J. D. WILLOUGHBY.

Hot Water Heating Apparatus.

No. 209,742. Fig. 1. Patented Nov. 5, 1878.

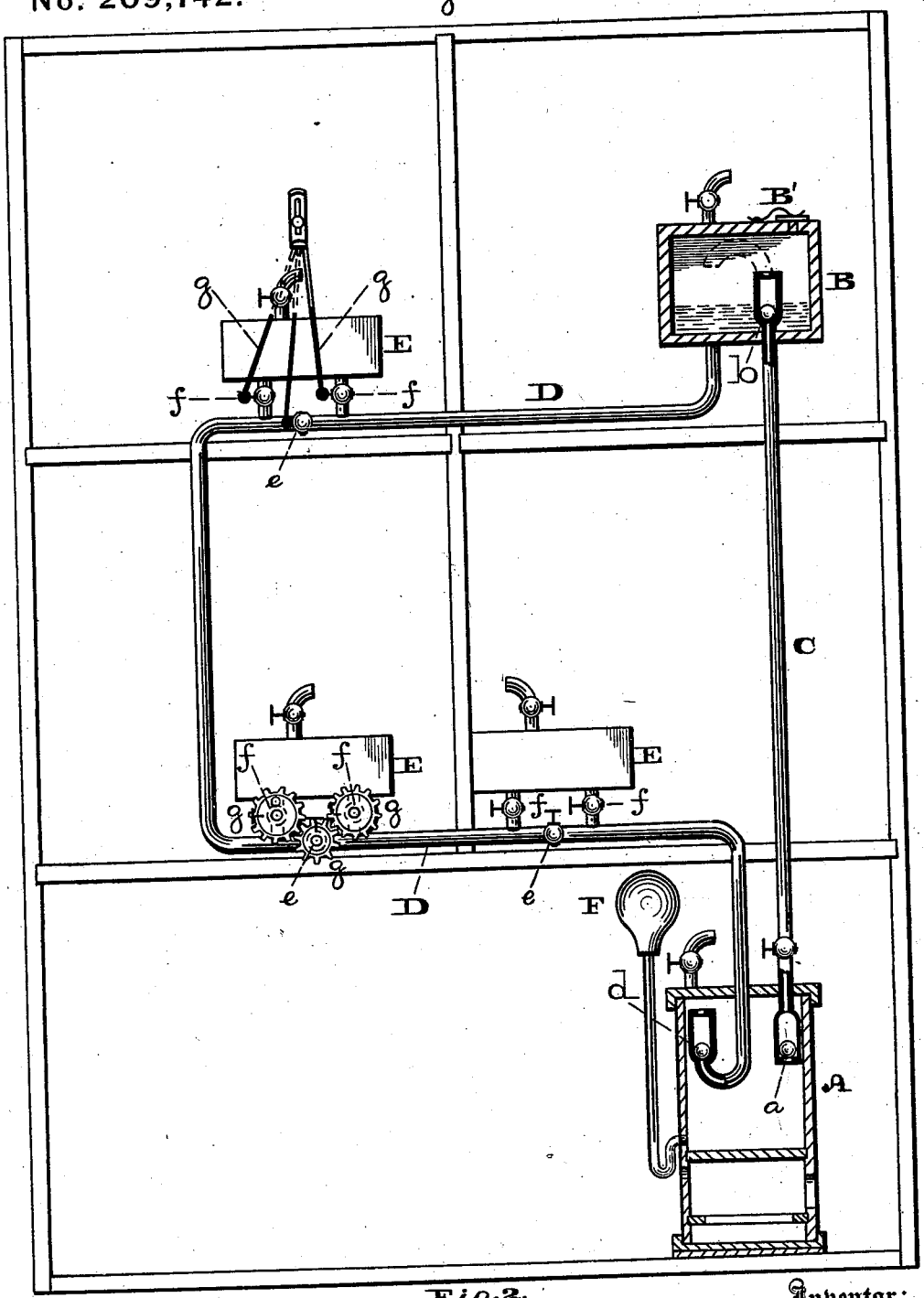
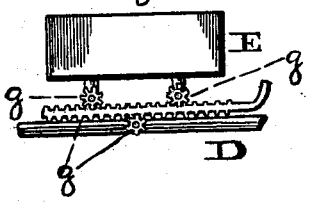


Fig. 2.



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IMPROVEMENT IN HOT-WATER HEATING APPARATUS.

Specification forming part of Letters Patent No. **209,742**, dated November 5, 1878; application filed December 3, 1877.

To all whom it may concern:

Be it known that I, JAMES D. WILLOUGHBY, of the city and county of Philadelphia, and State of Pennsylvania, have invented a new and useful Improvement in Hot-Water Heating Apparatus, which improvement is fully set forth in the following specification and accompanying drawings, in which—

Figure 1 is a side elevation, partly sectional, of the apparatus embodying my invention. Fig. 2 is a view of a detached part, modified.

Heretofore the circulation of hot water in heaters has been obtained by gravity and convection, or the difference in the weight of water consequent upon the difference in the amount of heat that is in the water. This circulating force, if force it may be called, is not sufficient to produce satisfactory results, except under the most favorable circumstances, and when all parts of the heater are constructed and arranged to favor circulation, and they are kept in good working order.

My invention relates to means for obtaining sufficient force to compel the water to circulate through all parts of the heater, and to return again into the boiler, where it is reheated and forced, as before, through pipes and radiators, as desired, substantially as hereinafter more fully described and claimed.

Referring to the drawings, A represents a boiler, which may be of cylindrical or other form, and of any desired construction. The boiler is placed in the cellar, but may be placed in any other convenient place. The boiler may have a separate hot-water chamber connected with it, which, in most cases, will be required if a number of pipes are used as a boiler to receive the heat from the fire, and convey the hot water and steam to the hot-water chamber. This chamber may also be in contact with the fire; or, if circumstances require, it may be in a position where the heat of the fire does not come in contact with it. The main object of the chamber is space or water-room.

B represents a reservoir or receptacle for hot water and steam, which is placed in one of the highest rooms. I have shown it in the drawing as being box-like in form; but any form may be used, the object being to have space into which hot water and steam from the boiler may enter, there being so much space in the reservoir that the upper part of it will always be cool enough to condense the steam that enters it.

C represents an outlet-pipe. The lower end of it enters the boiler, and the upper end enters the reservoir. In its lower end is a valve, *a*, within the boiler. This valve may be of any known form, and may be placed outside of the boiler at any desired place in the pipe, or in connection with the pipe, being so arranged that the pressure of steam in the boiler tends to raise the valve and permit water and steam from the boiler to pass through it and up through the pipe into the reservoir. At the top of the pipe C in the reservoir there is a valve, *b*, the object being to prevent water from the reservoir returning back into the pipe after the water has been blown out of it by steam from the boiler. The return of water into that pipe in most cases is not desired; but it will not prevent the action of the heater. In many cases it will be desirable to extend the upper end of the pipe C higher up in the reservoir than the water will ever be permitted to rise, when the valve can be dispensed with, and the tube C will remain comparatively free from water above the valve *a*, except as it is filled with water rising from the boiler.

D represents a pipe, the upper end of which enters at or near the bottom of the reservoir. This pipe is made to pass through all the apartment to be heated, and at its lower end enters into the boiler, and has a valve, *d*, so arranged that the pressure of steam in the boiler tends to hold it closed or shut, and not to open it, as is the tendency upon the valve *a* in the pipe C. This valve *d*, as well as the other, may be of any desired form or construction, and may be in the pipe in the inside of the boiler, as shown, or in any suitable place in the pipe, or connected with the pipe outside of the boiler, so arranged that when the column of water in the pipe D is heavier than the pressure in the boiler the valve will open and permit the water to pass into the boiler.

E represents radiators, which are receptacles for hot water, and may be box-like, as I have shown, or of any desired form or construction, or any suitable arrangement of pipes, and are

placed in the apartments to be heated, and are connected by two pipes or other suitable connection with the main return-pipe D.

In the main pipe D is a cock, *e*, and also cocks *f f* in the pipes that connect the radiator with the main pipe. The object of this connection and of these cocks is to be able to compel the hot-water to pass, or not to pass, through the radiators, as may be desired, or to compel just as much as may be desired to heat the room to pass through that radiator, the rest passing on through the main pipe D to the next room. These cocks can be moved by the skillful operator so as to regulate the flow of water as desired, and at the same time avoid throttling the water-passage; but to prevent error, especially by unskillful hands, I have connected the three cocks by rods *g g g*, so that as the cock in the main pipe D is closed the others will be opened, or when the others are closed the one in the main pipe will be opened correspondingly, and thus preserve an unthrottled water-passage. The connection that moves all three of the cocks at the same time may also be, by toothed wheels, arranged to mesh into each other, or by a rack and pinions, or by any known means of producing simultaneous motion in them.

B′ represents a safety-valve, that opens and discharges the steam from the reservoir in case the temperature of the reservoir does not condense it, and any undue pressure in the reservoir is avoided.

F represents an air-chamber, connected with the boiler, so to avoid a jar or concussion when the boiler suddenly fills with water after each pulsation. This is only required where the boiler fills very suddenly. I have shown but one outlet and one inlet pipe which enter the boiler, although others might be used to lead to separate apartments, or to other buildings to which it is not convenient to make the return-pipe D pass or extend.

These additional pipes may enter the boiler and be provided with valves, as the others, or they may unite with the other pipes at some point above the valves in the others, and can have a separate reservoir, into which the outlet-pipe discharges its waters. The relative amount of water which is made to pass through this auxiliary pipe from the main pipe C into its own reservoir can be determined by the use of a cock in each pipe, so that the size of the passage in each pipe can be regulated at will.

I have shown the outlet-pipe as running directly to the reservoir, where it discharges the water from the boiler. The outlet-pipe can be made to traverse the different apartments, and have the radiators connected with it instead of with the return-pipe. In that event the return-pipe can pass in the most direct way from the reservoir to the boiler, as the outlet-pipe now does, and the water will have to pass through the radiators on its way to the reservoir; but the plan shown is preferred.

The distance of the mouth of the outlet-pipe below the top of the boiler determines the amount of water which shall be thrown from the boiler at each pulsation. The end of this pipe within the boiler may have on it an elbow, or any adjustable device that can be turned or moved, so as to raise or lower it, thereby bringing the mouth of the pipe nearer to or farther from the top of the boiler, which will cause an increase or decrease in the amount of water thrown at each pulsation. If much water is thrown at each pulsation, the required heat will be obtained with a less number of pulsations in a given time.

To prepare the heater for operation, it is filled with water until the bottom of the reservoir is covered, and, if the valve *b* is employed, it is advisable that it is also covered with water. This filling is easily accomplished by introducing the water into the reservoir B, from which it will find its way into the boiler and radiators. The air, or as much of it as is desired, can be let out of the boiler and radiators by means of the pet-cocks. The top of the reservoir is closed; but it has a safety-valve in it, which will open by a light pressure of steam in the reservoir, should such pressure ever occur, and thus avoid any dangerous pressure of steam in the reservoir.

When steam is generated in the boiler it rises to the top or upper side of the boiler, and by its pressure forces the water into the mouth of the pipe C, which is below the surface of the water, and up through the valve or valves *a*, which are in the pipe or suitably connected to it, and is discharged into the reservoir B. When the steam in the boiler reaches the mouth of the pipe C it will pass suddenly into the reservoir B, and comparatively free the boiler and under side of the valves *a* from pressure. The valves *a* will then close, and the valve *d* in the inlet-pipe D, which was held closed by its own weight and the pressure of steam in the boiler, will now be opened by the weight of water in the inlet-pipe D. When the water from this pipe D enters the boiler its comparative coldness condenses the vapor or steam that may be in the boiler, thereby producing a vacuum, which joins its force with the weight of water in the inlet-pipe and in the radiators to force the water into the boiler until it is again full, and when reheated until steam is formed, as before, the water will again be forced in the reservoir or into the upper part of the pipes or devices used to answer as a reservoir or receptacle for the hot water forced up.

If the return-water is made to enter the boiler above the water-level, its immediate contact with the vapor or steam will produce rapid condensation, and consequently a vacuum will be more quickly and fully formed than if the water entered the boiler below the water-level.

The presence of air in a radiator of box form, as I have shown, or if formed so as not to permit the water to carry the air out of the radiator, does not prevent the action of the heat-

ing device; but I prefer in most cases to exclude all the air, or nearly all, from the radiators. Yet in some cases it may be desirable to permit air to be in such of the radiators that have a heating capacity greater than is required, as the air prevents them from being fully filled with hot water; and in some cases the presence of air in the radiators or pipes, or other suitable receptacle, may be desirable, to prevent any jar or concussion arising from the sudden stoppage of motion in the water when the boiler has suddenly become full of water. To prevent a jar in the boiler, an air-chamber, F, is connected with the boiler below the water-level, so that the air will not leave the chamber.

When the cock *e* in the main return-pipe D is opened, and the cocks *f f* in the pipes that enter the radiator or coil-pipe are closed, the hot water will pass the radiator or coil-pipe, and not enter them; and if the positions of the cocks are reversed, the water will have to pass through the radiator; or, if the three cocks are partially opened, the water will be divided in its passage, some entering the radiator, the rest will pass on through the main pipe, according to the position of the cocks, thereby regulating the amount of hot water that enters the radiator at each pulsation, and consequently the amount of heat radiated by that radiator.

The gearing rods, racks, and pinions, (shown at *e f*,) or their equivalents, are attached to the cocks, so that if the cock in the main pipe is partially or fully closed, the other two cocks will be partially or fully opened, thus insuring an unthrottled passage for the water, which would often be throttled if no such connection existed, especially if moved by inexperienced persons. In some cases I use the cocks without being connected.

I am aware that it is not new to raise water into an upper tank in a building by means of steam-pressure and that in some instances a small additional pipe has been arranged between such tank and the main water-supply chamber, so that when the latter becomes emptied of its water and filled with steam, which has been generated in a water-back, certain valves will be opened and a small stream of water will flow from the tank into the chamber, for the purpose of condensing the steam therein and creating a vacuum, whereby a fresh supply of water will be forced by external pressure into the said chamber, all substantially as found in Patents No. 101,334 and No. 141,249. But in these instances the invention relates to means for supplying the open tanks with water, which is to be conveyed by ordinary pipes to different places in the building for consumption. No provision is made for heating the rooms nor for heating the water sufficiently to render it available as a heating-agent.

What I claim, therefore, and desire to secure by Letters Patent, is—

1. In a hot-water heating apparatus for buildings, the boiler A, from which the supply of hot water is automatically forced by the expansion of steam generated therein, and the closed reservoir B, for receiving the water from the boiler, in combination with a pipe leading directly from the boiler to the reservoir, and provided with a valve, whereby the return of water is prevented, and a pipe also connecting the reservoir with the boiler and arranged to pass through the compartments of a building, said pipe also connecting with means for radiating the heat therein, and provided with a valve adapted to open when steam-pressure thereon is decreased, and thereby admit of a return of the water into the boiler, where it will be reheated, substantially as shown and described.

2. In a hot-water heating apparatus for buildings, the radiators E, adapted to be arranged within the apartments thereof, in combination with the pipes C D, and boiler A, and reservoir B, connected by said pipes, substantially as set forth, the whole making a complete circuit, in which all the water will circulate, substantially as shown and described.

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