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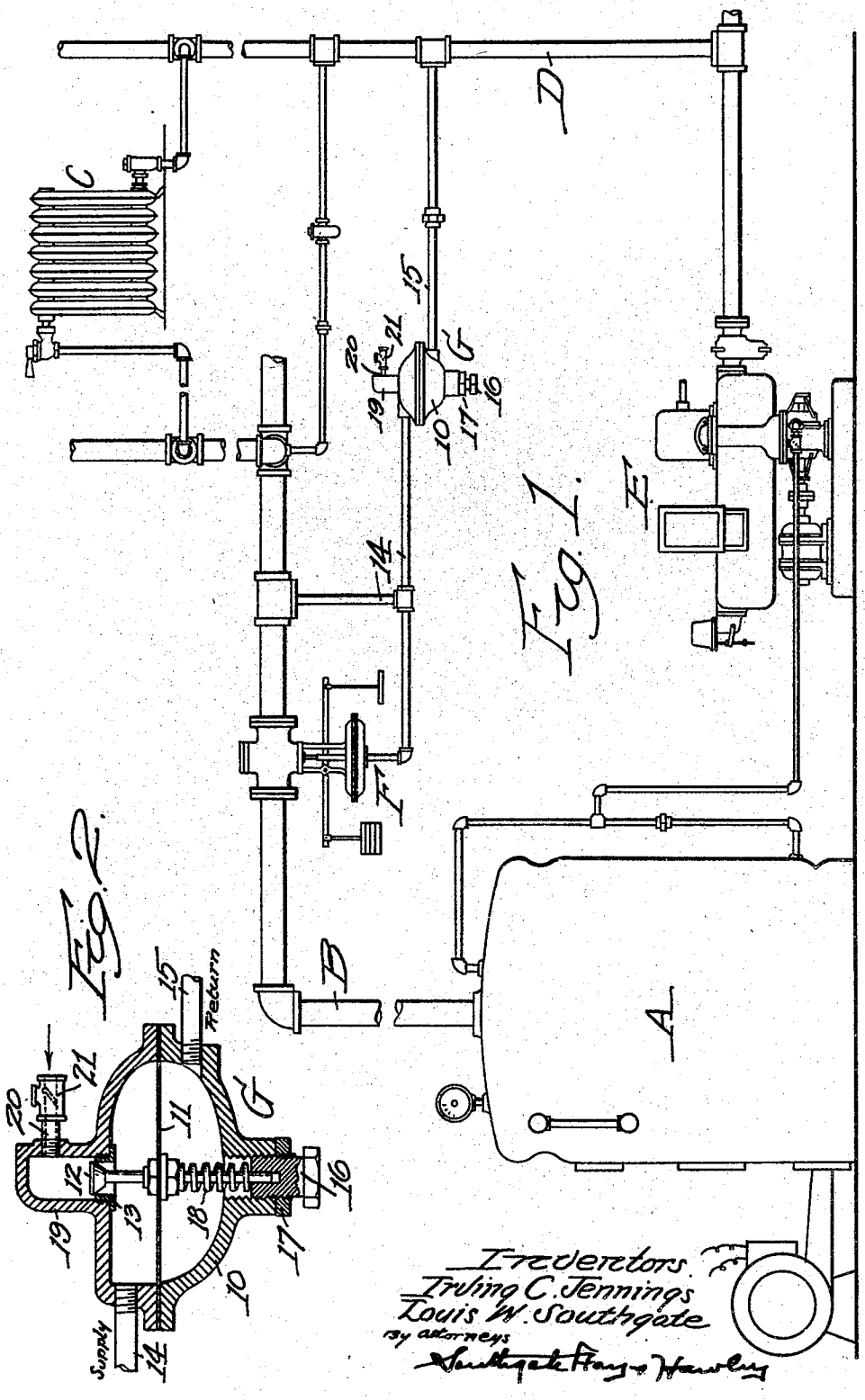

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STEAM HEATING SYSTEM

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The object of this invention is to improve steam heating systems and make them safer in operation, particularly at low temperatures. The invention has especial application to vacuum steam heating systems.

A vacuum steam heating system comprises a source of steam supply, as a boiler or street main, a supply line, radiators, a return line, and a pumping apparatus for exhausting air and gas from the system and for creating and maintaining a vacuum or sub-atmospheric pressure in the return line and radiators and for handling the water of condensation by returning the same to the boiler or hot well or by removing the same from the system.

In the art the pipe or piping forming the supply line is known as the supply side of the system and the pipe or piping forming the return line is known as the return side of the system.

In operating such a system, a difficulty has been encountered when the steam supply is lowered or shut off, as by the shutting down of an oil or a gas burner. In such instances, the steam may condense so rapidly in the system and the radiators, that a vacuum will be created in the radiators and supply line which will be greater than the vacuum created (or which can be created) in the return line by the pumping mechanism. In such case, the water of condensation may be held up in the radiators, as it is difficult for the same to flow back to the boiler through the supply line, particularly if the radiator valves are only partly opened or if measuring orifices and traps are used in connection with the radiators, as water will flow very slowly through a small opening as compared with the flow of vapor therethrough.

When this takes place, the boiler may be so depleted of water as to be burned out or explode, particularly when the system starts again in proper operation and the large quantity of water held up in the radiators is suddenly forced into the same.

Various expedients have been tried to overcome this difficulty, among which may be noted the following:

A shunt pipe line provided with a hand valve has been arranged between the supply and return lines. This is not practical as it is impossible always to have a skilled operator on the job. Dependence sometimes has been placed on the drip line employed between the supply and return lines, in which a thermostatically operating valve is used to allow a flow from the supply line to the return line, but to prevent any flow of steam or hot vapor therethrough. While this valve when cold may allow a flow from the return line to the supply line to balance the system, it is not always desirable to depend on temperature differences, particularly when operating at low temperatures.

A vacuum relief valve has sometimes been applied to the supply line to open when the pressure therein falls below atmospheric to admit atmospheric air into the supply line. This does not meet the various conditions encountered, particularly as it is common practice to run the entire system at sub-atmospheric pressures.

Another expedient that has been tried has been to arrange a check valve opening towards the supply line in the shunt pipe line between the return and supply lines. This does not meet all conditions because this check valve will open only when the pressure in the supply line is less than that in the return line.

The dangerous condition before explained, namely the holding up of water of condensation in the radiators may occur when the supply and return sides of the system are balanced or when the pressure in the supply line is only a little more than in the return line.

To meet all conditions and make the system absolutely safe, the following arrangement has been invented:

A valve is arranged so that atmospheric air can be admitted therethrough into the supply side of the system, and the opening and closing of this valve is governed so as to prevent the pressure in the supply side from falling below the pressure in the return side of the system.

This governing action is preferably obtained from the differential of pressure between the supply and return sides of the system.

When the pressure in the supply side falls to a point dangerously near the pressure in the return side, the valve will open and atmospheric air will be admitted to the supply side.

The term "pressure" as used in the previous description has been employed to designate absolute pressures, irrespective of the partial vacuum or sub-atmospheric pressure derived from the pumping apparatus. These partial vacuum pressures are usually measured by a mercury column, thirty inches thereon approximately representing the atmospheric pressure of fifteen pounds per square inch and a two inch drop thereon showing a minus pressure relatively to atmospheric pressure of one pound per square inch.

Adjusting mechanism is provided so that the operation of the means for operating the valve can be regulated, and this mechanism is preferably set so that the valve will open before the pressure in the supply side falls to the pressure in the return side, whereby the pressure in the supply will always exceed the pressure in the return side by a determined amount. By this arrangement, pressure will always exist in the supply side relatively to the return side so that there always will be a circulation through the radiators towards the return side of the system to the pump.

For example, suppose the pumping mechanism is set to create and maintain twelve inches of vacuum or a minus pressure of six pounds per square inch relatively to atmospheric pressure. Suppose the adjusting mechanism for the valve is set so that the valve will open when eleven inches of vacuum is created in the supply line or when the differential of pressures between the supply side and the return side is less than one inch of mercury or one-half pound per square inch. When the valve opens, enough atmospheric air at fifteen pounds will be admitted into the supply side to prevent the vacuum therein falling below eleven inches and proper circulation through the radiators will thus be insured. The operation of the valve will be in effect that of a pressure regulator, using atmospheric air as the source of pressure, and operating so that the pressure in the supply line can never fall below the pressure in the return line by the constant obtained by the adjustment.

Thus with the empirical figures stated, there always will be at least one-half pound per square inch more pressure in the supply line than in the return line and proper circulation will always be maintained.

The atmospheric air thus admitted into the supply side of the system will be ejected therefrom by the vacuum pump after it circulates through the radiators and return line. This air will help the operation as it will tend to cool the system, and the radiators, which is desirable, as the dangerous condition before detailed is usually encountered when the boiler is continually being shut down as on warm days.

The operation has been described in terms of the absolute pressures used in vacuum steam heating systems, wherein the pumping apparatus is set to maintain a vacuum in the return side of the system.

The inlet for atmospheric air for the above stated purpose is preferably provided with an inwardly opening check valve, so that if it is desired to operate the system above sub-atmospheric pressures, steam above atmospheric pressure will not be allowed to escape from the system through the valve.

One specific application of our invention is illustrated in the accompanying drawing, in which

Fig. 1 is a diagrammatic view of a vacuum steam heating system with our invention applied thereto; and

Fig. 2 is a sectional view on an enlarged scale, illustrating a specific form of valve mechanism that may be employed in practicing the invention.

Referring to the drawing and in detail, A designates a steam boiler, B a steam supply extending therefrom, C one of the radiators to which steam is fed, D the return line from the radiators, and E the pumping mechanism by which air or gas is removed from the system and a vacuum created and maintained in the return line and radiators, and the water of condensation handled or forced back to the boiler or hot well or removed from the system.

A pressure regulator F may be arranged in the supply line. These parts represent an ordinary vacuum steam heating system and need no further description.

The valve G forming our invention will now be described. This valve comprises a casing 10 having a diaphragm 11 arranged therein which is connected to a valve 12, coacting with a seat 13. The supply line B is connected to the casing 10 above the diaphragm by a pipe 14, and the return line D is connected to the casing 10 below the diaphragm by a pipe 15.

The stem of the valve 12 is extended to fit into a screw plug 16 adjustably threaded into the bottom of the casing 10 and a clamp nut 17 is threaded on the screw plug 16. A spring 18 is arranged on the valve stem between the screw plug 16 and the diaphragm 11. This spring tends to open the valve 12 and the screw plug 16 preferably is adjusted so that the spring will overcome the atmospheric pressure on top of the valve and cause the valve to open when the pressure in the supply line falls to any determined point relatively to the pressure in the return line.

The valve 12 works in a dome or cap 19, to which atmospheric air is supplied by pipe 20

having an inwardly opening check valve 21 for the purpose described.

When pressure in the supply line falls to the determined point relatively to the pressure in the return line, the valve 12 opens and atmospheric air is admitted into the supply line to maintain the pressure in the supply line at the desired point above the pressure in the return line.

Thus proper circulation is provided for throughout the system under all conditions of vacuum and water of condensation will not be held up in the system.

Thus a very simple mechanism is provided for the purposes stated.

While we have shown one form of apparatus for practicing our invention, we are aware that the same may be practiced in many other ways and we do not wish to be limited to the details of construction herein shown and described.

Having thus fully described our invention, what we claim and desire to secure by Letters Patent is:—

1. In a steam heating system having a radiator, a supply line to the radiator and a return line from the radiator, a valve connected to admit atmospheric air to the supply line and means governing the operation of the valve to prevent the pressure in the supply line from falling below the pressure in the return line.

2. In a steam heating system having a radiator, a supply line to the radiator and a return line leading from the radiator, a valve connected to admit atmospheric air to the supply line, and means for governing the operation of the valve by the differential of pressures between the supply and return lines of the system.

3. In a steam heating system having a radiator, a supply line to the radiator and a return line leading from the radiator, a valve connected to admit atmospheric air to the supply line, means for governing the operation of the valve by the differential of pressures between the supply and return lines of the system, and means for adjusting the operation of the valve.

4. In a steam heating system having a radiator, a supply line to the radiator and a return line leading from the radiator, a valve connected to admit atmospheric air to the supply line, and means for governing the operation of the valve by the differential of pressures between the supply and return lines of the system, said means being adapted to open the valve before the pressure in the supply line falls below the pressure in the return line of the system.

5. In a vacuum steam heating system, the combination of a source of steam supply, radiators, a supply line to the radiators from said source, a return line from the radiators, a pumping apparatus for exhausting air and gas from the system and handling the water of condensation and a valve connected to admit atmospheric air into the supply line governed by the differential of pressures between the supply and return lines.

6. In a vacuum steam heating system, the combination of a source of steam supply, radiators, a supply line to the radiators from said source, a return line from the radiators, a pumping apparatus for exhausting air and gas from the system and handling the water of condensation, a valve connected to admit atmospheric air into the supply line, governed by the differential of pressures between the supply and return lines, and means for controlling the operation of said valve.

7. In a steam heating system having a radiator, a supply line to the radiator and a return line from the radiator, a valve connected to admit atmospheric air into the supply line, means governing the operation of the valve to prevent the pressure in the supply line from falling below the pressure in the return line in the system, and a check valve for preventing an outward flow through said valve.

8. In a vacuum steam heating system, the combination of a source of steam supply, radiators, a supply line to the radiators from said source, a return line from the radiators, a pumping apparatus for exhausting air and gas from the system and handling the water of condensation, a valve connected to admit atmospheric air into the supply line, and a diaphragm for operating said valve exposed on one side to the pressure in the supply line and on the other side to the pressure in the return line.

9. In a vacuum steam heating system, the combination of a source of steam supply, radiators, a supply line to the radiators from said source, a return line from the radiators, a pumping apparatus for exhausting air and gas from the system and handling the water of condensation, a valve connected to admit atmospheric air into the supply line, a diaphragm for operating said valve exposed on one side to the pressure in the supply line and on the other side to the pressure in the return line, and a spring for helping the diaphragm open the valve.

10. In a vacuum steam heating system, the combination of a source of steam supply, radiators, a supply line to the radiators from said source, a return line from the radiators, a pumping apparatus for exhausting air and gas from the system and handling the water of condensation, a valve connected to admit atmospheric air into the supply line, a diaphragm for operating said valve exposed on one side to the pressure in the supply line and on the other side to the pressure in the return line, a spring for helping the diaphragm open the valve, and means for adjusting the action of the spring.

11. In a vacuum steam heating system, the combination of a source of steam supply, radiators, a supply line to the radiators from said source, a return line from the radiators, a pumping apparatus for exhausting air and gas from the system and handling the water of condensation, a valve connected to admit atmospheric air into the supply line, a diaphragm for operating said valve exposed on one side to the pressure in the supply line and on the other side to the pressure in the return line, a spring for helping the diaphragm open the valve, and means for adjusting the action of the spring so that the valve will open before the pressure in the supply falls below the pressure in the return line.

In testimony whereof we have hereunto affixed our signatures.

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