

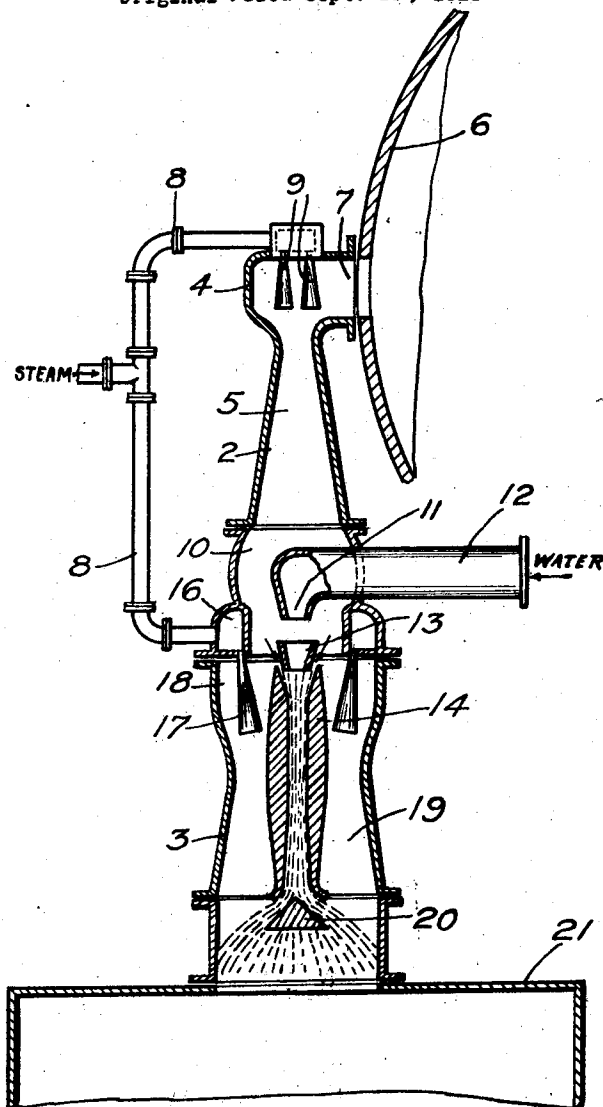
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R. N. EHRHART

EJECTOR APPARATUS

Original Filed Sept. 18, 1918



WITNESSES:

[Signature]

INVENTOR

R. N. Ehrhart.
BY *[Signature]*
ATTORNEYS.

Patented Aug. 4, 1925.

UNITED STATES PATENT OFFICE.

RAYMOND N. EHRHART, OF EDGEWOOD, PENNSYLVANIA, ASSIGNOR TO WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, A CORPORATION OF PENNSYLVANIA.

EJECTOR APPARATUS.

Application filed September 18, 1918, Serial No. 254,663. Renewed November 15, 1919. Serial No. 338,326.

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 ejector apparatus and particularly to that class of ejectors used for extracting air or other non-condensable fluids from condensers. Such ejectors are usually operated by steam, and two or more are connected in series forming a multi-stage ejector. The steam employed as the ejecting fluid in the initial stage or stages of a multi-stage ejector is usually withdrawn or ejected by the subsequent stage or stages, although multi-stage ejectors have been provided with inter-condensers or coolers so arranged that the ejecting fluid of the initial stage or stages is condensed and subsequent stages are thereby relieved of the work of ejecting this fluid. Ejectors so equipped are usually objectionable both from the standpoint of initial cost and the cost of maintenance and operation. The interstage and final condensers complicate the apparatus and increase the cost of manufacture and the cost of installing and also occupy considerable space.

An object of this invention is to produce an ejector equipped with an inter-stage condenser or cooler which is simple and compact and relatively cheap to manufacture and which is self-contained and forms in effect a single unit.

A further object is to produce an ejector apparatus in which a single water jet ejector serves to condense the ejecting fluid issuing from the various stages of the ejectors.

Another object is to produce an ejector apparatus having an interstage cooler or condenser which is simple to operate and is durable and efficient.

Another object is to produce an ejector apparatus wherein a condenser is interposed between the final stage of the ejector and the feed tank, and forms a part of the ejector apparatus, thereby eliminating the usual piping and conserving a maximum amount of heat.

These and other objects which will hereinafter appear, are attained by the apparatus embodying the features disclosed in the accompanying drawing, which illustrates one embodiment of the invention.

The figure is a diagrammatic longitudinal sectional view of the apparatus.

Referring to the drawing, the apparatus includes a multi-stage ejector comprising an initial stage ejector 2, and a final stage ejector 3, arranged to operate in series. The initial stage ejector 2 includes a combining or suction chamber 4, and a diffuser 5, through which the combined air and steam passes to the final stage ejector 3. The combining chamber 4 is adapted to communicate with a condenser 6 through an air offtake port 7, and the motive fluid is supplied to the ejector through the conduit 8 and divergent expansion nozzles 9 which latter expand the motive fluid and discharge it at a high velocity through the combining chamber 4 and into the diffuser 5.

The steam issuing from the diffuser 5 is received by a condensing chamber 10 and is there subjected to the condensing action of a water jet ejector which includes a water delivery nozzle 11 supplied with water under pressure through a water conduit 12 extending through the casing of the chamber 10. The nozzle 11 is directed downwardly and discharges through a combining and collecting cone 13, which is mounted within the casing some distance below the end of the nozzle 11, and is designed to collect the water delivered from the nozzle 11 and to deliver it in a substantially unbroken stream to the flared upper end of a diffuser 14, which extends downwardly through the diffuser 19 of the final stage ejector 3. The water delivered to the nozzle 11 need be only at a pressure slightly above atmosphere, since a moderate vacuum exists at the discharge end of the diffuser 5, and consequently a great amount of velocity energy is not necessary to cause the water to force its way through the diffuser 14. The position of the nozzle 11 with relation to the inlet of the diffuser 14 must be such as to expose sufficient surface of the water jet issuing from the nozzle 11 to accomplish the necessary condensation of the steam within the condensing chamber 10. The inlet of the diffuser 14 should also be materially above the ejector 3, so as to prevent the motive steam delivered to the ejector 3 from being drawn into the diffuser. It will be apparent that the jet of water issuing from the nozzle 11 not only cools the

interior of the chamber 10 but also accomplishes condensation by mechanically entraining steam within the chamber 10 and delivering it through the diffuser 14. In other words, the nozzle 11, combining and collecting cone 13 and diffuser 14 operate as a combined condenser and ejector, the entrained steam being condensed by contact with the water in traversing the passages of the water ejector.

The final stage ejector 3 consists of an annular expansion nozzle or an annular series of expansion nozzles 17, a combining chamber 18 and a diffuser 19. The chamber 18 surrounds the upper end of the diffuser 14 and is in open communication with the chamber 10. The diffuser 19 is annular in form and surrounds the diffuser 14.

The diffuser 14 terminates adjacent the lower end of the diffuser 19, and discharges the water passing through it against a conical spreader 20, located within the diffuser 19 and below the discharge end of the diffuser 14. The spreader 20 deflects the water radially toward the outer walls of the diffuser 19, thereby forming a conical sheet of water extending from the center of the diffuser to the walls thereof, through which the fluid exhausting from the diffuser 19 must pass in exhausting to the atmosphere or into a feed tank 21 which may communicate with the exhaust of the multi-stage ejector.

The efficiency of the condenser is increased by reason of the water jet ejector condenser functioning as ejector. The energy required for circulating the water through the usual surface condenser used in connection with ejector apparatus is therefore employed in an ejector embodying my invention in augmenting the ejector action. The cooling water for the water jet ejector may be supplied by the condensate pump of the main condenser and therefore no additional circulating pumps are necessary for the operation of the apparatus. It will be apparent, however, that the water must be supplied at a pressure sufficient to produce sufficient velocity to accomplish the necessary velocity conversion within the diffuser 14 since the pressure at the outlet of the diffuser 5 is less than that at the outlet of the diffuser 19, and it will be apparent that the apparatus is simple and compact, and that the condenser is, in effect, an integral part of the multi-stage ejector. The steam issuing from the initial stage ejector 2 is subjected to the condensing action of the water jet traversing the chamber 10 and, in addition, is entrained by the water jet, so that the major portion of the condensate resulting from the condensation of the steam in the chamber 10 is automatically discharged by the condensing jet.

While I have illustrated and described 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 the appended claims.

What I claim is:

1. The combination with a multi-stage ejector, of a jet condenser adapted to entrain the exhaust from one ejector by means of the cooling fluid from the condenser, and to discharge the condensate and cooling fluid into the diffuser of a second ejector.

2. The combination with a multi-stage steam operated ejector, of a water jet ejector having its suction in the diffuser of one stage ejector and discharging into the diffuser of another stage ejector.

3. The combination with a multi-stage steam operated ejector, of a water jet ejector having its suction communicating with the diffuser of one ejector stage and discharging into an exhaust passage of a second ejector stage.

4. The combination with a multi-stage steam operated ejector, of a water jet ejector having its suction communicating with the diffuser of one ejector stage and discharging radially into an exhaust passage of a second stage.

5. The combination with a multi-stage steam operated ejector, of a water jet ejector having its suction communicating with the diffuser of one ejector stage and discharging radially into the diffuser of another ejector stage.

6. A multi-stage ejector operating in series comprising an ejector stage, including a diffuser, a water jet ejector having its suction in communication with the exhaust of the ejector stage, a second ejector stage having its mixing chamber and diffuser surrounding the water jet ejector and provided with expansion nozzles surrounding the water jet ejector, and means for discharging the fluids exhausted from the water jet ejector into the exhaust passage of the second ejector stage.

7. A multi-stage ejector operating in series comprising an ejector stage, including a diffuser, a water jet ejector having its suction in communication with the diffuser of the ejector stage, a second ejector stage having its mixing chamber and diffuser surrounding the water jet and provided with expansion nozzles surrounding the water jet ejector, and means for discharging the fluids exhausted from the water jet ejector across the exhaust of the second ejector stage.

8. Ejector apparatus comprising in combination a feed tank, a multi-stage steam operated ejector discharging into the feed tank and a water jet ejector having its suction communicating with the diffuser of one

stage and discharging into the discharge passage of the ejector stage opening into the feed tank.

9. Ejector apparatus comprising in combination a feed tank, a multi-stage steam operated ejector discharging directly into the feed tank and a water jet ejector having its suction communicating with the diffuser of one stage and discharging into the diffuser of another ejector stage.

10. In combination with a multi-stage ejector, means for exposing fluid issuing from one stage of the ejector to the cooling action of a water jet, and means for exposing the fluid issuing from another stage of the ejector to the cooling action of water from the water jet.

11. In combination with a multi-stage ejector, means for exposing fluid issuing from one stage of the ejector to the cooling action of a water jet, a diffuser receiving said jet and discharging so as to expose the fluid issuing from a subsequent stage of the ejector to the cooling action of water which has traversed said jet.

12. In combination with a fluid operated multi-stage ejector, a nozzle for delivering a jet of water through an exhaust passage of a stage of the ejector, a diffuser spaced from said nozzle receiving the water from said nozzle and discharging the water through an exhaust passage of a subsequent stage of the ejector.

13. In combination in a fluid translating device, a combining chamber having an inlet port, a diffuser communicating therewith, a nozzle for delivering water to said combining chamber, and a plurality of nozzles for delivering steam to said diffuser, said steam nozzles surrounding said water nozzle.

14. In combination in a fluid translating device, a combining chamber having an inlet port, a diffuser communicating therewith, a nozzle for delivering motive steam to said diffuser, a nozzle for delivering water to said combining chamber, and a hollow member spaced from said water nozzle for receiving the jet from said water nozzle and a portion of the fluid to be entrained.

15. In combination, an initial ejector having a port adapted to communicate with a

receptacle to be evacuated, and comprising a steam delivery nozzle and a diffuser communicating with said port and through which steam delivered from said nozzle passes and from which all the entraining and entrained fluid is delivered, a second ejector communicating therewith comprising a combining chamber, a diffuser communicating therewith, a nozzle for delivering steam into said diffuser, and means for subjecting the entraining and entrained fluid traversing said diffuser to the condensing action of a cooling medium.

16. In combination in a multi-stage ejector, a steam actuated initial stage communicating with a source of fluid to be expelled, and a second stage comprising a steam actuated ejector and a liquid actuated ejector operating in parallel and receiving fluid from the initial stage.

17. An ejector apparatus comprising a steam operated initial stage, and a secondary stage comprising a steam actuated ejector and a liquid actuated ejector operating in parallel on fluid expelled from the first stage and in which the fluid traversing the working passages of the steam actuated ejector is subjected to the cooling action of liquid traversing the liquid actuated ejector.

18. In combination in an ejector apparatus, a fluid actuated ejector, means for exposing fluid entering the ejector to the condensing and cooling action of a liquid jet, and means for exposing the fluids issuing therefrom to the cooling action of liquid from said jet.

19. In combination in an ejector apparatus, a steam actuated ejector, means for subjecting fluid entering the ejector to the entraining and cooling action of a liquid jet, and means for subjecting the fluid traversing working passages of said ejector to the cooling action of water from said jet.

20. In combination with a multi-stage ejector, each stage being actuated by a jet of condensable motive fluid, and an ejector condenser disposed in parallel with one of the stages of the ejector.

In testimony whereof, I have hereunto subscribed my name this 14th day of September, 1918.

RAYMOND N. EHRHART.