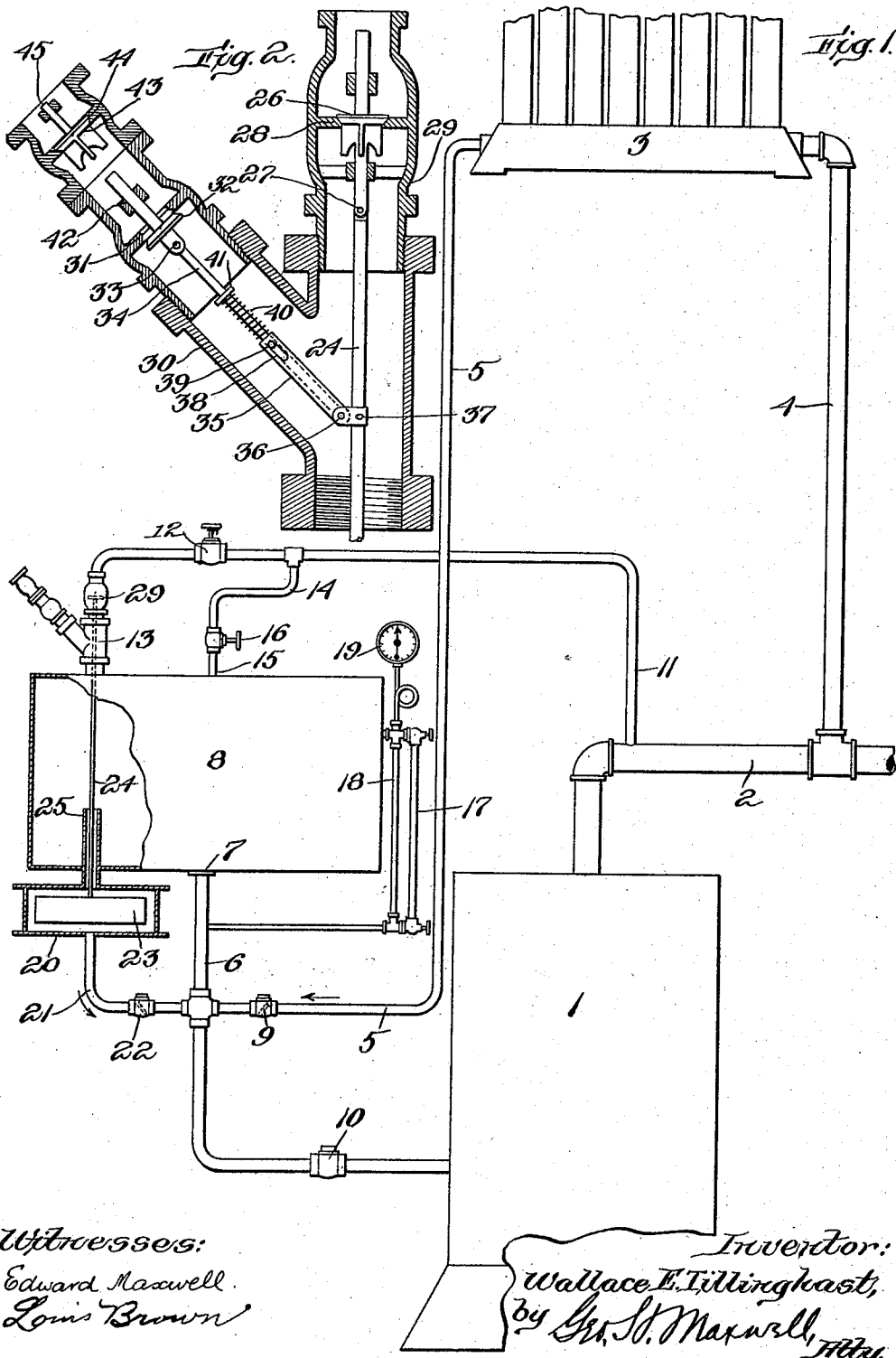


W. E. TILLINGHAST.
 VACUUM GENERATING APPARATUS FOR STEAM HEATING SYSTEMS.
 APPLICATION FILED MAY 27, 1908.

1,147,197.

Patented July 20, 1915.
 2 SHEETS—SHEET 1.



Witnesses:
 Edward Maxwell.
 Louis Brown.

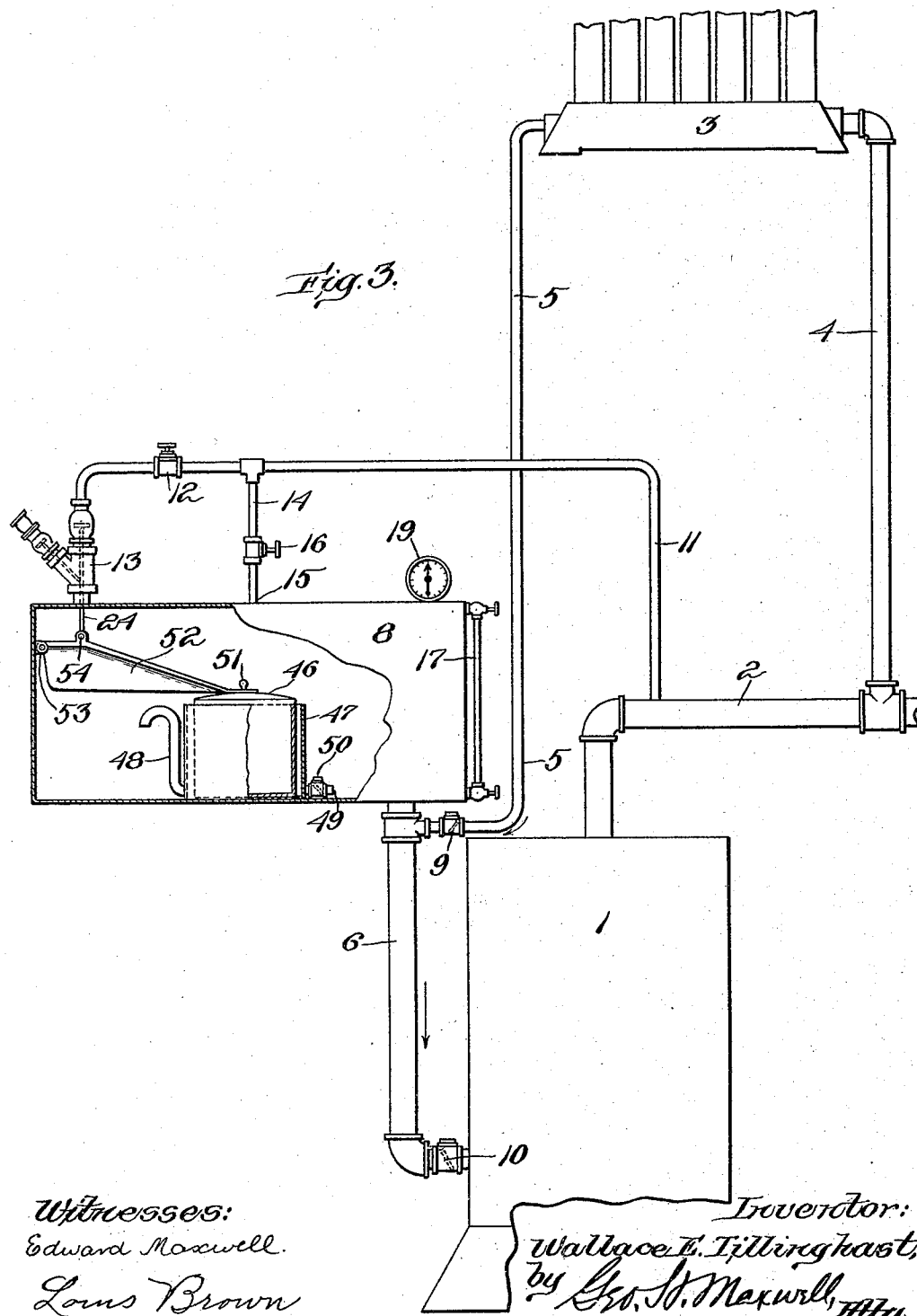
Inventor:
 Wallace E. Tillinghast,
 by Geo. S. Maxwell, Atty.

W. E. TILLINGHAST.
VACUUM GENERATING APPARATUS FOR STEAM HEATING SYSTEMS.
APPLICATION FILED MAY 27, 1908.

1,147,197.

Patented July 20, 1915.

2 SHEETS—SHEET 2.



UNITED STATES PATENT OFFICE.

WALLACE E. TILLINGHAST, OF WORCESTER, MASSACHUSETTS, ASSIGNOR TO SURE SEAL MANUFACTURING COMPANY, A CORPORATION OF MASSACHUSETTS.

VACUUM-GENERATING APPARATUS FOR STEAM-HEATING SYSTEMS.

1,147,197.

Specification of Letters Patent.

Patented July 20, 1915.

Application filed May 27, 1908. Serial No. 435,283.

To all whom it may concern:

Be it known that I, WALLACE E. TILLINGHAST, a citizen of the United States, and resident of Worcester, in the county of Worcester and State of Massachusetts, have invented an Improvement in Vacuum-Generating Apparatus for Steam-Heating Systems, of which the following description, in connection with the accompanying drawings, is a specification, like letters on the drawings representing like parts.

My present invention is a self-operating apparatus for facilitating the circulation of steam in heating plants whereby the system will continue to operate itself for an indefinite time with a minimum consumption of water and coal.

Among the particular advantages of my present invention is the provision of a vacuum tank having means producing a vacuum automatically without introducing cold water or any other wasteful means tending to interfere with the system, consumption of coal, etc., said means tending to render the system rapid, drawing the water of condensation forcibly at frequent intervals into said vacuum tank and discharging it therefrom rapidly back to the boiler.

In the drawings, in which I have shown preferred embodiments of my invention, Figure 1 shows in side elevation (parts being broken away) my apparatus as arranged for a comparatively low-pressure system; Fig. 2 is an enlarged longitudinal sectional detail showing the internal construction of the valve mechanism; and Fig. 3 is a view similar to Fig. 1 showing my apparatus adapted to a comparatively high-pressure system.

It will be understood that the boiler 1, main steam pipe 2 leading therefrom, and radiator or heater 3 connected thereto by a pipe 4 may be of any usual or preferred kind, and that I have herein shown simply one radiator of the system for the purpose of convenience in presenting the invention. From the radiator 3 a return pipe 5 extends to a main return pipe 6 connected at 7 to a vacuum tank 8, a check valve 9 being interposed in the pipe 5, opening toward said tank, and a check valve 10 in the main return pipe 6, opening toward the boiler or other source of steam. The tank 8 is located above the water level of the boiler, so

as to permit the water of condensation to flow from the tank by gravity to said boiler. The top of the tank 8 is in communication with the live steam space of the boiler by any suitable means, as by a pipe 11, which is provided with a hand-operated valve 12 as shown, thence passing to a special valve mechanism 13, presently to be described, and is connected by a by-pass pipe 14 to the pipe 11, this connection being controlled by a hand-operated valve 16. A water glass 17 is provided to show the amount of water in tank 8, and a gage pipe 18, and also preferably a compound vacuum and pressure gage 19. Suitably located below the special valve apparatus 13 is a float box 20, herein shown as located beneath the tank and connected by a pipe 21 with the main return pipe 6, a check valve 22 being interposed, opening toward said return pipe to prevent a back-flow into said box. In the box is a float 23 for operating a valve rod 24 arranged to reciprocate in a short pipe 25, which extends through the bottom of the tank 8 and opens at a desired predetermined distance within said tank. The valve rod 24 extends upwardly into the valve mechanism 13, best shown in Fig. 2, where it is provided with a valve 26 pivoted thereto at 27 and seating on a valve seat 28 in the upright or vertical fitting 29 of said valve mechanism. Extending from one side of said vertical fitting is a branch outlet pipe 30 preferably extending at an angle of about 45 degrees to the main fitting or upright, and provided with a valve seat 31 for receiving a valve 32 pivoted at 33 to a stem 34 slidingly connected to a rod 35 pivoted at 36 to a sleeve 37 fast on the rod 24. The rod 35 has a slot 38 in which travels a pin 39 extending from the stem 34, and the latter is supported yieldingly by a light spring 40 engaging the rod 35 at one end and a shoulder 41 on the stem 34 at the other end. The valve 32 is preferably guided accurately at 42. At the outer end of the branch outlet 30 is a check valve 43 seating inwardly against a seat 44 and guided by any suitable means, as by a guide finger 45.

In operation, the initial vacuum is created by manually opening valve 16 and allowing steam to flow from the boiler 1 through the main steam pipe 2, branch 11, and by-pass 14 into the tank 8. This expels all air from said tank through the check valve 43, it be-

ing understood that at this time the float 23 is at the bottom of its float box 20, and hence the valve 32 is in open position. After the air in the vacuum tank has thus been expelled, the valve 16 is closed and the valve 12 is opened, and thereafter allowed to remain open. The steam manually admitted to tank 8 through the valve 16 immediately condenses by radiation through the thin extensive walls of the tank, and as the valve 43 prevents any inrush of air, the initial vacuum is at once formed. This vacuum draws the water of condensation from the radiator system, from the radiator through the pipe 5, through check valve 9 into the tank. This suction is maintained until the water accumulates in the tank 8 sufficiently to overtop the tube 25 therein, whereupon it flows down said tube into the float box 20 and operates to raise the float 23 and its connected valve rod 24. When the float rises, the valve rod immediately raises valve 26 from its seat, and the upward motion of said rod at the same time closes valve 32 against its seat. The upward movement of rod 24 continues, not being retarded by the seating of valve 32 because of the interposed spring 40. This permits the steam valve 26 to be opened wide, with the result that the full steam pressure is instantly brought directly upon the contained water in the tank 8, thereby equalizing the pressure between the tank and boiler, and allowing the water to flow instantly by gravity through return pipe 6 and check valve 10 back to the boiler. The special mechanism described greatly facilitates the free, quick discharge of the water of condensation from the vacuum tank. As soon as the vacuum tank 8 has been entirely emptied, the steam inlet valve 26 having remained open and the valve 32 closed during this interval, the water from the float box 20 flows out through the comparatively small pipe 21 and check valve 22 to the boiler, with the result that the float 23 drops, and through its valve rod 24 closes the steam inlet valve 26 and opens the outlet valve 32. The expansion of the steam in the tank 8 is thereby allowed relief and operates to draw out with it whatever entrained air is contained in the tank 8, which passes out through the open valve 32. As soon as this discharge has taken place and the expansion has been relieved, condensation of the steam left in the tank immediately takes place, thereby automatically producing another vacuum, the check valve 43 preventing the entrance of any air through the valve mechanism 13, it being understood that the instant the vacuum begins to form in the tank 8 it immediately closes the valve 43, and hermetically seals the tank, excepting through the return pipe opening at 7. The vacuum thus formed again draws in a charge of water of condensation from the

radiator or radiators which constitute the system, and the above cycle of operations is repeated. This takes place again and again for an indefinite period, every time the water rises in tank 8 to a point where it overtops the tube 25.

In Fig. 3 I have shown a slightly different construction, capable of operating my system under a higher pressure on the boiler than the mechanism just described, this construction being the same as already described, excepting that I provide a float 46 within the tank, arranged to rise and fall in a float box or casing 47 open at its upper end and provided with preferably a siphon inlet pipe 48 and an outlet pipe 49, provided with a check valve 50 opening outward. The float 46 is loosely connected at 51 to the free end of a braced lever 52 pivoted at 53 to the tank and at 54 to the valve rod 24. The operation of this form of my invention is substantially the same as already described, excepting that it is capable of operating against a stronger steam pressure. When the tank gets sufficiently full of water of condensation to cause the siphon 48 to operate, the latter supplies a sudden and copious inrush of water, which fills the float box 47 and as a result exerts a strong upward pressure on the long end of the lever 52, which is thereby raised, and through the valve rod 24 operates the valve mechanism 13 as previously described. The water of condensation in the tank 8 passes out instantly through the main return pipe 6 to the boiler, the water in the float box 47 escaping past the check valve 50 from the pipe 49, which causes the steam inlet valve to close on the tank-full of steam, opening at the same time the outlet valve 32, which relieves the steam expansion and permits the escape of air from the tank until an equilibrium is restored, whereupon the check valve 43 instantly closes, the steam condenses by radiation, a vacuum results in the tank, a fresh charge of water of condensation is drawn into the tank, and so on, the process being repeated over and over the same as already described.

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

1. An apparatus for use with a steam generator and a steam radiator in a steam heating system, comprising a vacuum generator constructed and arranged for connection in and with said system, said generator having thin, extensive walls to induce rapid condensation, and a float-controlled means constructed to admit vapor from the steam generator when the water of condensation has reached a predetermined maximum height in the vacuum generating device, said float-controlled means including a valve, valve rod connection therefrom, and a float

fastened on said valve-rod connection, and a separate external float box or casing provided with an outwardly opening check valve and containing said float connected to said vacuum generating device.

2. An apparatus for use with a steam generator and a steam radiator in a steam heating system, comprising a vacuum generator constructed and arranged for connection in and with said system, said generator having thin extensive walls to induce rapid condensation, and a float-controlled means constructed to admit vapor from the steam generator when the water of condensation has reached a predetermined maximum height in the vacuum generating device, said float-controlled means including a valve, valve rod connection therefrom, and a float fastened on said valve-rod connection, and a separate external float box or casing connected by a governing tube to said vacuum generator and containing said float, an outwardly opening check valve for said box, and said governing tube extending upwardly in the vacuum generator to a predetermined maximum height arranged for delivering water suddenly from the main body of water collected in the vacuum generator to the before mentioned separate float box connected thereto.

3. An apparatus for use with a steam generator and a steam radiator in a steam heating system, comprising a vacuum generating tank, automatic pressure-equalizing means operated by the accumulation of the water of condensation in said tank, to permit the flow of the water of condensation contained in said generating tank to flow therefrom by gravity, said operating means consisting of an inlet valve to said tank for the admission of steam pressure therein, an outlet valve from said tank for the escape of air, coöperating sealing means for preventing the improper admission of air, a single valve rod connection joining said two valves, a float fastened on one end of said valve rod connection, a separate float box connected to said vacuum generating tank for said float, an inlet tube extending into said tank from said float box so positioned that the water contained in said vacuum generating tank must reach a predetermined maximum height before entering said tube and thence flow suddenly into said separate float box, an outlet valve for said float box so positioned that the water of condensation suddenly delivered from the main body of water collected in said tank may flow by gravity out of said separate float box after it has been suddenly admitted through the inlet tube from the main body of water collected in said tank.

4. An apparatus for use with a steam generator and a steam radiator in a steam heating system, comprising a vacuum generating

tank, an externally connected inlet valve therefor to admit steam thereto, an externally connected air outlet valve therefor, a coöperating sealing valve for preventing the improper admission of air through said air outlet valve, automatic means operated by the accumulation of the water of condensation in said vacuum generating tank for operating said externally connected inlet valve and externally connected outlet valve, a float box, a float positioned to operate in said box, a valve rod directly connected therewith and connected to said externally connected inlet valve and said externally connected air outlet valve, an inlet tube and a water outlet tube for said float box, said float permitting a free up and down movement of said valve rod connection without any lost motion in either of said upward or downward movements, said externally connected air outlet valve having a sliding sleeve and a spring connection with said valve rod connection permitting the closing of said air outlet valve upon the rising movement of said valve rod connection before compression of said spring is effected, and said externally connected inlet valve opening to its fullest area before the full compression movement of said spring is accomplished.

5. An apparatus for use with a steam generator and a steam radiator in a steam heating system, comprising a vacuum generating tank, a steam inlet valve externally connected with said tank, an air outlet valve externally connected with said tank, an externally connected inwardly closing check valve operated by gravity to prevent accidental admission of air through said air outlet valve, automatic means operated by the accumulation of the water of condensation in said vacuum generating tank for operating said externally connected inlet valve and outlet valve, including a direct-connected valve rod connected to said externally connected inlet valve and outlet valve, a float in full operative connection with said valve rod, and a separate float box for said float provided with an outwardly opening check valve, said float operating freely both upwardly and downwardly without lost motion in either of said movements, permitting the opening of the said inlet valve and the closing of the said externally connected outlet valve with the upward movement of said automatic means, and permitting the closing of said inlet valve and the opening of said outlet valve with the downward movement of said automatic means, the connections of said valve rod with said outlet valve including an auxiliary rod connection formed in two relatively sliding parts having a slot and pin connection, a spiral spring normally maintaining said parts extended, the main valve rod having a free upward movement when said spiral spring is being compressed by the

upward movement of said automatic means, and said slot and pin permitting the opening of said outlet valve upon the downward movement of said automatic means.

- 5 6. An apparatus for use with a steam generator and a steam radiator in a steam heating system, comprising a vacuum generating tank, an externally connected steam inlet valve for said tank, an externally connected
10 air outlet valve for said tank, an externally connected inwardly closing check valve to prevent accidental admission of air through said air outlet valve, automatic means operated by the accumulation of the water of
15 condensation in said tank for operating said externally connected inlet valve and outlet valve, said automatic means including

a separate float box, an inlet tube from said box within said tank, an outlet valve from said box permitting a free flow of the water 20 from said separate float box by gravity upon the occurrence of a predetermined pressure in said tank, and a float connected to control said valves free to rise in said box when the water of condensation has reached a pre- 25 determined maximum height in said tank.
- In testimony whereof, I have signed my name to this specification, in the presence of two subscribing witnesses.

WALLACE E. TILLINGHAST.

Witnesses:

MARY M. DANIEL,
LOUIS R. HUNT.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."