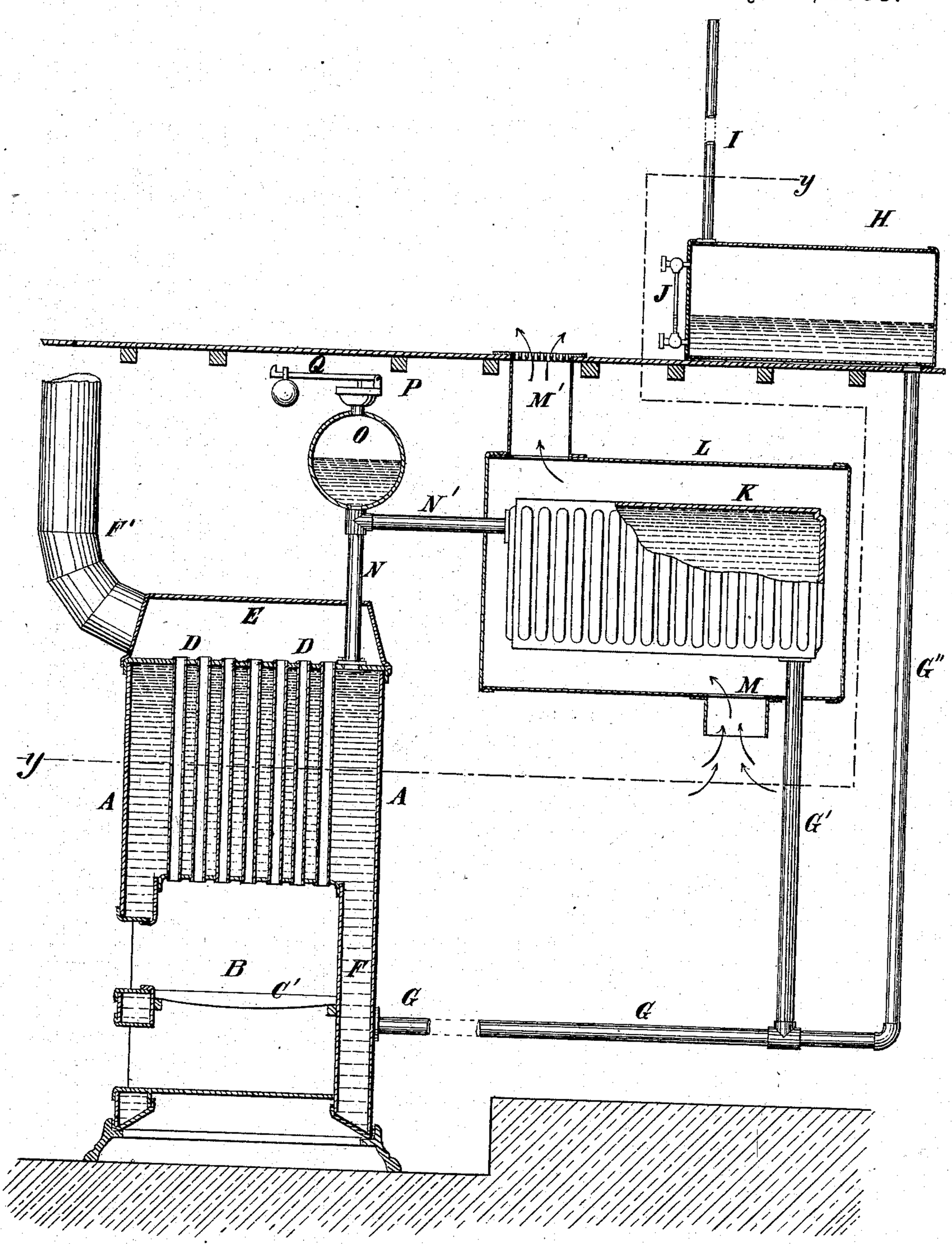
(No Model.)

F. TUDOR.

STEAM AND HOT WATER HEATING APPARATUS.

No. 278,636. Patented May 29, 1883.



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STEAM AND HOT-WATER HEATING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 278,636, dated May 29, 1883.

Application filed October 5, 1882. (No model.)

To all whom it may concern:

Be it known that I, FREDERIC TUDOR, of Boston, in the county of Suffolk and State of Massachusetts, have invented an Improvement in Steam and Hot-Water Heating Apparatus; and I do hereby declare that the following is a full, clear, and exact description of the same, reference being had to the accompanying drawing, forming part of this specification.

My invention relates to apparatus of the kind named, whether the heat be applied by what is known as "direct" or "indirect" radiation. The drawing, however, illustrates the improvement only as used in a system of apparatus for supplying heat by indirect radiation; and as the principle and action of the invention are sufficiently shown in such an apparatus, it will be unnecessary to elaborately show or describe its application to a system of direct radiation.

The object of the improvement is to supply an apparatus which can be used either for heating by hot water or by steam, according to the degree with which the fire is urged in the furnace—that is to say, it circulates hot water with a moderate heat maintained in the furnace, and steam when a more intense heat is kept up, the heating by hot water being more desirable and more easily controlled in moderate weather than steam-heating, while for intensely-cold weather steam-heating is preferable.

The drawing represents partly a side view and partly a sectional view of an apparatus designed to effect the object set forth.

The boiler A is shown as a vertical tubular boiler; but the invention is not confined to this type of boiler, and any other approved kind of boiler may be used.

B represents the furnace; C, the grate; D, the vertical tubes; E, the smoke-box, and F′ the uptake. The water-space is shown by shade-lines between the shell A and tubes D, which latter are inserted into the crown-sheet and flue-sheet and fastened by expanding them in the usual manner.

At F is shown a water-leg which passes around the furnace B, and into the lower part of which is inserted a pipe, G. The pipe G connects the water-leg F with a relief-tank, H, which also, within certain limits, performs the functions of a hydrostatic-pressure regulator for regulating the pressure at which steam will circulate through the system of pipes and radiators employed for distributing heat, as will hereinafter appear. From the relief-tank H rises a stand-pipe, I, which acts as hereinafter explained, and to the side of said tank is attached a water-gage, J, for indicating the height of water in the said tank. A branch pipe, G′, leads from the pipe G to the bottom of the indirect radiator K, which is inclosed in of the usual case, L, and supplied with an inlet, M, and outlet M′ for ingress and egress of air to be heated and circulated. A pipe, N N′, also leads from the top of the water-space in the boiler A to the upper part of the radiator K. The part N of the pipe N N′ is in this example of my improvement placed in a vertical position, and at its top is affixed an air-trap, O, preferably of spherical form. This air-trap is furnished with a valve, P, held to its seat by a weighted lever, Q, after the manner of a safety-valve, which it is in fact. When this valve is opened it will permit escape of the air, which, when expelled from the water by heat, rises first to the top of the boiler, and thence passes through the pipe N into the air-trap O. This valve P will therefore serve as a safety-valve, so as to open automatically when the pressure to which it is set is exceeded, and thus relieve the apparatus of undue pressure, and it will at the same time serve as an air-cock to permit the removal of air accumulated in the trap O when the valve is opened by hand, as will be understood.

Now, the apparatus will act either as a hot-water heater or as a steam-heater, according to the intensity of the heat maintained in the boiler-furnace. The drawing shows it as when performing the function of a hot-water heater. In this use of the apparatus only a moderate heat is maintained in the furnace, and the pressure in the boiler is, by the water-column rising from the water-leg of the boiler to the level in the tank H, maintained at a point at which the nascent steam generated in the boiler will not be sufficient to depress the water-level in the water-space of the boiler A. The boiler therefore remains filled with water, which also fills the pipes G N N′, radiator K, and rises in the tank H to the level shown. This level of the water in the tank should be sufficiently above

the top of the boiler to provide a water-column sufficient to keep the water under some tension in the boiler, and thus compel it to become heated therein to a temperature corresponding to this tension, yet not allow it to generate steam sufficient to expel the water from the boiler or its connected circulating-pipes, &c., as will be understood. The normal level of the water in the tank, or rather the position of the water-tank above the boiler, may hence be higher or lower, according to the tension or temperature desired to be imparted to the water-circulation, without its giving off free steam, as will be understood, and which may be varied as circumstances require. Under these conditions, therefore, the water will be effectually heated in the boiler to or above the boiling-point, (according to the height of the tank H,) and will thence circulate through the pipes N N′ into and through the radiator K, and thence back to the boiler through the pipes G′ and G, thus maintaining a constant circulation of hot water through the radiator K and boiler A; the boiler, when the apparatus is thus used, being a water-heater rather than strictly a boiler.

It may be noted that the water-tank H is closed at the top, and from the top a stand-pipe, I, rises to any suitable height, limited by the limit of steam-pressure permissible in the apparatus, the stand-pipe being preferably open at the top to the atmosphere, although it may be closed, if desired. Now, the tank should be of such a size that the space between its closed top and its normal water-line, as shown, should be equal to the capacity of the pipes N N′, the radiator K, and the steam-space of the boiler when used for generating steam—that is, the space from the flue-sheet of the boiler to its steaming water-line *y y*. It will therefore be now understood that if, while the apparatus is acting as a circulating-water heater, as previously described, and as shown in the drawing, the fire be now urged in the furnace so as to heat the water rapidly in the boiler and to a high temperature sufficient to generate a pressure of steam exceeding the pressure of the water-column from the tank H, this steam will then immediately accumulate in the top of the boiler and in the upper part of the heating system, and thus commence to at once expel the water from the boiler and the pipes N N′ and radiator K through the pipe G′ and G″ into the tank H. The water will thus continue to flow out of the boiler and out of the pipes and radiators, being displaced by the steam, and the expelled water will thus continue to rise in the tank H until the water of the boiler is depressed to the water-line *y y*, and until the water is all expelled from the radiator K and its pipes N N′ from the upper part of pipe G′ down to the water-line *y*, by which time the water-tank will be filled to the top, and the water will thence commence to rise in the stand-pipe I. As the water begins to rise in the stand-pipe a sudden and greatly increased hydrostatic pressure will thus be exerted on the mass of water, which will hence cause the limit of the expelling action of the steam to be reached, so that the water will now remain supported in the tank by the pressure of steam, and the water-column in the stand-pipe will oscillate up and down slightly as the pressure of the steam increases or diminishes, while the steam will continue to flow from the boiler through the pipes N N′ into the radiator, and there condense and give off its heat, while the condensation will trickle into the pipe G′ and return to the boiler, thus maintaining a nearly constant water-level in the boiler, while the water is being constantly distilled off and diffused through the pipes and radiators in the form of live steam under any desired pressure—say, preferably, five to ten pounds to the square inch—and thence returned to the boiler after condensation. The apparatus thus forms a most efficient steam-heater when operated in this way, and which becomes self-acting and very safe and economical. If the pressure of steam increases in the boiler and radiator, the water-column will rise correspondingly in the stand-pipe I, and thus tend to check, restrain, or limit the pressure; but if the steam-pressure at any time exceeds the pressure which it is desired to maintain the safety-valve P will open and relieve the apparatus of the excess, as will be readily understood. In practice, however, the boiler will be provided with a damper-regulator, in precisely the same manner as commonly employed in heating boilers, so that the steam-pressure, when at its maximum, will act to distend the diaphragm of the regulator, raise a weighted lever, and thus close the damper, while the descent of the lever when the pressure falls will act to open the damper in the usual way, thus tending to maintain a uniform steam-pressure in the heating system, as will be understood.

When steam heat is not desired any longer, owing to the mildness of the weather or other cause, the fire in the boiler-furnace may be checked or allowed to decline, when the steam-pressure will immediately fall and the water will gradually subside from the tank I and return into the radiator and boiler, so as to fill the same, as before, and thus form a hot-water-circulating apparatus, as first described, and shown in the drawing, which will provide a more gentle heat than the steam, as will be understood. The entire apparatus thus becomes self-acting, so that to operate as a water-heater it is only necessary to shut the ash-pit door, and thus check the fire, while to operate as a steam-heater the ash-pit door is opened wide, thus allowing the fire to burn brightly, when the damper-regulator will now automatically control the pressure of steam generated, as will be understood.

The proper level for the normal water-line in the tank H, as shown in the drawing, when the apparatus is acting as a water-heater, will be indicated by a distinct mark on the gage-

tube J, so that the space above the water-line will be of the correct capacity to receive all the water expelled from the boiler, the pipes, and radiators when the action of the apparatus changes to steam-heating. This water-level can be readily found by calculation or experiment, and when marked on the gage no further attention is necessary, except to occasionally add some water to the tank, so as to make up for any slight losses by evaporation or leakage, and thus keep its normal water-line constant, or nearly so.

If desired, the stand-pipe I might be dispensed with and in its place a float-valve substituted, which would act to shut the air-vent at the top of the tank when the water rose to the desired limit, thus preventing the further rise of the water, or confining a cushion of air above it, which would be the equivalent of the stand-pipe in offering a sudden increased resistance to the motion of the water, which would prevent any more from being expelled from the boiler, and thus compel the apparatus to then act as a steam-heater, as already described. I much prefer the stand-pipe, however, as it is very simple, inexpensive, and efficient. Hence by this means a simple and efficient heating apparatus is provided whose action can be automatically and economically adapted or changed for either high or low heating, suited for either mild or severe weather, thereby enabling the heating effect to be readily adjusted to the changes in the weather.

A very convenient means of preventing the overheating of apartments in mild weather is thus afforded by the automatic substitution of hot water for steam, controlled solely by the intensity of the fire in the furnace, and one of the important difficulties in the management of steam-heating apparatus as heretofore constructed is thereby removed. An economy of fuel is also secured as a collateral advantage, because all surplus heat supplied to apartments is of necessity, for the most part, allowed to go to waste, windows or ventilators being opened wider for its escape, which excessive wasteful and unpleasant disposition of the heat is obviated in my system.

The radiator K may of course be replaced by any other appliance for receiving hot water or steam and emitting a distributing heat therefrom without in any wise departing from the principle and operation of my invention.

Having thus described the construction and operation of my improvement, what I consider as my invention is as follows:

1. A heating apparatus adapted to heat either by circulating water or steam, and to shift from one condition to the other, as required, consisting of a boiler, in combination with one or more radiators connected with the top and bottom of the boiler, with a charge of liquid filling the same and forming a water-circulating system, together with an overflow tank or receptacle connected with the base of the system, and adapted to receive the liquid from the circulating system down to the steaming water-line of the boiler when said water is expelled by generation of steam, and to resist the further expulsion of liquid, whereby the apparatus will act as a steam-heater when the fire is increased and as a water-heater when the fire is decreased, substantially as set forth.

2. A combined water and steam heating apparatus, consisting in the combination, with a boiler, A, of a radiator, K, placed above the steaming water-line of the boiler, and connected with the top and bottom thereof, and a charge of liquid filling said boiler, radiators, and connections, together with the closed tank H, connected with the base of the boiler or its connections, and acting to receive the liquid expelled from the radiator and steam-space of the boiler, and to resist the further expulsion of liquid, substantially as and for the purpose herein shown and described.

3. The combination, with a boiler, A, of a radiator, K, connected with the boiler to form a water-circulating system, with the closed tank H, connected with the base of said system, and stand-pipe I rising from said tank, substantially as and for the purpose set forth.

4. The combination, with the boiler A, radiator K, and tank H, connected substantially as set forth, of the air-trap O and valve P, substantially as herein shown and described.

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Witnesses:

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