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J. A. TRANE.

STEAM HEATING SYSTEM.

(Application filed Jan. 25, 1901.)

(No Model.)

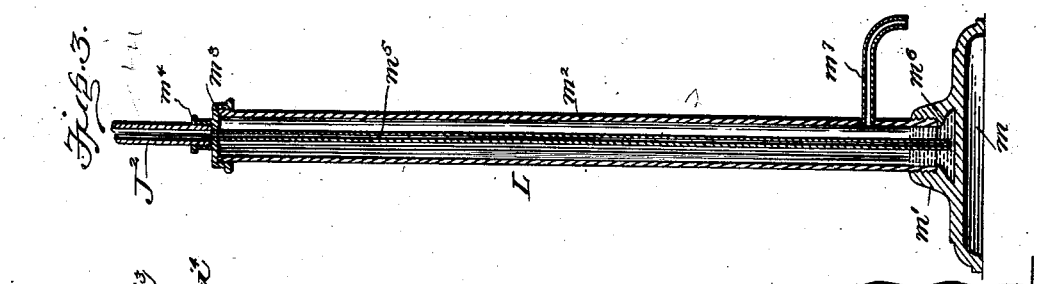

Fig. 3.

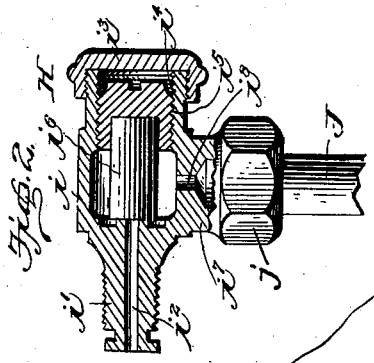

Fig. 2.

Fig. 1.

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UNITED STATES PATENT OFFICE.

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STEAM-HEATING SYSTEM.

SPECIFICATION forming part of Letters Patent No. 686,666, dated November 12, 1901.

Application filed January 25, 1901. Serial No. 44,728. (No model.)

To all whom it may concern:

Be it known that I, JAMES A. TRANE, a citizen of the United States, residing at La Crosse, in the county of La Crosse and State of Wisconsin, have invented certain new and useful Improvements in Steam-Heating Systems; and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

The invention relates to improvements in steam-heating systems, and particularly to means for creating a vacuum or partial vacuum throughout the system to insure free and perfect circulation of the heating fluid and to avoid the deleterious influences occasioned by the presence in the system of air. The advantages of withdrawing the air from the radiators and pipes of steam-heating systems are well known, and to this end it has heretofore been proposed to employ pumps for withdrawing the air therefrom or in lieu thereof automatically-operating thermostatic or vacuum valves so arranged as to be normally open to allow air to be forced out under the steam-pressure and then to close to prevent the return of the air. The objection to the use of pumps is that additional power is required to operate them and the cost of erecting a steam-heating system within a building and maintaining it in operation is increased, and where valves of the character described have been employed it has been found practically impossible to maintain a vacuum or high partial vacuum on account of leakage, and such valves are further objectionable on account of the liability of the water of condensation passing out therethrough into the air and discharging either into the room being heated or into the pipes designed to carry off the air only, rendering the operation of such valves more or less uncertain and necessitating careful attention and accurate adjustment in order to maintain the same in working order.

The object of my invention is to provide simple and effective means whereby the air forced from the radiators by the steam-pressure is allowed to discharge to the atmosphere and the discharge-pipe therefor then sealed to prevent inlet of air and to employ for this purpose a seal—preferably a liquid metallic seal, such as mercury—which will efficiently perform such function and may be supplied at a comparatively low cost, whereby all liability of the inlet of air into the radiators through the pipes provided for its discharge will be avoided and the necessity of employing power for maintaining the vacuum entirely obviated.

To this end the invention consists, broadly, in the combination in a steam-heating system, with a radiator or heater having an automatic valve, of a discharge-conduit for the exhaust-air from the heater, said discharge-conduit having a liquid metallic seal adapted to allow the air therein from the heater to exhaust under pressure to the atmosphere, but to prevent the inlet of atmospheric air thereto, whereby the vacuum or partial vacuum created within the system may be maintained, so as to provide for the free and perfect circulation of the heating fluid.

The invention further consists in a system of this character embodying a liquid metallic seal of novel construction, the same being adapted to permit of the exhaust of the air and any water of condensation that may be carried along therewith, but to efficiently prevent the return of air back into the system; also, in certain other novel features of construction, combination, and arrangement of parts, which will be hereinafter more fully described, and particularly pointed out in the appended claims.

In the accompanying drawings, Figure 1 is a sectional elevation of a portion of a building, showing radiators for heating the several rooms thereof, in which a single-pipe heating system is employed and showing also the novel construction and arrangement of connections for maintaining a vacuum throughout the system. Fig. 2 is a longitudinal sectional view of the automatic air-valve, showing in elevation the upper end of the discharge-pipe connected therewith. Fig. 3 is a central vertical section of the device for sealing the discharge-pipe to prevent the inlet thereto of air.

In the drawings my invention is shown as applied to what is ordinarily termed a "single-pipe heating system," in which one and the same pipe serves as the supply-pipe to supply steam and also as the return-pipe to

permit the escape or return of the water of condensation. My invention may be equally as well applied, however, to what is ordinarily termed a "double-pipe heating system," in which there is a supply-pipe for supplying the steam to the heaters or radiators and a separate return-pipe for permitting the escape or return of the water of condensation. As these two systems of heating are well known, I have shown in the drawings connected herewith only one system—to wit, the single-pipe system.

In the drawings, A and B represent rooms or apartments to be heated, and C C′ represent heaters or radiators of any suitable construction located, respectively, in said apartments.

A low-pressure boiler D of any approved form or construction is arranged in the cellar or at any other convenient point, and from said boiler passes a pipe E, from which extend branch pipes F F′, communicating with the radiators, the inlet of each radiator being controlled by any preferred form of valve, as shown at G, the parts thus described and shown constituting a single-pipe heating system in which the heating agent is supplied to the radiators and the water of condensation returned by gravity therethrough to the boiler through the pipe E and its branches F F′, as will be readily understood. A check-valve e, located in the pipe E, prevents the return thereinto of the water of condensation from the boiler.

Each radiator is provided with an automatic air-valve H of the "Jenkins" or any other preferred type, which allows the air to exhaust from the radiator under the pressure of the entering steam. In the present instance I have shown for purposes of illustration the use of a Jenkins valve, the same comprising a casing i, having a threaded end i', which enters a threaded opening in the radiator and is formed with a port or passage i^2 for the exhaust of air. At its opposite end the casing is closed by a cap i^3 and has a threaded bore i^4, in which is fitted a screw-plug i^5, which carries an expansible plug i^6, acting in the nature of a valve to control the flow of air through said casing. The lower end of the casing has an extension i^7, in which is formed a discharge-port i^8, controlled by the said expansion-valve i^6, and connected to this extension by means of a nut j or any other suitable form of fastening is a discharge or vent pipe J. The discharge-pipes of the two radiators shown in the present instance are connected by a union-pipe J′, which in turn is coupled to a pipe J^2, leading to a sealing device L, which may be located in the cellar or at any other convenient point. The pipes J, J′, and J^2 may be applied and arranged in any preferred manner other than that herein shown and constitute an exhaust-pipe, vent, or conduit for the discharge of the air from the radiator or heater to the atmosphere.

The sealing device L comprises a base m, which is formed with a chambered extension m', threaded interiorly at its upper end to receive the lower end of a protecting tube or frame m^2, which tube is closed at its upper end by a screw-cap m^3, having a threaded nipple m^4, which receives the lower end of the pipe J^2. Supported by the cap m^3 is a tube m^5, which depends therefrom concentrically within the tube m^2 and terminates a short distance above the base of the chamber of the said extension m' and is immersed in a liquid seal m^6—preferably a liquid metallic seal, such as mercury—which normally fills the chamber to the height of the upper end of said extension m'. The side wall of the chamber is undercut at its base to increase the size thereof and so as to provide for a minimum rise and fall of the mercury, which is adapted to ascend and descend within the tube or column m^5, as hereinafter described. I preferably employ mercury as a sealing agent because of its density and because of the limited height to which it is adapted to rise in the creation of a vacuum in the heating system of a large building, which enables me to employ a stand-pipe or column of much less length than would be the case if other liquid sealing means were used. A vent-tube m^7, having a downwardly-directed nozzle, enters the frame or tube m^2 at a point a short distance above the chambered extension m' of the base and above the level of the mercury and serves for the escape of the air passing through the discharge-pipe and any water of condensation that may be carried along therewith.

In operation steam passing through the main pipe E and branch pipes F F′ to the radiators C C′ may be admitted to said radiators by opening the valve G. The steam entering each radiator forces the air contained therein out through the ports i^2 and i^8 in the automatic air-valve H, the expansible plug i^6 of which is normally arranged to maintain the valve open. When the air is completely exhausted from the radiator and the expansible plug i^6 becomes heated and closes against its seat to cut off communication between the passages i^2 i^8, the exhaust of the steam with the air is prevented. The air exhausted from the radiator passes downwardly through the pipes J J′ and into the pipe J^2, and thence flows through the tube or column m^5 into the chamber of the base m of the sealing device, whence it bubbles up through the mercury seal m^6 and passes, with any moisture or water of condensation which may have passed outward therewith, through the vent m^7, which discharges it into the atmosphere. The mercury m^6 thus permits of the outflow of the air, which bubbles up therethrough on account of its having less specific gravity; but it will be readily understood that as the chamber of the base m and the tube m^5 are sealed by the mercury which is drawn up within said tube upon creation of a vacuum in the system no air can return therethrough into

the system. Hence a vacuum will be at all times preserved. The exhaust of the water of condensation from the radiators into the branch pipes and thence to the main, whence it flows back to the boiler D, facilitates this operation, and as the radiators are clear of all obstruction it will be apparent that a quick circuit of the steam throughout the entire system may take place and that the radiators will become much more rapidly heated than when air is present. By employing mercury as a sealing agent I am enabled to employ a tube or pipe m^5 of minimum height, whereby simplicity of construction and economy of space in installing a plant are insured.

By the use of a liquid metallic seal of the character shown and described I am also enabled to secure a desirable and peculiar coaction between said seal and the automatic air-valve, whereby the column of mercury of the seal is made to subserve the function of a pump-plunger and a partial vacuum is produced between the mercury seal and thermostatic valve to facilitate the discharge of the air from the radiators, thus greatly increasing the efficiency of the apparatus in maintaining a high partial vacuum in the system. As before described, the opening and closing of the exhaust-passage i^2 of the automatic air-valve is effected by the contraction and expansion of the thermostatic plug i^6. When the radiator C is set in action by the admission of steam thereinto through the valve G, the air contained therein is forced out through the passage i^2 under the pressure of the steam, a stream of which follows the course of the air until the plug i^6 has been heated sufficiently to expand and close said passage i^2. The steam which passes the thermostatic valve i^6 upon entering exhaust-pipes J J' J^2 and mercury-tube m^5 displaces the air therefrom by forcing it through the mercury seal, and when said thermostatic valve has been closed by the action of the steam the condensation of the steam in said exhaust-pipes and tube creates a partial vacuum between the thermostatic valve and the mercury seal, causing the mercury to rise in the tube by reason of atmospheric pressure, thereby effectually preventing the reentrance of air to said exhaust-pipes and mercury-tube. The radiator is then clear from air and the steam is allowed to come in direct contact with the entire interior surface thereof, resulting in rapid radiation. After a time, however, the upper portion of the radiator becomes filled with air, due to the liberation of air by the condensation of the steam. This air gradually increases in volume and cools the valve i^6, which opens, and the air begins to exhaust and fills the partial vacuum in the exhaust-pipes. When this occurs, the column of mercury in the tube m^5 drops and, acting in the nature of a pump-plunger, effects the rapid withdrawal from the radiator of the air, allowing live steam to enter to take its place.

The partial vacuum created in the exhaust-pipes, as above explained, is maintained and by reason of the action of the thermostatic valve operates intermittently to exhaust the air from the radiator which has been liberated by the condensation of steam therein until the pressure in the exhaust-pipes and mercury-tube reaches that in the radiator, when the air will again be forced from said pipes and tube and a vacuum again created therein in the manner before described. The result of this action of the parts is to prevent undue fluctuations in heating and to maintain at all times an even temperature.

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

1. In a steam-heating system, the combination with a heater having an automatic air-valve, adapted to allow the passage of a small quantity of steam before closing, of a vacuum-creating discharge-pipe connected to the air-valve, and means for allowing the escape of air therefrom and for preventing the return of air thereto, substantially as set forth.

2. In a steam-heating system, the combination with a heater having an automatic air-valve, adapted to allow the passage of a small quantity of steam before closing, of a vacuum-creating discharge-pipe connected at its upper end to said air-valve for conveying away the exhaust-air from the heater, and a liquid-sealing device connected to the lower end of the discharge-pipe and having a confined liquid sealing medium, a vent above the level of said medium, and a tube submerged at one end in the sealing medium and in communication at its other end with the discharge-pipe, said sealing medium allowing the escape of air therefrom and preventing the return of air thereto, substantially as set forth.

3. In a steam-heating system, the combination with suitable steam supplying and return connections, of radiators provided each with an automatic air-valve, adapted to allow the passage of a small quantity of steam before closing, vacuum-creating discharge-pipes connected with said valves for conveying away the exhaust-air from the radiators, a common union to which the discharge-pipes are connected, and a sealing device communicating with the common union and having a confined liquid sealing medium, a vent above the level of said medium, and a tube submerged at one end in the sealing medium and in communication at its opposite end with the union and the discharge-pipes, said sealing medium allowing the escape of air therefrom and preventing the return of air thereto, substantially as set forth.

4. In a steam-heating system, the combination with a heater having an automatic air-valve, adapted to allow the passage of a small quantity of steam before closing, of a vacuum-creating discharge-pipe connected with the valve for the discharge of air, and a sealing device connected with said pipe and contain-

ing a confined liquid metallic sealing medium to allow the escape of air therefrom and prevent the return of any air thereto, substantially as set forth.

5. In a steam-heating system, the combination with a heater having an automatic air-valve, adapted to allow the passage of a small quantity of steam before closing, of a vacuum-creating discharge-pipe connected to the air-valve, and a sealing device connected with said discharge-pipe, said sealing device having a chamber, a liquid metallic seal confined therein, a tube or column in communication with the discharge-pipe and immersed within said seal, and a vent above the level of the liquid seal, said seal adapted to allow the escape of air therefrom and prevent the return of air thereto, substantially as set forth.

6. In a steam-heating system, the combination with a heater having an automatic air-valve, adapted to allow the passage of a small quantity of steam before closing, of a vacuum-creating discharge-pipe connected at one end of said valve for conveying away the exhaust-air from the heater, and a liquid-sealing device connected to the other end of said discharge-pipe, the same consisting of a base having an undercut chamber containing a liquid metallic sealing medium, a tube or casing tapped at one end in said chamber and closed at its other end by a cap connected to the said discharge-pipe, a column or tube inclosed within the casing and submerged at one end in the sealing medium and connected at its other end with said cap in communication with said discharge-pipe, and a vent in the casing above the level of the sealing medium, said sealing medium adapted to allow the escape of air therefrom and to prevent the return of air thereto, substantially as set forth.

7. In a steam-heating system, the combination of a low-pressure boiler, radiators, means for supplying steam from the boiler to the radiators and for conducting the water of condensation from the radiators back to the boiler by gravity, automatic air-valves connected to the radiators, adapted to allow the passage of a small quantity of steam before closing, vacuum-creating discharge-pipes connected with the automatic valves, and a sealing device connected with the said discharge-pipes and containing a confined liquid metallic sealing medium to allow the air to discharge, but to prevent the return of any air, substantially as set forth.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

JAMES A. TRANE.

Witnesses:
BENJ. G. COWL,
GUY E. PADGETT.