J. L. SPARKS & E. R. EDDINS.

HEATING SYSTEM.

APPLICATION FILED MAY 13, 1909.

929,720.

Patented Aug. 3, 1909.

2 SHEETS—SHEET 1.

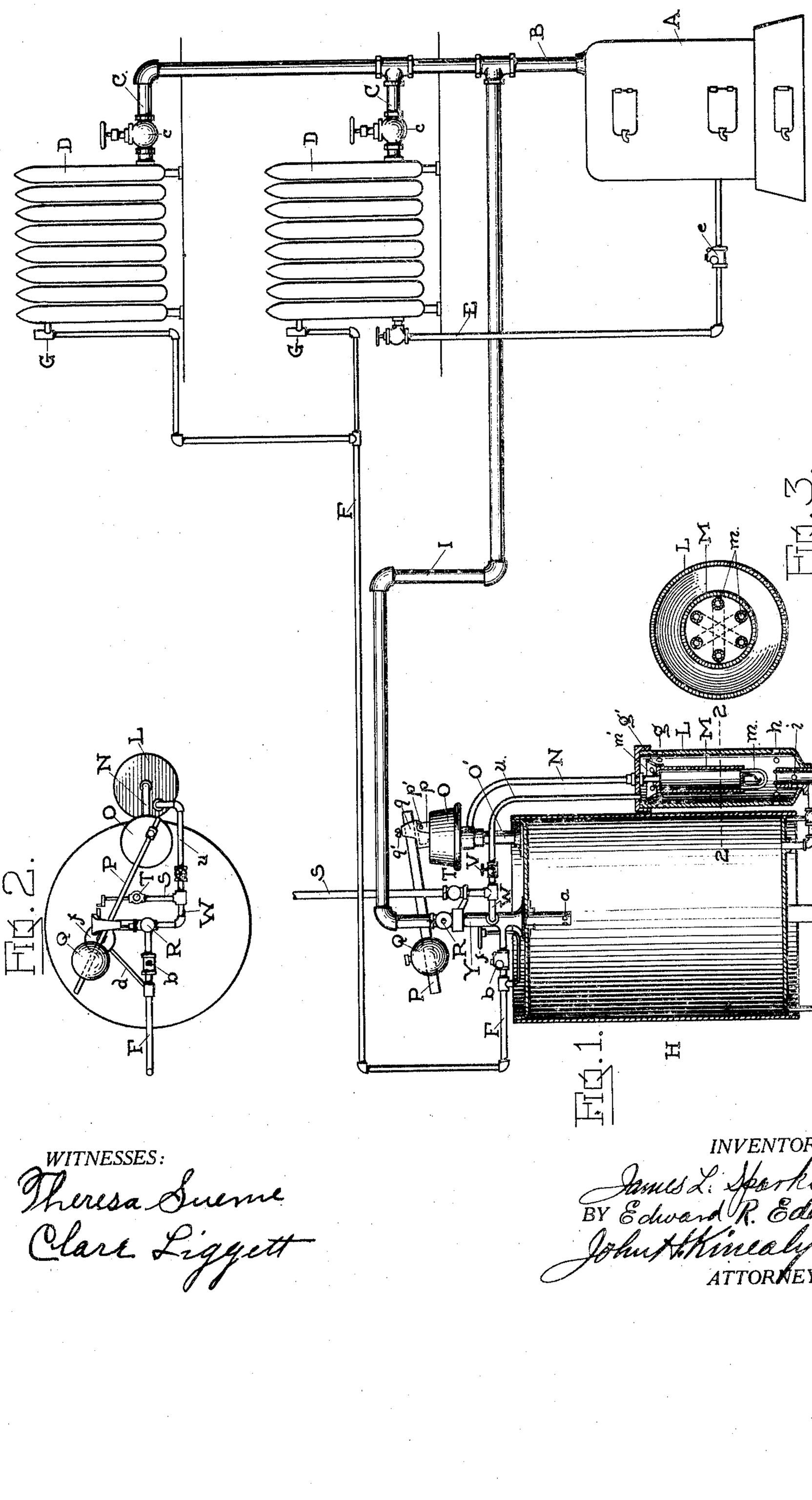

FIG. 1.

FIG. 2.

FIG. 3.

WITNESSES:

Theresa Sueme

Clare Liggett

INVENTORS

James L. Sparks and

BY Edward R. Eddins

John H. Kincaly.

ATTORNEY.

J. L. SPARKS & E. R. EDDINS.

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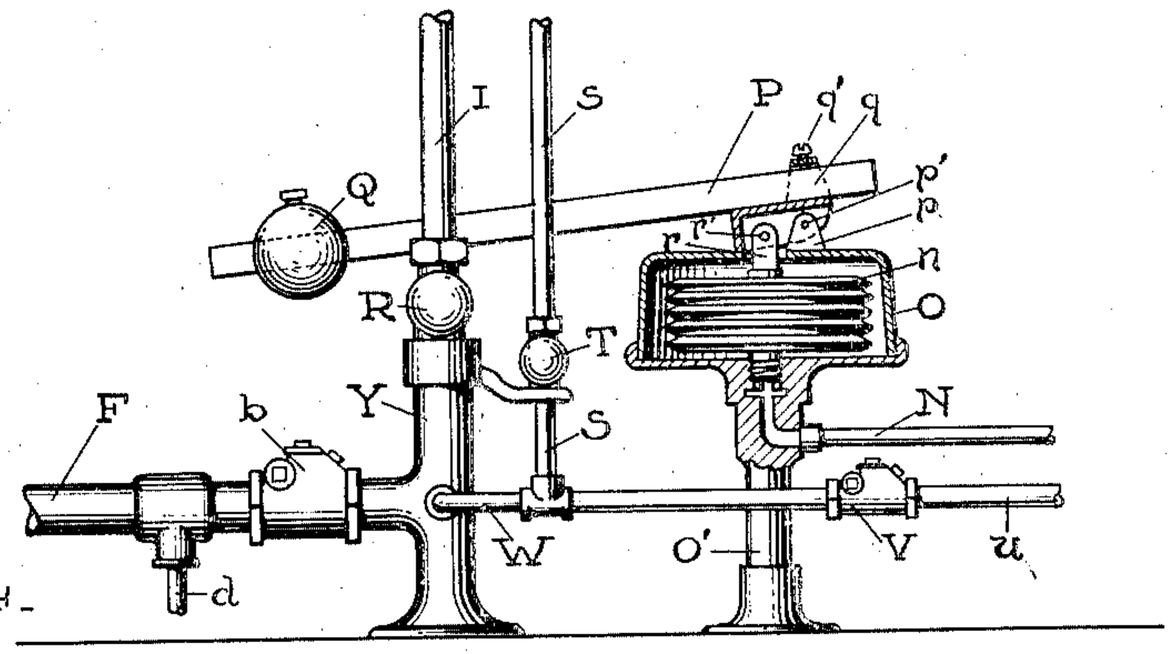

FIG. 4.

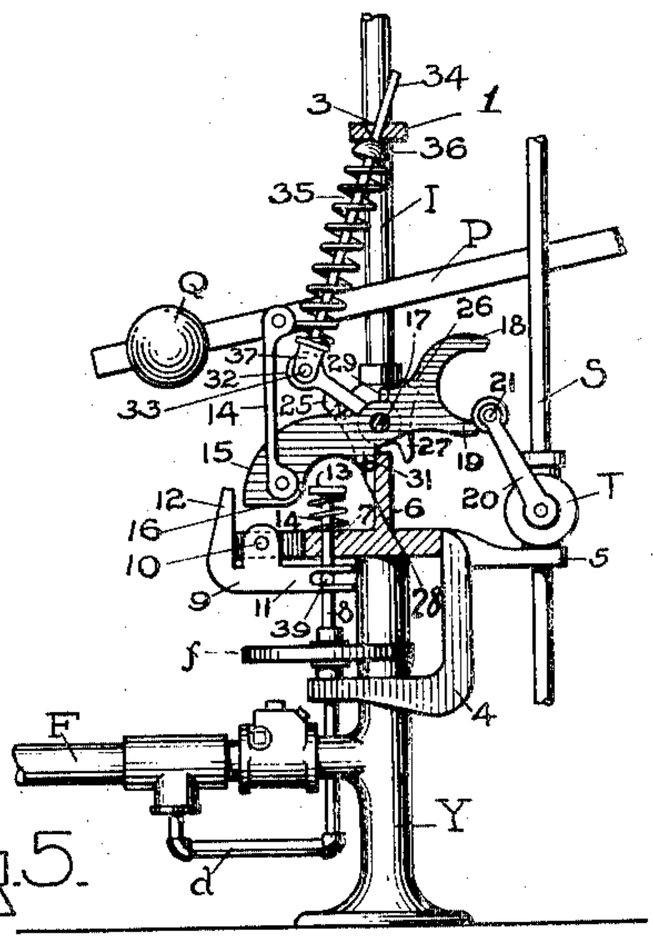

FIG. 5.

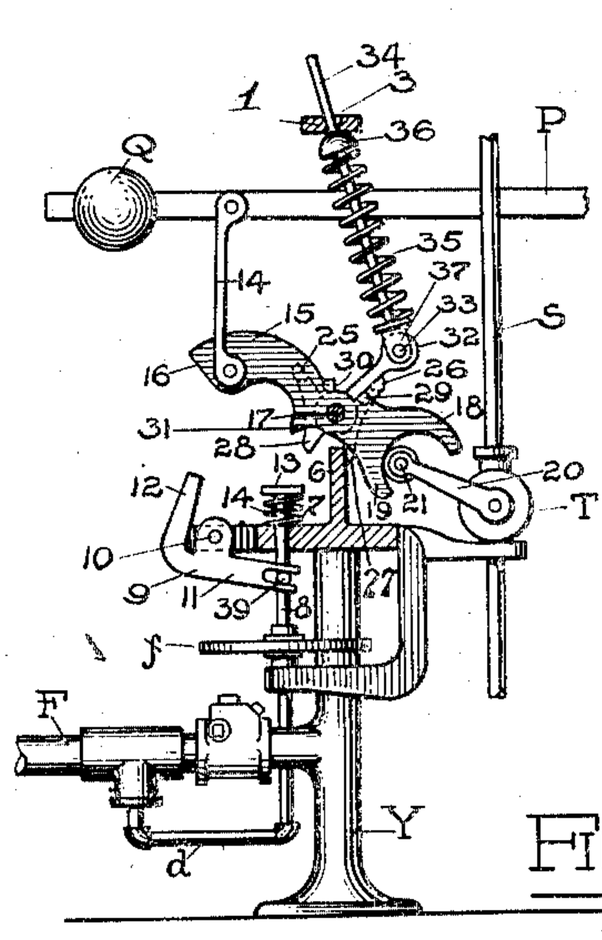

FIG. 6.

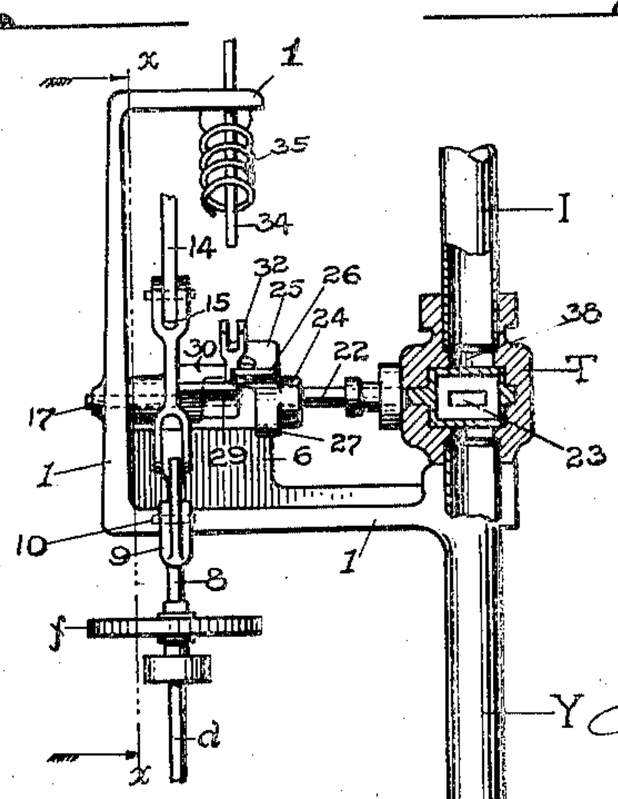

FIG. 7.

WITNESSES:

Theresa Sweeney

Clare Liggett

INVENTORS.

James L. Sparks and

BY Edward R. Eddins

John A. Kinealy.

ATTORNEY.

UNITED STATES PATENT OFFICE.

JAMES L. SPARKS AND EDWARD R. EDDINS, OF ST. LOUIS, MISSOURI.

HEATING SYSTEM.

No. 929,720. Specification of Letters Patent. Patented Aug. 3, 1909.

Application filed May 13, 1909. Serial No. 495,620.

To all whom it may concern:

Be it known that we, JAMES L. SPARKS and EDWARD R. EDDINS, citizens of the United States, residing in the city of St. Louis and State of Missouri, have invented a new and useful Improvement in Heating Systems, of which the following is a full, clear, and exact specification, reference being had to the accompanying drawings, which form a part thereof.

Our invention relates to steam heating systems wherein there is an air pipe connected with the radiators or heaters in addition to the supply and return pipes with an exhausting apparatus connected with the air pipe whereby a vacuum is created and maintained in said air pipe so as to draw the air from the radiators or heaters and thus facilitate the entrance of steam therein and increase the heating efficiency of said radiators by keeping them free from air at all times. In such systems the exhausting apparatus is usually some form of ejector which requires for its operation steam at a higher pressure than that of the steam circulated through the radiators, or some form of electrically driven pump. The electrically driven pump is costly to operate, requires considerable attention, and is likely to get out of order; and when a steam operated pump or ejector is used it is necessary to maintain in the boiler of the system a pressure higher than that in the radiators and to supply the steam to said radiators through some device whereby the pressure is automatically reduced as it is supplied to the radiators from the boilers.

The object of our invention is to provide in a system of steam heating a condensing apparatus in addition to the usual radiators, whereby through the superior condensation of steam in this apparatus of the system the air will be automatically drawn out from the radiators through the air pipe into this condensing apparatus, and then by means of steam at the same pressure as that used in the radiators be discharged from the system.

Our invention is fully shown in the accompanying drawings where similar characters are used to designate similar parts.

Figure 1 is a view showing the different parts of a steam heating system embodying our invention; Fig. 2 is a top view of the condensing apparatus whereby the air will be automatically drawn out from the radiators through the air pipe; Fig. 3 is a section on the line 2—2 of Fig. 2 of a thermostat by which the admission of steam to the condensing apparatus is controlled; and Figs. 4 5, 6, and 7 are views showing in detail the mechanism by which the operation of the condensing apparatus is controlled. Fig. 4 is an enlarged view showing the relative positions of the pipes connected with the top of the condensing apparatus; Figs. 5, 6, and 7 are enlarged views showing in detail the mechanism whereby the valves controlling the admission of steam and water to the condensing apparatus are operated. Figs. 5 and 6 are each a section on the line *x*—*x* of Fig. 7 and differ only in having their parts in different positions

Referring to the figures, A is a boiler which serves as the source of supply of steam; B, a main supply pipe connected with the radiators D by the branch pipes C which have in them the valve *c*. The lower radiator has a return pipe E, in addition to the supply, through which the water of condensation returns from the radiator to the boiler, and which is connected into the boiler below the water line. The check valve *e* prevents water from being forced from the boiler up through the pipe E when for any cause the pressure in the radiator from which E leads is less than that in the boiler. The water of condensation from the upper radiator runs out through the same pipe C through which steam enters the radiator, so that this pipe is a supply and return pipe.

F is an air pipe separate from and in addition to the supply and return pipes connected to the radiators above where the water of condensation usually collects and provided with the air valves G by which steam is automatically prevented from passing in any material quantity from the radiators into the air pipe. This air valve may be of any proper construction but is preferably of the well known thermostatic form constructed so as to allow the passage from the radiator of comparatively cool air but to close when heated by contact with steam.

H is a closed tank provided with the inlet fitting Y to which is connected the air pipe F and the steam inlet pipe I which leads from the main supply pipe B. The fitting Y is hollow and is supported on the top of the tank H with its lower end protruding downward therein and having small openings *a*

whereby communication between the inside of the fitting and the inside of the tank is established.

b is a check valve in the air pipe F which allows the contents of the air pipe to flow into the tank H, but prevents the flow of air or steam from the tank into the air line.

R is a valve in the steam pipe I by which the flow of steam into the tank H is controlled.

S is a water pipe connected to any convenient source of supply of water and provided with the valve T by which the flow of water may be controlled.

W and *u* are branches of the pipe S. Pipe W is connected to the inlet fitting Y so that water may be introduced into the tank H. The water which enters the tank H through the pipe W is sprayed or divided into a series of fine streams by means of the small openings *a* through which it leaves the fitting Y. The branch *u* of the pipe S has in it a valve V for controlling the flow of water therethrough and discharges inside the casing L into the funnel shaped rim *m'* at the top of the thermostat M. The water runs from *m'* through the holes *g'* down the sides of the thermostat to the bottom of the casing L and from there through the openings *i* into the outlet pipe K.

h and *g* are circumferential openings in the lower and upper parts, respectively, of the casing L through which air circulates. The thermostat M contains a volatile fluid, and has projecting downward from the bottom the bent tubes *m* which serve to increase the exposed surface of the thermostat. The interior of the thermostat is connected by the tube N to a bellows-shaped motor *n* in the casing O, which is supported on the top of H by the stand O'. This motor is constructed so that an internal pressure greater than that of the atmosphere makes the top rise toward the top of the casing. Referring to Fig. 4, it is seen that the top of the motor *n* has attached to it a rigid piece *r* which projects through the top of the casing O and is pivotally connected by means of the pin *r'* to the member *q*. The member *q* is supported by the motor casing O, being pivotally attached to the projecting piece *p* by the pin *p'*. The arm P passes through the member *q* and is held in place by the set screw *q'*.

Q is a weight on the arm P. The normal position of the arm P when the thermostat is cool is as shown in Fig. 5, but when the thermostat is heated some of the fluid is volatilized and passes through the tube N into the motor *n* and there exerts an internal pressure by which the top is raised, and the member *q* is thereby made to revolve about the pin *p'* and to raise the farther end of the arm P with the weight Q to the position in Fig. 6. When the thermostat is cooled, the liquid therein is condensed, and the pressure in the motor *n* is reduced and the weight Q acting on the arm P and the member *q*, aided by the atmospheric pressure exterior of the motor, depresses the top of the motor and moves the outer end of the arm P downward to the position shown in Figs. 1, 4, and 5.

The tank H is provided with a discharge pipe J having a check valve *k* adapted to allow the passage therethrough of any fluid from the tank when the pressure inside the tank is greater than that outside, but which prevents air from flowing into the tank from the exterior thereof when the pressure inside is less than that of the atmosphere outside the tank. The discharge pipe J is connected with the outlet piece K of the casing L so that when water is discharged from the tank it falls downward through the pipe K away from the casing L, but when air or steam is discharged from the tank into the pipe K part of it passes upward into the casing L, comes in contact with the thermostat M, heats it so as to volatilize some of the liquid therein, and thus operates the bellows-shaped motor *n* to raise the arm P to the position shown in Fig. 6.

When the arm P is down, in the position shown in Fig. 5, the valve R in the steam pipe is open and the valve T in the water pipe S is closed and steam flows from the pipe I into the tank H; but when the arm P is raised to the position shown in Fig. 6, the valve R is closed and the valve T is opened, and water flows from the pipe S through the branch pipes W and U, respectively, into the tank H and onto the thermostat M.

The operation of the valves R and T is brought about by means of the mechanism shown in detail in Figs. 5, 6, and 7, and is as follows: The inlet piece Y is provided with arms 1, 4, and 5, by which the various parts of the mechanism are supported and held in place. The arm 1 is provided with a pin 17 fixed in a horizontal position in line with the stem 22 of the valve T so that they have the same axis; and the outer end of the valve stem is close to, but not in direct contact with, the end of the pin. Loosely mounted on the pin 17 is the rocker arm 15 which is connected by the link 14 to the arm P. The link 32 is mounted on the pin 17 so as to be free to revolve about it through a limited angle independent of the rocker arm 15. The upper end of the link 32 is attached by means of the pin 33 to the casting 37 which has projecting from it the rod 34 which passes through the opening 3 in the upper end of the arm 1. The rod 34 carries a coil spring 35, the lower end of which is held in place by the casting 37 and the upper end of which rests against the bearing piece 36 carried on the rod 34 and contacting with the arm 1 along the lower periphery of the opening 3. If the link 32 be in the position shown in Fig. 5 and then be made to revolve toward the right, the spring 35 will be compressed until the link attains a vertical posi-

tion, when the rod 34 and the link 32 will be in the same line. As soon as the link passes a vertical position toward the right the expansive force of the spring will tend to make the link move quickly toward the right to the position shown in Fig. 6. And if the link be in the position shown in Fig. 6, and it be turned toward the left the spring will be compressed and resist the turning motion until the link passes the vertical position, when the spring will tend to aid the turning force to bring the link to the position shown in Fig. 5. Attached rigidly to the rocker arm 15 and projecting inwardly on each side of the link 32 are the lugs 29 and 30. When the rocker arm is moved from the position shown in Fig. 5 to that shown in Fig. 6 the lug 30 presses against, and carries with it, the link 32 until the link passes the vertical position; then the spring 35 expands and moves the link 32 rapidly away from the lug 30 toward the position shown in Fig. 6. When the rocker arm 15 is in the position shown in Fig. 6 and it is turned toward that shown in Fig. 5, the lug 29 presses against the link 32 and makes it revolve until it passes the vertical, when the spring 35 expands and makes the link move rapidly away from the lug 29 to the position shown in Fig. 5. Thus the raising of the arm P from the position shown in Fig. 5 to that shown in Fig. 6 makes the rocker arm move from the position shown in Fig. 5 to that shown in Fig. 6, and this movement of the rocker arm moves the link 32 from the position shown in Fig. 5 to that shown in Fig. 6; and because of the presence of the spring 35 the motion of the link after it has passed the vertical toward the position shown in Fig. 6 is quick and independent of the rocker arm 15. 31 is a stop lug that engages with the web 6 of the arm 1 and prevents the rocker arm 15 from falling too low when it is turned from the position shown in Fig. 6 to that shown in Fig. 5.

Rigidly attached to the valve stem 22 is a boss 24 which carries lugs 25 and 26 which project outwardly toward the rocker arm 15 past the link 32. On the under side of the boss 24 are attached stop lugs 27 and 28 which engage with the web 6 and prevent the boss with the attached valve stem 22 from being turned too far in either direction.

When the arm P is in the position shown in Fig. 5 the link 32 is pressed against the lug 30 by the expansive force of the spring and when the arm P is raised, the rocker arm 15 is made to turn and the lug 30 pressing against the link 32 carries the link with the arm and compresses the spring 35 until the rocker arm P approaches the position shown in Fig. 6 and the lug 30 has carried the link 32 just beyond the vertical; then the expansive force of the spring 35 acts and makes the link 32 revolve suddenly to the position shown in Fig. 6. At the beginning of the operation the lug 26 of the boss 24 is in the position shown by the dotted lines in Fig. 5 and when the link 32 passes the vertical and revolves suddenly it engages with this lug 26 and turns it to the position shown in Fig. 6. By this turning of the lug 26 the valve stem 22 is turned so that the port 23 inside of the valve T, shown in section in Fig. 7, is moved out of register with the inlet port 28 of the valve body and steam is thereby prevented from passing from the pipe I through the inlet piece Y into the tank. When the arm P is in the position shown in Fig. 6 and is made to fall toward the position shown in Fig. 5, the operation just described is reversed: the lug 29 on the rocker arm 15 engages with the link 32 and carries it beyond the vertical, then the expansive force of the spring 35 acts to make the link 32 move quickly to the position shown in Fig. 5 and carry with it the lug 25, thus revolving the valve stem 22 and making the port 23 register with the inlet port 38 in the body of the valve T, so that steam can pass from the pipe I through the inlet piece Y into the tank H.

The valve T in the pipe S is fitted with a handle 20 carrying at its extremity the roller 21 which engages with the prongs 18 and 19 of the forked end of the rocker arm 15. When the arm P falls toward the position shown in Fig. 5 the prong 19 presses against the roller 21 and turns the valve handle upward to the position shown in Fig. 5 and closes the valve T so as to prevent the flow of water from the pipe S into the branch pipes W and U; and when the arm P rises to the position shown in Fig. 6 the prong 18 engages with the roller 21 and presses the handle 20 of the valve down to the position shown in Fig. 6 and thus opens the valve T and allows water to flow therethrough from the pipe S. When the mechanism is in the position shown in Fig. 5 the steam valve R is open and the water valve T is closed; and when in the position shown in Fig. 6 the steam valve R is closed and the water valve T is open. These valves are so adjusted that the water valve T is closed before the steam valve R is opened, and is opened after the steam valve R is closed, thus preventing the simultaneous flow of steam and water into the tank.

d is a pipe connecting the air pipe F with the chamber *f*. This chamber *f* has a flexible diaphragm top to which is fixed a rod 8 which projects vertically upward through the opening 7 in the lower part of the arm 1 and has at the upper end the nut 13. Between the nut 13 and arm 1 is the coiled spring 14 which by its expansive force tends to lift the rod 8 and hold the diaphragm top of the chamber 7 to its highest position.

9 is a bell crank movable about the pin 10 and having a vertical leg 12 and a horizontal leg 11. The horizontal leg 11 is forked and

engages with the pin 39 in the rod 8. When the vacuum in the air pipe F has reached a certain amount, the upward force exerted through the pipe *d* onto the diaphragm top of the chamber *f* together with the expansive force of the spring 14, is sufficient to raise the rod 8 upward and carry with it the horizontal leg of the bell crank 9 and swing the vertical leg 12 outward to the position shown in Fig. 5. But when the vacuum prevailing in the pipe F is great, the pressure of the atmosphere exerted on the diaphragm top of the chamber *f* is sufficient to overcome the expansive force of the spring 14 and to depress the diaphragm top of the chamber *f* so as to carry down the rod 8, thereby moving the leg 11 of the bell crank 9 downward and moving the vertical leg 12 inward to the position shown in Fig. 6. When the leg 12 is in the position shown in Fig. 6 and the arm P falls, the face 16 of the rocker arm 15 will rest on top of the leg 12 and thus prevent the rocker arm from moving to the position shown in Fig. 5 and thereby prevent the steam valve R from being opened; but when the vacuum in the pipe F becomes such that the pressure of the atmosphere on the top of the chamber *f* is not sufficient to overcone the expansive force of the spring 14 then the leg 12 is moved to the position shown in Fig. 5 and the face 16 does not engage with the top of this leg and the steam valve R is opened. That is to say, the opening of the steam valve R to admit steam from the pipe I through the inlet piece Y to the tank H can only take place when the vacuum or pressure prevailing in the air pipe F has risen to a certain predetermined point dependent upon the expansive force of the spring 14 and the area of the diaphragm top of the chamber *f*.

The operation of the system is as follows: When the pressure of the steam in the boiler A has become slightly greater than that of the atmosphere, the steam passes from the boiler through the main supply pipe B into the pipe I and from there through the valve R and the inlet piece Y into the tank H, and forces from this tank any air that may be in it. After the greater part of the air has been forced from the tank H through the discharge pipe J and the outlet pipe K, some steam will begin to pass out with the air which will become somewhat heated. As this heated air and steam pass out some of it will rise through the upper part of the outlet piece K into the casing L and come in contact with the thermostat M. The thermostat will be heated and some of the liquid therein will be volatilized and made to pass upward through the tube N into the bellows-shaped motor *n* and make it expand so as to raise the arm P. When the arm P is raised, the rocker arm 15 will be raised from the position shown in Fig. 5 to that shown in Fig. 6 and by means of the various mechanism which we have already described the valve R will be closed and steam will cease to flow into the tank. Immediately after the valve R is closed the valve T will be opened and water will be admitted into the tank in a finely divided form through the openings *a* of the lower end of the inlet piece Y, and at the same time water will be admitted through the pipe U into the casing L onto the upper portion of the thermostat M. The steam in the tank H will be condensed and a vacuum will be formed therein and air will be drawn through the air line F and the air valves G from the radiators D into the tank H. While the steam in the tank H is being condensed and the air is being drawn from the air pipe F into this tank, the thermostat M is being cooled by the water from the pipe U; and, finally, when the thermostat is cooled sufficiently the pressure in the motor *n* is reduced and the weight Q together with the pressure of the atmosphere on the top of the motor *n* moves the arm P downward from the position shown in Fig. 6 to that shown in Fig. 5. The valve T is thereby closed and the valve R opened so as to shut off the flow of water into the tank and onto the thermostat and allow steam to flow from the pipe I into the tank. This steam forces both the water resulting from the condensation of steam in the tank, and the air drawn from the air pipe F, out through the discharge pipe J. The hot air and steam which are discharged from the tank into the outlet pipe K rises and comes in contact with the thermostat, heats it, and causes the pressure in the motor *n* to be increased thereby causing said motor to operate to raise the arm P so as to close the steam valve R and open the water valve T. This alternate heating and cooling of the thermostat M, which is placed in the path of the air discharged from the discharge pipe J, thus controls the admission of steam from the system into the tank H to discharge the air therefrom, and to create a vacuum therein whereby the air is drawn from the air pipe F. This continued action of the tank on the air pipe F creates and maintains in this pipe a vacuum so that the air passes from the radiators through the air valves G into the air pipe and from there into the tank. The action of the vacuum in the air pipe F enables steam to pass easily from the pipes C into the radiators D; and steam may, therefore, be circulated from the boiler through the various pipes into the radiators with a less pressure in the boiler than would be required if a vacuum were not maintained in the air pipe. When the steam has entered a radiator and completely filled it some of the steam will pass from the radiator into the air valve and then the air valve will automatically close so as to prevent any material amount of steam from passing from the radiator into the air line. What slight amount of steam

might accidentally pass through the air valve will be carried through the air pipe into the tank F and will there be condensed. The air valve G will stay closed as long as the radiator is filled with steam up to said air valve, but if for any reason air should enter the radiator it will accumulate in that part of the radiator near the air valve G, which will allow it to pass into the air pipe and from there into the tank H. In this way the radiators will at all times be kept free and clear of air so that steam may circulate freely in them. The water resulting from the condensation of steam in the radiators will run back through the proper pipes to the boiler by gravity.

The check valve *b* in the air line F prevents air or steam from passing from the tank H back into the air line when the pressure in the tank is greater than that in the air line; and the check valve *k* in the discharge pipe prevents air from passing from the atmosphere into the tank when a vacuum is created therein. The water which runs onto the top of the thermostat M passes through the holes *g'* down to the bottom of the casing L and from there it passes through the openings *i* into the outlet pipe K and away. When the tank H is in a comparatively cold place it is unnecessary to admit water to the tank or onto the thermostat, and then the handle 20 of the valve T is swung to the right of the position shown in Fig. 5 so that the roller 21 is disengaged from the prongs 18 and 19 of the rocker arm 15. In some cases it is desirable to introduce water into the tank H to accelerate the formation of a vacuum therein, but it is not necessary to discharge water onto the thermostat for the purpose of cooling it. In such a case the handle 20 is left in such a position that the prongs 18 and 19 engage with the roller 21, but the valve V on the pipe U is closed, thus preventing the flow of water through the pipe U onto the thermostat. When water is not used on the thermostat, air enters the casing L through the openings *h* and passes upward in contact with the thermostat and out from the casing through the openings *g*. This circulation of air through the casing over the thermostat cools the thermostat sufficiently to operate the motor *n*. If after the thermostat M has cooled, the vacuum prevailing in the air pipe F is such that the difference between the pressure of this vacuum and the atmospheric pressure on the outside exerted on the diaphragm-top of the casing *f* is sufficient to overcome the expansive force of the spring 14 the bell crank 9 will be moved so that the leg 12 will be brought into the position shown in Fig. 6; and as the arm P moves down toward the position shown in Fig. 5, the face 16 of the rocker arm will rest on the end of the leg 12 and the valve R will thereby be prevented from being opened and steam will not be admitted into the tank. When the vacuum in the air line has been reduced by the flow of air from the radiators past the air valves G, the difference between the vacuum inside the casing *f* and the atmospheric pressure will not be sufficient to overcome the expansive force of the spring 14, and the leg 12 will be moved to the position shown in Fig. 5 and the rocker arm 15 will be allowed to fall so as to open the steam valve R to admit steam into the tank H.

By the condensation of steam in the tank H the air is drawn and collected to this one part of the heating system, while the remaining parts of the system are kept free from air and the circulation of the steam throughout these remaining parts is very greatly facilitated; and by the admission of steam to the tank H the air collected therein from the radiators and other parts of the heating system is discharged from the system; and both operations are controlled by the thermostat M. When the system is used without the aid of water from the pipe S to condense the steam in the tank H and to cool the thermostat M, the condensation of the steam in the tank is brought about by the cooling effect of the surrounding air acting on the walls of the tank, and then the tank may serve as a heater to supply heat to the place where it is located. In this case the system becomes one in which the air is collected in one heater of the system by the condensation of steam therein and then automatically discharged therefrom. In all cases, however, the air is drawn to and collected in one part of the system, namely, the tank, by increasing the condensation of steam at that particular part, and then having collected the air in this part it is discharged therefrom by the admission thereto of steam at a pressure somewhat greater than that of the atmosphere. It is evident that the size of the tank H and of the various other parts of the system must depend upon the number and sizes of the radiators connected in the system from which air must be withdrawn.

It is evident that our system of heating is peculiarly adapted to those low pressure systems in which the pressure in the boiler rarely exceeds two pounds. The various pipes by which steam is supplied to the radiators and the water of condensation is returned to the boiler are the circulating pipes of the system. The air and water of condensation are separated from one another in the radiators of the system and the air is discharged by means of the tank through the air pipe F while the water of condensation returns by gravity from the radiators to the boilers. No electrical devices of any kind are required in connection with our system nor are there any pumps or exhausting apparatus used which require for their operation steam at a comparatively high pressure.

What we claim as new and desire to secure by Letters Patent, is:

1. In combination with a steam heating system, an air pipe in addition to the circulating pipes connected with the system, means to prevent the flow of steam in material quantities from the system into the air pipe, a closed tank connected with the air pipe and having a discharge pipe provided with means to prevent the entrance therethrough of air into the tank, an inlet pipe for supplying steam to said tank to discharge the air therefrom and to create a vacuum therein, means to control the flow of steam through the inlet pipe into said tank, and a thermostat in the path of the air discharged through said discharge pipe for controlling said means for controlling the flow of steam into said tank, substantially as described.

2. In combination with a steam heating system, an air pipe in addition to the circulating pipes connected with a radiator, means to prevent the flow of steam in material quantities from the radiator into the air pipe, a closed tank connected with the air pipe and having a discharge pipe provided with means to prevent the entrance therethrough of air into the tank, an inlet pipe for supplying steam to said tank to discharge the air therefrom and to create a vacuum therein, a valve in said inlet pipe to control the flow of steam into the tank, and a thermostat in the path of the air discharged through said discharge pipe for controlling the operation of said valve, substantially as described.

3. In combination with a steam heating system, an air pipe in addition to the circulating pipes connected with the system, means to prevent the flow of steam in material quantities from the system into the air pipe, a closed tank connected with the air pipe and having a discharge pipe provided with means to prevent the entrance therethrough of air into the tank, an inlet pipe for supplying steam from the system to said tank to discharge the air therefrom and to create a vacuum therein, a valve in said inlet pipe for controlling the flow of steam into said tank, means for operating said valve, and a thermostat in the path of the air discharged through said discharge pipe for controlling the means for operating said valve, substantially as described.

4. In combination with a steam heating system, an air pipe in addition to the circulating pipes connected with a radiator above the part of the radiator where the water of condensation ordinarily collects, an automatic air valve to prevent the flow of steam into said air pipe, a closed tank connected with the air pipe and having a discharge pipe provided with means to prevent the entrance therethrough of air into the tank, an inlet pipe for supplying steam to said tank to discharge the air therefrom and to create a vacuum therein, a valve in said inlet pipe to control the flow of steam into said tank, and a thermostat in the path of the air discharged through said discharge pipe for controlling the means for operating said valve, substantially as described.

5. In combination with a steam heating system, an air pipe in addition to the circulating pipes connected with the system, means to prevent the flow of steam in material quantities from the system into the air pipe, a closed tank connected with the air pipe and having a discharge pipe provided with means to prevent the entrance therethrough of air into the tank, an inlet pipe for supplying steam to said tank to discharge the air therefrom and to create a vacuum therein, a valve in said inlet pipe to control the flow of steam into said tank, means for operating said valve, and a thermostat beyond the tank in the path of the air discharged through said discharge pipe for controlling said means for controlling the flow of steam into said tank, substantially as described.

6. In combination with a steam heating system, an air pipe in addition to the circulating pipes connected with a radiator, means to prevent the flow of steam in material quantities from the radiator into the air pipe, a closed tank connected with the air pipe and having a discharge pipe provided with means to prevent the entrance therethrough of air into the tank, an inlet pipe for supplying steam from the system to said tank to discharge the air therefrom and to create a vacuum therein, a valve in the inlet pipe to control the flow of steam into said tank, and a thermostat beyond the tank in the path of the air discharged through said discharge pipe for controlling the operation of said valve, substantially as described.

7. In combination with a steam heating system, an air pipe in addition to the circulating pipes connected with a radiator above the part of the radiator where the water of condensation ordinarily collects, an automatic air valve to prevent the flow of steam from the radiator into said air pipe, a closed tank connected with the air pipe and having a discharge pipe provided with a check valve to prevent the entrance therethrough of air into the tank, an inlet pipe for supplying steam from the system to said tank to discharge the air therefrom and to create a vacuum therein, a valve in said inlet pipe to control the flow of steam into said tank, means for operating said valve, and a thermostat beyond the tank in the path of the air discharged through said discharge pipe for controlling the means for operating said valve, substantially as described.

8. In combination with a steam heating system, an air pipe in addition to the circu-

lating pipes connected with a radiator, an automatic air valve to prevent the flow of steam from the radiator into the air pipe, a closed tank connected with the air pipe and having a discharge pipe provided with a check valve to prevent the entrance therethrough of air into the tank, means to prevent the flow of air or steam from said tank into the air pipe, an inlet pipe for supplying steam from the system to said tank to discharge the air therefrom and to create a vacuum therein, a valve in said inlet pipe to control the flow of steam into the tank, means for operating said valve, and a thermostat beyond the tank in the path of the air discharged through said discharge pipe for controlling the means for operating said valve, substantially as described.

9. In combination with a steam heating system, an air pipe in addition to the circulating pipes connected with a radiator, an automatic air valve to prevent the flow of steam from the radiator into said air pipe, a closed tank connected with the air pipe and having a discharge pipe provided with a check valve to prevent the entrance therethrough of air into the tank, a check valve in the air pipe to prevent the flow of steam or air from the tank into said air pipe, an inlet pipe for supplying steam from the system to said tank to discharge the air therefrom and to create a vacuum therein, a valve in said inlet pipe to control the flow of steam into said tank, a thermostat beyond the tank in the path of the air discharged through said discharge pipe for controlling the operation of said valve, and means for causing said valve to remain at rest as long as the vacuum in the air pipe exceeds a certain amount, substantially as described.

10. In combination with a steam heating system, an air pipe in addition to the circulating pipes connected with a radiator above the part of the radiator where the water of condensation ordinarily collects, an automatic valve to prevent the flow of steam from the radiator into said air pipe, a closed tank connected with the air pipe and having a discharge pipe provided with a check valve to prevent the entrance therethrough of air into the tank, a check valve to prevent the flow of steam or air from the tank into said air pipe, an inlet pipe for supplying steam from the system to said tank to discharge the air therefrom and to create a vacuum therein, a valve in said inlet pipe to control the flow of steam into the tank, means for operating said valve, a thermostat beyond the tank in the path of the air discharged through said discharge pipe for controlling the means for operating said valve, and means for causing said means for operating said valve to remain at rest as long as the vacuum in the air pipe exceeds a certain amount, substantially as described.

11. In combination with a steam heating system, an air pipe in addition to the circulating pipes connected with a radiator above the part where the water of condensation ordinarily collects, an automatic air valve to prevent the flow of steam from the radiator into said air pipe, a closed tank connected with the air pipe and having a discharge pipe provided with a check valve to prevent the entrance therethrough of air into the tank, a check valve in the air pipe to prevent the flow of steam or air from the tank into said air pipe, an inlet pipe for supplying steam from the system to said tank to discharge the air therefrom and to create a vacuum therein, a valve in said inlet pipe to control the flow of steam into said tank, means for operating said valve, a thermostat beyond the tank in the path of the air discharged through said discharge pipe for controlling the means for operating said valve, and means for introducing water onto said thermostat, substantially as described.

12. In combination with a steam heating system, an air pipe in addition to the circulating pipes connected with a radiator above the part of the radiator where the water of condensation ordinarily collects, an automatic air valve to prevent the flow of steam from the radiator into said air pipe, a closed tank connected with the air pipe and having a discharge pipe provided with means to prevent the entrance therethrough of air into the tank, a check valve to prevent the flow of steam or air from the tank into said air pipe, an inlet pipe for supplying steam from the system to said tank to discharge the air therefrom and to create a vacuum therein, a valve in said inlet pipe to control the flow of steam into said tank, means for operating said valve, a thermostat beyond the tank in the path of the air discharged through said discharge pipe for controlling the means for operating said valve, and means for introducing water into said tank to cause the steam therein to condense, substantially as described.

13. In combination with a steam heating system, an air pipe in addition to the circulating pipes connected with a radiator above the part of the radiator where the water of condensation ordinarily collects, an automatic air valve to prevent the flow of steam from the radiator into said air pipe, a closed tank connected with the air pipe and having a discharge pipe provided with a check valve to prevent the entrance therethrough of air into the tank, a check valve to prevent the flow of air or steam from the tank into the air pipe, an inlet pipe for supplying steam from the system to said tank to discharge the air therefrom and to create a vacuum therein, a valve in said inlet pipe to control the flow of steam into said tank, means for operating said valve, a thermostat

beyond the tank in the path of the air discharged through said discharge pipe for controlling the means for operating said valve, and means controlled by said thermostat for admitting water into said tank and onto said thermostat when the valve controlling the flow of steam into said tank is closed, substantially as described.

14. In combination with a steam heating system, an air pipe in addition to the circulating pipes connected with a radiator above the part of the radiator where the water of condensation ordinarily collects, an automatic air valve to prevent the flow of steam from the radiator into said air pipe, a closed tank connected with the air pipe and having a discharge pipe provided with a check valve to prevent the entrance therethrough of air into the tank, a check valve to prevent the flow of air or steam from said tank into the air pipe, an inlet pipe for supplying steam from the system to said tank to discharge the air therefrom and to create a vacuum therein, a valve in said inlet pipe to control the flow of steam into said tank, means for operating said valve, a thermostat beyond the tank in the path of the air discharged through said discharge pipe for controlling the means for operating said valve, means for causing said means for operating said valve to remain at rest as long as the vacuum in the air pipe exceeds a certain amount, means controlled by said thermostat for admitting water into said tank and onto said thermostat when the valve controlling the flow of steam into said tank is closed, substantially as described.

In testimony whereof we have signed our names to this specification in the presence of two subscribing witnesses.

JAMES L. SPARKS.
EDWARD R. EDDINS.

Witnesses:
RAYMOND G. SCOTT,
A. HORTLEDER.