

**March 12, 1935.**

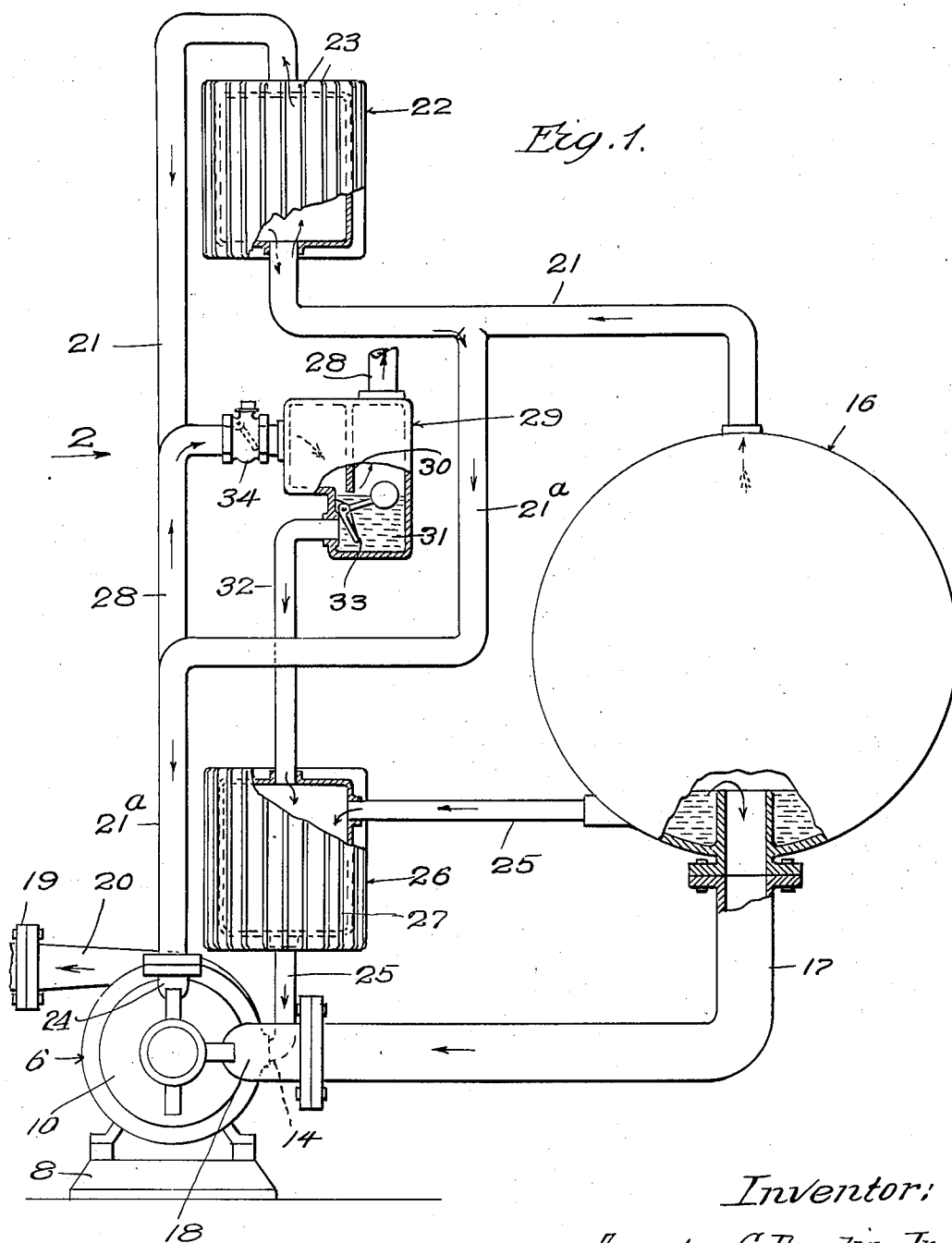
A. C. DURDIN, JR

**1,993,832**

## STEAM HEATING SYSTEM

Filed June 11, 1931

4 Sheets-Sheet 1



**March 12, 1935.**

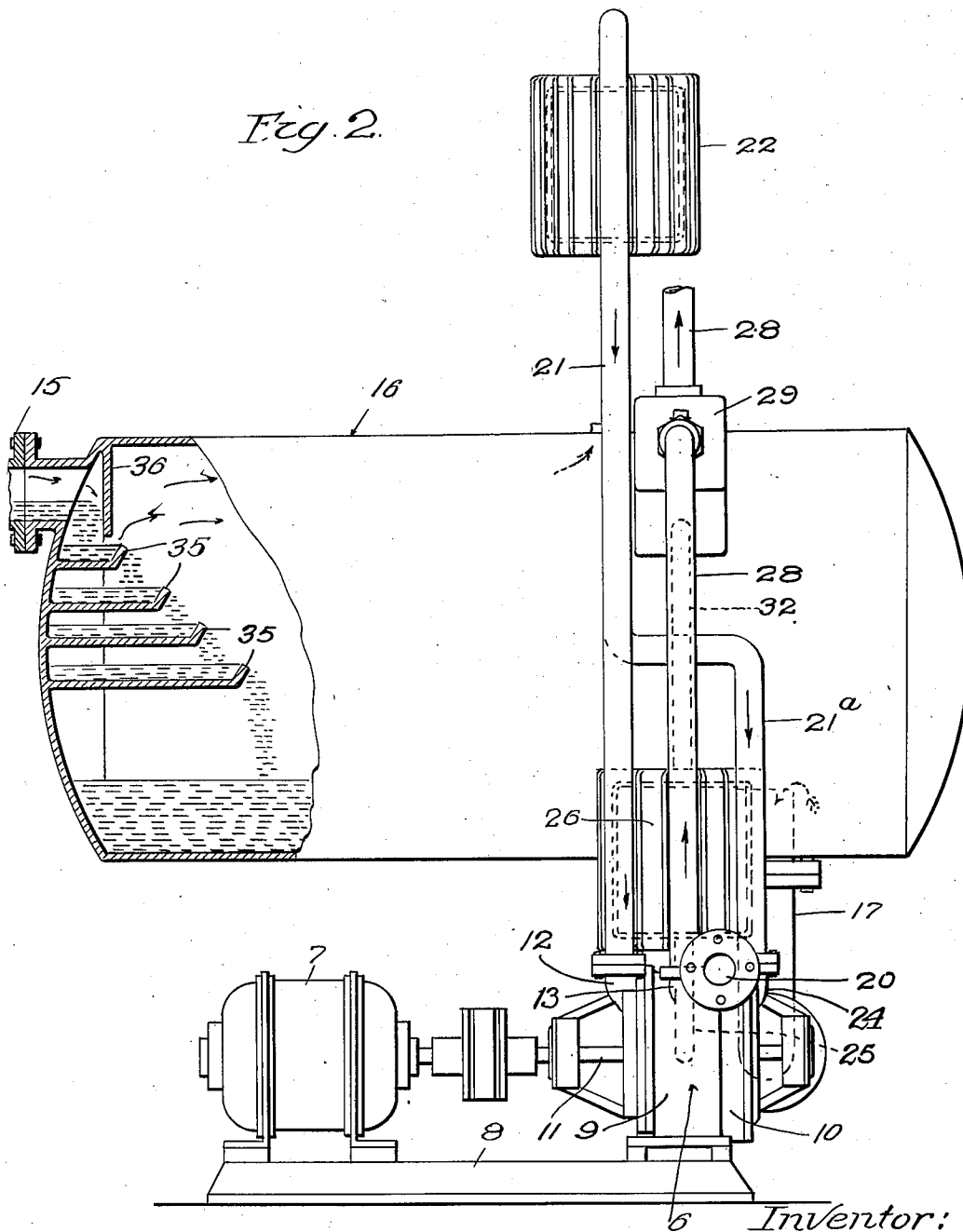
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## STEAM HEATING SYSTEM

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4 Sheets-Sheet 2



6 Inventor:  
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1,993,832

STEAM HEATING SYSTEM

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*Fig. 3.*

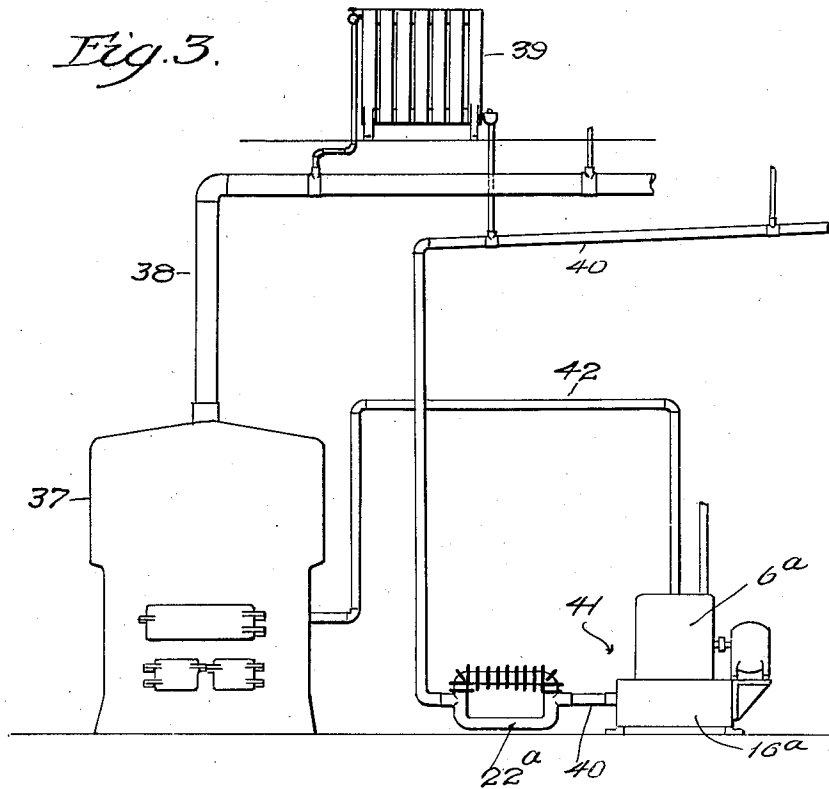


*Fig. 4.*

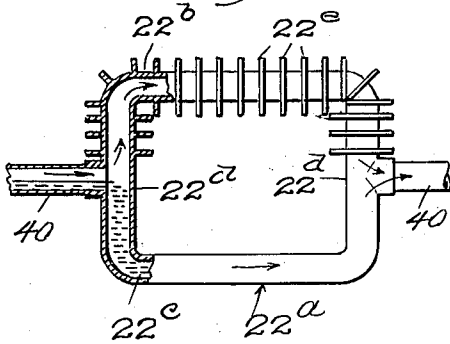
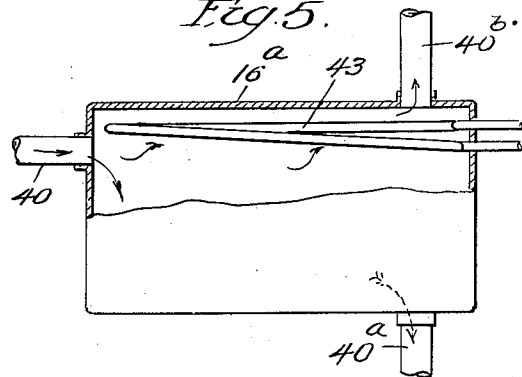


*Fig. 5.*



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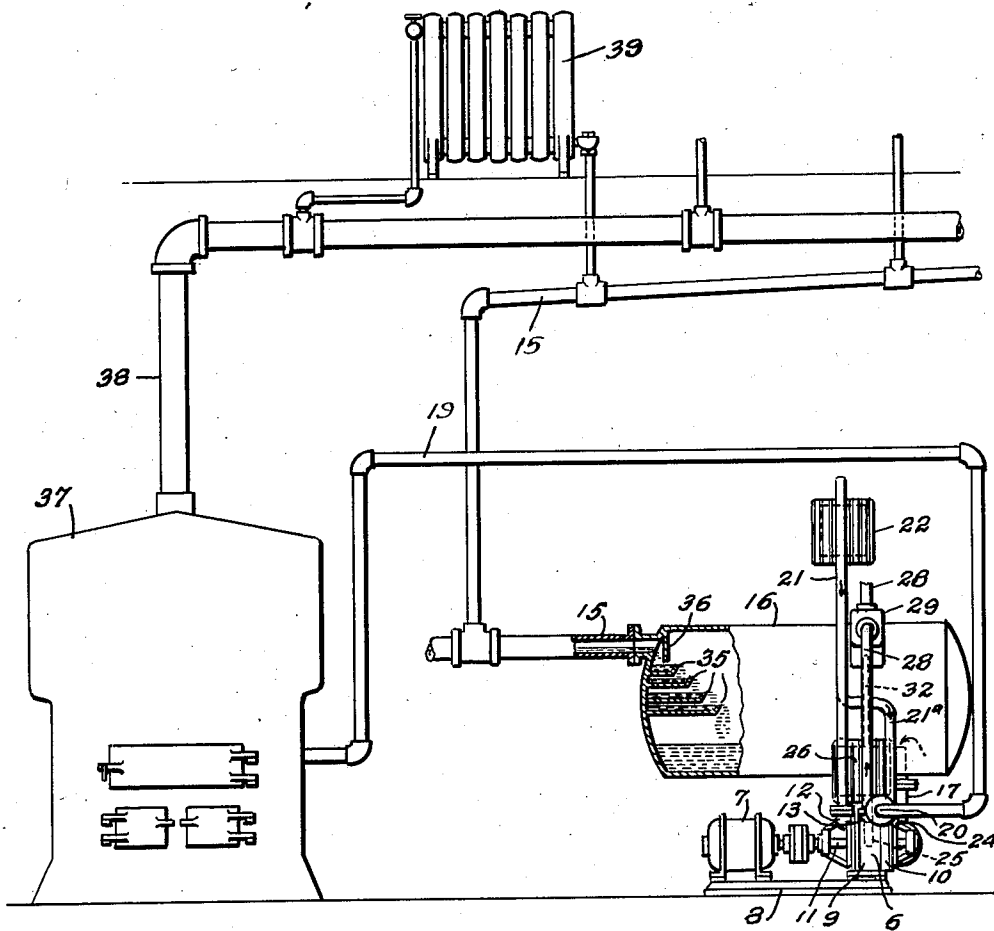
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Fig. 6.



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## UNITED STATES PATENT OFFICE

1,993,832

## STEAM HEATING SYSTEM

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Application June 11, 1931, Serial No. 543,644

3 Claims. (Cl. 237—67)

This invention relates to steam heating systems of that type wherein a vacuum condensation pump is employed for creating a partial vacuum in the return pipes of the heating system and for returning the water of condensation back to the boiler.

Inasmuch as some air is likely to leak into heating systems, and since the steam traps of the radiators do not always function properly, air, steam and vapor return with the water of condensation and ordinarily must be handled by the vacuum condensation pump. A vacuum condensation pump, such as is used in connection with steam heating plants, ordinarily comprises a vacuum pump usually of the type employing water for its pumping action and a centrifugal water pump mounted on the same shaft. Owing to the fact that considerable quantities of steam and vapor must be handled by the vacuum pump, its capacity for creating a vacuum is reduced materially and this reduction in efficiency usually increases as the temperature of the condensate increases.

The principal object of the present invention is the provision of means in advance of the vacuum pump for condensing any steam and vapor that returns with the water of condensation from the radiator, thereby reducing the volume of condensable fluids, and, as a result, permitting the vacuum pump to handle practically only air and non-condensable gases. Another object is to provide means whereby the efficiency of the vacuum pump for producing a partial vacuum in the returns is maintained at a maximum, despite the fact that steam and vapors return with the water.

Another object is to condense the steam and vapors which return with the water of condensation without correspondingly reducing the temperature of the water, thereby effecting a great saving of the heat units and, at the same time, minimizing any loss by reason of the discharge of steam or vapor from the system. Another object is the provision of means for separating and discharging from the system any dissolved oxygen that finds its way into the condensate. It is well known that the presence of dissolved oxygen in the water has a tendency to increase the corrosion of the return pipes, and by separating the dissolved oxygen from the water and discharging the dissolved oxygen, the process of corrosion of the return pipes is reduced to a minimum.

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 diagrammatic view, in end elevation, of the pumping apparatus of a steam heating system embodying a simple form of the present invention, certain portions being broken away to illustrate parts that would otherwise be hidden from view;

Fig. 2 is a side elevation of the apparatus seen in Fig. 1, looking in the direction of the arrow 2 in Fig. 1 and showing certain parts broken out;

Fig. 3 is a diagrammatic view, in side elevation, of a steam heating system illustrating a slightly modified form of the invention;

Fig. 4 is a side elevation, partly broken out, of the condenser shown in Fig. 3;

Fig. 5 is a side elevation, partly broken out, of a second modified form of condenser; and

Fig. 6 is a diagrammatic view, in side elevation, partly broken out, of a steam heating system illustrating the application of the invention to a steam heating plant.

Referring to said drawings, and first to Figs. 1, 2 and 6, the reference character 6 designates a vacuum condensation pump and 7 an electric motor connected thereto and operating to drive the pump, both of these mechanisms being mounted upon a base 8. The vacuum condensation pump may be of any of the well known types now in common use and embodying a vacuum pump 9 on one side of its center and a water pump 10 on the other side thereof, both having impellers mounted upon a common shaft 11. The vacuum pump 9, illustrated, is of the type which employs make-up water or throwing water for its pumping action. The air inlet to the vacuum pump is illustrated at 12, the air discharge at 13 and the inlet for the make-up water at 14.

A vacuum condensation pump, like the one illustrated herein, in which the vacuum pump employs water for its pumping action is more fully shown and described in the patent to I. C. Jennings, No. 1,447,854, dated March 6, 1923, but it is understood that I do not desire to limit myself to the particular vacuum condensation pump disclosed in said patent. Another form of a vacuum condensation pump usable in the present system is disclosed in my companion application Serial No. 545,916, filed June 22, 1931.

In the steam heating plant illustrated in Fig. 6, wherein the preferred embodiment of the invention is illustrated, a boiler 37 is shown, from which rises a steam supply pipe 38 that connects with the radiators, one of which is shown at 39. The return pipe 15 from the radiators, opens to a re-

ceiver 16 into which the water of condensation and any steam, vapor, air and other non-condensable gases are discharged. Leading from a point adjacent the bottom of the receiver is a water pipe 17 which runs to the inlet 18 of the water pump 10. A pipe 19 connected with the outlet 20 of the water pump leads back to the boiler or other place where it is desired to discharge the water of condensation.

Leading from the top of the receiver 16 is a pipe line 21 which runs to the air inlet 12 of the vacuum pump 9. Any steam, vapor, air and other non-condensable gases that enter the receiver are exhausted therefrom by the vacuum pump through the pipe line 21. The vacuum pump produces a partial vacuum in the receiver 16 and the return pipe 15 of the heating system, and discharges the air and non-condensable gases to the atmosphere, and the water pump 10 discharges the water of condensation which collects in the receiver back to the boiler or other place where it is desired to discharge the water.

To condense the steam and vapor which flow back through the return pipe, I provide a condenser 22 in advance of the vacuum pump. In the form of the invention illustrated in Figs. 1 and 2, the condenser 22 is interposed in the pipe line 21 between the receiver and vacuum pump and operates to condense the steam and vapor, thereby reducing the volume of fluid which the vacuum pump has to handle besides producing a partial vacuum in the receiver and return pipe, and in this manner aiding the vacuum pump in performing its function.

The condenser may take various forms, it may be air cooled or liquid cooled, and in Figs. 1 and 2, it is shown in the form of a tank interposed in the pipe line 21 and provided with a series of fins 23 on its outer surface which are cooled by the outer atmosphere and absorb the heat from the tank. A pipe 21<sup>a</sup> leads from the section of the pipe 21, located between the receiver 16 and condenser 22, and runs to a water inlet 24 of the water pump. Water of condensation which collects in the condenser 22 flows back through said section of the pipe 21 to the receiver and through the pipe 21<sup>a</sup> to the water pump and is discharged back to the boiler.

The water used for the pumping action of the vacuum pump is taken from the system, and, as shown in the drawings, a pipe line 25 leads from a point near the bottom of the receiver 16 to the water inlet 14 of the vacuum pump. Means are provided for cooling the water, and, as shown, a water cooler 26 is interposed in the pipe line 25 in which the water is cooled somewhat before entering the vacuum pump. Any suitable form of water cooler may be employed, the one illustrated comprising a tank provided with fins 27 on its outer surface and operating to absorb heat from the tank.

The vacuum pump discharges air and other non-condensable gases, which are drawn from the system, through an air discharge pipe line 28 to the atmosphere. Any water which the vacuum pump discharges through the discharge pipe 28 is collected in a collecting tank 29 that is interposed in said pipe 28. In said collecting tank 29 is a baffle plate 30 which separates the inlet side from the outlet side of the collecting tank, and below said baffle plate the collecting tank is formed with a well 31 in which the water may collect, whereas the air escapes out through the air discharge pipe at the top of the collecting tank. A water pipe 32 connects the well 31 of the

collecting tank 39 with the water cooler 26 and a float valve 33 is provided in the well 31 for controlling the inlet opening to said pipe 32, the arrangement being such that when the level of the water in the well 31 reaches a certain height it lifts the float and opens the float valve, thereby permitting the water to discharge from the well to the water cooler 26 where it is cooled before entering the vacuum pump. A check valve 34 opening towards the collecting tank 29 is provided in the section of the pipe line 28 between the vacuum pump and collecting tank.

To remove any dissolved oxygen which finds its way into the return pipes of the system, I provide means in the receiver 16 for agitating the water of condensation under a vacuum, said means being here shown in the form of a series of pans or baffle plates 35 contained in the receiver and arranged one above the other and into which the water of condensation flows after entering the tank. A baffle plate 36 is provided above the uppermost pan at the inlet opening to the receiver, which baffle plate directs the incoming fluids down upon the uppermost pan.

The pans are made of gradually increasing widths, from the uppermost one to the lowermost one, which arrangement causes the water to tumble from one pan into the other on its way towards the bottom of the receiver, whereby the water is agitated and dissolved oxygen is liberated therefrom and passes through the upper portion of the receiver along with any steam or vapor that may enter with the water. The steam, vapor and gases are exhausted from the receiver through the pipe line 21 and through the condenser 22 where the steam and vapor are condensed and the air and non-condensable gases discharged to the outer atmosphere by the vacuum pump.

In the operation of a steam heating system embodying the form of the invention illustrated in Figs. 1, 2 and 6, the vacuum pump creates a partial vacuum in the return pipes of the heating system and the condensate which discharges from the radiators, including any steam, vapor, air and other non-condensable gases, flow through the return pipe to the receiver where the steam, vapor, air and other non-condensable gases collect in the upper portion thereof and the water in the lower portion, the vacuum pump exhausting the steam, vapor, air and other non-condensable gases from the receiver and the water pump discharging the liquid therefrom and returning it back to the boiler. As the water of condensation enters the receiver it flows down over the pans or baffle plates therein in the form of a cascade, and as a result of the agitation imparted to it under the vacuum in the receiver, the dissolved oxygen is separated from the water and passes on in the form of a gas to the vacuum pump which discharges it to the atmosphere.

Before the steam, vapor, air and other non-condensable gases reach the vacuum pump they pass through the condenser where the steam and vapor are condensed and discharged to the water pump, and, as a result, the volume of the vaporous fluid passing to the vacuum pump is greatly reduced, thereby aiding the vacuum pump in producing a partial vacuum in the system and enabling the vacuum pump to handle only air and non-condensable gases. For this reason, the vacuum pump may, therefore, operate at its full capacity in handling air and non-condensable gases only, and, consequently, it produces a higher vacuum in the system, despite the fact that it is handling hot fluids. This has not been

possible heretofore with systems unprovided with a condenser, since the vacuum pump had to pump not only air and non-condensable gases, but also quantities of steam and vapor which were discharged to the outer atmosphere with the resulting loss of heat values and the water of condensation contained in said steam and vapor. It will be observed, therefore, that not only is practically all of the water retained in the system, but the steam and vapors returning with the water of condensation are condensed and reclaimed without materially lowering the temperature of the water.

In the form of the invention illustrated in Fig. 3, I have shown, conventionally, a steam boiler 37, a steam supply pipe 38 leading therefrom, a radiator 39 connected to the steam supply pipe, a return pipe 40 connected to the radiator, and pumping apparatus 41 connected to the return pipe 40 and to the pipe 42 which leads from the pumping apparatus back to the boiler 37. The pumping apparatus 41 may, of course, be of the form illustrated in Figs. 1 and 2, but, as shown, embodies a vacuum condensation pump 6<sup>a</sup> and a condenser 22<sup>a</sup> interposed in the return pipe 40 in advance of the pump 6<sup>a</sup>. The condenser 22<sup>a</sup> is here shown in the form of an upper conduit 22<sup>b</sup> and a lower conduit 22<sup>c</sup> which connect at both ends with the return pipe 40 through upright conduits 22<sup>d</sup>. Means are provided for cooling the upper conduit of the condenser 22<sup>a</sup>, and it is here shown as provided with fins 22<sup>e</sup> upon its outer surface for absorbing the heat from said upper conduit.

In this form of the invention, the condensate flows into the condenser 22<sup>a</sup>, the water flowing into the lower conduit 22<sup>c</sup> thereof and thence to the vacuum condensation pump 6<sup>a</sup> or to the receiver 16<sup>a</sup> of the vacuum condensation pump, and the steam, vapor, air and other gases flowing through the upper conduit 22<sup>b</sup> of the condenser where they are condensed. The water of condensation flows through the lower conduit 22<sup>c</sup>, and the air and other non-condensable gases pass on through the upper portion of the return pipe 40 to the vacuum condensation pump 6<sup>a</sup> or to the receiver 16<sup>a</sup>.

In the operation of a steam heating system employing the modified form of condenser shown in Figs. 3 and 4, the condensate, including steam, vapor, air and other non-condensable gases passes through the condenser before entering the receiver or before entering the vacuum condensation pump. As a result, the steam and vapor are condensed, thus reducing the volume of fluid which the vacuum pump must handle.

In the form of the invention illustrated in Fig. 5, a cooling pipe 43 or other conduit is contained in a tank such as a receiver 16<sup>a</sup> that receives the condensate from the return pipe. A cooling medium is passed through the pipe or other conduit 43 and, as a result, any steam or vapor entering the tank along with the water of condensation is condensed in the tank. The tank may be connected at its receiving end to the return pipe 40 of the steam heating system and at its discharge end it may be connected to a water pipe 40<sup>a</sup> leading to the water pump and to a pipe 40<sup>b</sup> leading to the vacuum pump. It will be observed that any fluid passing through the tank from the return pipe 40 to the pipe 40<sup>b</sup> is cooled by the cooling coil 43, the steam and vapor being condensed and falling into the lower part of the tank, whereas the air and other non-condensable vapors pass on to the pipe 40<sup>a</sup>.

It is observed that in the present system the

water is separated from the steam and vapor and the steam and vapor are condensed and returned to the boiler instead of passing to the vacuum pump. This separation of the water from the steam and vapor takes place in advance of the vacuum pump and may be accomplished in the receiver, as in the preferred form, or in a condenser as in the modified forms. Furthermore, the steam and vapor are condensed without materially cooling the water, a higher vacuum is maintained with a vacuum pump of given capacity, the heat losses are reduced, and practically all of the water is maintained in the system.

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. A steam heating system comprising in combination a steam boiler, a steam supply pipe leading therefrom, a radiator connected with said pipe, a return pipe connected with the radiator, a receiver connected to the return pipe and wherein water is separated from the steam, vapor and other non-condensable gases of the condensate, a vacuum pump of the type employing water for its pumping action and having its air inlet connected to the top of said receiver, and having a pipe connection for its make-up water connected to the receiver, a water cooler interposed in said pipe connection for the make-up water, a water pump connected to the bottom of the receiver, a condenser interposed between the receiver and vacuum pump for condensing steam and vapor exhausted from the receiver by the vacuum pump, and a connection from the condenser for returning the condensed steam and water to the system.

2. A steam heating system comprising in combination a steam boiler, a steam supply pipe leading therefrom, a radiator connected with said pipe, a return pipe connected with the radiator, a receiver connected to the return pipe wherein water is separated from the steam, vapor, air and other non-condensable gases of the condensate, a vacuum pump employing water for its pumping action and having its air inlet connected to the top of the receiver, and having a pipe connection for its make-up water connected to the receiver, a water cooler interposed in said pipe connection for the make-up water, a water pump connected to the receiver, a condenser interposed between the receiver and vacuum pump for condensing the steam and vapor exhausted from the receiver by the vacuum pump, a conduit connected to the condenser for returning said condensed steam and vapor to the system, a collecting tank having a pipe connection with the discharge side of the vacuum pump for collecting any water discharged by the vacuum pump and a conduit for returning it to the system.

3. A steam heating system comprising in combination a steam boiler, a steam supply pipe leading therefrom, a radiator connected with said pipe, a return pipe connected with the radiator, a receiver connected to the return pipe wherein water is separated from the steam, vapor, air and other non-condensable gases of the condensate, a vacuum pump employing water for its pumping action and having its air inlet con-

5 nected to the top of the receiver, and its pipe line for make-up water connected to the receiver, a water cooler interposed in the pipe line for make-up water, a water pump connected to the bottom of the receiver, a condenser interposed between the receiver and vacuum pump for condensing the steam and vapor exhausted from the receiver by the vacuum pump, a conduit for re- turning said condensed steam and vapor to the system, a collecting tank having a pipe connection with the discharge side of the vacuum pump, for collecting any water discharged by the vacuum pump, and a conduit for discharging said collected water into said water cooler. 5

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