(No Model.) 2 Sheets—Sheet 1.

A. G. PAUL.

HEATING SYSTEM,

No. 526,733. Patented Oct. 2, 1894.

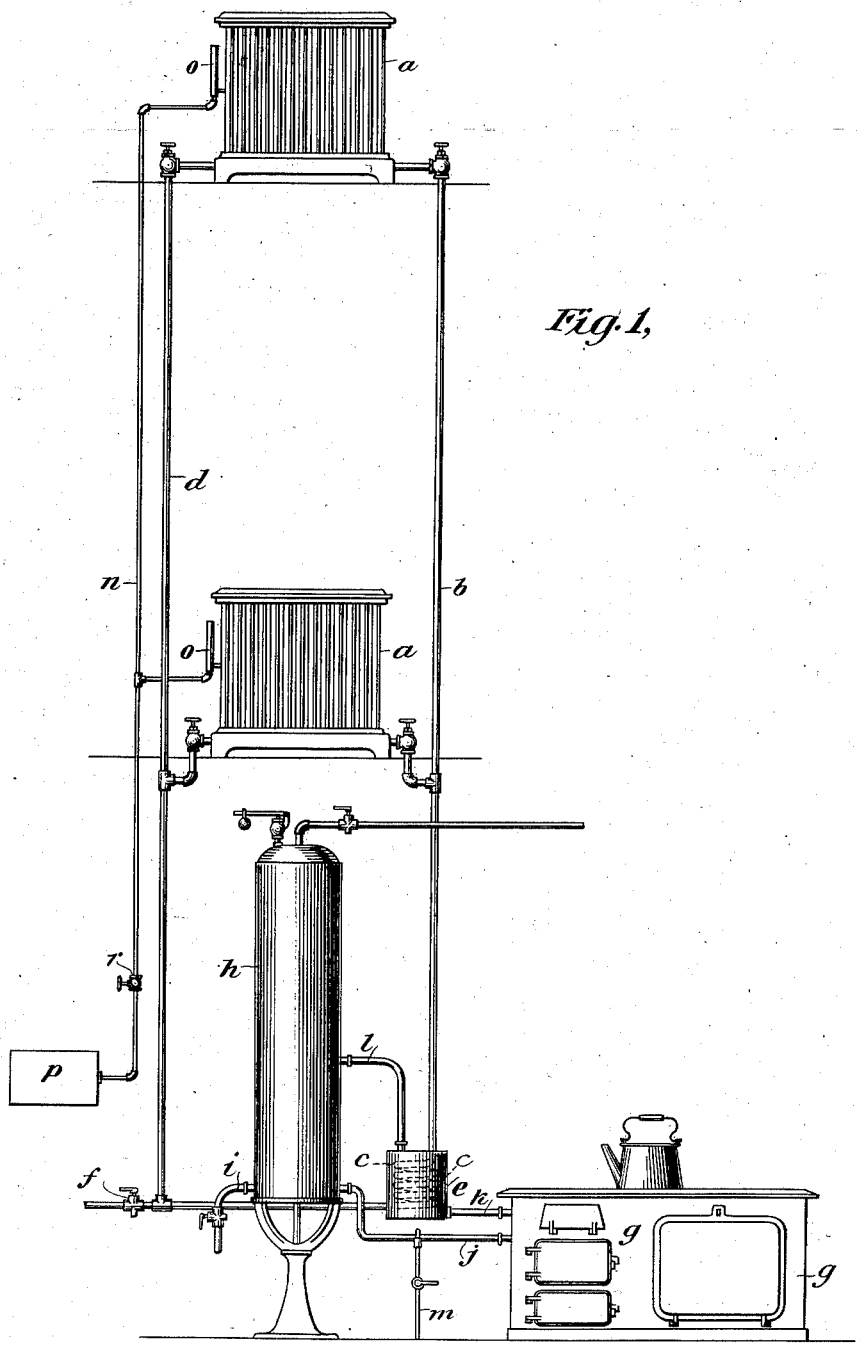

Fig. 1.

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(No Model.) 2 Sheets—Sheet 2.

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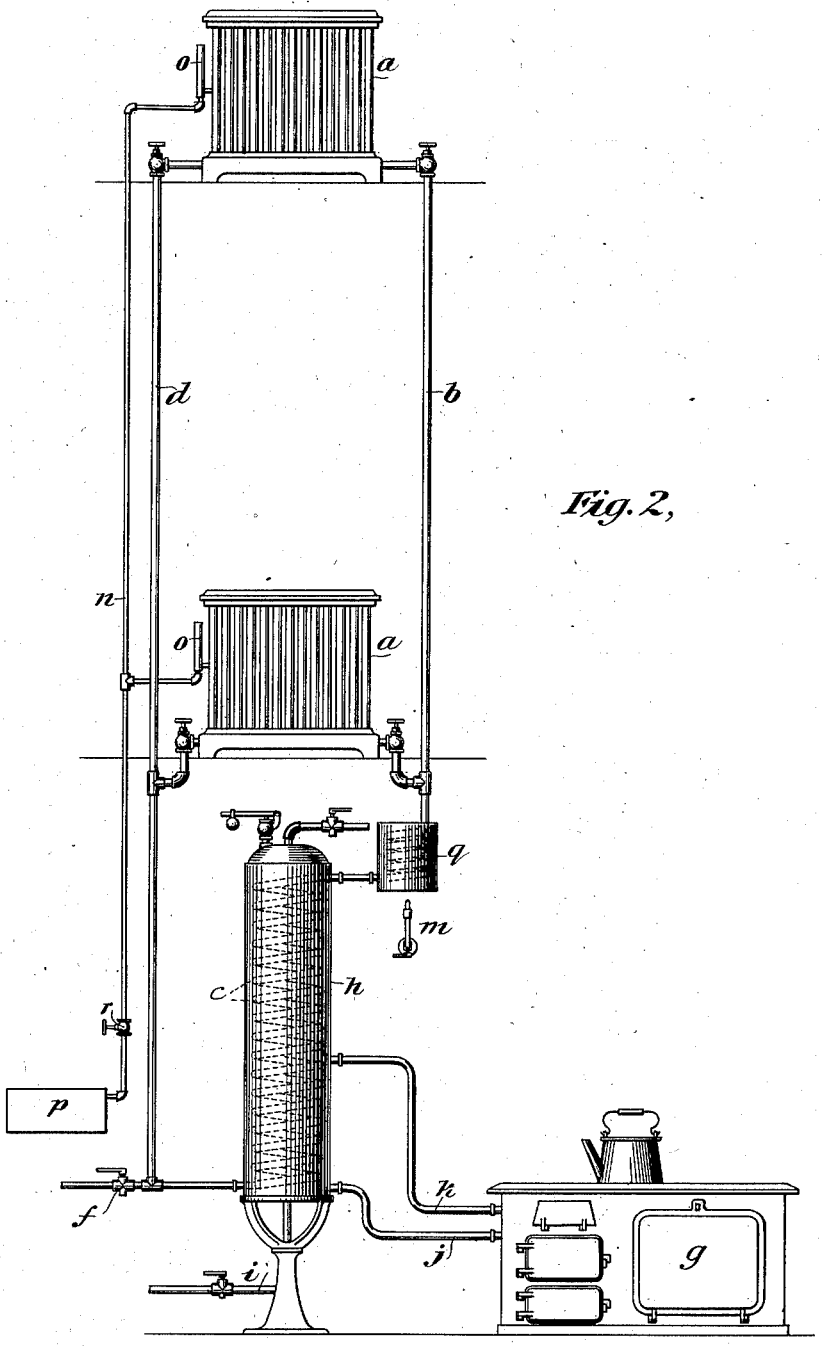

Fig. 2,

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UNITED STATES PATENT OFFICE.

ANDREW G. PAUL, OF BOSTON, MASSACHUSETTS.

HEATING SYSTEM.

SPECIFICATION forming part of Letters Patent No. 526,733, dated October 2, 1894.

Application filed December 7, 1891. Serial No. 414,222. (No model.)

To all whom it may concern:

Be it known that I, ANDREW G. PAUL, a citizen of the United States, and a resident of Boston, in the county of Suffolk and State of Massachusetts, 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 hereof.

My invention is in the nature of an improvement upon the invention of William P. Skiffington, described and claimed by him in his patent, No. 464,946, granted December 18, 1891.

My invention consists broadly in the combination of a source of heat, a circulatory system including radiators and the necessary connections, an intervening heating medium between the source of heat and the system of such a nature that it cannot be heated above a limited degree, and a positive air exhauster connected with the system.

It also consists in combining with the other elements specified a circulatory system containing a limited quantity of the heating vehicle.

One form or embodiment of my invention is shown in Figure 1 of the accompanying drawings. A second form or embodiment of it is shown in Fig. 2.

Similar letters of reference refer to similar parts in the two figures.

Referring to Fig. 1, *a* is a radiator or heater of any ordinary or usual construction. Two radiators are shown in the drawings, but any number of radiators may be employed, according to the size of the building or place to be heated.

b is the supply pipe, connecting the radiators with the coil or boiler *c*, where the steam or other heating vapor is generated. This pipe *b* has branches, one for each radiator, and these branches are provided with suit able cocks or valves.

d is the return pipe for the condensed heating vehicle. This pipe is also provided with branches, one for each radiator, and these branches are provided with suitable valves or cocks.

c is a generating coil or boiler in which the condensed heating vehicle is again turned into vapor.

The return pipe *d* of the system is preferably connected with the lower end of the coil *c* and the supply pipe *b* is preferably connected with the upper end of the coil *c*. The coil *c* is arranged or supported within the vessel or tank *e*, in such a manner as to cause the heated water which passes through the tank *e* to come into contact with and heat the coil *c*. The pipe *d* is provided with a valve *f* by means of which more of the heating vehicle can be introduced into the system at any time, or the heating vehicle can be entirely withdrawn, if desirable for any purpose.

g represents the ordinary kitchen range.

h is a hot water boiler.

i is a water supply pipe leading from any suitable source of supply to the boiler, for supplying the boiler with water.

j is a pipe leading from the bottom of the boiler to the range, through which the cold water passes from the boiler to the range to be heated in the ordinary way, and *k* is the return water pipe leading from the range. This pipe *k* is connected with the lower end of the tank *e*, so as to deliver the warm water from the range into the lower end of the tank.

l is a pipe connecting the upper end of the tank *e* with the boiler *h*. The boiler *h* is provided with the usual safety valve and the outlet pipe at the top.

m represents a gas jet underneath the tank *e* by means of which also the tank can be heated, if desired.

The parts *g*, *h*, *i* and *j* are in no respect different from the well-known arrangement of ranges and boilers.

n is an air pipe having branches connected with each radiator. These branches are provided with suitable valves or cocks *o*, preferably automatic valves designed to permit the escape of air, but to prevent the escape of steam.

p is an exhauster of any suitable construction, preferably an exhauster operated by a jet of water, air or steam, what is commonly termed an ejector.

r represents a valve in the air pipe for controlling the operation of the exhauster. This

valve is of the well-known construction and acts to turn on the water or steam that works the exhauster whenever the pressure in the air pipe *n* between this valve *r* and the automatic valves *o* rises above some pre-determined point.

Having described my improved apparatus, I will now explain the operation of the same.

I will suppose that the heating agent to be employed is steam. I introduce into the generating coil or boiler *c* the proper quantity of water. This quantity is to be regulated in accordance with the size or cubic contents of the system through which steam is to be circulated, and in accordance also with the degree or amount of heat to be employed in heating the heating vehicle and also in accordance with the pressure or temperature which is desired in the heating system. Such a quantity of water must be employed as will produce when evaporated a sufficient quantity of steam to fill the system and to convey the necessary amount of heat or heat units to accomplish the work for which the system is designed. A somewhat greater quantity of water is usually employed in the system than would be necessary to furnish the requisite amount of steam at the required temperature and pressure if all the water were evaporated, for the reason that the water will ordinarily not all be turned into steam at any one time, but in the usual operation of the system there will be some of the heating vehicle in condensed form or in the form of water during the entire operation. It is necessary of course to avoid putting into the system too large a quantity of water, because if this were done, the pressure in the system might become so great as to cause danger of explosion and by reason of the excessive amount of the heating vehicle more heat would be absorbed and conveyed than was necessary and consequently there would be a great waste of heat which would also result in inconvenience or discomfort to the user of the system. Air is then exhausted from the system by means of the air pipe *n* and the positive exhauster *p*, the valve *o* operating to permit the escape of air from said system, and the water in the coil *c* is heated.

In my invention the heat is conveyed or imparted to the heating vehicle indirectly, that is to say, through and by means of an intervening medium, such as water for example, which is such that it cannot impart to the heating vehicle in the heating system more than a certain degree or amount of heat. The heat which is imparted to the heating vehicle in the system is thus limited no matter how much heat may be employed or supplied in the original source of heat. In the form of my invention shown in Fig. 1, this heating of the water in the coil *c* is accomplished by utilizing the current of warm water which constantly flows from the range *g* to the boiler *h*, through the pipe *k*, the tank *e* and the pipe *l*. This current of water is in ordinary cases at a temperature of about 212° Fahrenheit, and under a pressure about equal to atmospheric pressure. This current of water flows through the tank *e* and passes around the coil *c* in that tank and delivers up a part of its heat to the coil *c* and the water contained in the coil. The exhaustion of air from the system causes the pressure upon the water in the coil *c* to be reduced to a point below atmospheric pressure. By reason of this reduced pressure the water in the coil *c* will boil at a temperature less than 212° Fahrenheit, the particular temperature at which it will boil depending upon the extent to which the pressure has been reduced in the system. Under these conditions the heat which is contained in the current of warm water passing through the tank *e* will be sufficient to cause the water in the coil *c* to boil. The water in the coil *c* will thus be evaporated or turned into steam and the system will be filled with steam at a pressure less than atmospheric pressure and at a temperature less than 212° Fahrenheit. As soon as the system is filled with steam, the automatic valves of the branches of the air pipes close, thus preventing loss of steam through the air pipe. The system is now supplied with steam. As the steam gives off its heat in the system the steam is condensed and the water of condensation flows from the radiators through the return pipe back to the generating coil or boiler *c*, where it is again supplied with heat from the warm water in the tank *e*, and again turned into steam and circulated through the system. The circulation of the steam is of course effected by means of the condensation of the steam in the radiators. As the steam condenses in the radiators more steam flows into them and thus the circulation is made continuous.

The arrangement of the boiler *h* and range *g*, with their connecting pipes, which is shown in the drawing and which I employ in my invention is the ordinary arrangement of such devices. In such ordinary arrangement or construction the water in the boiler *h* and the connecting pipes is not generally under a pressure greater than five pounds above the atmosphere. Under this pressure the water cannot be heated above 228° Fahrenheit and it is generally not heated above 212°. This is true no matter how much heat is employed or generated in the range. The heating vehicle in the heating system will always be at a somewhat lower temperature than the current of water by which it is heated. Hence it follows that in the case supposed the heating vehicle in the heating system cannot be heated above or in fact quite up to 228° Fahrenheit, and will ordinarily be somewhat below 212°. In this way the amount of heat which is imparted to the heating vehicle is limited, and prevented from rising to such a point as to

endanger the system, or cause waste of heat or discomfort.

By increasing the pressure on the water in the boiler *h* and connecting pipes, that water can be made to take up and to impart to the heating vehicle in the heating system a higher degree of heat, and by decreasing the pressure upon it the amount or degree of heat imparted to the heating vehicle in the system can be decreased. Such devices are purposely constructed in such a way as to prevent as far as possible the generation or accumulation of steam in the boiler *h*. In my invention therefore an intervening heating medium is employed such as will furnish only a moderate or limited degree of heat to the water in the heating system. As a result of this, while sufficient heat is imparted to the water in the system to convert it into steam, there is no danger of increasing the pressure of the steam to such a point as to endanger the safety of the apparatus.

When it is determined at what temperature it is desired to circulate the heating vehicle in any given system, then by estimating the cubic contents of the system, and by putting into the system a limited quantity of heating vehicle and subjecting it to a limited degree of heat in the manner already explained, the desired result can be obtained with perfect safety. The amount of heat furnished in the system can thus be adapted to the requirements of those using it without waste, and with great economy and safety.

One feature of my invention is that but little heat is wasted, almost the entire number of heat units imparted to the heating vehicle being utilized in the actual work of heating which the system performs. In ordinary methods of heating a much larger quantity of heating vehicle is employed than is necessary to convey the number of heat units that are required to do the work of the system, and a much larger number of heat units are constantly imparted to the heating vehicle than are actually used in the work of heating, the extra or superfluous number of heat units being simply wasted. Oftentimes this extra heat causes the building or place to be overheated to the great discomfort and inconvenience of those using the system.

In my invention I use as nearly as possible the exact amount of heating vehicle which is necessary to carry or convey the required number of heat units, and as a result of this almost all the heat units which I impart to the heating vehicle are given off by the heating vehicle in the system and are utilized in the proper working of the system.

As there will be some slight waste of the heating vehicle or steam from time to time, I occasionally add a small quantity of the heating agent to that already in the system through and by means of the valve *f*. In place of using the current of warm water passing from the range to the boiler to heat the coil *c*, I can fill the tank *c* with water in any way and heat this water by means of a gas jet, such as represented at *m*. This can be done for example in a house where there is no boiler or when the boiler and range are not in use. In such a case if the tank is left open to the atmosphere, the water in the tank can be heated only to 212° Fahrenheit, and the heating vehicle in the system to a point somewhat below that. But by inclosing the tank *e* and regulating the pressure upon the water in it as by a safety or regulating pressure valve, the water can be heated to a higher point or degree, if desired, and the temperature in the heating system correspondingly increased. If where the range and boiler are used as described, it be found that for any reason the current of warm water passing through the tank *e* is not heated sufficiently or to its full capacity in the range or heater the gas jet *m* can be used for the purpose of securing such additional heat as may be required.

In Fig. 2 I have shown a second form or modification of my improved apparatus. The only difference between this and the apparatus shown in Fig. 1 being that the coil *c* is enlarged and is placed directly in the boiler *h*, and a second coil *q* is placed in the tank *e*. This arrangement of apparatus, of course provides larger heating surface for the heating of water or other heating vehicle in the system, but in other respects the apparatus in its construction and operation is identical with that shown in Fig. 1.

It is apparent that the particular construction or form of the apparatus may be greatly varied.

Some of the advantages of my invention may be secured by employing only so much of my invention as relates to the employment of an intervening heating medium which operates to limit the amount or degree of heat imparted to the heating vehicle in the system, and to the exhaustion of air and the sealing of the system, without employing that part of my complete invention which relates to the limitation of the amount of heating vehicle used in the system, that is to say, some of the advantages of my invention will be secured if an unlimited amount of heating vehicle be employed, but the other parts of my invention be carried out.

My invention may be employed also in a single pipe heating system, that is one in which the steam or heating vehicle is supplied to the heaters or radiators and the water of condensation is returned through one and the same pipe. I have not shown my invention embodied in a single pipe system as the construction of a single pipe system is well known.

It is obvious also that in my invention the heating vehicle can be circulated in the system at a pressure above atmospheric pressure, if desired, by employing an intervening heat-

ing medium that can be heated to a point above 212° Fahrenheit, and by increasing the quantity of heating vehicle in the system.

The advantages of my improved system will be readily understood from what has already been said. Great economy results from the use of my invention. Thus an ordinary dwelling house may be entirely heated by steam without requiring the use of much more fuel than would be used ordinarily even were my apparatus not employed, that is to say, by utilizing the current of warm water which passes from the range to the boiler for imparting heat to the heating vehicle the entire heating system can be carried on without making it necessary to employ in the range much more fuel than would be ordinarily employed to keep the water in the hot water boiler at the required temperature. This is due partly to the fact that in ordinary cases a good deal of the heat which is imparted to the water in the hot water boiler is wasted or lost either by radiation from the boiler or by radiation from other parts of the hot water system, and a considerable part of the heat which is used for producing the steam in the heating system in my invention would be wasted or lost anyway if it were not utilized in this manner. Moreover, since the water which circulates between the boiler and range will not absorb or take up from the fire in the range more than a limited quantity of heat, it follows that in the ordinary arrangement of boiler and range, a large quantity of the heat produced in the range is not absorbed by the water but passes up the chimney. When my invention is used in connection with such boiler and range, whatever amount of heat is imparted to the heating vehicle in the heating system from the water, an equal amount is again absorbed by the water when it flows back to the range and thus a portion of the heat generated in the range is utilized which if my invention were not employed would simply pass up the chimney and be wasted. To put it in another way, my entire heating system is carried on by utilizing a portion of what would otherwise be wasted heat from the range or the hot water in the hot water system. The result so far as economy is concerned is that the expense of operating my improved system is very little over and above the expense of operating the range and the hot water boiler and their connections. Moreover, my invention makes it possible for a steam heating system to be used in any dwelling house where a range and hot water boiler are used, at very trifling additional expense and without any danger of explosion and without the necessity of employing an engineer.

Another feature of my improvement is its simplicity both as to construction and operation. The safety of the apparatus is also a great advantage. Where a boiler is employed there is always more or less danger of explosion. With my invention such danger is entirely done away with, as the quantity of heating vehicle is limited in the first place and the amount of heat that can be imparted to it is limited in the second place.

The pressure under which the system is operated and the temperature of the steam during its circulation will of course depend upon the quantity of water which is originally put into the system, and secondly, upon the quantity of heat which is imparted to this water. If a low pressure and temperature is desired in the system the quantity of water is reduced, or a smaller amount of heat is imparted to it, or both the quantity of water and the heat are reduced. In place of using the hot water from the range or boiler for imparting heat to the heating vehicle any other suitable heating medium may be employed that will absorb and convey only a limited degree of heat.

It is of course essential that the radiators and connecting pipes should be made air tight, or as nearly so as possible, so as to prevent or decrease to the lowest possible point the admission of air into it. Whenever during the operation of my apparatus air does collect in the same, the exhauster may be put into operation and the air drawn out in this way.

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

1. The combination substantially as before set forth of a source of heat, a steam circulatory system including radiators and the necessary connections, an intervening heating medium between the source of heat and the system, substantially as described, and a positive air exhauster connected with the system.

2. The combination substantially as before set forth, of a source of heat, a circulatory system including radiators and the necessary connections, and containing a limited quantity of the heating vehicle, an intervening heating medium between the source of heat and the system, substantially as described, and a positive air exhauster connected with the system.

3. The combination, substantially as before set forth, of the heaters, and supply and return pipe of a heating system, a boiler or generating coil, an intervening heating medium for conveying heat to the boiler or coil, substantially as described, a tank or suitable device to support said heating medium in contact with the boiler or coil, an air pipe, and an exhauster for exhausting air through said air pipe.

4. The combination with the heaters and supply and return pipe of a heating system, of a boiler or generating coil and an intervening heating medium for conveying heat to the boiler or coil, adapted to absorb and

convey only a limited amount of heat, and a tank or suitable device to support said heating medium in contact with the boiler or coil, and an air pipe and exhauster for exhausting air through said air pipe and a valve to control the passage of air through the air pipe, substantially as set forth.

5. The combination with the heaters and supply and return pipe of a heating system of the coil *c*, the tank *e* the boiler *h*, the range *g*, and the connecting pipes *j*, *k* and *l*, and the air pipe *n* provided with suitable valves and the exhauster *p* substantially as set forth.

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Witnesses:
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