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AUXILIARY APPARATUS FOR CONDENSERS

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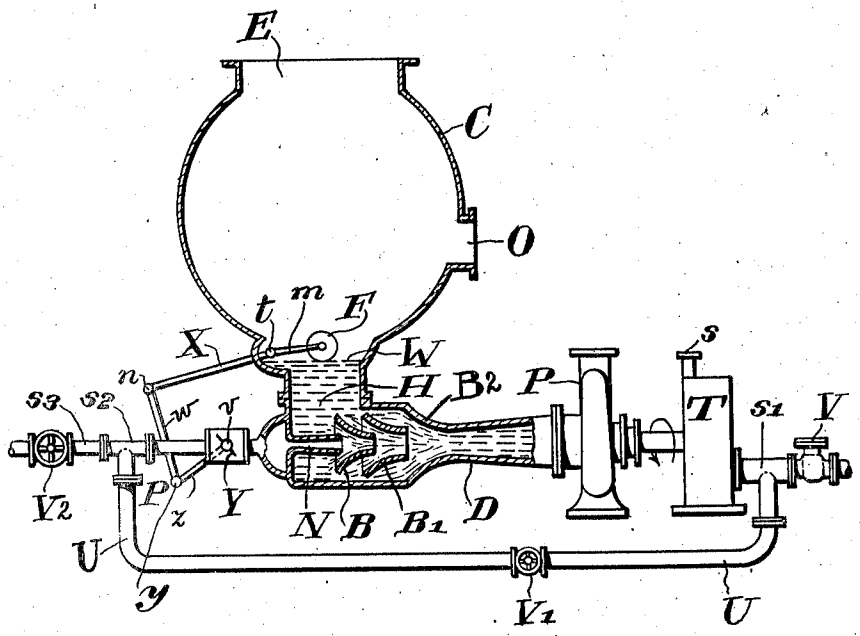

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UNITED STATES PATENT OFFICE.

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AUXILIARY APPARATUS FOR CONDENSERS.

Application filed April 26, 1922. Serial No. 556,719.

To all whom it may concern:

Be it known that I, ROBERT SUCZEK, a citizen of the United States, residing in the city and county of Philadelphia, State of Pennsylvania, have invented certain new and useful Improvements in Auxiliary Apparatus for Condensers, of which the following is a specification.

My invention relates to apparatus for removing liquid or gas, or both, by ejector action, from a region or regions of lower pressure to a region or regions of higher pressure; and more particularly, my invention relates to apparatus for removing condensate or air, or both, from a condenser.

My invention resides in apparatus for removing condensate from a condenser or liquid from a receptacle comprising an ejector submerged in the condensate or liquid for delivering it to or against higher pressure, the ejector apparatus comprising one or more mixing cones or guide tubes disposed in alignment with and between the motive-fluid-delivering means and the discharge tube or diffuser.

My invention resides in other features of, and in combination with, ejector condensate or liquid-removing apparatus.

For an illustration of some of the various forms my invention may take, reference is to be had to the accompanying drawing, in which:

The figure is a vertical sectional view, some parts in elevation, through a condenser and associated condensate-removing means.

Referring to Fig. 1, C represents the shell of a condenser, for example, the shell of a surface condenser having the inlet E for the steam to be condensed, such as steam exhausted from a steam turbine, engine, or from any other suitable source. Air and uncondensable vapors or gases are removed from the condenser C through the port O, by any suitable means, for producing or maintaining within the condenser C the usual high vacuum.

The steam entering at E is condensed in well known manner into water, which is the condensate which collects in the bottom of the shell C and is delivered to any suitable receptacle, as the hot well H. Disposed in and submerged in the liquid in the receptacle H is the nozzle N of ejector apparatus comprising, in addition, the diffuser guides, guide tubes or mixing cones B and B′ disposed in horizontal alignment with the combining tube or diffuser D at whose intake is the combining or mixing chamber or cone B^2. The diffuser D delivers directly, or indirectly through any suitable length of pipe or conduit, into the centrifugal or other type of pump P driven by the steam turbine T or any other suitable motor, as an electric motor. When the motor T is a steam turbine, it receives steam, as live or high pressure steam, through the pipe s and exhausts it at lower pressure through the pipe or conduit s^1 controlled by the valve V. Branched from the exhaust pipe s^1 is the pipe U, controlled by valve V^1 and communicating with the pipe s^2 controlled by the valve Y and communicating with the nozzle N. Communicating with the pipe s^2 is another pipe s^3, controlled by the valve V^2 and connected with any suitable source of motive fluid, as live steam. Upon the upper surface W of the liquid or condensate collected in the bottom of the condenser C and in hot well H is the float F, carried on the end of the lever m secured upon the pivotal shaft t, which extends through a vacuum-tight joint to the exterior of the condenser shell C, where there is secured thereto the link X pivoted at n to the link w pivoted at y to the link z, whose other end is secured upon the pivotal shaft v upon which is secured the valve Y.

With the valve V^1 closed and the valves V and V^2 open, the steam turbine T drives the pump P to remove condensate from the receptacle H and discharges the same against atmospheric or any other pressure, as into a boiler against boiler pressure, the exhaust steam from the turbine passing through the pipe s^1 and valve V to atmosphere, or to a condenser, feed water heater, or to any other suitable point. Simultaneously, live or high pressure steam admitted through the valve V^2 and pipe s^3 and s^2 passes the open valves Y to the nozzle N, in and by which it is expanded into a jet which draws into the members B, B^1 and B^2 the condensate in the receptacle H, delivering the same through the diffuser D at higher pressure to the pump

P, thus causing the pump P to operate with an effective submergence greater than that due to the height of water level W in the absence of the ejector.

Or with the valves V and V^2 closed and the valve V^1 open, the ejector nozzle N is supplied with low pressure or exhaust steam from the turbine T, in which case the action is again similar to that above described.

Or when using exhaust or low pressure steam as described, high pressure or live steam may also be used simultaneously by partially opening the valve V^2, which throttles the high pressure or live steam to a pressure substantially the same as the exhaust steam delivered through pipe U.

Or exhaust steam from any other source than the turbine T may be employed; for example, the exhaust steam may be derived from the turbine or engine driving the pump which supplies the cooling water to the cooling water system of the condenser C.

The motive fluid, whether high or low pressure steam, or whether a mixture of them, delivered to the nozzle N, is controlled by the float F. In case the water level W falls, the float descends, and through the system of levers described moves the valve Y toward closed position, thereby shutting off more or less completely the supply of motive fluid to the nozzle N, with the result that the submerged ejector removes or assists in removing less condensate, thereby causing the level to again rise to maintain proper submergence of the ejector. In case the water level W falls sufficiently, the valve Y will be completely closed until the water level rises to sufficient extent, in which case the float F will again open the valve Y and cause the ejector again to operate and remove condensate.

The motive fluid delivered to the submerged ejector is accordingly controlled in response to changes in rate of discharge of condensate from the hot well H or in response to changes in demand or requirements for the liquid or condensate beyond the diffuser D or pump P.

While steam or other elastic fluid is preferred as the motive fluid, it will be understood that liquid, as water, may be utilized as motive fluid. When the preferred motive fluid, as steam, is employed, and particularly when it is low pressure or exhaust steam of otherwise small value, it is most economically employed. Furthermore, whether high or low pressure steam be employed, the heat content thereof is delivered into the condensate, due to condensation of the steam thereby, and the heat gained by the condensate is a factor of economy when condensate is returned to a boiler or through a feed water heater or economizer, or both, to a boiler.

The jet of motive fluid issuing from the nozzle N draws into the large or intake end of the combining tube B liquid from the receptacle H which is discharged as a jet from the small or discharge end of the tube B, that jet in turn drawing liquid directly from the receptacle H into the second mixing cone or combining tube B^1, and the jet issuing at its discharge or smaller end correspondingly draws into the cone or combining tube B^2 liquid directly from the hot well H, the liquid being then discharged by the diffuser D at higher pressure.

The float F may control the action of the ejector in any other suitable way, as by adjusting an adjustable diffuser or adjustable nozzle, or both.

The apparatus herein described is disclosed in my prior Letters Patent No. 1,342,471, June 8, 1920.

What I claim is:

1. The combination with a condenser, of a receptacle for the condensate therefrom, an ejector employing elastic motive fluid and comprising divergent nozzle structure and diffuser structure having their outlet and inlet, respectively, disposed within said receptacle, and guide tube structure disposed between said nozzle and diffuser structures and having its inlet and outlet submerged in the condensate.

2. The combination with a condenser, of a receptacle for the condensate therefrom, an ejector employing elastic motive fluid and comprising nozzle and diffuser structures having their outlet and inlet, respectively, disposed within said receptacle, and a plurality of serially arranged guide tubes disposed between said nozzle and diffuser structures and having their inlets submerged in the condensate.

3. The combination with a surface condenser and its hot well, of an ejector operated by elastic motive fluid comprising nozzle and diffuser structures having their outlet and inlet, respectively, submerged in the condensate in said hot well, and a plurality of serially disposed guide tubes disposed between said nozzle and diffuser structures having their inlets submerged in the condensate in said hot well.

4. The combination with a surface condenser and its hot well, of ejector apparatus comprising horizontally aligned nozzle and diffuser structures having their outlet and inlet, respectively, within said hot well, and guide tube structure aligned with said nozzle and diffuser structures submerged in the condensate in said hot well.

5. In combination with a condenser and its hot well, an ejector comprising a motive fluid delivery nozzle, a combining cone, the inlet of which is in open communication with the hot well and a diffuser alined with said cone and having its inlet in open communication with the hot well and its discharge subjected

to a pressure greater than that existing in the condenser.

6. The combination with a condenser and its hot well, an ejector comprising a fluid delivery nozzle, a plurality of alined cones alined with said nozzle, and a diffuser alined with said cones characterized by that the nozzle projects into the hot well, the inlet and outlet of each cone is in open communication with the hot well and the inlet to the diffuser is in open communication with the hot well.

7. In combination with a condenser, a hot well, an ejector having a plurality of combining cones in direct communication with the hot well, means for delivering motive fluid to the combining cones at high velocity, and a diffuser for receiving the fluids discharged from the combining cones.

8. An ejector having a nozzle, a plurality of combining cones, a diffuser, and a common inlet and overflow chamber, for said combining cones.

9. An ejector having a nozzle, a combining cone having a plurality of entraining and overflow ports, a diffuser, and a common inlet and overflow chamber for the several entraining and overflow ports of the combining cone.

10. The combination with a receptacle for liquid, of an ejector submerged in the liquid in said receptacle comprising a divergent motive fluid nozzle, a discharge conduit and a guide tube between them, and means for delivering low pressure elastic fluid to said nozzle.

11. The combination with a receptacle for liquid, of an ejector submerged in the liquid in said receptacle comprising a divergent motive fluid nozzle, a discharge conduit and a guide tube between them, means for delivering low pressure elastic fluid to said nozzle, and automatic means controlling delivery of said motive fluid to said nozzle in response to changes in the quantity of said liquid.

12. The combination with a receptacle for liquid, of an ejector submerged in the liquid in said receptacle comprising a divergent motive fluid nozzle, a discharge conduit and a guide tube between them, and means for delivering high pressure elastic fluid to said nozzle.

13. The combination with a receptacle for liquid, of an ejector submerged in the liquid in said receptacle comprising a divergent motive fluid nozzle, a discharge conduit and a guide tube between them, means for delivering high pressure elastic fluid to said nozzle, and automatic means controlling delivery of said motive fluid to said nozzle in response to changes in the quantity of said liquid.

14. The combination with a receptacle for liquid, of an ejector submerged in the liquid in said receptacle for removing the liquid from said receptacle, and means for simultaneously delivering to said ejector motive fluids from different sources.

15. The combination with a receptacle for liquid, of an ejector submerged in the liquid in said receptacle for removing the liquid from said receptacle, means for simultaneously delivering to said ejector motive fluids from different sources, and automatic means controlling delivery of said motive fluids to said ejector in response to changes in the quantity of said liquid.

16. The combination with a condenser, of a receptacle for the condensate therefrom, a pump for removing the condensate having its suction submerged, an ejector submerged in the condensate and comprising a divergent motive fluid nozzle for delivering said condensate from said receptacle directly to the suction of said pump, a source of elastic motive fluid for said ejector, and means controlled by the condensate controlling said motive fluid.

17. The combination with a condenser, of a receptacle for the condensate therefrom, a pump for removing the condensate having its suction submerged, an ejector submerged in the condensate delivering said condensate from said receptacle directly to the suction of said pump, a steam-operated motor driving said pump, and means conducting steam exhausted by said motor to said ejector.

18. The combination with a condenser, of a receptacle for the condensate therefrom, a pump for removing the condensate having its suction submerged, an ejector submerged in the condensate delivering said condensate from said receptacle directly to the suction of said pump, a steam-operated motor driving said pump, means conducting steam exhausted by said motor to said ejector, and automatic means responsive to changes in quantity of condensate controlling said steam delivered to said ejector.

19. The combination with a receptacle for liquid, of an ejector submerged in the liquid in said receptacle comprising a motive fluid nozzle and a conduit through which the fluid from said nozzle delivers said liquid, a source of low pressure steam connected to said nozzle, and a source of high pressure steam having a connection to said nozzle.

20. The combination with a condenser, of a receptacle for the condensate therefrom, a pump for removing the condensate having its suction submerged, an ejector submerged in the condensate delivering said condensate from said receptacle directly to the suction of said pump, a steam-operated motor driving said pump, means conducting steam exhausted by said motor to said ejector, and a source of high pressure steam having a connection with said ejector.

21. The combination with a condenser, of

a receptacle for the condensate therefrom, a pump for removing the condensate having its suction submerged, an ejector submerged in the condensate delivering said condensate from said receptacle directly to the suction of said pump, a steam-operated motor driving said pump, means conducting steam exhausted by said motor to said ejector, automatic means responsive to changes in quantity of condensate controlling said steam delivered to said ejector, and a source of high pressure steam having a connection with said ejector.

22. The combination with a condenser, of a receptacle receiving the condensate therefrom, an ejector for removing the condensate from said seceptacle comprising a motive fluid nozzle structure and a discharge conduit having their outlets and inlets submerged in said condensate, and a series of horizontally aligned mixing cones submerged in said condensate and aligned with said nozzle structure.

23. The combination with a condenser, of a receptacle receiving the condensate therefrom, an ejector for removing the condensate from said receptacle comprising a motive fluid nozzle structure and a discharge conduit having their outlets and inlets submerged in said condensate, a series of horizontally aligned mixing cones submerged in said condensate and aligned with said nozzle structure, and means for delivering elastic motive fluid to said nozzle structure.

24. The combination with a condenser, of a receptacle for the condensate therefrom, ejector structure for removing the condensate from said receptacle comprising a divergent motive fluid expanding nozzle, a plurality of spaced guide tubes in alignment with said nozzle, and means for delivering elastic motive fluid to said nozzle.

25. The combination with a condenser, of a receptacle for the condensate therefrom, ejector structure for removing the condensate from said receptacle comprising a divergent motive fluid expanding nozzle, a plurality of spaced guide tubes in horizontal alignment with said nozzle, and means for delivering elastic motive fluid to said nozzle.

26. The combination with a condenser, of a receptacle for the condensate therefrom, a condensate pump, and an ejector operated by elastic fluid submerged in said condensate and delivering it at higher pressure to said pump.

27. The combination with a condenser, of a condensate receptacle, an ejector submerged in the condensate and removing the condensate to a region of higher pressure, a steam motor, a pump driven thereby, and a connection for delivering steam exhausted from said motor to said ejector.

28. The combination with a condenser, of a condensate receptacle, an ejector submerged in the condensate, a pump receiving the condensate delivered by said ejector, a steam motor driving said pump, and a connection delivering exhaust steam from said motor to said ejector.

29. The combination with a condenser, of a condensate receptacle, an ejector submerged in the condensate and removing the condensate to a region of higher pressure, a steam motor, a pump driven thereby, a connection for delivering steam exhausted from said motor to said ejector, and means responsive to changes in level of the condensate controlling the steam delivered to said ejector.

30. The combination with a condenser, of a condensate receptacle, an ejector submerged in the condensate, a pump receiving the condensate delivered by said ejector, a steam motor driving said pump, a connection delivering exhaust steam from said motor to said ejector, and means responsive to changes in level of the condensate controlling the steam delivered to said ejector.

31. The combination with a condenser, of a condensate receptacle, an ejector for removing the condensate from said receptacle, a plurality of sources of motive fluid for said ejector, and means controlled by the condensate controlling the amount of motive fluid delivered to said ejector.

32. In combination with a receptacle containing liquid, an ejector for removing the liquid from said receptacle, a fluid-operated motor, and a connection for delivering fluid discharged from said motor to said ejector.

33. In combination with a receptacle containing liquid, a pump, an ejector delivering liquid from said receptacle to said pump, a fluid-operated motor driving said pump, and a connection delivering fluid discharged by said motor to said ejector.

34. In combination with a receptacle containing liquid, an ejector for removing the liquid from said receptacle, a fluid-operated motor, a connection for delivering fluid discharged from said motor to said ejector, and means responsive to changes in the quantity of said liquid controlling delivery of said fluid to said ejector.

35. In combination with a receptacle containing liquid, a pump, an ejector delivering liquid from said receptacle to said pump, a fluid-operated motor driving said pump, a connection delivering fluid discharged by said motor to said ejector, and means responsive to changes in the quantity of said liquid controlling delivery of said fluid to said ejector.

36. In combination with a condenser having a hot well, an ejector in said hot well for removing condensate therefrom, a source of steam, and means controlling delivery of steam from said source to said ejector

for varying the operation of said ejector in response to change in quantity of condensate produced by said condenser.

37. In combination with a condenser having a hot well, an ejector having divergent motive fluid expanding nozzle structure submerged in said hot well, a source of steam, and means controlling delivery of steam from said source to said nozzle structure in response to change in quantity of condensate produced by said condenser.

38. The combination with a condenser, of a condensate receptacle, an ejector for removing condensate from said receptacle, a source of exhaust steam, means for diverting a portion of said exhaust steam to said ejector as motive fluid thereof, and means controlled by the condensate controlling said ejector motive fluid.

39. The combination with a condenser, of a condensate receptacle, a pump, an ejector delivering condensate from said receptacle to said pump, a steam-operated motor driving said pump, means for diverting a portion of the exhaust steam from said motor to said ejector for motive fluid thereof, and means responsive to changes in the quantity of condensate for controlling said motive fluid.

In testimony whereof I have hereunto affixed my signature this 25th day of April, 1922.

ROBERT SUCZEK.