of fluid or air to be abstracted.

Where steam actuated air ejectors are employed for extracting air on non-condensable fluid from condensers, it is customary to deliver a constant quantity of steam or motive fluid to the ejector independently of the amount of extraction to be accomplished. This practice results from the fact that such ejectors operate effectively and efficiently, only under certain conditions of fluid flow through them, and are likely to upset or become ineffective where the flow conditions are materially varied. Such procedure obviously results in poor economy, and an object of the present invention is to produce steam actuated air ejector apparatus for condensers or like apparatus wherein, the quantity of motive fluid (steam) delivered to the ejector apparatus is automatically proportioned to the work of extraction imposed upon the apparatus.

A further object is to produce an air ejector apparatus for condensers or like receptacles including a series of separately controlled ejectors in connection with which automatic means are employed for successively rendering ejectors of the series operative as the amount of non-condensable fluid to be extracted increases, and for successively rendering ejectors of the series inoperative as the amount of fluid to be extracted decreased.

A further object of the invention is to produce an air ejector apparatus including a plurality of separate ejectors and in connection with which automatic means are employed for varying the number of operating ejectors in response to variations in the amount of necessary extractions.

A further object of the invention is to produce an ejector apparatus having a plurality of small capacity ejectors operating jointly to extract non-condensable fluid from a condenser or similar receptacle, and having automatic controlling means for the motive fluid supplied thereto, whereby certain ejectors are cut out of service when the load imposed on the ejector apparatus diminishes to a point where it may be carried by a smaller number of ejectors with maximum efficiency.

A further object of the invention is to produce an ejector apparatus comprising a plurality of ejecting units, and having simple effective automatic controlling means for the motive fluid supplied thereto, responsive in operation to the quantity of air or other fluid to be extracted.

These and other objects which will hereinafter be made more apparent, are obtained in the apparatus herein illustrated in the accompanying drawing wherein—

The figure is a diagrammatic sectional showing of apparatus embodying the features of this invention.

Referring to the drawing, the apparatus includes a plurality of jet ejectors of 1, 2 and 3, connected in parallel with the air offtake port 4, of a condenser 5, by means of a manifold conduit 6. The ejectors are adapted to discharge into an exhaust manifold 7,

and the discharge ports of the ejectors 1, 2 and 3, which term includes any portion of the diffuser of each ejector, are provided with check valves 8, 9 and 10 respectively adapted to prevent a back flow of fluid from the exhaust manifold when the respective ejector is cut out of operation. The purpose of the check valves will hereinafter be more apparent.

The exhaust manifold 7, is connected with an exhaust pipe 11, which terminates in a delivery nozzle 11ª located within a condenser or feed-water heater 12, which is preferably of the open type. Fluid discharged from the ejector apparatus, is discharged through the nozzle 11ª, which as indicated, consists of a series of perforations 13, in such manner that the cooling water, or feed-water sprayed from the water delivery nozzle 14 of the feed-water heater, contacts therewith to the best advantage so that the steam will be condensed and the temperature of the feed-water raised.

As shown, the water heater or condenser discharges the feed-water and condensate into a feed tank 15, which may be of any construction, and the heater is provided with a restricted vent 16, leading to the atmosphere for permitting the escape of the non-condensable fluids extracted by the ejector apparatus. It will be apparent, that if the area of the orifice is such that the air within the heater 12 is compressed, due to the ingress of air being greater than the egress thereof through the vent 16, the pressure within the heater 12 will vary with the quantity of air being forced into the heater. It is assumed, of course, that the heater or condenser is of sufficient condensing capacity to condense all of the motive fluid delivered thereto, when the ejector apparatus is operated under maximum extraction or full load conditions.

The variations of pressure in the heater occasioned by variation in the quantity of air delivered thereto, are utilized in controlling the supply of motive fluid to the ejector apparatus by means of apparatus to be described. The ejectors 1, 2 and 3, are independently supplied with motive fluid from a common steam supply pipe 17 and header 18, by means of steam conduits 19, 20 and 21 respectively. The conduits 19, 20 and 21, are provided with valves 22, 23 and 24 respectively, for the purpose of independently controlling the motive fluid admission to the ejectors, whereby any or all of the ejectors may be cut out of operation.

As previously set forth, ejectors work most efficiently when working under the condition of fluid flow through them for which they are designed, and that regardless of the load, whether light or heavy, the steam supply is maintained constant so as to ensure effective operation of the ejectors. In order to obtain flexibility in operation of the ejectors and attain an economy in steam consumption, the plurality of ejectors, each having a capacity less than is required to eject the maximum amount of air accumulating in the condenser, is provided so that when the load is light, certain ejectors may be cut out of operation. Valves 22, 23 and 24 are therefore of a type adapted to open and close quickly in response to the following operating mechanism.

A float tank 25 is provided, having a float chamber 26 and a stand-pipe 27, communicating with the chamber adjacent the bottom, and the upper portion of the float tank communicates with the upper portion of the heater 12, through a pipe 28, so that the level of the liquid 29, within the float chamber 26, is subject to the pressure existing in the heater, and the water level in the float chamber therefore varies in response to variations of pressure within the heater 12.

The controlling valves 22, 23 and 24 are operated in response to variations of the pressure within the heater 12, by means of the float 30, which moves vertically with variations in the water level in the chamber 26. Diagrammatic means are illustrated, by which the float actuates the valves 22, 23 and 24. As shown, the float carries upon a stem 30′, a series of contact collars 31, 32 and 33, which successively engage the valve levers 22′, 23′ and 24′ respectively. Valve levers 22′, 23′ and 24′, operate or trip the quick acting valves 22, 23 and 24, respectively, which are preferably designed to normally remain closed. The float is normally adjusted to hold the valve 22 open, as indicated by the inclination of the valve lever 22′, when the apparatus is operated under minimum extraction conditions. The operation of the apparatus is as follows.

In starting up the ejector apparatus, one or all of the ejector valves may be opened manually, so as to start the operation of the ejector. Motive fluid entering the ejector immediately forces the check valves 8, 9 and 10 open, permitting the ejected air and exhaust motive fluid to enter the heater 12. The pressure in the heater will correspond to the quantity of air extracted, and if a slight amount only is being extracted, the pressure in the heater 12 will be such that the float 30 will occupy the normal position in which the collars 33 and 32, disengage the levers 24′ and 23′ respectively, permitting the automatic closing of the valves 24 and 23 of the ejectors 2 and 3, because they are no longer necessary for carrying the reduced load.

Should a greater quantity of air be delivered to the heater than can escape through the vent 16, to the atmosphere under the

existing pressure conditions within the heater, the pressure within the heater will rise until the escape of air is the equivalent of the inflow. The increased pressure in the heater 12, depresses the water level in the float chamber 26, and causes the float to drop, bringing the collar 32, first into engagement with the valve lever 23′, and thereby causing the valve 23 to open to supply the ejector 2 with steam.

A further increase in the quantity of air delivered to the heater will cause the float to drop still further and finally open the valve 24 by reason of the contact of the collar 33 with the lever 24′. A decrease in the pressure causes the reverse operation, and the valves 24 and 23 will be successively closed. The instant the steam is shut off from the ejector 3, the check valve 10 will close to prevent a reverse flow of fluid from the manifold 7. When the motive fluid is cut off from the ejectors 2 and 1, the check valves 9 and 8 will close.

It will be seen from the foregoing that the above described apparatus is flexible and that it automatically controls the motive fluid supply, so as to eject non-condensable fluids from a condenser with an economy of steam consumption unattainable with a single ejector.

In the apparatus illustrated, I have shown cooperating springs and abutments 35 and 36, 37 and 38, and 39 and 40 associated with the valve levers 22′, 23′, and 24′, respectively, for the purpose of maintaining the valves 22, 23, and 24 normally closed. The valves will automatically close when their respective arms or levers are disengaged by their respective controlling stop on the float stem 30′. However, it will be apparent that any equivalent means may be utilized for the purpose of automatically closing the valves and that means may be employed whereby the stem 30′ positively closes the different valves as they move the float upwardly.

What I claim is:

1. The combination with a plurality of separately controlled fluid operated ejectors for extracting fluids from a receptacle to which they are connected, of a vented water heater for receiving the exhaust motive fluid and extracted fluid from the ejectors, and means responsive to pressure within the water heater for controlling the admission of motive fluid to the ejectors.

2. The combination with a fluid operated ejector for extracting fluid from a receptacle, of a vented water heater receiving exhaust steam and extracted fluid from the ejector, and means responsive to pressure in the heater for controlling the admission of motive fluid to the ejector.

3. Ejector apparatus comprising in combination a fluid operated ejector for extracting fluid from a receptacle, a float tank subject to pressure in the delivery of the ejector, containing liquid responsive to pressure in the float tank, a float in the tank adapted to rise and fall with the level of the liquid in the tank, and a motive fluid control valve connected to the float and actuated by vertical displacement of the float.

4. Ejector apparatus comprising a plurality of fluid operated ejectors adapted to extract fluid from a receptacle and arranged in parallel, a condensing receptacle connected to the discharge ends of said ejectors and provided with an air vent, a pressure responsive device in communication with said condensing receptacle, valves for controlling the flow of motive fluid to said ejectors, means for normally holding the valves closed, and an element moved by said pressure responsive device to open said valves.

5. In combination with a receptacle to be evacuated of a compressible fluid, a plurality of evacuating devices connected in parallel to said receptacle, and means responsive to variations in the amount of fluid being withdrawn for varying the number of the effective evacuating devices.

6. In combination with a receptacle to be evacuated of a compressible fluid, a plurality of evacuating devices connected in parallel to said receptacle, and means responsive to variations in the amount of fluid being withdrawn for varying the number of the effective evacuating devices, including means for successively rendering operative or inoperative the several evacuating devices.

7. In combination with a condenser, a plurality of evacuating devices arranged in parallel for the withdrawal of non-condensable fluids from the condenser, and means responsive to variations in the quantity of non-condensable fluids being withdrawn for increasing or decreasing the number of effective evacuating devices.

8. In combination with a vessel to be evacuated of non-condensable fluids, a plurality of ejectors connected in parallel for the evacuation of the vessel, means for controlling the supply of motive fluid to each ejector the means associated with said control means for increasing or decreasing the number of ejectors to which motive fluid is supplied in response to an increase or a decrease in the quantity of the non-condensable fluids being withdrawn.

9. The method of maintaining a condenser at a substantially uniformly low vacuum pressure under varying load conditions which comprises initially entraining the non-condensable fluids from the condenser in one or more of a plurality of parallelly arranged evacuating devices, and varying the number of the effective evacuating devices in accordance with the variations

in the quantity of the non-condensable fluid being withdrawn.

10. The method of compressing varying quantities of non-condensable fluid, which comprises initially entraining the non-condensable fluid in rapidly moving motive fluid, and increasing the entraining area of said motive fluid substantially in accordance with increases in the amount of non-condensable fluid being entrained.

In testimony whereof, I have hereunto subscribed my name this 17th day of August, 1918.

RAYMOND N. EHRHART.