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MULTIPLE STAGE EJECTOR.

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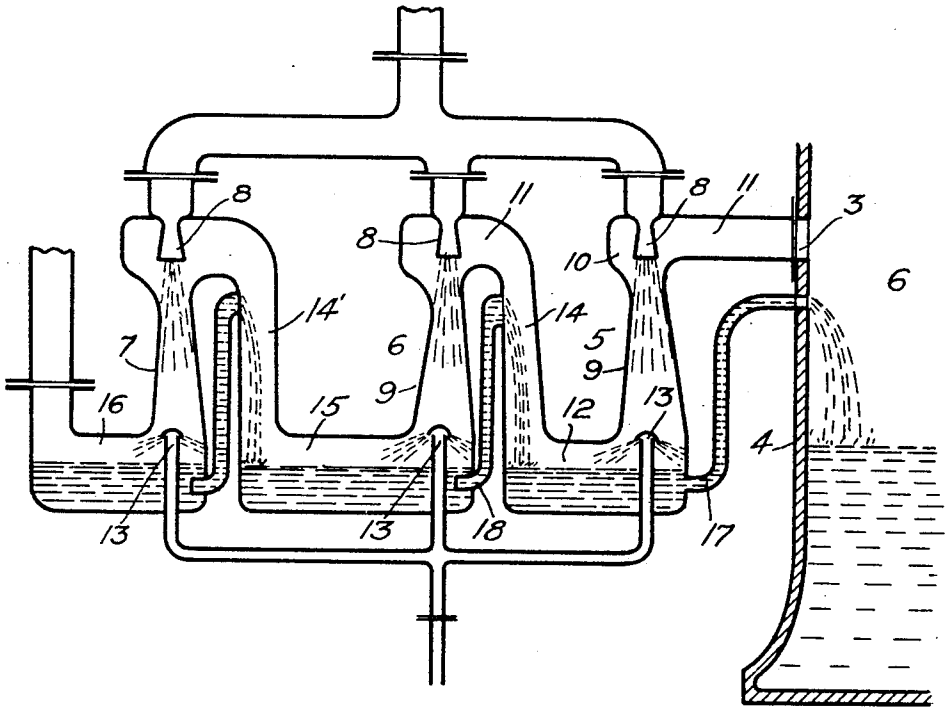
1,397,924.

Patented Nov. 22, 1921.



WITNESSES:

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MULTIPLE-STAGE EJECTOR.

1,397,924. Specification of Letters Patent. Patented Nov. 22, 1921.

Application filed October 18, 1917. Serial No. 197,362.

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 Park, in the county of Allegheny and State of Pennsylvania, have made a new and useful Invention in Multiple-Stage Ejectors, of which the following is a specification.

This invention relates to ejector apparatus and particularly to such apparatus capable of operating in withdrawing non-condensable fluids from a condenser or similar receptacle in which a relatively high vacuum is maintained.

An object of the invention is to produce an effective ejector apparatus which operates on expansive motive fluid, is of simple construction, efficient in operation and capable of being employed for withdrawing non-condensable fluids from a condenser.

These and other objects, which will be made apparent throughout the further description of my invention, are attained by means of apparatus embodying the features herein described and illustrated in the drawing accompanying and forming a part hereof.

In the drawing I have diagrammatically illustrated an ejector apparatus embodying my invention and shown in section in connection with a fragmental sectional view of a condenser.

As illustrated, the apparatus consists of a plurality of steam actuated ejectors adapted to operate in series and provided with intercoolers or condensers arranged between the ejectors of the series.

Referring to the drawing, the air offtake port 3 of the condenser shell 4 communicates with the inlet of the ejector apparatus. As shown, the ejector apparatus includes three ejectors 5, 6 and 7, each comprising a fluid delivery nozzle 8 and a diffuser tube 9. The nozzle 8 is preferably divergent and adapted to expand the motive fluid (herein termed steam) traversing it to the pressure normally existing at its outlet, or within the inlet to the ejector which it serves. As shown, each nozzle 8 projects into a combining chamber 10, which communicates with the inlet end of the diffuser and which is provided with an inlet port 11. Each nozzle is shown axially alined with its coöperating diffuser 9, or so located with reference to the diffuser that the stream of motive fluid issuing from it is discharged into and through the diffuser. As illustrated, the outlet of the diffuser forming a part of the ejector 5 communicates with a receptacle or chamber 12, which may be termed an intercooler or condenser. Means are employed within the chamber 12 for condensing the condensable fluids issuing from the ejector 5. As shown, cooling or condensing water is introduced into the receptacle 12 by means of a spray nozzle 13, which is preferably so located that the fluids issuing from the outlet of the ejector are subjected to the cooling action of the water by being intimately mixed with it.

Besides operating as a collecting chamber for the water issuing from the nozzle 13 and the condensate resulting from the condensation of the condensable fluids such as the steam and vapor issuing from the ejector, the chamber 12 forms a means of communication between the ejectors 5 and 6. As shown, the chamber 12 is provided with a passage 14 which communicates directly with the inlet port 11 of the ejector 6. The outlet of the ejector 6 communicates with a chamber 15 similar to the chamber 12 and which forms a means of communication between the ejectors 6 and 7. The ejector 7 discharges into a chamber 16 similar to the chamber 12 and which may communicate directly with the atmosphere, with a fourth ejector or with any type of air pump. Both the chambers 15 and 16 are shown provided with spray nozzles 13 and both operate to collect the cooling liquid and condensate.

The ejector 5 partially compresses the fluids withdrawn from the condenser and consequently the pressure within the chamber 12 is higher than that within the condenser. By taking advantage of this superior pressure I am able to dispose of the liquid collected within the chamber 12. As illustrated, I provide a pipe or passage 17 which is adapted to form a manometric connection between the chamber 12 and the condenser. As shown, the inlet of the passage 17 is so located that it is normally below

the level of the liquid contained within the chamber 12 and the passage is so arranged as to maintain a column of water between the chamber 12 and the condenser, which is capable of counterbalancing the superior pressure of the chamber 12 over that of the condenser, and at the same time is capable of discharging the excess water from the chamber 12 into the condenser. As illustrated, the passage 17 extends upwardly so that its outlet into the condenser is located sufficiently above its inlet to provide a column of water within the passage capable of counterbalancing the differences in pressure between the condenser and the chamber 12. Similar connections are provided between the chambers 12 and 15 and the chambers 15 and 16. As shown, a passage 18 is provided between the chambers 12 and 15, the inlet end being located below the normal water level within the chamber 15 and the outlet end so arranged as to discharge into the passage 14. With this arrangement, the passage 18 not only discharges excess water from the chamber 15, but discharges the water in such a way as to insure the condensation of steam leaving the chamber 12 and entering the passage 14.

It will, of course, be understood that any type of condenser may be employed as intercooler between adjacent ejectors and that a plurality of steam delivery nozzles may be employed for expanding and delivering the steam to each ejector. Exhaust steam may be employed as the motive fluid for the ejectors and, if desired, each ejector may receive motive fluid from a separate source.

The operation of the apparatus is as follows: The ejector 5 withdraws non-condensable fluids from the condenser and partially compresses these fluids in delivering them to the chamber 12. The steam issuing from the ejector 5 is condensed within the chamber 12 or in its passage from that chamber to the ejector 6. The ejector 6 receives the partially compressed non-condensible fluid and further compresses it in delivering it to the chamber 15. The steam issuing from the ejector 6 is condensed within the chamber 15 or within the passage 14′ and non-condensable fluid from the chamber 15 is delivered to the ejector 7. The ejector 7 further compresses the fluid and delivers it to the atmosphere or to additional compressing apparatus. The difference in pressure between the chambers 15 and 16 occasions the discharge of water from the chamber 16 to the chamber 15 and the difference in pressure between the chambers 12 and 15 operate to occasion the discharge of the excess water from the chamber 15 into the chamber 12, from which all excess water is discharged into the condenser and through the passage 17, as has been described.

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 illustrated without departing from the spirit and scope of the invention, as set forth by the appended claims.

What I claim is:

1. In combination in a multi-stage ejector apparatus, a plurality of ejectors operating in series, intercoolers between adjacent ejectors of the series, and manometric connections between adjacent intercoolers for discharging excess liquid from one intercooler to an intercooler of lower pressure.

2. In combination in a multi-stage ejector, a plurality of ejectors operating in series, each ejector of the series discharging into a condenser, with which the inlet of another ejector of the series communicates, and manometric connections between adjacent condensers for delivering liquid from condensers of high pressure to condensers of lower pressure.

3. In combination in a multi-stage ejector, an ejector, the inlet of which communicates with a source of fluid to be ejected, an intercooler communicating with the discharge of said ejector, a second ejector communicating with the intercooler, and a second intercooler communicating with the discharge of said second ejector, and a manometric connection between the intercooler for delivering excess liquid.

4. In combination with a condenser, a plurality of ejectors operating in series, intercoolers between adjacent ejectors of the series, and means forming a liquid seal between intercoolers for delivering excess liquid from one intercooler to another and to the condenser.

5. In combination with a condenser, a plurality of ejectors operating in series, intercoolers located between adjacent ejectors of the series, and means for delivering cooling water from one intercooler to another and finally to the condenser.

6. In combination in an apparatus of the character described, an ejector, a condenser communicating with the outlet thereof, a second ejector communicating with said condenser, a second condenser communicating with the outlet of the second ejector, and means for delivering liquid from the second condenser to the communicating passage between the first mentioned condenser and the second ejector.

7. In combination in an apparatus of the character described, an ejector, a condenser communicating with the outlet thereof, a second ejector communicating with said condenser, a second condenser communicating with the outlet of the second ejector, and a manometric connection between the second condenser and the communicating passage

between the first mentioned condenser and the second ejector for delivering liquid from the second condenser to the said passage.

8. In combination in a multi-stage ejector apparatus, a plurality of ejectors operating in series, intercoolers between adjacent ejectors of the series, and means for connecting the intercoolers in series whereby excess liquid in one intercooler may automatically flow to an intercooler of lower pressure.

In testimony whereof I have hereunto subscribed my name this 17th day of October, 1917.

RAYMOND N. EHRHART.

Witness:

C. W. McGHEE.