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W. T. THOMSEN

VACUUM HEATING SYSTEM

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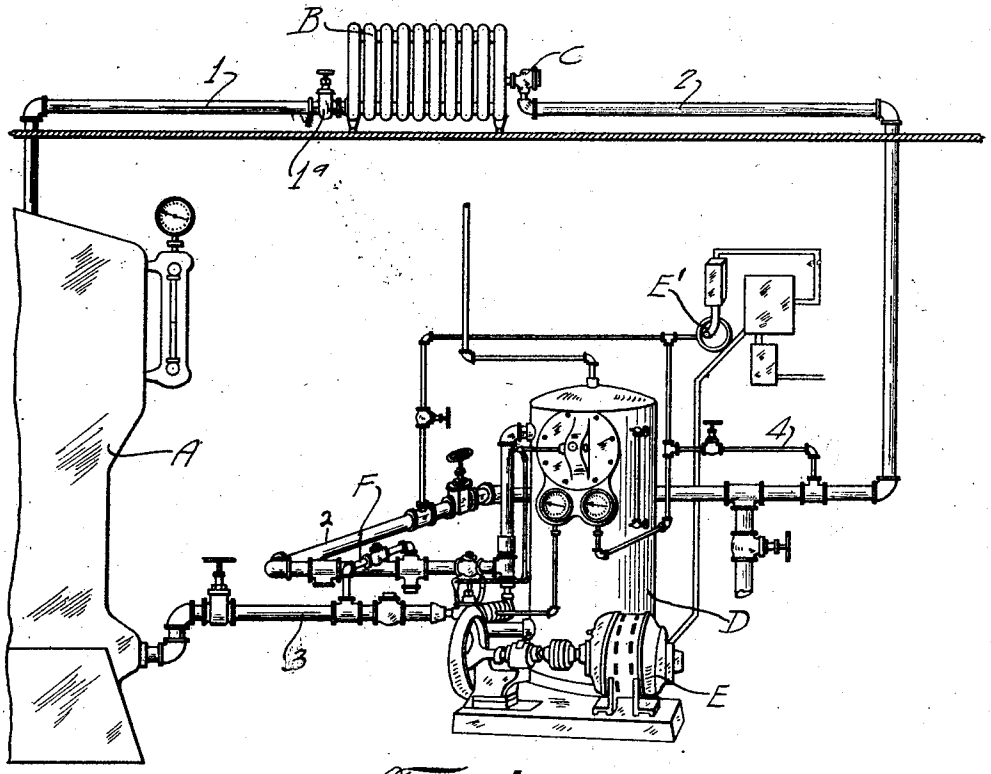

Fig. 1.

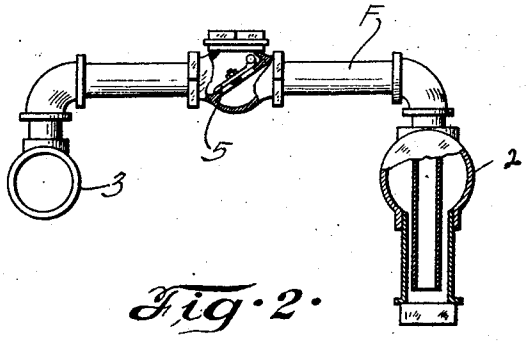

Fig. 2.

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VACUUM HEATING SYSTEM.

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To all whom it may concern:

Be it known that I, WILLIAM T. THOMSEN, a citizen of the United States, residing at St. Louis, Missouri, have invented a certain new and useful Improvement in Vacuum Heating Systems, of which the following is a full, clear, and exact description, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to vacuum heating systems.

In the conventional vacuum heating systems now in general use the water of condensation that collects in the radiators and return lines is pumped back to the boiler by a vacuum pump which is also used to remove air from the radiators and return lines and create a vacuum in the return lines. Each radiator is equipped with a thermostatic or other type of trap that permits the water of condensation to escape from the radiator through the return line, but which prevents the steam supplied to the radiator from escaping from same through the return line. In the normal operation of the system the vaccum pump starts and stops automatically according to the vacuum that exists in the return line leading back to the pump, the pump being governed by a controlling device which causes the pump to start when the vacuum drops below a certain degree, and which causes the pump to stop and remain inoperative after the vacuum has been restored to normal. When the radiators are filled with steam the vacuum pump will be maintained in an inoperative condition by the vacuum which then exists in the return lines. When one or more of the radiators start to cool off the water of condensation that collects in the radiators escapes from the same into the return lines, and after a certain quantity of water of condensation has collected in the return system, the weight or pressure exerted by said water on the controlling device of the pump causes the pump to become operative, whereupon the water of condensation will be pumped back to the boiler. The above cycle continues so long as sufficient steam is being generated in the boiler to keep the radiators full of steam, but if the pressure in the boiler drops to such a point that sufficient steam is not being generated to keep the radiators filled with steam, then the thermostatic traps on the radiators cool off, due to the rapid condensation taking place in the radiators, and assume such a condition that direct communication is established between the radiators and the return lines. The rapid condensation taking place in the radiators creates a high vacuum in the radiators which is exerted on the boiler and on the return lines that lead from the radiators. The vapor forming in the boiler is drawn into the radiators by this high vacuum, and as soon as said vapor condenses in the radiators, the water of condensation escapes from same through the return lines, but in view of the fact that the radiators are then in direct communication with the return lines, due to the cooling off of the thermostatic traps, the high vacuum that exists in the radiators is exerted on the water of condensation in the return line in such a way as to prevent said water from exerting sufficient weight or pressure on the controlling device of the pump to cause the pump to become operative, even though an abnormally large quantity of water of condensation has collected in the return pipe of the system.

Under such a condition the supply of water in the boiler rapidly becomes diminished, and if the condition is allowed to continue for a considerable period, the boiler is liable to break, due to an insufficient supply of water. Accordingly, in the conventional vacuum heating systems it is necessary to carefully watch the fire in the boiler, in order to maintain sufficient pressure on the boiler to keep the radiators filled with steam, for if the pressure is allowed to drop below a certain point, there is great danger of the boiler breaking, due to an abnormal drop in the level of the water in the boiler, caused by an abnormally large quantity of water of condensation collecting and remaining in the return pipe of the system. In order to overcome this inherent defect of conventional vacuum heating systems, a device commonly termed "a vacuum breaker" is sometimes installed in the return line leading to the boiler so as to automatically admit sufficient air to the return line to prevent an abnormally high vacuum from being created in the return line when the boiler is not generating sufficient steam to keep the radiators filled with steam, or, in other words, when the thermostatic traps on the radiators are in such a condition that the high vacuum created in the radiators by

the condensation of vapor drawn from the boiler is exerted on the return line. The air that is admitted to the return line by the vacuum breaker effectively destroys a high vacuum in the return line and permits the water of condensation in the return line to exert sufficient weight or pressure on the controlling device of the vacuum pump to cause said pump to become operative after a certain quantity of water of condensation has collected in the return line, but the use of a vacuum breaker is objectionable, because it admits air to the system, thus necessitating the expenditure of considerable power to expel said air, because the efficiency of a vacuum heating system is dependent upon the absence of air in the circulating system.

One object of my invention is to provide a sealed vacuum heating system which is constructed in such a manner that it is not necessary to admit air to the return line leading to the boiler or carefully watch the fire in moderate weather and keep a certain pressure on the boiler, in order to eliminate the possibility of the boiler bursting, due to an abnormal drop in the level of the water in the boiler, thereby effecting a considerable saving in the quantity of fuel used to operate the system in moderate weather and insuring a highly efficient heating system, due to the absence of an abnormal quantity of air in the circulating system.

Another object is to provide a vacuum heating system which is completely sealed to the atmosphere and constructed in such a manner that the vacuum pump can remain inactive for longer periods than in the conventional vacuum heating systems without reducing the efficiency of the system, thereby effecting a considerable saving in the power used to operate the pump.

Another object is to provide a steam heating system that will function like a conventional vacuum heating system in extremely cold weather, like a vapor system in moderately cold weather, and like a vapor vacuum system in mild weather, the system being constructed in such a way that vapor will be supplied to the radiators at low temperatures, such as 170° to 190°, and the water of condensation returned to the boiler while the vacuum pump is inoperative.

Another object is to provide a vacuum heating system which is constructed in such a way that the amount of vapor in each radiator can be accurately controlled, thereby reducing the quantity of fuel required to operate the system in moderate weather.

And still another object is to provide a vacuum heating system which is so constructed that the water of condensation will be returned automatically to the boiler, regardless of the conditions existing in the system, even when the vacuum pump is inoperative, thereby insuring a safe water line in the boiler at all times. Other objects and desirable features of my invention will be hereinafter pointed out.

To this end I have devised a sealed vacuum heating system which is constructed in such a way that the return line leading from the radiators is connected with a boiler in such a manner that a high vacuum created in the radiators by rapid condensation of vapor therein, when the radiators are not completely filled with steam, will be exerted uniformly or equally on the steam supply line leading from the boiler to the radiators and on the return line leading from the radiators to the boiler, thereby permitting the water of condensation to return freely by gravity to the boiler, even though the vacuum pump is maintained in an inoperative condition by the vacuum which then exists in the return line. I accomplish this highly desirable result by connecting the radiating devices with the boiler so as to produce a sealed system that is cut off from the atmosphere, arranging a by-pass in the return line around the vacuum pump and providing said by-pass with a check valve that opens towards the boiler, thereby producing a vacuum heating system in which the water intake to the boiler is connected with the return line leading from the radiators, in such a manner that a pull exerted on the boiler in a direction tending to draw vapor from same into the radiators is also exerted on the return line in a direction tending to draw water of condensation from same into the boiler.

Figure 1 of the drawings is a perspective view illustrating my improved vacuum heating system; and

Figure 2 is a detail view of the by-pass around the vacuum pump that forms a direct connection between the water intake to the boiler and the return line leading to the vacuum pump from the radiators of the system.

Referring to the drawings, A designates a boiler of any preferred type or construction, B designates one of the radiators of the system, 1 designates the steam supply line leading from the boiler to the radiator through which steam is supplied to the radiator, 2 designates the return line leading from the radiator through which the water of condensation escapes therefrom, 1^a designates a manually-operable valve in the steam supply line that is adapted to be adjusted to regulate the supply of steam or vapor to the radiator, C designates an automatic trap, preferably, a thermostatic trap, that governs the escape of the air and water of condensation from the radiator into the return line 2, D designates a vacuum pump operated by an electric motor E or other suitable source of power and combined with

the return line 2 in such a manner that it will discharge the air and water of condensation from the return line 2 and create a vacuum in said return line, the water and air that enter the pump D being separated therein and the water thereafter discharged into the boiler A through a water intake 3 that leads from the pump D. The pump D is started and stopped automatically by a controlling device E′ that is governed by the vacuum existing in the return line 2, said controlling device E′ being connected with the return line by means of a pipe 4. I have not illustrated the construction of the controlling device E′, as said device may be of the type or kind now generally used in vacuum heating systems, the conventional vacuum pump controlling device comprising a diaphragm that is moved in one direction and maintained in a certain position by the vacuum that exists in the return line 2 and moved in the opposite direction by the weight or pressure exerted on same by water of condensation that collects in the return line 2 and rises in the pipe 4. In the normal operation of the system, when sufficient steam is being generated in the boiler to keep the radiators filled with steam, the vacuum pump D is maintained at rest by the vacuum created in the return line 2 by the previous operation of said pump. The condensation of the steam in the radiator B causes water to collect in the return line 2, and after a certain quantity of water of condensation has collected in said return line, the vacuum therein is reduced sufficiently to permit the diaphragm of the controlling device E′ to flex, due to the weight or pressure of the water of condensation on same, and thus cause the vacuum pump D to become operative. As soon as said pump cuts into service, the water of condensation that has collected in the return line 2 and any air that has entered said line, are pumped out of same into the separating chamber of the pump D, thereby causing the normal vacuum to be re-established in the return line and the water removed from the line 2 to be returned to the boiler. The pump D becomes inoperative as soon as the normal vacuum has been re-established.

If the pressure on the boiler A drops to such a point that sufficient steam is not being generated to keep the radiator B filled with steam, the thermostatic trap C cools off and assumes such a condition that the return line 2 is in direct communication with the radiator B. The rapid rate of condensation which then takes place in the radiator creates a high vacuum therein, which high vacuum, in the conventional vacuum heating system, virtually holds the water of condensation in the return line 2 in suspension and prevents said water from acting on the controlling device E′ of the pump in such a way as to cause said pump to become operative. In my improved system, however, the high vacuum that is created in the radiator B by the rapid condensation of steam or vapor therein, when said radiator is not completely filled with steam, has no effect on the return of the water of condensation to the boiler, owing to the fact that a by-pass or vacuum equalizer pipe F is arranged in the return line 2 leading from the radiators to the boiler in such a way that it forms a direct cross connection between said return line 2 and the water intake 3 of the boiler A ahead of the discharge valve of the pump D, the water of condensation in the return line 2 being capable of passing freely from same directly into the boiler through the by-pass F. As shown in Figure 2, the by-pass F is provided with a check valve 5 that opens towards the boiler A, so as to prevent the water in the boiler being sucked out of same through the intake 3 and by-pass F when the vacuum pump D is in operation. With a vacuum heating system of the construction above described the by-pass F is always in a condition to permit water of condensation to pass freely from the return pipe 2 to the boiler when vapor is being drawn from the boiler by a high vacuum existing in the radiators. Accordingly, the system is absolutely automatic, as the by-pass F and pump D are always in readiness to perform their respective functions and neither one affects the other. That is to say, in my improved system the vacuum pump D starts and stops automatically so as to discharge water of condensation and air from the return system when the boiler is generating sufficient steam to keep the radiators filled with steam, without liability of drawing water out of the boiler through the by-pass F. When the pressure on the boiler drops to such a point, however, that sufficient steam is not being generated to keep the radiators filled with steam, the thermostatic traps C on the radiators open and the by-pass F becomes operative to permit water in the return system to pass around the pump D and enter the water intake of the boiler A when a high vacuum is established in the radiators, due to the rapid condensation of the vapor that is drawn into the radiators from the boiler. The result is that the vacuum pump D remains inactive when the pressure on the boiler is low, but this low pressure has no tendency to cause the water level of the boiler to drop abnormally, due to the fact that the by-pass F equalizes the vacuum on the boiler, and thus permits the water of condensation in the return pipe 2 to flow back to the boiler.

From the foregoing it will be seen that

my invention eliminates the possibility of the boiler bursting, due to diminution of the water in the boiler when the steam pressure is low, and it produces a steam heating system that will function like a conventional vacuum heating system in extremely cold weather, function like a vapor system in moderately cold weather and function like a vapor vacuum heating system in mild weather, the change from one type to the other being automatic.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. A vacuum steam heating system, comprising a boiler, radiating devices combined with said boiler so as to produce a sealed system that is cut off from the atmosphere, a return line leading from said radiating devices back to the boiler, an automatic vacuum pump for removing water of condensation and air from the return line and for feeding said water back to the boiler, and means whereby the water of condensation in the return line can flow back to the boiler in the event the vacuum pump remains inoperative at a time when the return line is under an abnormally high vacuum.

2. A vacuum steam heating system, comprising a boiler, radiating devices combined with said boiler so as to produce a sealed system that is cut off from the atmosphere, a return line leading from said radiating devices back to the boiler, an automatic vacuum pump for removing water of condensation and air from the return line and for feeding said water back to the boiler, and means whereby a vacuum exerted on the boiler in a manner tending to draw vapor from same into the radiating devices of the system causes the water of condensation that has collected in the return line to be conducted back to the boiler, even though the vacuum pump is at rest.

3. A vacuum steam heating system, comprising a boiler, radiating devices combined with said bolier so as to produce a sealed system that is cut off from the atmosphere, a return line leading from said radiating devices back to the boiler, an automatic vacuum pump for removing water of condensation and air from the return line and for feeding said water back to the boiler, and a by-pass in the return line extending around said pump and provided with a check valve that opens towards the boiler.

4. In a vacuum steam heating system, a boiler, radiating devices combined with said boiler so as to produce a sealed system that is cut off from the atmosphere, a return line leading from said radiating devices back to the boiler, an automatic vacuum pump arranged in said return line, a thermostatic trap associated with each radiating device for governing the discharge of air and water of condensation from same into said return line, an equalizing pipe connected at one end to said return line at a point beyond the intake of the pump and connected at its opposite end to said return line at a point beyond the discharge of the pump, and a check valve in said equalizing pipe that opens towards the boiler.

WILLIAM T. THOMSEN.