(No Model.) 2 Sheets—Sheet 1.

W. P. SKIFFINGTON.

METHOD OF HEATING.

No. 527,029. Patented Oct. 2, 1894.

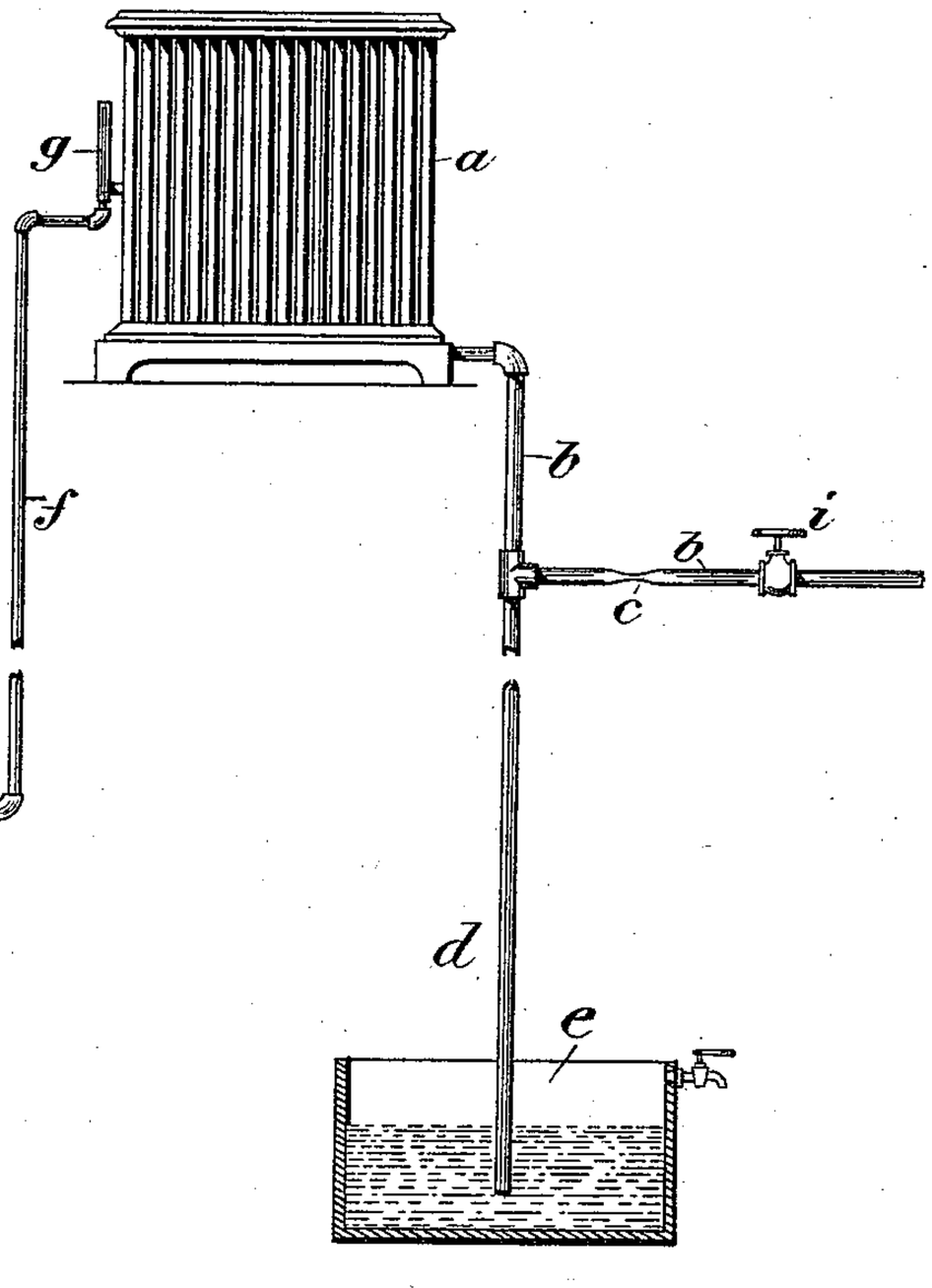

Fig. 1

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(No Model.) 2 Sheets—Sheet 2.

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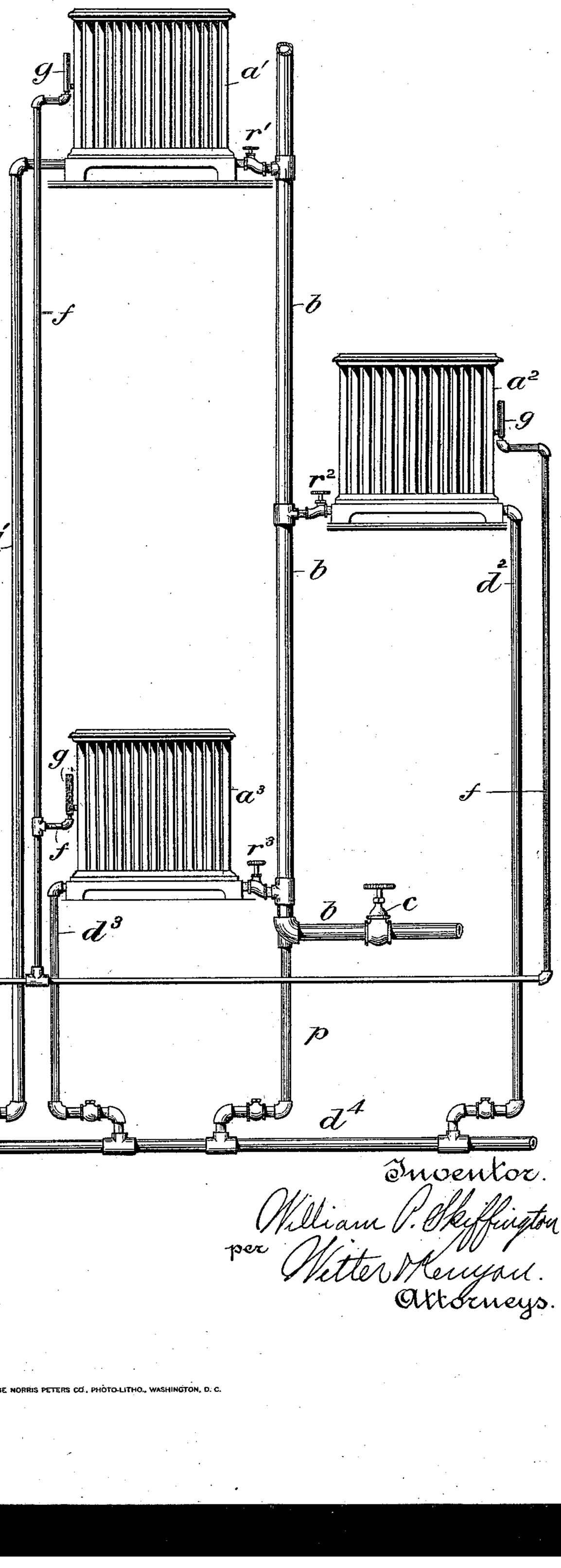
Fig. 2.



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UNITED STATES PATENT OFFICE.

WILLIAM P. SKIFFINGTON, OF NEW YORK, N. Y., ASSIGNOR OF THREE-FOURTHS TO ANDREW G. PAUL, OF BOSTON, MASSACHUSETTS.

METHOD OF HEATING.

SPECIFICATION forming part of Letters Patent No. 527,029, dated October 2, 1894.

Application filed August 8, 1892. Serial No. 442,424. (No specimens.)

To all whom it may concern:

Be it known that I, WILLIAM P. SKIFFINGTON, a citizen of the United States, and a resident of the city of New York, in the county and State of New York, have invented a certain new and useful Method of Heating; and I do hereby declare that the following is a full, clear, and exact description of the same.

This invention relates to the method of heating which consists in supplying steam, or other suitable heating agent, to systems employed for heating buildings, and maintaining the circulation of the heating agent throughout the system, and it originally formed part of the subject matter of my application for Letters Patent filed August 11, 1891, under Serial No. 402,384.

My improved method consists, in supplying steam or other heating agent (drawn from a boiler, or other suitable source) in measured quantities, at or below atmospheric pressure and causing said steam to flow to the place of use by reducing the pressure thereat.

In the best embodiment of my improved method the air which is in the heating system at the start, or which collects therein from time to time during its operation, is removed from the system independently of the pressure within the system. By this method I am also enabled to regulate more accurately, and between wider limits, the amount of heat which is given off by the radiating apparatus. Thus, while the radiator, (by having its heating agent under a pressure somewhat less than the atmospheric pressure,) would heat the air in a room substantially as efficiently as the same radiator having the same heating agent under a pressure of thirty pounds, it will be seen that by reducing sufficiently the pressure upon the heating agent in the radiator, such heating agent may be so expanded, and the number of heat units contained in it may be so reduced as to supply a less degree of heat to the air of the apartment. In this way the temperature of the apartment is readily reduced, whereas, in the old systems, if the radiator were used at all, the heat given off by it could only be changed within very narrow limits and this mainly by varying the pressure of the heating agent in the boiler, or other source of supply.

From the above it will be apparent that my improved method secures marked advantages, from the fact that the pressure within the radiating apparatus can be reduced to any point desired, and the temperature thus accurately regulated, so that a given temperature can be produced by the use of a minimum quantity of steam, or other heating agent.

It will be obvious that my improved method may be efficiently operated not only when embodied in a heating system in which only one radiator or heater is employed, but also with pluralities of heaters or radiators, as shown in the accompanying drawings forming part of this specification, to which reference should be had to fully comprehend the invention.

In said drawings similar letters of reference indicate like parts in the both figures which will now be described sufficiently to enable those skilled in the art to readily understand the practical adaptations of my method.

Figure 1 shows an apparatus containing but a single radiator or heater, the same being connected on the plan of a single pipe system,—that is to say, having but one pipe for the admission of the heating agent and the return of the water of condensation. Fig. 2 illustrates an apparatus containing three radiators or heaters, all of them connected on the plan of a double pipe system, and each radiator having in its own particular supply pipe a measuring device which is supplemental to the restricted or contracted opening in the main supply pipe.

I will now describe in their order the different forms of apparatus shown in both the figures, and the manner in which my improved method is carried out in such several arrangements.

Referring to Fig. 1, *a* is a radiator or heater which is constructed in any usual or ordinary manner. *b* is the supply pipe, which is connected with any suitable source from which the steam or other heating agent is to be supplied to the system. This supply pipe is provided with a measuring device consisting of a restricted or contracted opening *c*. This opening *c* can be made in any suitable manner, as by reducing the diameter or size of the pipe,

or by employing a valve adapted to reduce the opening in the pipe to the desired point, or by employing what is technically called a reducing valve, that is to say, a valve which will operate to keep the pressure in the pipes at one side of it at a certain point, no matter how the pressure may vary above that point in the pipes on the other or supply side of the valve. The size of this restricted opening will depend upon the extent of surface to which heat has to be supplied in the radiating appliances, and upon the pressure of the steam or other heating agent in the source of supply from which the heating agent is drawn. *d* is an extension of the supply pipe, running down to the tank *e*, in which the water of condensation is collected. This tank *e* as shown, is open to the atmosphere, but the pipe *d* extends down nearly to the bottom of the tank *e*, so that the lower end of the pipe *d* can be sealed by the water of condensation which escapes into the tank *e*. *f* is an air pipe independent of the supply pipe *b*, and connected at one end with the heater *a*, and at the other end with an exhauster *h*. The exhauster may be of any ordinary construction adapted to the work to be performed,—the varieties of exhauster which I prefer to use being a steam-jet exhauster, when steam above the pressure of the atmosphere can be conveniently obtained to supply it,—or a water-jet exhauster supplied by water under pressure. In the construction shown in the drawings the pipe *f* is connected with the heater at a suitable place above the point where the water of condensation collects. *g* is an automatic valve placed upon the air pipe *f*, for preventing the steam or other heating agent from being drawn through the pipe *f* after the air has been exhausted from the heater. This valve *g* is constructed in such a way that it closes when the heating agent is brought into contact with it, but opens when any quantity of air collects near it, and thus reduces the temperature of that part of the heater. *i* is an ordinary valve placed in the supply pipe *b*, to enable the supply of the heating agent to be entirely cut off when desired.

My improved method is carried out in the employment of the apparatus just described and shown in Fig. 1 of the drawings as follows: I will suppose that the heating agent employed is to be steam. The steam is taken from any source of supply and may be under any degree of pressure, either above atmospheric pressure, or just equal to atmospheric pressure, or below atmospheric pressure. The valve *i* is opened so as to permit the steam to pass through the supply pipe *b* and through the restricted opening *c* in that pipe. The exhauster *h* is put into operation preferably at or about the same time, and the air is exhausted from the radiator *a* and the supply pipe *b* and its extension *d*, through the air pipe *f*. Before the operation is begun, the lower end of the pipe *d* is sealed in the tank *e*, by placing water in the tank *e* to a height sufficient to seal the lower end of the pipe *d*, or by using an ordinary check valve. By reason of the exhausting of the air from the radiator and its pipes, the steam is very quickly introduced into the radiator *a*, and the radiator is in this way brought into almost immediate operation in heating the surrounding atmosphere. As soon as the steam reaches the automatic valve *g*, that valve is closed by the action of the heat given off by the steam at that point. The system is now full of steam. This steam will be under a pressure just equal to or less than atmospheric pressure, by reason of the fact that the steam has had to pass through the restricted opening *c* of the supply pipe and into a space, to wit, the pipes of the heater from which air has been exhausted and in which the pressure has therefore been reduced. As the radiator gives off its heat the steam in such radiator will be condensed, tending in this way to reduce the pressure in the radiator. As a result of this condensation and consequent reduction of pressure, more steam will flow into the radiator through the restricted opening *c* in the supply pipe, and in this way the supply of steam in the radiator will be maintained; but, by reason of the restricted opening in the supply pipe, the steam in the radiator will, under ordinary conditions, be kept at a pressure equal to or less than atmospheric pressure, and will therefore be expanded into greater volume and a smaller amount of steam will fill the radiator and will accomplish the work of heating the same. As the steam is condensed in the radiator, the water of condensation flows back through the vertical part of the supply pipe *b* and its extension *d*, down into the tank *e*, where it is collected.

The operation above described is made possible by the fact that the escape or return pipe for the water of condensation is sealed at its lower end. The effect of sealing this pipe is to prevent the pressure of the steam in the system from being in any way affected or modified by any pressure which might otherwise be admitted into the system by the return pipe.

In a heating system it is generally known beforehand what pressure the steam will be under in the boiler, or other source of supply from which the steam is taken. This being known, and the extent of surface in the heating system which has to be heated being also known, the restricted opening *c* can be made of such a size as under the conditions named to permit the entrance of only such an amount of steam as will keep the steam within the system at atmospheric pressure or a pressure less than atmospheric pressure.

As already stated, in place of the restricted opening *c* of the form shown in Fig. 1, a reducing valve could be put in its place, which would also operate in the manner already explained to keep the steam in the system at the desired pressure.

It is necessary in carrying out my improved method by the apparatus just described, to keep the system substantially exhausted of air. This is accomplished by bringing the exhauster *h* into operation, whenever air collects in the radiator or at any point or points of the system.

Referring to Fig. 2, a', a^2 and a^3 are radiators or heaters made of any suitable construction, and the number of which may be varied as desired. *b* is the supply pipe for the admission of steam. *c* is a reducing valve placed in the supply pipe, constructed in such a way that the pressure on the heating system side of it can be kept at a pressure just equal to atmospheric pressure, or at a pressure below that point, irrespective of the variations of the pressure of the steam upon the other side of it in the source of supply. The radiators shown in this figure are all constructed in accordance with the double pipe system, that is to say, the steam is admitted to each radiator through the branch of the supply pipe *b*, and the water of condensation is permitted to escape from each radiator through a separate return pipe. d' is the return pipe for the water of condensation leading from the radiator a' to the tank *e*, or to a common pipe d^4 which connects the return pipes from the different radiators and which itself runs into the tank *e*. d^2 is the return pipe for the water of condensation leading from the radiator a^2 and connecting with the common pipe d^4 that extends into the tank *e*. d^3 is the return pipe that leads from the radiator a^3 into the common pipe d^4 that runs into the tank *e*. Each of the return pipes d', d^2, d^3 is provided with a check valve near its lower end, just above where it connects with the pipe d^4. These check valves serve to permit of the escape of the water of condensation through the return pipe d^4, but to prevent the return in the contrary direction of any steam or air into such return pipes. *f* is the air pipe which is provided with several branches leading to each radiator and one branch leading to the top of the tank *e*. The air pipe is connected at one end to the exhauster *h*. This air pipe is also provided with automatic valves *g* at the points where it is connected with the radiators and with tank, for the purpose of preventing the exhaustion of steam from the radiators and tank into the air pipe, as already explained in connection with Fig. 1. *p* is a pipe running from the lower end of the supply pipe *b* down to the common pipe d^4 for permitting the escape of such water of condensation as may flow down the supply pipe *b*. This pipe *p* is also provided at its lower end with a check valve for the purpose already described. The tank *e* is provided with two valves or pet-cocks *t*, *l*, one at the top of the tank to admit the air when it is desired to draw off the water of condensation, and one at the bottom of said tank to permit the escape of the water of condensation. Any other suitable means may be employed for this purpose. r', r^2 and r^3 are reducing valves placed in the short branches of the supply pipe *b*, which lead to the radiators a', a^2, and a^3 respectively. These valves r', r^2, and r^3 are reducing valves similar in character to the valve *c* and tend to supplement the action of the valve *c*. They also enable the three radiators to be operated under different pressures, that is to say, the valve r' may be so regulated as to keep the steam in the radiator a' at atmospheric pressure, the valve r^2 may be so regulated as to keep the steam in the radiator a^2 under a pressure of three pounds below the atmosphere at the same time, and the valve r^3 may be so regulated as to keep the steam in the radiator a^3 under a pressure of six pounds below the atmosphere at the same time. In this way the three radiators may be operated under different pressures, the result of which would be that the three radiators would tend to heat the rooms in which they were placed, respectively, to different degrees.

My improved method is carried out by the apparatus shown in Fig. 2 in substantially the same manner as already explained in connection with the other figure, with the exception that in addition to regulating the pressure of the steam in the system by means of the reducing valve *c*, the pressure in each radiator can be separately regulated below that point by its own reducing valve.

It is obvious that the supplemental reducing valves r', r^2 and r^3 might be omitted, and the pressure in the system controlled simply by the reducing valve *c*.

Although the different forms and arrangements of apparatus above described are eminently suitable for use in the employment of my improved method, it must be understood that I do not limit myself thereto, as it will be apparent to those skilled in the art that such apparatus may be differently constituted and arranged by the mere exercise of an engineer's judgment while not departing from the essential principle or sacrificing the advantages of the invention.

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

1. The method of heating which consists in supplying steam in measured quantities at or below atmospheric pressure and causing the flow of said steam to the place of use by reducing the pressure thereat.

2. The method of heating which consists in supplying steam in measured quantities at or below atmospheric pressure, and causing the flow of said steam to the place of use by exhausting the air therefrom, and causing the steam to condense thereat and conducting away the water of condensation, substantially as before set forth.

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