

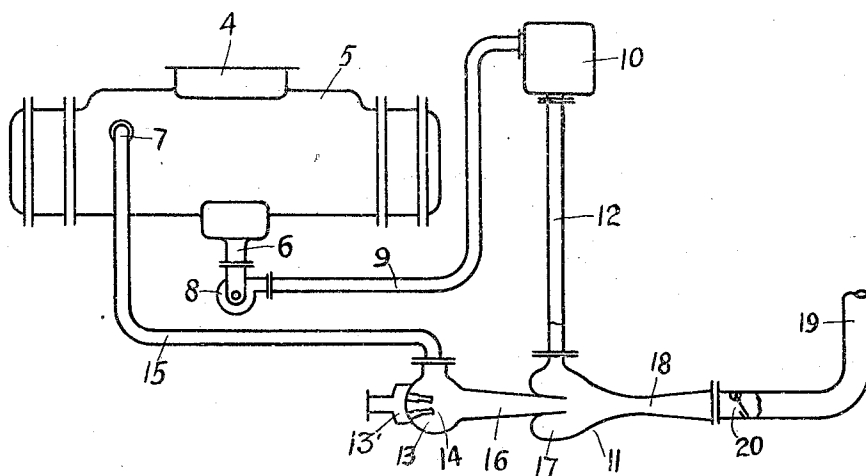
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FLUID TRANSLATING DEVICE

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UNITED STATES PATENT OFFICE.

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FLUID-TRANSLATING DEVICE.

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To all whom it may concern:

Be it known that I, HENRY F. SCHMIDT, a citizen of the United States, and a resident of Pittsburgh, in the county of Allegheny and State of Pennsylvania, have made a new and useful Invention in Fluid-Translating Devices, of which the following is a specification.

This invention relates to fluid translating devices and particularly to apparatus for withdrawing air and non-condensable vapors and condensate from a condenser.

In condenser installations it is necessary to withdraw the air and non-condensable vapors and also the condensate from the condenser. This is ordinarily accomplished with two distinct devices, such for example as an air pump or air ejector and a wet pump or condensate pump. The use of an air ejector is desirable first because such an apparatus is capable of maintaining a more nearly perfect vacuum than a reciprocating pump, and second because of its simplicity (having no moving parts) and its relatively great capacity in comparison to its size and weight.

It is well known that ejectors are not as efficient as well designed reciprocating pumps. For the purpose of increasing the efficiency of the air ejector and also for the purpose of employing low pressure steam in evacuating the condenser and at the same time conserving the heat of the low pressure steam thus employed, I have produced a combined air and condensate ejector which operates to withdraw the air and condensable vapors from the condenser and which also operates to assist in the removal of the condensate from the condenser. By this arrangement the heat of the expelling motive fluid is imparted to the condensate and thus conserved.

I have found in my experiments with condensate ejectors that it is necessary to supply the condensate to the ejector under a head greater than the head corresponding to the pressure existing within the condenser and that this head should be increased as the temperature of the condensate is increased. I have also found that low pressure steam, such as steam at about atmos-

pheric pressure may be employed in expelling hot condensate from a condenser and that, under favorable conditions, a condensate ejector operating with steam at about atmospheric pressure will expel or withdraw air from a condenser. In a steam actuated air ejector it is, however, necessary to use high pressure steam, since the steam must not only compress the air or non-condensable vapors, withdrawn from the condenser, to atmospheric pressure but, after expansion to substantially condenser pressure, must recompress itself up to or above atmospheric pressure. If it were possible to condense a steam jet and at the same time impart all the velocity energy of the jet to the condensing medium, steam considerably below atmospheric pressure could be employed in removing the condensate, air and non-condensable vapors from the condenser. My present invention employs this principle, in so far as it can be employed, in evacuating condensers. In carrying out my invention, I first subject the air or non-condensable vapors to the entraining action of a condensable motive fluid such as steam. I then employ the mixture of entrained and entraining fluid in ejecting condensate withdrawn from the condenser. In other words, I entrain the non-condensable fluids to be expelled by means of a steam jet and then employ the velocity energy of the jet of mixed steam and noncondensable fluids in imparting velocity energy to the condensate. Under such conditions the condensate condenses the steam and mechanically entrains the air or non-condensable fluid which has been previously broken up and intimately mixed with the steam. The breaking up and the intimate mixing of the steam and noncondensable fluids overcomes the possibility of the condensate ejector becoming air bound, since the condensation of the steam leaves the air well broken up and well distributed throughout the stream of condensate, thus occasioning a more or less intimate mixture of the condensate and small globules of entrained air.

In the drawings accompanying and forming a part hereof I have diagrammatically illustrated a condenser installation embody-

ing my invention; portions of the apparatus are diagrammatically shown in section for convenience of illustration.

The apparatus illustrated includes a condenser 5, a condensate pump 8, and a combined air and condensate ejector 11. The condenser is provided with an inlet port 4, a condensate discharge port 6 and an air off-take port 7. The pump 8 is illustrated as of the rotary type and is adapted to withdraw the condensate from the condenser and subject it to a head greater than that corresponding to the pressure within the condenser, but less than atmospheric pressure. As illustrated, the condensate pump discharges through a pipe 9 into a receiver 10 which is located the desired distance above the ejector 11 to insure the delivery of condensate under the desired head to the condensate ejector.

The ejector 11 is illustrated as comprising an air entraining portion and a condensate ejecting portion. The air entraining portion may be termed the air ejector and includes a combining chamber 13 provided with an inlet port, adapted to communicate with the air offtake port 7 through a pipe or passage 13'. Motive fluid delivery nozzles 14 project into the chamber 13, and as illustrated, receive motive fluid from a steam chamber 15, which preferably communicates with a source of low pressure steam supply, such as a receiver, into which the auxiliaries exhaust. As shown, the chamber 13 is formed with a converging diffuser 16 which terminates in the combining chamber 17 which forms a part of the condensate ejecting portion of the combined ejector. The chamber 17 is provided with an inlet port which, as shown, communicates with the receiver 10 through a pipe 12. A converging diverging diffuser 18 communicates with the chamber 17 and is axially aligned with the diffuser 16. The diffuser 18 communicates with the discharge pipe 19 in which a check valve 20 is shown for the purpose of preventing a back flow of fluids into the ejector.

The operation of the apparatus is as follows: The nozzles 14 expand the steam or motive fluid to substantially the pressure existing within the chamber 13 or to the pressure existing within the condenser. The expanded steam is discharged at a high velocity through the chamber 13 and the jets issuing from each nozzle unit form in effect a single jet which traverses the diffuser 16. The steam in traversing the chamber 13 entrains the air or noncondensable vapors to be expelled and the entrained fluid is intimately mixed with the entraining fluid in its passage through the diffuser 16. The diffuser 16 may be so formed that the pressure of the mixture of entrained and entraining fluids may be increased by a

partial conversion of the velocity energy of the mixed fluids as they traverse the diffuser. I prefer to so design the diffuser that a partial conversion of the velocity energy will be accomplished and the pressure of the mixed fluids raised to a pressure slightly above the pressure corresponding to the head under which condensate is delivered to the chamber 17. The discharge end of the diffuser 16 in effect forms the motive fluid delivery nozzle of the condensate ejector portion of the apparatus. Fluids discharged from the diffuser 16 entrain condensate entering the chamber 17 and by an injection action impart sufficient velocity to the condensate to discharge it through the discharge pipe 19, which communicates with the atmosphere. As in an injector the motive fluid is subjected to the condensing action of the liquid acted upon and the steam or condensable fluid content is condensed. This leaves the air or noncondensable vapors mechanically suspended within the jet of moving condensate and it also occasions a uniform distribution of the non-condensable vapors throughout the jet.

In the above description it is assumed that the work of accelerating the condensate delivered to the chamber 17 is entirely accomplished by the fluids delivered through the diffuser 16, but it is evident that the condensate may be so delivered by the pump, that the fluids merely assist in accelerating and discharging the condensate into the atmosphere.

While I have described and illustrated but one embodiment of my invention, it will be apparent to those skilled in the art that various modifications, changes, 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. In combination in a condenser installation, an air ejector means, condensate ejector means into which the air ejector means discharges, an elevated receiver for delivering condensate withdrawn from the condenser to the condensate ejector means, and means for elevating condensate from the condenser to said receiver.

2. In combination with a condenser, an ejector for withdrawing air and condensate from the condenser, an elevated receiver for delivering condensate to the ejector, and means for elevating condensate from the condenser to the receiver.

3. A condenser installation comprising a condenser, a condensate pipe leading from the condenser an ejector having an air inlet and a condensate inlet, means for delivering motive fluid at high velocity to entrain air from the condenser, means whereby the air and motive fluid entrain condensate, and

means for delivering condensate to the ejector under a pressure in excess of the pressure at which the condensate is discharged from the condenser.

5 4. The method of ejecting non-condensable vapors and condensate from a condenser, which consists in withdrawing condensate from the condenser and subjecting it to a head greater than the head corresponding to the pressure within the condenser, entraining the vapors by means of a jet of steam and thereby intimately mixing the steam and the vapors and producing a motive fluid, and then subjecting the condensate to the expelling action of the mixture of steam and vapors, thereby discharging the combined condensate and mixed vapors against atmospheric pressure.

10 5. The method of ejecting air and condensate from a condenser, which consists in entraining the air in a high velocity jet of steam, intimately mixing the steam and air and discharging the mixture at a high resultant momentum, withdrawing the condensate from the condenser and imparting thereto an increase in pressure, subjecting the condensate at its increased pressure to the mixed air and steam to condense the steam and to impart to the condensate a high momentum, and effecting a thermodynamic conversion of the energy of momentum of the air and condensate to pressure energy sufficient to discharge the air and condensate into a region of higher pressure.

35 6. The method of ejecting non-condensable fluids and condensate from a condenser which comprises entraining the non-condensable fluids by means of a high velocity jet of condensable fluid and thereby imparting velocity to the non-condensable fluids and intimately mixing the condensable and non-condensable fluids, withdrawing the condensate from the condenser and imparting thereto an increase in pressure, subjecting the condensate at its increased pressure to the action of the rapidly moving mixed fluid to impart the velocity energy of the mixed fluids to the condensate and to condense the condensable fluid, and effecting a velocity-pressure conversion of the velocity energy of the condensate and non-condensable fluids for discharging condensate and non-condensable fluids into a region of higher pressure by means of the velocity-pressure conversion of energy.

7. In combination with a condenser, a combined air and condensate ejector provided with an air inlet port and a condensate inlet port, a pump for withdrawing condensate from the condenser and imparting thereto an increase in pressure, means for delivering the condensate withdrawn from the condenser to the condensate inlet port, means for subjecting the condensate

so delivered to the discharging action of a mixture of expelling motive fluid and air withdrawn from the condenser by the expelling action of the motive fluid, and means for effecting a velocity-pressure conversion of the mixed air and condensate for discharging the air and condensate to a region of higher pressure by reason of the velocity-pressure conversion.

8. In combination with a condenser having an air offtake port and a condensate discharge port, a two stage ejector comprising an initial stage and a secondary stage, said initial stage consisting of a mixing chamber having an inlet port in communication with the air offtake port of the condenser, a delivery means leading from said mixing chamber, and motive fluid delivery nozzles for delivering expelling motive fluid into and through said mixing chamber and said delivery means, said secondary stage consisting of an inlet chamber having an inlet port through which condensate withdrawn from the condenser is delivered, a converging-diverging diffuser and a port through which combined air and expelling motive fluid is discharged from the initial stage and delivered to the inlet chamber of the secondary stage to impart the velocity energy of the mixed motive fluid and air to the condensate and deliver the commingled condensate, air and condensed motive fluid into the diffuser at a high velocity, and a pump for raising the pressure of the condensate delivered from the condenser to the condensate inlet port of the second stage of the ejector.

9. In combination with a condenser having a non-condensable fluid offtake port and a condensate discharge port, a combined condensate and non-condensable fluid ejector comprising an initial and a secondary stage, said initial stage entraining and partially compressing non-condensable fluid withdrawn from the condenser, and said second stage comprising an inlet chamber and a diffuser, said inlet chamber receiving condensate from the condenser and the fluids discharged from the initial stage in such manner as to condense the condensable portions thereof and to impart a resultant velocity to the condensate, said diffuser receiving the high velocity condensate and air to effect a velocity-pressure conversion, and a pump for raising the pressure of the condensate delivered from the condenser to the condensate inlet port of the second stage of the ejector.

10. In combination with a condenser, a combined air ejector and condensate ejector, means for entraining air from the condenser in a jet of motive steam, delivered into the air ejector, means for delivering condensate from the condenser to the condensate ejector, a pump interposed in the

last said means for imparting to said condensate being withdrawn an increased pressure, means for delivering the mixed steam and air to the condensate ejector to impart the velocity energy of the mixed steam and air to the condensate, and means for effecting a velocity-pressure conversion of the velocity energy of the mixed fluids for dis-

charging mixed fluids into a region of higher pressure by the energy conversion effected within the velocity-energy conversion means. 10

In testimony whereof, I have hereunto subscribed my name this 8th day of May, 1919.

HENRY F. SCHMIDT.