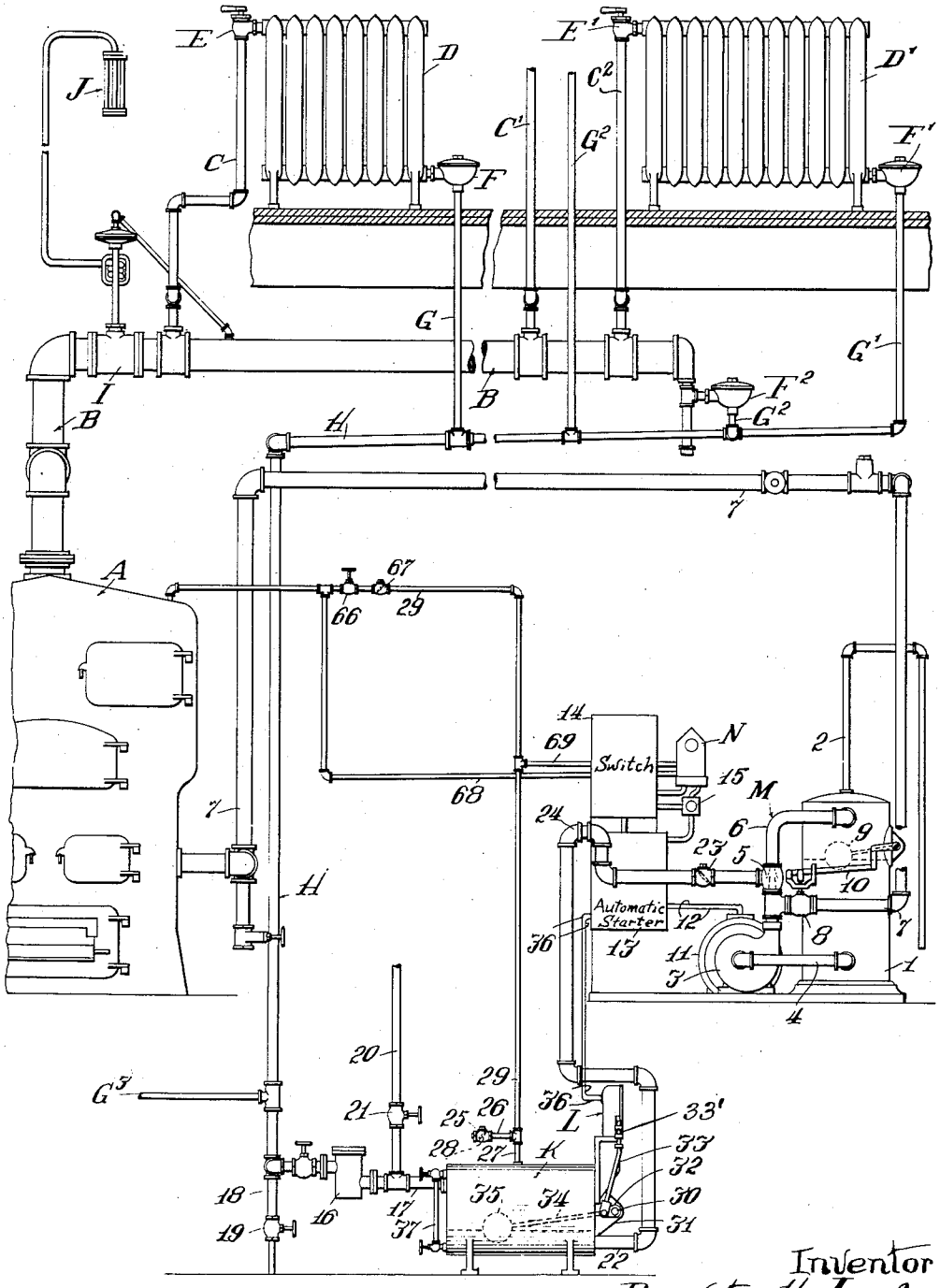
April 28, 1931. B. H. JARVIS 1,802,384

STEAM HEATING SYSTEM

Original Filed June 14, 1926



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Patented Apr. 28, 1931

1,802,384

UNITED STATES PATENT OFFICE

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STEAM HEATING SYSTEM

Original application filed June 14, 1926, Serial No. 115,866. Divided and this application filed July 21, 1930. Serial No. 469,510.

This invention relates to certain improvements in steam heating systems, especially those systems normally operated to maintain a pressure in the radiators below atmospheric and including a boiler and a pumping means for returning condensate to the boiler and for also maintaining a predetermined pressure differential between the supply and return sides of the system. This invention relates particularly to a means of equalizing pressures between the steam side and the return side of the system so that at no time is there any possibility of a higher vacuum being created on the steam side than exists on the return side. This application is a division of my copending application Serial No. 115,866, filed June 14, 1926.

The principal object of this invention is to provide a new and improved means of equalizing pressures between the steam side and the return side of a steam heating system, in case a higher vacuum should be created on the steam side than exists on the return side.

Other objects and advantages of the invention will be more apparent from the following detailed description of one improved form of installation involving the principles of this invention.

In the accompanying drawing, the figure is a diagrammatic view of a heating system including the improved equalizing pipe connection.

In the heating system here shown, A designates a steam generator or boiler, and B is the steam supply pipe leading from the boiler for supplying steam through the branch supply pipes C, C′ and C^2 to a plurality of radiators, two of which are shown and designated D and D′, respectively. Steam is admitted to the radiators D, D′, etc., through control valves E, E′, etc., and F, F′, and F^2 are steam traps associated with the radiators and with the end of the supply line B, from which the condensate passes through pipes G, G′, G^2, G^3, etc., to the common return main H. At I is indicated a pressure reducer in the supply pipe B, which is controlled by pressure of the steam on the low pressure side of the reducer, and by a thermostat J which may be located at any desired point either within or outside of the building heated by the apparatus.

At K is shown the accumulator tank, and L indicates the float controlled switch associated with this tank, these features constituting the particular improvements claimed in my parent application Serial No. 115,866, hereinabove referred to.

At M is indicated the pumping system which functions to maintain the desired pressure differential between the supply and return sides of the system, and also functions to force the liquid condensate back into the boiler A. This pumping system comprises a receiving tank 1, always containing a variable supply of water, and a pipe 2 for venting air or other gases from this tank. The centrifugal pump 3 operates to force water through a hurling circuit, the water being withdrawn through pipe 4 from the lower portion of tank 1, and forced through the jet exhauster 5 and return pipe 6 back into the upper portion of tank 1. The jet exhauster 5 communicates with the end of return pipe H, and functions to create a suction in this return main, and to withdraw condensate from this return main into the hurling circuit and deliver the condensate into the tank 1. The gases are permitted to escape through vent pipe 2. At 7 is shown a pipe leading from the hurling circuit, beneath the jet exhauster 5, to the boiler A, and the centrifugal pump 3 is adapted to force water from the tank 1 through the pipe 7 into the boiler. A control valve 8 in pipe 7 is normally closed so that all of the liquid withdrawn by the pump 3 from tank 1 will be forced through the hurling circuit and back into the tank. However, when the water level within tank 1 reaches a predetermined height, (the accumulation of water in this tank being constantly increased by the addition of condensate from return main H), the float 9 in tank 1 will, through the lever and link connections 10, open the valve 8 and permit the pump 3 to force part of the water in the hurling circuit through pipe 7 to the boiler. When the water level in tank 1 has been lowered sufficiently, valve 8 will close. The centrifugal pump 3 is driven by

electric motor 11, controlled through leads 12 from the automatic starter indicated diagrammatically at 13. For reasons of economy, the pump 3 need not be operated continuously, but its action is controlled by the automatic starter 13 and certain switch mechanism hereinafter described, so that the pump will only be driven when it is necessary to increase the pressure differential between the two sides of the system, or to force condensate back to the boiler.

At N is shown diagrammatically the vacuum regulator which acts, through switch 14 and automatic starter 13, to start and stop the motor 11 when necessary, in accordance with the variations in pressure between the supply and return sides of the heating system. When the difference in pressure between the supply and return sides of the system falls below a certain predetermined minimum, the vacuum regulator N will function to start the pump 3, and thus increase the vacuum in the return main. When a desired maximum pressure differential is reached, the regulator N will function to shut off power to the motor 11 and thus stop the pump 3.

In any heating system, especially at night, there are times when it is desired to reduce the cost of operating the vacuum pump. In such instances, especially when the fires are banked, it is desired to preclude the possibility of damaging the boiler by providing automatic return of condensate, and at the same time to avoid the expense of constant operation of the pump. In such cases, the snap switch, shown at 15, would be set to disconnect the vacuum regulator, and the condition then prevailing in the return line would be substantially atmospheric pressure, and the condensate could gravitate directly into the tank 1, provided all of the returns from the radiators came in at a higher level than the pump 3 or tank 1. In such cases, a switch could be provided, controlled by the float 9, for only actuating pump 3 at such intervals as became necessary to force the excess accumulation of water in tank 1 back to the boiler.

However, in some heating installations, the arrangement is necessarily such that some of the return pipes come in at a lower level than the boiler or pumping system, and obviously the return main cannot drain directly into the boiler or into the receiving tank 1. For example, in the figure a return pipe G^3 is shown delivering into the return main H at a lower level than the pumping system. It is to adapt a system of the type hereinabove briefly described to such conditions that the accumulator tank K is provided, which may if necessary be located in a pit beneath the floor which supports the boiler and pumping system. The lowest portion of the return main H drains through the suction strainer 16 and the pipe connection 17 into the upper portion of the tank K. At 18 is indicated a by-pass from the lower end of return main H to the sewer, this by-pass being controlled by the valve 19, and at 20 is indicated a pipe connection with the outside water supply, this connection being controlled by the valve 21, in order to admit additional water to the system when necessary. The accumulator tank K is merely a substantially closed metal receptacle of suitable size, into the upper portion of which one section of the return main H drains at 17, and from the lower portion of which the further extension of the return main H leads, as shown at 22. This portion of the return main leads up to the jet exhauster 5, as already described. A check valve or one-way valve 23 of any approved type is located in the return main H near the jet exhauster 5, this valve 23 permitting fluids to be drawn up through this portion of the return main H, by the action of the jet exhauster and hurling circuit, but preventing the back flow of any fluids toward the accumulator tank K. The siphon loop 24, positioned between the vertical and horizontal portions of this section of return main H, is for the purpose of providing space for the water to accumulate after reaching the top, and to prevent the water slug, which is the form in which the liquid is lifted from the accumulator tank K, from breaking up and running back down the vertical section of return main H. At 25 is shown an air release check valve, connected by pipes 26 and 27 with the accumulator tank K. This release valve may be of any approved form which will permit the flow of air or gases from the tank K, but prevent any inflow. The valve is here shown as comprising an outwardly swinging flap or check 28. The low pressure air pipe 29 extends from the connection to the air release check valve 25 to make connection direct with the top inlet to boiler A or to the boiler steam header, with a gate valve 66 and a check valve 67, (which may be similar in construction to valve 25) installed in this extension of air line 29. The check valve is so installed as to close against the steam pressure. The vacuum or pressure differential regulator N is connected with the supply and return sides of the system in any suitable manner for example by the pipes 68 and 69 connected respectively with the high and low pressure sides of the equalizing pipe 29.

A short shaft 30 is pivoted horizontally in an outwardly projecting portion 31 of one end of tank K, and one end portion of this shaft projects outside of the tank and is connected by crank-arm 32 and link 33 with the operating mechanism of snap-switch L which may be of any approved type, for example the structure disclosed in detail in my parent application Serial No. 115,866 hereinabove referred to. A lever 34 within the tank is secured at one end to shaft 30 and carries at its

other end the float 35 adapted to be sustained by the accumulated liquid in tank K.

As the water level rises in tank K, the float 35 will be raised and through link 33 and the lost-motion connections indicated at 33′ will eventually operate the snap-switch L to close a circuit through wires 36 leading to starter 13 thus starting the motor 11 driving the pump 3. The water of the hurling circuit propelled by pump 3 will pass through jet exhauster 5 creating a suction in return main H, which will draw water from the accumulator tank through outlet 22 and return main H into the hurling circuit and thence into receiving tank 1. When the water level has been lowered to the desired extent, the downward movement of float 35 will open snap-switch L causing motor 11 and pump 3 to stop.

A water level gauge 37 of any suitable type may be connected at one end of tank K.

In normal operation of this heating system, when a desired predetermined pressure differential is to be maintained between the supply and return sides of the system, steam passes from the boiler or generator A through supply pipe B and pressure reducer I to the several branch pipes C, and thence through control valves E to the radiators D. In the normal operation of the apparatus the pressure on the radiators and at times also in the boiler will be below atmosphere. That is, the quantity of steam admitted to the radiators, which are kept free of air and water by action of the vacuum pump, is so limited by the pressure reducing valve I that the pressure in the radiators is below atmospheric pressure and the temperature of the steam correspondingly low. For all except excessively cold weather this system will operate in this manner, the steam supply being regulated for different outside temperatures so that the radiators will receive steam in proportion to heat losses from the building. The thermostatic traps F permit condensate to pass from the several radiators, and from the end of supply pipe B, through the return pipes G to the return main H. The condensate gravitates down through return main H, and strainer 16 into the accumulator tank K. If the difference in pressure between the supply and return sides of the system falls below a certain minimum, the vacuum regulator N functions to start the operation of motor 11 and pump 3, and the water in the hurling circuit passing through jet exhauster 5 creates a suction in that portion of return main H connecting the jet exhauster with the tank K, this suction extending back through the entire return side of the system as far as the thermostatic traps F. The air and water, or both, which have drained into tank K, will be drawn up into the hurling circuit and delivered into the receiving tank 1. The air and other gases will escape through vent pipe 2, and when the accumulated liquid in tank 1 reaches a certain level, the float 9 will function to open the valve 8 and permit the pump 3 to force a portion of the water in the hurling circuit through pipe 7 to the boiler. During this operation, since the pressure in tank K is sub-atmospheric, the air release check valve 25 will remain closed and all gases in the condensate will be drawn up along with the liquid, into tank 1, the gases then escaping through the vent pipe 2. When the desired maximum pressure differential has been established in the system, the vacuum regulator N will operate to shut off power to the motor 11, and the pump 3 and the hurling circuit will cease to operate until it is again necessary to build up the pressure differential. In case there is sufficient accumulation of water in tank K during the period when the vacuum established is higher than that requiring the vacuum regulator to operate the pump, the float 35 will function, through switch L, and automatic starter 13, to start the operation of pump 3 and draw the excess fluids up into the receiving tank 1. It will be seen that the pump-driving motor 11 is normally under the control of either or both of the switches N and L, that is, the pump will be started or stopped by the vacuum regulator N, in accordance with the requirements of maintaining the desired pressure differential in the system, and the pump will simultaneously be controlled by the float-operated switch L in accordance with the water level within the tank K.

Now at times, especially at night when the fires are banked, it is desirable to reduce the cost of operating the vacuum pump, and it is unnecessary at such times to maintain the pressure differential between the two sides of the system. In such cases, the snap switch 15 will be turned to disconnect the vacuum regulator N, and the pump 3 will then be left entirely under the control of the float operated switch L. The condensate materials will now simply gravitate into the accumulator tank K, and since the pressure in the return line is now substantially atmospheric, the air release check valve 25 will open to permit the escape of air and gases which accummulate in tank K. When the liquid accumulated in tank K reaches a certain maximum level, the float 35 will operate the switch L so that pump 3 will be started and the accumulated liquid will be drawn up into the receiving tank 1, in the manner hereinabove described. When this accumulated liquid in tank 1 reaches a certain level, the float controlled valve 8 will be opened so that the excess liquid will be forced through pipe 7 into the boiler. This operation of pump 3 will only be required at long intervals, and the pump will be operated for only a very short period of time, and a very ap-

preciable reduction in the cost of electric current results.

When heat is on, and the system being supplied by boiler A and pump M is operating on vacuum control there will necessarily be a greater pressure on the steam side of the system e. g. boiler A, steam header B, and steam risers C, C′ and C², etc., than on the return side of system, e. g. return lines G, G′, G³, H and accumulator tank K, and this will cause check valve 67 in the equalizing air line 29 to be closed. Should however the source of heat being supplied to the boiler be shut off by thermostatic, manual, or other control the steam side of the system, including the radiators, by natural condensation of steam therein may have a high vacuum created in it, and this may be even a higher vacuum than exists on the return side of the system due to the exhausing action of the pump. Under this condition check valve 67 will open thus permitting the vacuum on the return side of the system to equalize with that of the steam side of the system so that natural gravitation of water from the radiators through the returns and into accumulator tank K will be accomplished.

I claim:

1. In a steam heating system, the combination of a boiler, radiators, supply pipes extending from the boiler to the radiators, return pipes from the radiators, a shunt pipe line extending from the return side of the system to the supply side of the system, and means for allowing a flow through the shunt pipe line from the return side of the system to the supply side of the system only.

2. In a steam heating system, the combination of a boiler, radiators, steam supply pipes extending from the boiler to the radiators, return pipes from the radiators, steam traps in said return pipes, a shunt pipe line extending from the return side of the system to the supply side of the system, and means for allowing a flow through the shunt pipe line from the return side of the system to the supply side of the system only.

3. In a vacuum steam heating system, the combination of a boiler, radiators, steam supply pipes extending from the boiler to the radiators, pumping mechanism, return pipes extending from the radiators to said mechanism, said mechanism being adapted to maintain a vacuum in the return pipes and to pump water of condensation back to the boiler, a shunt pipe line extending from the return side of the system to the supply side of the system, and means for allowing a flow through said shunt pipe line from the return side of the system to the supply side of the system only.

4. In a vacuum steam heating system, the combination of a boiler, radiators, steam supply pipes extending from the boiler to the radiators, pumping mechanism, return pipes extending from the radiators to said mechanism, said mechanism being adapted to maintain a vacuum in the return pipes and to pump water of condensation back to the boiler, steam traps in said return pipes, a shunt pipe line extending from the return side of the system to the supply side of the system, and means for allowing a flow through said shunt pipe line from the return side of the system to the supply side of the system only.

5. In a steam heating system, the combination of a boiler, radiators, supply pipes extending from the boiler to the radiators, return pipes from the radiators, a shunt pipe line extending from the return side of the system to the supply side of the system, and means for allowing a flow through the shunt pipe line from the return side of the system to the supply side of the system only, said means comprising a check valve opening towards the supply side of the system.

6. In a vacuum steam heating system, the combination of a boiler, radiators, steam supply pipes extending from the boiler to the radiators, pumping mechanism, return pipes extending from the radiators to said mechanism, said mechanism being adapted to maintain a vacuum in the return pipes and to pump water of condensation back to the boiler, steam traps in said return pipes, a shunt pipe line extending from the return side of the system to the supply side of the system, and means for allowing a flow through said shunt pipe line from the return side of the system to the supply side of the system only, said means comprising a check valve opening towards the supply side of the system.

7. In a steam heating system the combination of a boiler, radiators, supply pipes extending from the boiler to the radiators, a water collecting tank, return pipes from the radiators to said water collecting tank, a shunt pipe line extending from the water collecting tank above the normal water level therein to the supply side of the system above the normal water level of the boiler and a check valve in said shunt pipe line for allowing flow therethrough in the direction of the supply side of the system only.

8. In a vacuum steam heating system, the combination of a boiler, radiators, steam supply pipes extending from the boiler to the radiators, return pipes leading from the radiators, means including an exhausting mechanism acting through the return pipes for maintaining a vacuum in the heating system and a pressure differential between the supply and return sides of the system, a shunt pipe line extending from the return side of the system to the supply side of the system, and means for permitting a flow through said shunt pipe line from the return side of

the system to the supply side of the system only.

9. In a vacuum steam heating system, the combination of a boiler, radiators, steam supply pipes extending from the boiler to the radiators, return pipes leading from the radiators, means including an exhausting mechanism acting through the return pipes for maintaining a vacuum in the heating system, means for controlling the exhausting means to maintain a pressure differential between the supply and return sides of the system, means for temporarily rendering the control means inoperative, a shunt pipe line extending from the return side of the system to the supply side of the system, and means for permitting a flow through said shunt pipe line from the return side of the system to the supply side of the system only.

10. In a vacuum steam heating system, the combination of a boiler, radiators, steam supply pipes extending from the boiler to the radiators, return pipes leading from the radiators, steam traps at the outlets of the radiators, an exhausting mechanism, return pipes leading from the steam traps to the exhausting mechanism, means including the exhausting mechanism and a controlling mechanism therefor for maintaining a vacuum in the system and a pressure differential between the supply and return sides of the system, a shunt pipe line extending from the return side of the system to the supply side of the system, and a check valve in this shunt pipe line opening toward the supply side of the system only.

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