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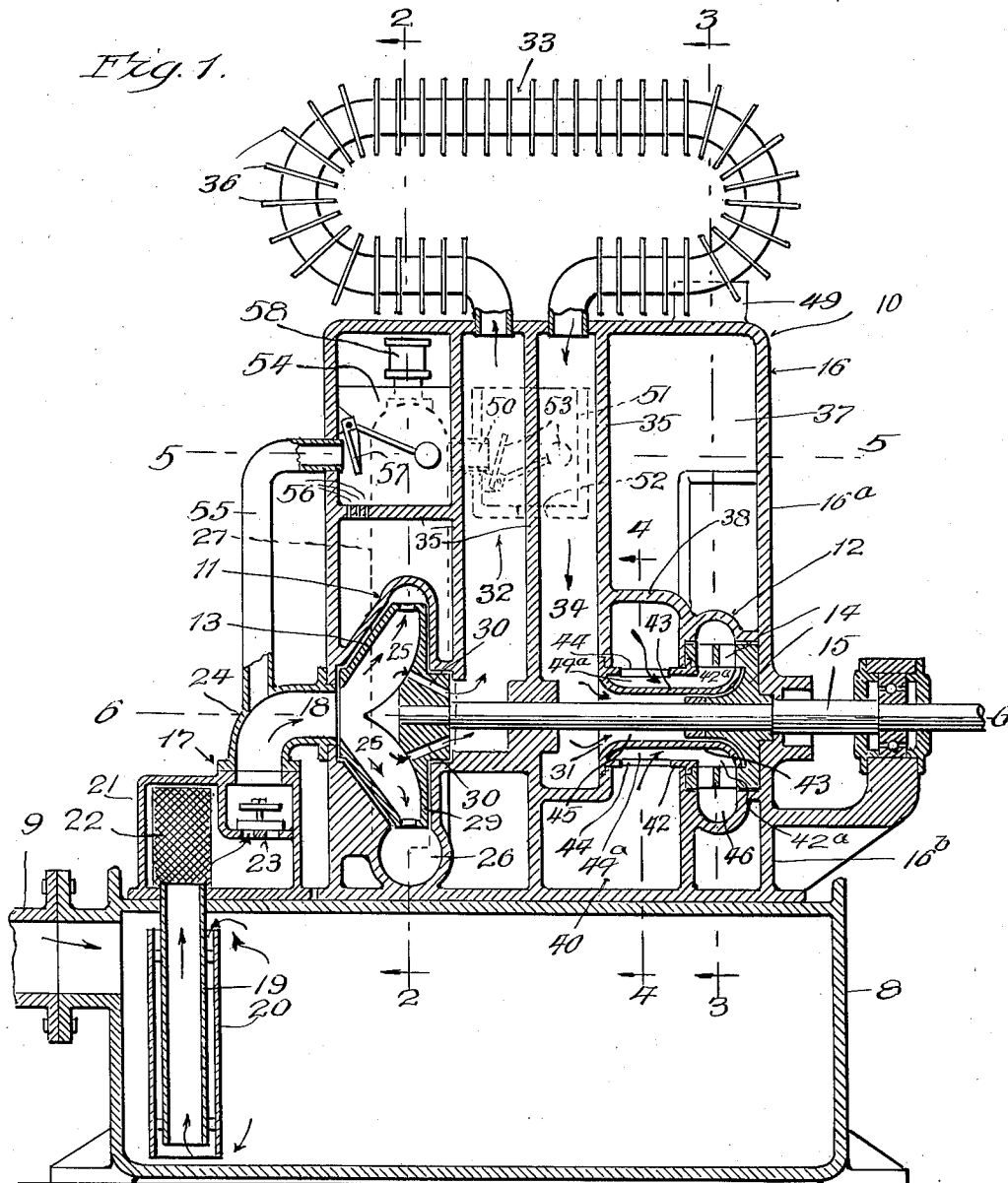
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1,901,154

VACUUM CONDENSATION PUMP

Filed June 22, 1931.

3 Sheets-Sheet 1



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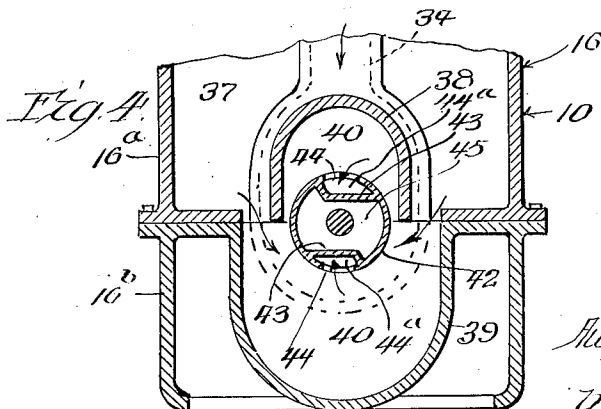
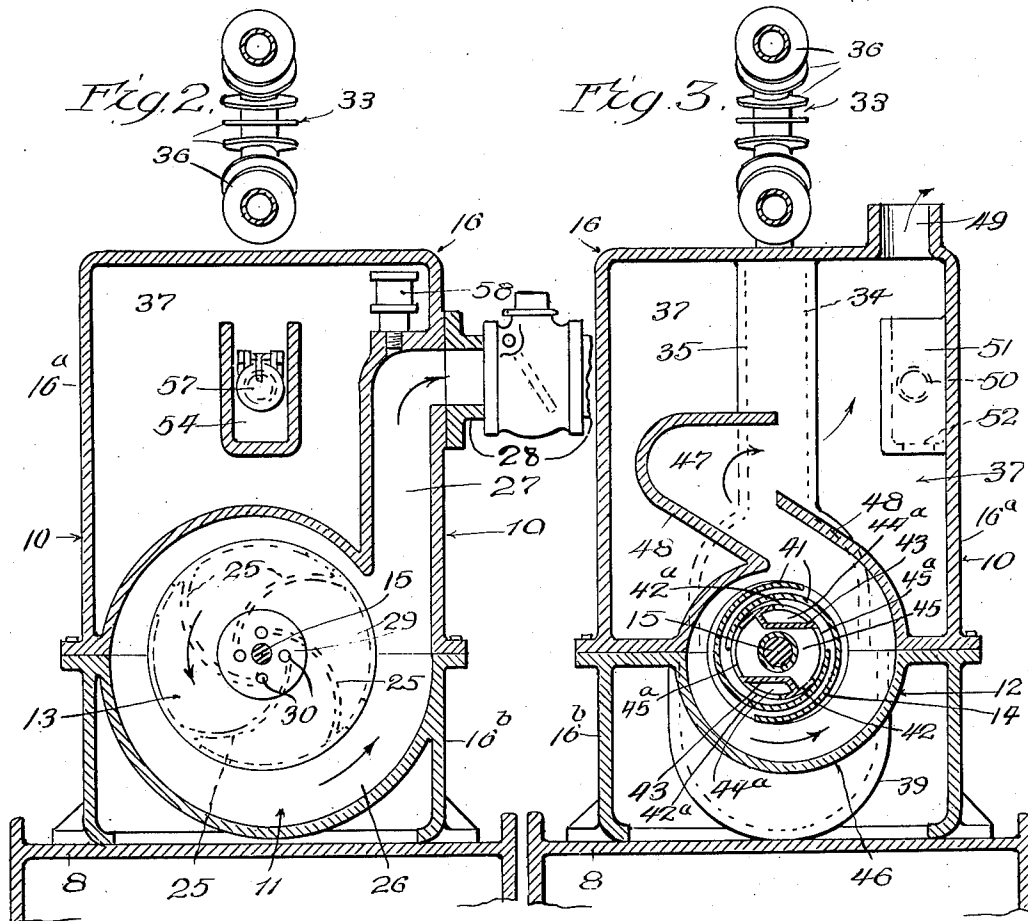
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3 Sheets-Sheet 2



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Fig. 5.

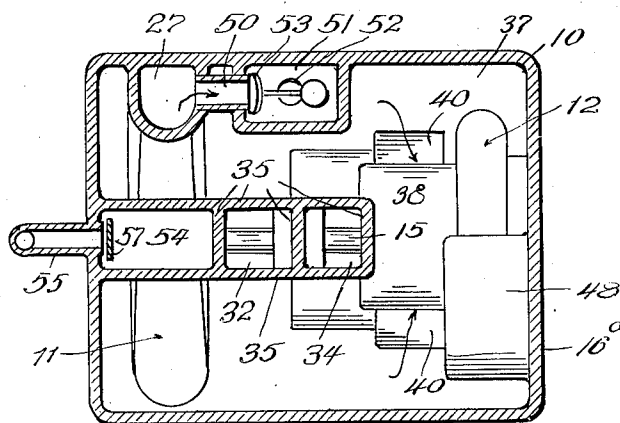


Fig. 6.

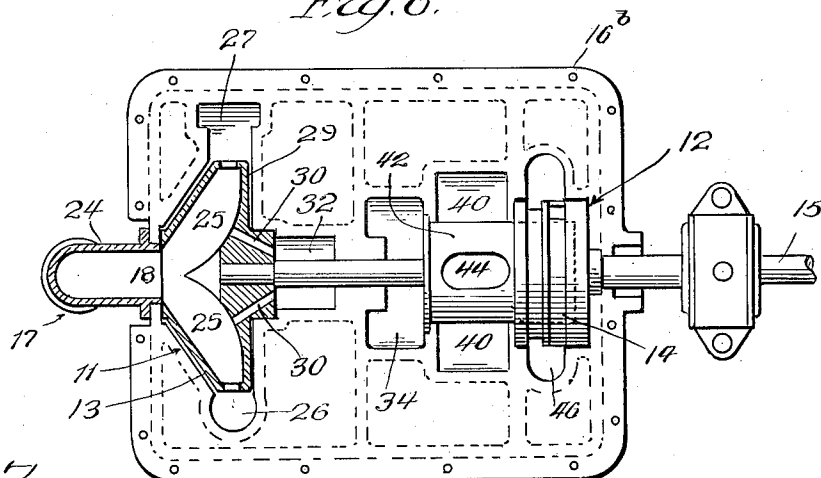
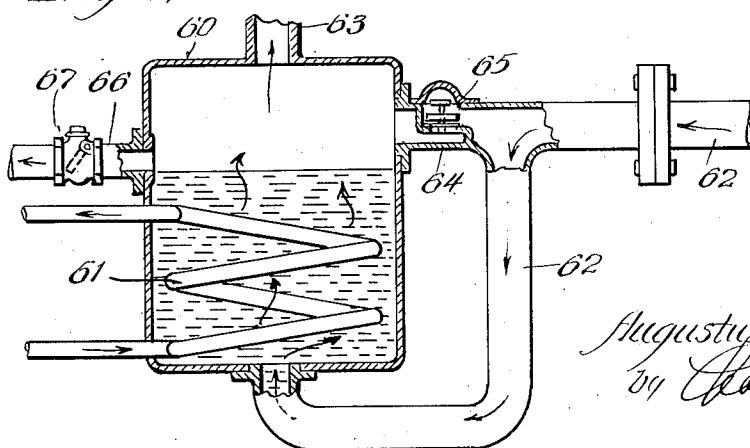


Fig. 7.



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VACUUM CONDENSATION PUMP

Application filed June 22, 1931. Serial No. 545,916.

This invention relates to vacuum condensation pumps adapted for use in connection with steam heating systems, and among its objects are to provide improved means for increasing the efficiency of the pumping apparatus. The present invention has reference more particularly to pumping apparatus of that type in which is comprised a vacuum pump or other vacuum apparatus for creating a partial vacuum in the return pipes of the steam heating system and a water pump for pumping back to the boiler the water of condensation which returns from the radiators. The vacuum pump or vacuum apparatus is usually of the type which employs water for its pumping action.

It is well known that a considerable amount of steam, vapor, air and other non-condensable gases return with the water of condensation coming from the radiators of a steam heating plant. In pumping apparatus formerly on the market, the steam and vapor was usually handled by the vacuum pump, and a considerable amount of the steam and vapor was discharged to the atmosphere along with the air and other non-condensable gases, and, as a consequence, the heat units contained in the steam and vapor, as well as the water of condensation resulting therefrom, was lost.

One of the objects of this invention is to provide improved means for reclaiming any steam and vapor that may return with the water of condensation from the radiators and retain it in the system. Another object is to provide means, located between the usual receiver and the vacuum pump, for condensing any steam and vapor returning with the water of condensation.

Another object is to connect the water pump and vacuum pump with the receiver by a single conduit. Another object is to provide a single conduit between the return pipe of the steam heating system and the pumping apparatus, through which conduit wa-

ter is pumped by the water pump and gases are pumped by the vacuum pump. Another object is to provide pumping apparatus having a single pipe or conduit between the receiver and the water pump and the vacuum pump, and a condenser for condensing steam and vapor that is carried through said pipe or conduit, thereby condensing said steam and vapor before it reaches the vacuum pump.

With these and other objects and advantages in view, this invention consists in the several novel features hereinafter fully set forth and claimed.

The invention is clearly illustrated in the drawings accompanying this specification in which—

Figure 1 is a view, partly in side elevation and partly in vertical longitudinal section, of a vacuum condensation pump embodying a simple form of the present invention;

Fig. 2 is a vertical cross section taken on the line 2—2 of Fig. 1;

Fig. 3 is a vertical cross section taken on the line 3—3 of Fig. 1;

Fig. 4 is a fragmental vertical cross section taken on the line 4—4 of Fig. 1;

Fig. 5 is a horizontal section taken on the line 5—5 of Fig. 1;

Fig. 6 is a horizontal section taken on the line 6—6 of Fig. 1; and

Fig. 7 is a view, partly in side elevation and partly in central vertical longitudinal section, showing a modified form of condenser.

Referring to said drawings, and first to Figs. 1 to 6, inclusive, the reference character 8 designates a receiver or tank connected to the return pipe 9 of a steam heating plant and adapted to receive the condensate which returns from the radiators of the plant. As is well known, steam, vapor, air and other non-condensable gases are included in the condensate which returns from the radiators and

the vapors and gases collect in the upper portion of the receiver, whereas the water collects in the lower portion thereof.

Associated with the receiver is a pump structure 10, which is shown as mounted upon the top of the receiver 8. The pump structure embodies a water pump 11 and a vacuum pump 12. The water pump is preferably of the centrifugal type and the vacuum pump shown is of the type which employs water for its pumping action. The impellers 13 and 14 of the pumps are mounted upon a common shaft 15 journaled in suitable bearings carried by the casing 16 of the pump structure. Usually the casing is formed of upper and lower sections 16^a and 16^b bolted together. The pump shaft 15 is connected to an electric motor or other suitable source of power as is well understood. An inlet conduit 17 leads from the receiver to the inlet opening 18 of the water pump, and in the operation of the pumping apparatus, the condensate is moved through said conduit to the water pump where the water is separated from the gases by centrifugal action thereon and the gases are exhausted from the water pump by the vacuum pump, as will be presently explained.

In the form of the invention illustrated, the conduit 17 comprises, among other things, a pipe 19 which extends up from a point adjacent the bottom of the receiver, a sleeve 20 spaced away from and surrounding said pipe and extending from points adjacent the top and bottom of the receiver. The upper end of the pipe 19 opens into the chamber of a housing 21 which is supported upon or adjacent the casing 16 of the pump structure, in which housing is a screen 22 and an upwardly opening check valve 23. Connecting the housing 21 with the casing of the pump structure is an elbow or other pipe 24 which delivers the condensate to the water pump.

In the operation of the pumping apparatus, the water enters the pipe 19 at its lower end and the steam, vapor, air and other non-condensable gases enter the sleeve 20 through the opening at the top thereof and flow down to the open lower end of the pipe 19 where said fluids are drawn up and mix with the water.

The water pump is of novel construction. The impeller 13 is provided with impeller blades 25, as usual, which throw the water outward into a volute 26, discharging the water through a discharge passage 27, from which leads a water pipe 28 that runs back to the boiler or other place where it is desired to deliver the water.

Extending through one wall 29 of the impeller are a series of air ports 30, arranged circumferentially around the axis of the impeller, through which any steam, vapor, air and other non-condensable gases escape from the impeller of the water pump. It may be

stated at this point that as the condensate

enters the impeller of the water pump, the heavier fluid, namely, the water is thrown outward and separated from the lighter fluids, namely, the steam, vapor, air and other non-condensable gases, and said lighter fluids are removed from the impeller through the air ports 30 by the vacuum pump.

Leading from the air ports 30 to the air inlet 31 of the vacuum pump 12 is a conduit, designated by the characters 32, 33 and 34, which in effect forms a continuation of the conduit 17, the part designated 33 being in the form of a condenser, whereby any steam or vapor passing through said conduit is condensed before entering the vacuum pump. The portions 32 and 34 of the conduit are here shown as formed between walls 35 usually made integral with the upper casing section 16^a of the pump structure. The part 32 of the conduit leads upward to the top of the casing where it joins with the inlet of the condenser, and the part 34 leads down from the top of the casing at which place it joins with the outlet of the condenser, and at its lower end opens to the air inlet 31 of the vacuum pump.

Any suitable type of condenser may be employed for condensing the steam and vapor, the one illustrated in Figs. 1, 2 and 3 comprising a pipe formed with fins 36 on its outer surface which act to absorb heat from the pipe. The part 34 of the conduit extends down below the shaft 15 and collects the water which is condensed from the steam and vapor by the condenser 33, and said water is discharged by the vacuum pump into a chamber 37 formed in the upper casing section 16^a around the walls of the conduit sections 32, 34.

Upper and lower baffles or walls 38 and 39 (see Fig. 4) formed on the upper and lower casing sections 16^a and 16^b of the pump structure provide a water passage 40 above and below the water inlets 44 to the vacuum pump, which water passage 40 is spaced away from the chamber 37 by the walls 38 and 39. Any suitable vacuum pump or apparatus, preferably of the type employing water for its pumping action, may be employed, and for a full description of a pump of this character, reference may be had to my prior Patent No. 1,699,328, dated January 15, 1929.

Briefly, the impeller 14 of the vacuum pump is provided with spiral blades 41 (see Fig. 3) which revolve about a cylindrical wall 42 supported by the upper casing section 16^a and forming, with other walls 43, water inlet passages 44^a which open through the inlet openings 44 into the water passage 40 and through outlet openings 42^a to the spaces between the spiral blades 41. Between the walls 43 is the air inlet passage 45 which leads from the air inlet opening 31 at the section 34 of the conduit, through the air outlet openings

45^a to the spaces between the spiral blades. The operation of vacuum pumps of this character is well known and requires no detailed description. The gases and water are discharged into a volute 46 surrounding the impeller 14 from which they are discharged into the chamber 37 through a passage 47 formed by walls 48 cast integral with the upper casing section 16^a. The discharged water and gases collect in the chamber 37 and the gases escape through a port 49 at the top of said chamber. The water flows back into the water passage 40 to the vacuum pump and is used over and over again.

15 The water for the vacuum pump is supplied to the chamber 37 by the water pump 11 through a port 50 which leads from the upper end of the water discharge passage 27 of the water pump and opens into a small tank 51 formed as a part of the upper casing section 16^a. The tank 51 is provided with a discharge opening 52 in its bottom through which the water discharges into the chamber 37 and a float valve 53 is provided in the tank 51 for controlling the port 50. When the water in the chamber 37 and tank 51 reaches a predetermined high level, the float of the float valve 53 rises, thereby closing the valve and shutting off further supply of water to the chamber 37 until the level thereof falls below normal.

When water, which is condensed from the steam and vapor entering the condenser 33, is pumped into the chamber 37 by the vacuum pump 12 and raises the level of the water therein beyond a predetermined level, it is permitted to escape through an overflow tank 54 formed in the upper end of the chamber 37 and through a pipe 55 which leads from said overflow tank down to the elbow 24 of the conduit 17. Orifices 56 in the bottom wall of the overflow tank 54 connect the chamber 37 with the overflow tank 54 and a float valve 57 in said overflow tank is provided for closing the inlet opening to the pipe 55 whenever the level of the water in the chamber 37 and overflow tank 54 falls below normal. An inwardly opening check valve 58 is provided in the top of the water discharge passage 27 from the water pump to admit air from the chamber 37 to the water pump when the pumps are at rest. The receiver 8 is provided with the usual float switch and pressure switch (not shown), as is customary for starting and stopping the pumps.

In the operation of the apparatus, the condensate flows into the receiver 8, and when the vacuum condensation pump is in operation, the vacuum pump creates a partial vacuum which extends through the conduit 34, 33, 32, the air ports 30 in the water pump impeller, the conduit 17, and receiver 8 to the return pipes 9 of the steam heating plant. The condensate is, therefore, drawn from the receiver into the water pump which, by reason of the

centrifugal action of the impeller thereon, separates the water from the gases by throwing the water outward and discharging it through the passage 27; the gaseous fluids, which are thus separated from the water, being drawn through the air ports 30, the sections 32 and 34 of the conduit and the condenser 33 wherein steam and vapor are condensed, the water of condensation falling into the bottom of the section 34 of the conduit and the gases being exhausted and discharged by the vacuum pump into the chamber 37 from which the gases escape through the discharge port 49. Water which accumulates in the lower end of the section 34 of the conduit is pumped out by the vacuum pump and discharged into the chamber 37. When the water in the chamber 37 and overflow tank 54 rises sufficiently, it opens the float valve 57, thereby permitting any excess to flow back to the water pump through the pipe 55 and elbow 24 of the conduit 17.

From the above it is to be observed that the water and the gases that accumulate in the receiver are exhausted therefrom through a single conduit which leads to the water pump from which the air is pumped through an air conduit leading to the vacuum pump. It will also be observed that any steam and vapor that find their way through the conduits 32, 33 and 34, are condensed before reaching the vacuum pump, so that the volume of the fluid passing through said conduit is reduced materially, thus aiding the vacuum pump in maintaining the vacuum in the system, and, at the same time, enabling the vacuum pump to exert its entire capacity in handling gaseous fluid. As a result, all of the water is retained in the system and the heat losses are lessened due to the fact that the steam and vapor are not discharged to the atmosphere.

In the modified form of condenser illustrated in Fig. 7, a condenser tank 60 is provided in which is contained a cooling coil 61 through which is circulated a cooling medium, such as cold water. The tank is interposed between the receiver and the vacuum pump, and, as shown, the bottom of the tank 60 is connected to a pipe 62 which leads to the receiver 8 or to the section 32 of the air conduit, and the top of the tank is connected to a pipe 63 which leads to the section 34 of the conduit. The steam, vapor, air and other non-condensable gases are, therefore, moved through the tank from the bottom towards the top thereof in their passage from the receiver to the vacuum pump. The pipe 62 also communicates with the upper end of the receiver through a branch 64 in which is contained a check valve 65 opening away from the interior of the tank 60.

An overflow pipe 66 containing an outwardly opening check valve 67 leads from the upper portion of the tank 60 and runs to the inlet side of the water pump. A body of

water is maintained in the lower portion of the tank 60 which is replenished by the condensation obtained from the steam and vapor passing through the water contained in the tank, and said body of water is cooled by the cooling medium passing through the cooling coil 61. In this form of the invention, the steam, vapor, air and other non-condensable gases pass up through a cooled body of water contained in the tank 60 and, as a result, the steam and vapor are completely condensed and returned to the system, the air and other non-condensable gases passing on to the vacuum pump from which they are discharged to the atmosphere.

More or less variation of the exact details of construction is possible without departing from the spirit of this invention. I desire, therefore, not to limit myself to the exact form of the construction shown and described, but intend, in the following claims to point out all of the invention disclosed herein.

I claim as new, and desire to secure by Letters Patent:

1. In a vacuum condensation pump, the combination of a centrifugal water pump having an axially disposed inlet in its casing communicating with the return pipe of a steam heating plant, an impeller having an axially disposed inlet and operating to separate water from gaseous fluid by centrifugal action and discharge the water through a water discharge passageway, there being a separate gaseous fluid outlet in said impeller adjacent its axis of rotation, and a vacuum pump having its inlet connected to said gaseous fluid outlet of the impeller.

2. In a vacuum condensation pump, the combination of a water pump communicating with the return pipe of a steam heating plant and operating to separate water from steam, vapor and other gaseous fluids, said pump having a water discharge passageway and a separate steam, vapor and other gaseous fluid outlet, a vacuum pump, and a conduit having a condenser interposed therein and leading from the gaseous fluid outlet of the water pump to the steam, vapor and other inlet of the vacuum pump.

3. In a vacuum condensation pump, the combination of a receiver connected to the return pipe of a steam heating plant, a water pump, and a vacuum pump having a common impeller shaft, and a single conduit leading from said receiver to said water pump through which water, steam, vapor and other gaseous fluids are pumped from the receiver and a conduit leading from said water pump to the vacuum pump, whereby water is pumped from said receiver by said water pump and gaseous fluid is pumped from said receiver through said water pump by said vacuum pump.

4. In a vacuum condensation pump, the combination of a receiver connected to the

return pipe of a steam heating plant, a centrifugal water pump having an impeller, and a water discharge passageway, the impeller having a separate gaseous fluid outlet, a vacuum pump, a single conduit for water and gaseous fluid leading from said receiver to said water pump, and a continuation of said conduit leading from the gaseous fluid outlet of the impeller of said water pump to the vacuum pump.

5. In a vacuum condensation pump, the combination of a receiver connected to the return pipe of a steam heating plant, a water pump having a gas and water inlet and a water discharge passageway and an impeller provided with a separate gaseous fluid outlet, a conduit for water and gaseous fluid leading from the receiver to the inlet of the water pump, a vacuum pump, and a conduit forming a continuation of the conduit between the receiver and water pump and leading to the vacuum pump, there being a condenser interposed in said continuation of the conduit wherein condensible fluids are condensed.

6. In a vacuum condensation pump, the combination of a receiver connected to the return pipe of a steam heating plant, a water pump having a gas and water inlet and a water discharge passageway and an impeller formed with a separate gaseous fluid outlet, a conduit for water and gaseous fluid leading from said receiver to the inlet of said water pump, a vacuum pump of the type employing water for its pumping action, a conduit leading from the gaseous fluid outlet of the water pump to the vacuum pump, and a condenser interposed in said last mentioned conduit.

7. In a vacuum condensation pump, the combination of a receiver connected to the return pipe of a steam heating plant, a water pump having a water discharge passageway and an impeller formed with a separate gaseous fluid outlet, a conduit for water and gaseous fluid leading from said receiver to said water pump, a vacuum pump of the type employing water for its pumping action, a conduit leading from the gaseous fluid outlet of the water pump to the vacuum pump, and a condenser interposed in said last mentioned conduit.

8. In a vacuum condensation pump, the combination of a centrifugal water pump having an inlet and a water discharge passageway and an impeller provided with a separate gaseous fluid outlet, a vacuum pump of the type employing water for its pumping action, and a conduit leading from said gaseous fluid outlet of the impeller of the water pump to the vacuum pump.

9. In a vacuum condensation pump, the combination of a water pump having a water discharge passageway and a separate gaseous fluid outlet, a vacuum pump of the type

employing water for its pumping action, a conduit leading from the gaseous fluid outlet of the water pump to the vacuum pump, and a chamber for supplying water to the vacuum pump communicating with the discharge passageway of the water pump and into which chamber the vacuum pump discharges water and gases, there being a gaseous fluid outlet leading from said chamber.

ceiver to the inlet of the water pump and having means for admitting gaseous fluids from the upper end of the receiver to the conduit, said water pump having a water discharge passageway, and an impeller provided with a gaseous fluid outlet separate from its inlet, and a condenser having its inlet end connected to the gaseous outlet of the impeller of the water pump and its outlet end connected to the inlet of the vacuum pump.

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10 10. In a vacuum condensation pump, the combination of a water pump having an inlet conduit, a water discharge passageway and a separate gaseous fluid outlet, a vacuum pump employing water for its pumping action,
15 a conduit connecting the gaseous fluid outlet of the water pump with the vacuum pump, a chamber for supplying water to said vacuum pump and having a valve controlled port leading from the water discharge passageway of the water pump, said vacuum
20 pump discharging water and gaseous fluid into said chamber and there being a gas outlet leading therefrom, and a valve controlled water outlet leading from said chamber to
25 the inlet conduit of the water pump.

11. In a vacuum condensation pump, the combination of a water pump having an inlet conduit, a water discharge passageway and a separate gaseous fluid outlet, a vacuum pump
30 employing water for its pumping action, a conduit connecting the gaseous fluid outlet of the water pump with the vacuum pump, a chamber for supplying water to said vacuum pump and having a valve controlled port
35 leading from the water discharge passageway of the water pump, said vacuum pump discharging water and gaseous fluid into said chamber and there being a gas outlet leading therefrom, an overflow tank communicating
40 with said chamber, and a valve controlled water outlet leading from said overflow tank to the inlet conduit of the water pump.

12. In a vacuum condensation pump, the combination of a receiver connected to the return pipe of a steam heating plant, a pump
45 structure mounted thereon and containing a water pump and a vacuum pump of the type employing water for its pumping action, a conduit leading from the bottom of the receiver to the inlet of the water pump and
50 having means for admitting gaseous fluids from the upper end of the receiver to the conduit, said water pump having a water discharge passageway, and an impeller provided with a gaseous fluid outlet separate from its
55 inlet, a conduit leading from said gaseous fluid outlet of the impeller to the inlet of the vacuum pump.

13. In a vacuum condensation pump, the combination of a receiver connected to the return pipe of a steam heating plant, a pump
60 structure mounted thereon and containing a water pump and a vacuum pump of the type employing water for its pumping action, a conduit leading from the bottom of the re-
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