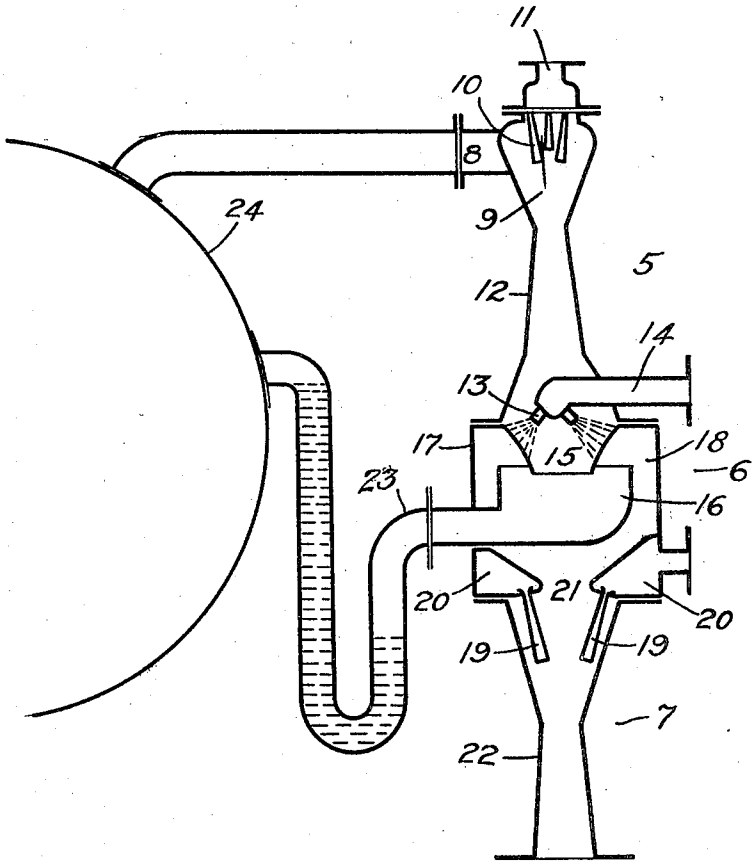
R. N. EHRHART.

EJECTOR.

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1,324,236. Patented Dec. 9, 1919.



INVENTOR.

BY Raymond N. Ehrhart,
Green & McAllister
ATTORNEYS.

UNITED STATES PATENT OFFICE.

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

EJECTOR.

1,324,236. Specification of Letters Patent. Patented Dec. 9, 1919.

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

This invention relates to ejectors and has for an object to produce a new and improved multi-stage ejector which is more efficient than other ejectors of similar capacity now in use and known to me.

A further object of my invention is to produce a new and improved two stage ejector in which the motive fluid employed in the first stage is condensed between the stages and withdrawn from the ejector so that the second stage handles substantially nothing but non-condensable fluids and vapors discharged from the first stage.

A further object is to produce a two stage steam actuated ejector in which a simple condenser or intercooler is employed between stages and improved means are employed for withdrawing the cooling water employed in said intercooler.

A further object is to produce a multi-stage ejector in which a new and improved condenser and separator are employed between stages for condensing the condensable fluids discharged from one stage and for separating and withdrawing the condensed fluids so that the subsequent stage of the ejector handles only non-condensable fluids and vapors.

These and other objects are attained by means of an ejector embodying the features herein described, and illustrated in the drawings accompanying and forming a part hereof.

The drawing is a diagrammatic sectional view of a two stage ejector embodying my invention.

The ejector illustrated includes an initial stage 5, an intermediate condenser and separator 6, and a second stage 7. As shown, fluids to be compressed are received by the initial stage 5 through an inlet port 8, which communicates with a combining chamber 9. A group of divergent nozzles 10 extend into the chamber 9 and receive motive fluid, hereinafter called steam, from a steam chamber 11. The nozzles expand the steam traversing them and discharge it at high velocity into and through the chamber 9, and a diffuser 12 which is in open communication with the chamber 9, and is illustrated as a converging diverging diffuser tube 12. In fact the chamber 9 may be considered as the converging portion of the diffuser. The nozzles 10 expand the steam to substantially the pressure normally existing within the chamber 9, that is, to the pressure of the fluid to be exhausted or compressed and the velocity energy of the mixture of steam and entrained fluid is converted into potential or pressure energy in the passage through the divergent portion of the diffuser.

At the outlet or divergent end of the diffuser 12, I have shown an intercooler or condenser of the jet type having a centrally located group of nozzles 13 which receive cooling water through an inlet pipe or passage 14 and which discharge it in finely divided form into and through a combining cone 15. The mixture of fluid and steam discharged by the initial stage 5 is intimately mixed with the cooling water in the combining cone 15, and the steam and other condensable fluids are condensed.

The cooling water, the condensate and the uncondensed fluids and vapors pass through the combining cone 15 into a separator or trap 16 which, as shown, comprises, an open receptacle serving as a baffle and receiver in which the liquids are brought to rest so that the air and other non-condensable fluids and vapors may separate out. The receptacle 16 is surrounded by a casing 17 which forms an open and free means of comumnication between the outlet of the first stage 5 and the inlet to the second stage 7. As shown, a passageway 18 is formed between the receptacle and the casing which establishes communication between the outlet of the combining cone 15 and inlet to the second stage. The air and other non-condensable gases and vapors therefore pass around the receptacle 16 to the stage 7 of the ejector.

As shown, the stage 7 is provided with an annular group of divergent nozzles 19 located below the receptacle 16 and adapted to receive steam from an annular steam chamber 20, which is so formed that it forms the inlet 21 of the second stage. The nozzles 19 are designed to expand the fluid to substantially the pressure normally existing

at the inlet to the second stage and are inclined so as to discharge a conical jet of steam into the converging end of a converging diverging diffuser 22, which forms a portion of the second stage. The fluids issuing from the first stage are entrained by the conical jet of steam issuing from the nozzle 19, and the velocity energy of the mixture of steam and entrained fluid is converted into pressure energy in the passage through the diffuser 22, which is so designed that the pressure of the mixture is raised to that existing at the outlet of the diffuser.

As illustrated, the water and condensate collected in the receptacle 16 may be withdrawn through a lateral conduit 23 by any suitable means.

Where the ejector is employed for removing air or non-condensable fluids from a condenser, I preferably discharge the cooling or condensed water employed in the intercooler into the condenser by taking advantage of the differences in pressures within the condenser and the intercooler. In order to prevent air or non-condensable fluids from passing into the condenser from the intercooler, I employ a manometric connection 23 between the intercooler and the condenser which is capable of delivering water to the condenser and of preventing the delivery of air or non-condensable fluids from the intercooler to the condenser. In the drawings I have illustrated the ejector in connection with a portion of a condenser 24. The inlet 8 of the ejector communicates with the air offtake port of the condenser and the receptacle 16 of the intercooler communicates with a U-shaped pipe or passage 23 which, in turn, communicates with a port formed in the shell of the condenser. The pipe 23 is so formed that the legs of the U-shaped portion are of sufficient length to provide for a column of water of sufficient head to counterbalance the differences in pressure which may exist within the intercooler and the condenser 24. With this arrangement, the water collected by the receptacle 16 is delivered to the condenser 24 and forms a seal between the condenser and the intercooler which prevents air or non-condensable gases entering the condenser from the intercooler.

In the ejector illustrated the work of the second stage is reduced to a minimum because the quantity of fluids it must compress is reduced substantially to the quantity of non-condensable fluids and vapors initially drawn into the ejector. As a result the second stage may be small as compared with the second stage of an ejector not provided with an inter-stage condenser. The condenser and the trap are simple, compact and efficient. The cooling water employed in the intercooler or condenser 6 may advantageously be condensate withdrawn from the main condenser 24.

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

What I claim is:

1. In combination with a condenser, a multi-stage steam actuated ejector having substantially axially alined diffusers for withdrawing air and non-condensable vapors from the condenser, an intercooler between stages of the ejector and a manometric connection between the intercooler and the condenser.

2. In combination with a condenser, a multi-stage ejector having substantially axially alined diffusers for withdrawing air and non-condensable vapors from the condenser, an intercooler between adjacent stages of the ejector and comprising means for subjecting the fluids discharged from one stage to cooling action of a water spray, and a receptacle for collecting the water issuing from said means, and a manometric connection between the receptacle and the condenser.

3. In combination with a condenser, a multi-stage ejector for withdrawing air and non-condensable vapors from the condenser, an intercooler between stages of the ejector and comprising a convergent combining cone receiving fluid discharged from one stage, means for subjecting the fluids traversing said cone to the action of cooling water, a receptacle receiving the water issuing from said cone and a passage for delivering water from said receptacle to the condenser, said passages being so arranged as to form a water seal between the working passage of the ejector and the condenser.

4. In combination with a condenser, an ejector for withdrawing air and non-condensable vapors therefrom, comprising a diffuser communicating with an air offtake port of the condenser, at least one divergent nozzle for expanding motive fluid to substantially the pressure existing at the inlet to the diffuser and for discharging the fluid so expanded into and through the diffuser, a second ejector communicating with the outlet of the first and a cooler between the ejectors comprising means for subjecting the fluids discharged from the diffuser to the action of a jet of cooling water, means for collecting the cooling water, and a U-shaped passage for delivering the cooling water to said condenser.

5. In combination with a condenser having an air offtake, an ejector for withdrawing air and non-condensable vapors from the

condenser, comprising a convergent divergent diffuser communicating with the air offtake of the condenser, a steam delivery nozzle for expanding and delivering a jet of steam into and through the diffuser, an intercooler receiving the fluid issuing from the diffuser and comprising a convergent cone communicating with the outlet of the diffuser, spray nozzles located within said cone, a receptacle for receiving water issuing from said cone, a casing inclosing said receptacle and the outlet of said cone and forming a means of communication between the cone and the inlet to a second ejector, and a second ejector communicating with said casing.

6. In combination with a condenser, a multi-stage ejector, an inter-stage condenser, a separator provided with a fluid off-take into which the condensed and non-condensable fluids are discharged from the condenser and in which the uncondensed fluid separates from the condensed fluids, means for withdrawing the condensed fluids from the separator and delivering them to the condenser, and means connecting with the interstage condenser beneath the separator offtake for delivering the uncondensed fluids to the next succeeding stage of the ejector.

7. An interstage condenser and separator for multi-stage ejectors, comprising a combining cone in which condensable fluids from the first ejector are condensed, means for delivering jets of cooling water to the combining cone, a receptacle below the combining cone in which the liquids are collected and having an outlet port through which liquids may be withdrawn, and means for bypassing the gases and vapors separated from the liquids to the region below the receptacle and to a second ejector.

8. In a two stage ejector having substantially axially alined diffusers, means located between the stages for condensing condensable fluids discharged by the first stage, a trap into which the condensed and uncondensed fluids are discharged by the condensing means, and in which the condensed and uncondensed fluids are separated, and means for connecting the trap to a point of low pressure, said means being arranged to maintain a head of liquid sufficient to seal the trap.

9. In combination in a two-stage ejector, an initial stage for partially compressing fluids, a condenser located between the stages for condensing condensable fluids discharged from the first stage, a water sealed trap for receiving the fluids discharged from the condenser, means for withdrawing condensed fluids from the trap, and means for passing uncondensed fluids around and beneath the trap to the second stage of the ejector.

10. A two-stage ejector comprising a combining chamber, nozzles for delivering jets of motive fluid for entraining fluids in the combining chamber, a diffuser tube in which the fluids are partially compressed, a condenser for condensing condensable fluids discharged from the diffuser tube, means for separating the condensed from the uncondensed fluids, a second combining chamber for receiving the uncondensed fluids, an annular row of nozzles surrounding said chamber, and a second diffuser tube for receiving the jets from the annular row of nozzles and the fluids entrained thereby and in which the fluids are finally compressed.

11. In a multi-stage ejector, an interstage cooler including a combining cone, a receptacle for receiving the fluids issuing from the combining cone and having a lateral offtake port, a casing surrounding the receptacle and spaced therefrom, and an annular steam chamber located below the receptacle and forming an inlet to the next stage of the ejector.

12. In a multi-stage ejector, an initial stage including a combining chamber and a diffuser tube, means for discharging motive fluid at high velocity through the combining chamber and into the diffuser tube, a condenser into which the diffuser tube discharges, a combining cone forming a part of the condenser, means for delivering cooling water in finely divided form into and through said combining cone, a trap into which the combining cone discharges and in which the non-condensable gases and vapors are separated from the condensed fluids, means for withdrawing the liquids from the trap and the ejector, and means for delivering the non-condensable gases and vapors to the inlet of the next stage of the ejector.

In testimony whereof, I have hereunto subscribed my name this 6th day of October, 1917.

RAYMOND N. EHRHART.

Witness:
C. W. McGHEE.