(No Model.) 4 Sheets—Sheet 1.

A. G. PAUL.

STEAM HEATING SYSTEM.

No. 604,335. Patented May 17, 1898.

Fig. 1.

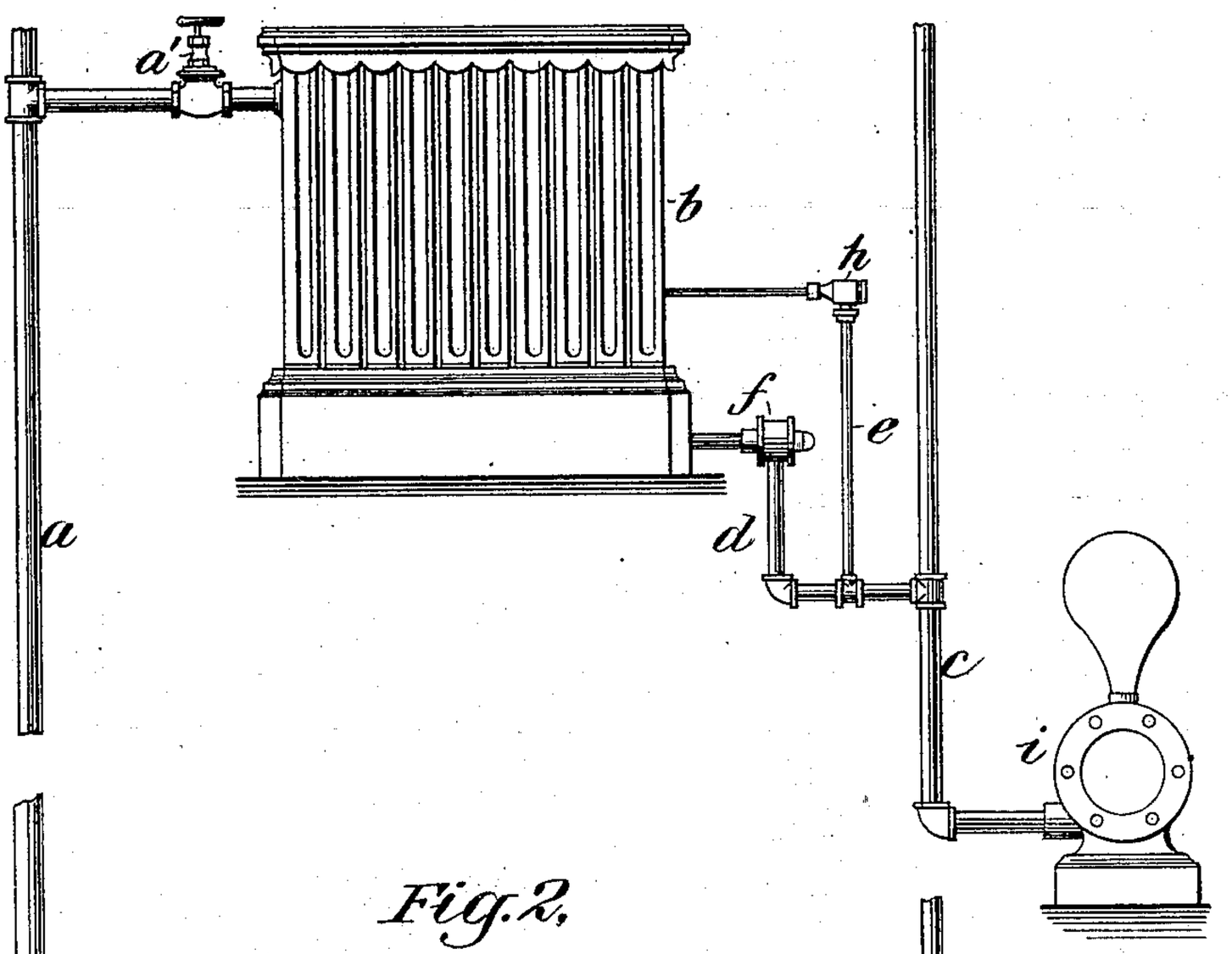
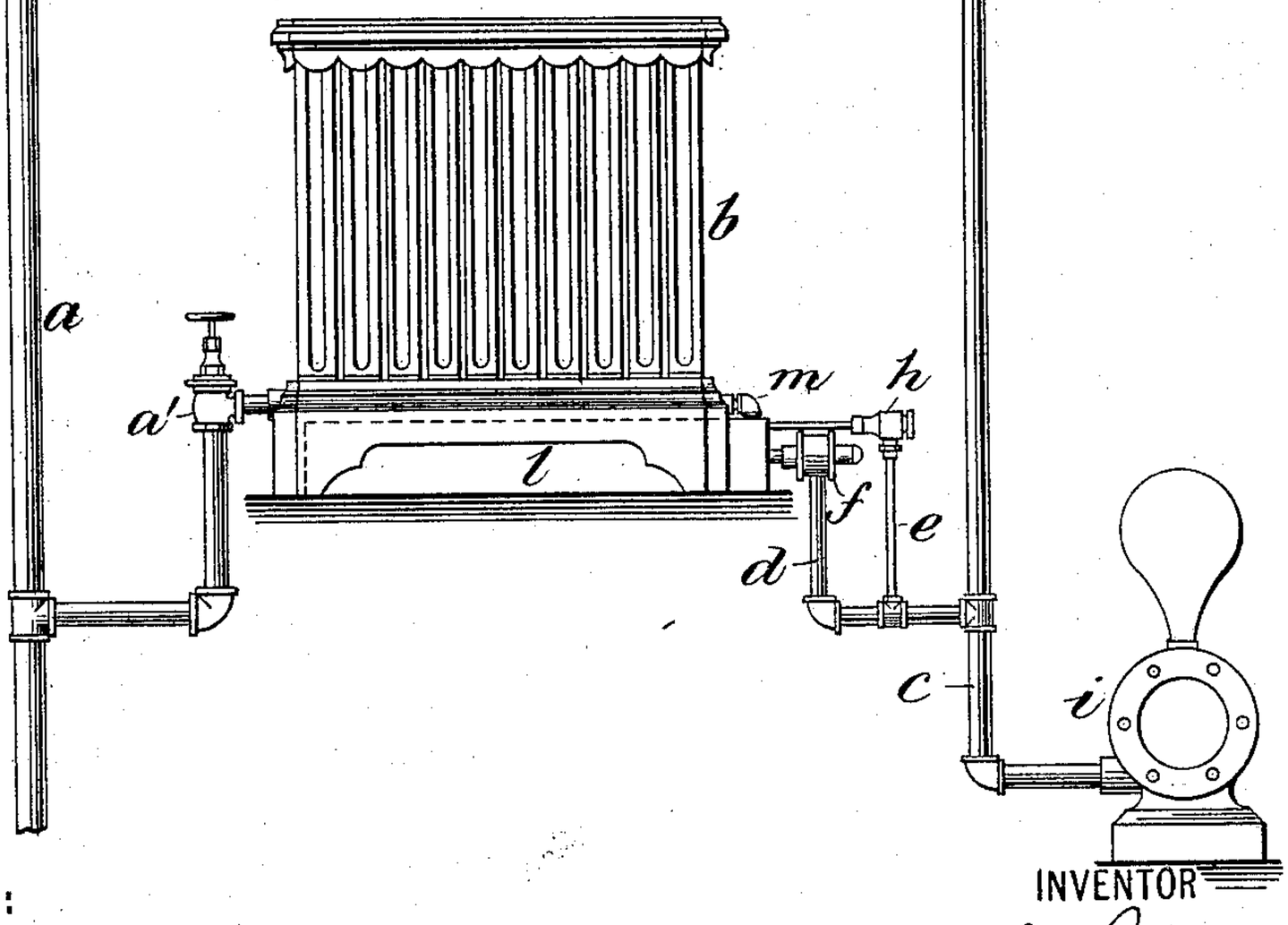


Fig. 2.



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(No Model.) 4 Sheets—Sheet 2.

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Fig. 3,

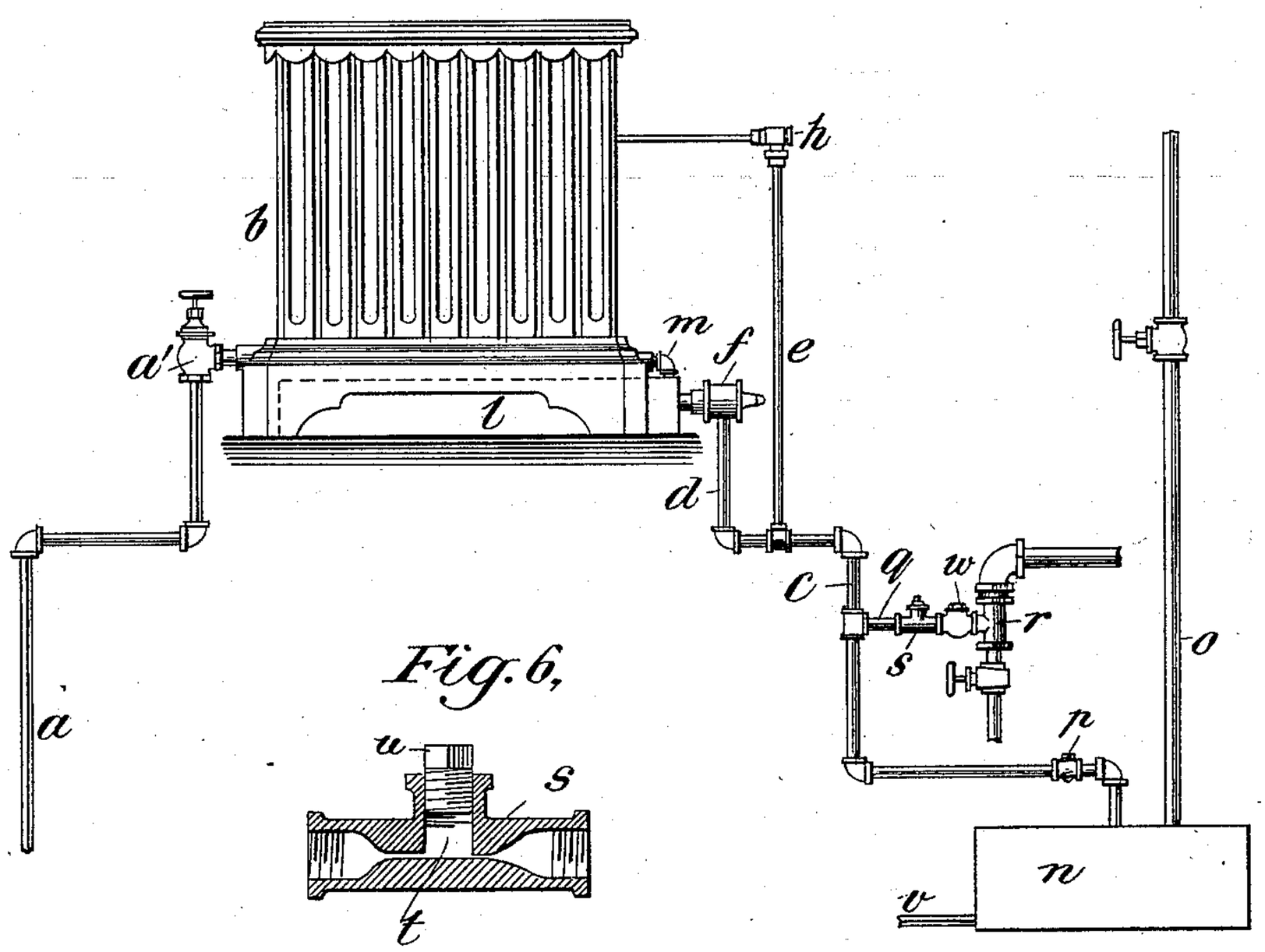
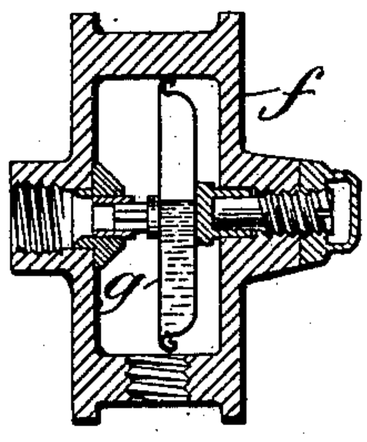


Fig. 6,

Fig. 5



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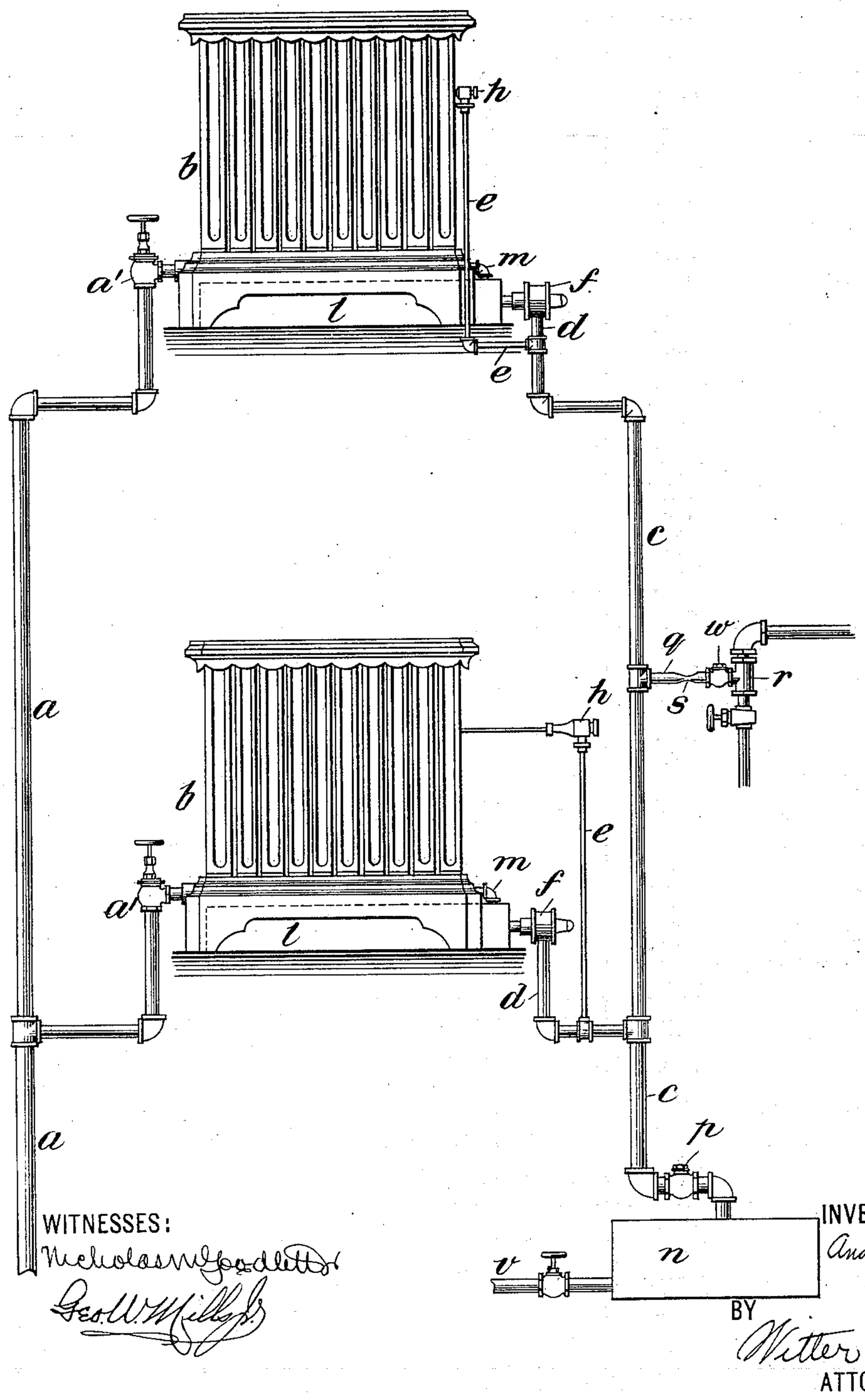
STEAM HEATING SYSTEM.

No. 604,335. Patented May 17, 1898.

Fig. 4.



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STEAM HEATING SYSTEM.

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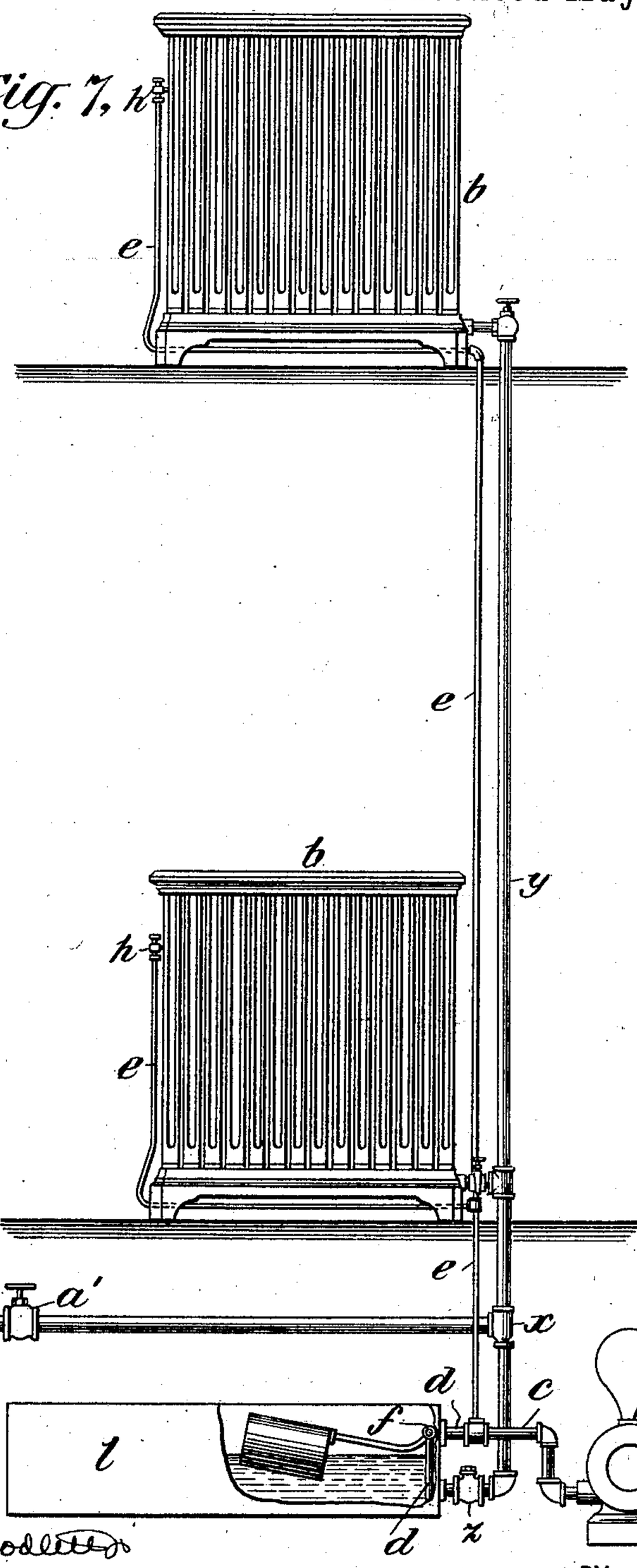
Fig. 7.



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UNITED STATES PATENT OFFICE.

ANDREW G. PAUL, OF BOSTON, MASSACHUSETTS.

STEAM-HEATING SYSTEM.

SPECIFICATION forming part of Letters Patent No. 604,335, dated May 17, 1898.

Application filed November 25, 1895. Serial No. 569,980. (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 Steam-Heating Systems, of which the following is a specification.

My invention relates to heating systems in which steam or some other similar heating vehicle is caused to flow to the radiators or heaters through a suitable system of pipes and to give off a portion of its heat, as a result of which the whole or a part of the heating vehicle is condensed in the radiator or heater.

The object of my invention is to improve the movement of the heating vehicle in the system and to remove the water of condensation therefrom, as well as the air and other gases that may collect therein, and to do this in an efficient, reliable, and economical manner.

My invention consists, first, in the combination, with a radiator or heater and the other necessary parts of a heating system, of a return or discharge pipe having two branches or passages, the first branch being connected with the lower part of the radiator or heater or with a tank or receptacle for the water of condensation below the heater, and said branch being provided with an automatic steam-trap, whereby the water of condensation is intermittently discharged without a substantial waste of the heating vehicle, and the second branch having one end connected with the discharge-pipe beyond the steam-trap and the other end connected with the heater or the discharge-pipe on the other or supply side of the steam-trap, whereby the air and other gases which collect in the heater are removed independently of the water of condensation.

My invention also consists in combining with the elements above recited an exhausting device connected with the discharge-pipe, whereby the discharge of the water, as well as of the air and gases, through the discharge-pipe is facilitated.

My invention also consists in the combination, with the elements above named, of an automatic valve in the upper branch of the discharge-pipe, whereby the air and gases are intermittently discharged from the heater through said branch without substantial waste of the heating vehicle.

My invention also consists in providing the discharge-pipe with a trap consisting of a valve device and combining with it a relief-pipe, the said relief-pipe being connected with the discharge-pipe at some suitable point above the valve device. My invention also contemplates the combination with such a relief-pipe of an exhauster.

My invention also consists in certain novel features of construction and combinations of parts hereinafter described and claimed.

The accompanying drawings fully illustrate my improved apparatus.

Figure 1 shows a radiator, the lower part of which is adapted to serve as a tank or receptacle for the water of condensation. Fig. 2 shows a radiator provided with a separate tank underneath. Fig. 3 shows a construction in which a relief-pipe and exhauster are employed. Fig. 4 shows an arrangement of two radiators. Fig. 5 is a sectional view of the expansion-trap. Fig. 6 is a sectional view of the restricted passage in the relief-pipe, and Fig. 7 shows a modified form of steam-trap and its combination with a number of radiators.

Similar letters indicate similar parts in the different figures.

In the drawings, *a* is the supply-pipe, which can be connected with any suitable source of supply and is provided with suitable valves *a' a'*.

b is an ordinary radiator or heater.

c is the return or discharge pipe. This pipe has two branches *d* and *e*, the former connecting it with the lower part of the heater, as shown in Fig. 1, or with a tank underneath the heater, as shown in Fig. 2, and the latter connecting it with the heater or tank at a higher point.

f is an automatic steam-trap consisting of a valve device. The form of this trap can be greatly varied. The form I prefer is shown in section in Fig. 5. It is what is commonly known as an "expansion-trap." As the particular construction of this trap is well understood and separately considered forms no part of my invention, I shall not describe it in detail further than to say that when the vessel *g* is exposed to a certain degree of

heat it will expand and close the valve, and when it is cooled again it will contract and open the valve. This vessel is ordinarily filled with some volatile liquid, such as ether, which when heated expands into gaseous form and extends the inclosing vessel. In place of an expansion-trap a float-valve trap can be used, such as is shown in Fig. 7.

h is an automatic air-valve of well-known construction, which opens to permit the passage of air and gases and closes to prevent the passage of the heating vehicle, this operation being due to the effect of heat and cold upon the said valve. This valve is placed in the branch pipe *e*.

i is an exhausting device of any suitable construction, which is connected with the discharge-pipe.

In the construction shown in Fig. 1 the lower part of the radiator is so shaped as to form a tank or receptacle for the water of condensation, and the branch *d* of the discharge-pipe is connected with the lower part of this tank, while the upper end of the branch *e* is connected near the top of the radiator. The exhausting mechanism *i* is an ordinary pump of any suitable construction and is connected with the end of the discharge-pipe. Only one radiator is shown; but other radiators could be similarly connected with the supply and discharge pipes.

In the construction shown in Fig. 2 a separate tank *l* for the water of condensation is placed under the radiator and is connected with the base of the radiator by the pipe *m*, through which the water of condensation flows from the radiator into the tank. A valve may be placed in the pipe *m*, if desired. The branch pipe *d* is connected with the lower part of the tank *l* and the branch pipe *e* with the upper part of the tank. The exhausting mechanism shown is the same as in Fig. 1 and is similarly connected. Any number of radiators may be used. The operation of the device shown in these two figures is as follows: The exhauster *i* is started and the valves in the supply-pipe opened. The air is caused to flow out quickly from the system through both the branch pipes *d* and *e*, and the steam or other similar heating vehicle flows in and fills the radiator. When the steam reaches the steam-trap *f*, the valve in the trap is closed by the heat imparted from the steam, and the escape or waste of any substantial quantity of steam at that point is prevented. When the steam reaches the automatic valve *h* in the branch pipe *e*, that valve is likewise closed, and the escape or waste of any substantial quantity of steam is prevented there also. As the steam is condensed in the radiator the water collects in the lower part thereof or in the separate tank *l* and comes in contact with the steam-trap. When the water cools sufficiently to cause the valve in the trap to open, some of the water will be discharged, and this discharge will continue until the trap is again closed by contact with steam or with hotter portions of the water of condensation. The trap can be regulated so as not to discharge water until the water has been substantially cooled or until it has fallen below a certain predetermined temperature. In this way the trap can be regulated so that only cool water will pass into the main return or discharge pipe. When any air collects in the radiator, the automatic valve *h* is cooled and thereby opened and the air escapes through the branch pipe *e* and the discharge-pipe *c*. When the steam again comes into contact with the valve *h*, it is closed, as before. The exhauster *i* operates to cause a flow through the discharge-pipe either of air or water of condensation, as the case may be, whenever the automatic valve *h* or the steam-trap *f* is open. Thus there is an intermittent discharge of air through the branch pipe *e* and an intermittent discharge of water through the branch pipe *d*. The radiator is kept substantially free from air and sufficiently free from water—that is to say, only a certain amount of water is permitted to collect therein. The air and water are removed through the said main discharge-pipe and by means of a single exhauster and without interfering in any way with each other.

As a result of employing an expansion-trap a special advantage is secured. The water is retained in the radiator until it has given up a much larger number of its heat units in effective work. This avoids the waste of heat which results where the water of condensation is allowed to run away in a hot state. Moreover, the lower the temperature of the water the easier it is to handle it.

Some of the advantages of my invention can be secured without employing an automatic valve on the branch pipe *e;* but in the best form of my invention such an automatic valve is used. Other forms of valve may also be used. For example, the form of valve shown in my earlier patent, No. 563,880, might be employed in some cases.

In Figs. 3 and 4 a modification of my improvement is shown. The return or discharge pipe *c* empties into a tank *n*, which is preferably open to the atmosphere through a pipe *o*, as shown in Fig. 3, although it may be a closed tank, as shown in Fig. 4, or may be connected with the relief-pipe. The pipe *c* is provided with a check-valve *p* above the tank to permit the discharge of the water of condensation, while preventing anything from flowing into the pipe *c* in the opposite direction. A relief-pipe *q* is connected with the discharge-pipe above the check-valve and preferably at a point above where the water of condensation ordinarily collects in that pipe. *r* is an exhauster of any suitable form, such as a steam-jet connected with the relief-pipe. The relief-pipe is provided with a restricted opening *s*, which may be formed in any suitable way, as by a restriction in the pipe itself, as shown in Fig. 4. My preferred form of restricted opening is, however, shown

in section in Fig. 6. It consists of a T-shaped section of pipe provided with a small opening or passage, as shown, and with a chamber *t* in the perpendicular member into which the restricted passage opens, and with a screw-plug *u* fitting and closing the outer end of said chamber. When a current from the discharge-pipe is flowing through this device, an eddy is created in the chamber *t*, which serves to retard the current and thus aids the operation of the restricted passage. A good example of such a restricted opening, so far as dimensions are concerned, would be one a thirty-second of an inch in diameter and half an inch in length. *v* is an outlet-pipe from the tank *n*, which is preferably connected with a pump for pumping the water to the boiler. It may be provided with a valve. The relief-pipe is also provided with a check-valve *w*, which permits the contents of the relief-pipe to escape outwardly, but prevents anything from entering that pipe in the opposite direction.

In Fig. 4 a system is shown having two radiators with a relief-pipe connected with the discharge-pipe between the radiators. The point of connection of the relief-pipe can be greatly varied. The operation of this form of my invention is the same as above explained, except that the water of condensation instead of passing through the relief-pipe and exhauster falls to the bottom of the discharge-pipe, and when a sufficient column has collected above the check-valve is partly or wholly discharged into the tank. The air is caused to flow, as before, through the branch pipe *e* and discharge-pipe *c* and then is discharged through the relief-pipe and exhauster. The water is discharged intermittently, as before, through the steam-trap *f* and branch pipe *d* and discharge-pipe *c*. The exhauster *r* tends to cause a flow from the discharge-pipe through the relief-pipe and thereby to reduce the pressure in the discharge-pipe. When the air-valve *h* opens, this reduced pressure causes the air or gases to flow from the radiator through the branch pipe *e* and to be discharged. When the trap *f* opens, this reduced pressure causes the water in like manner to flow through the branch pipe *d* and down to the bottom of the discharge-pipe. By reason of having the restricted opening in the relief-pipe no substantial quantity of water passes through the relief-pipe. The matter discharged through the steam-trap substantially increases the pressure in the discharge-pipe *c*, or, as it might be termed, substantially "breaks" the vacuum therein, and before the exhauster which by reason of the restricted opening in the relief-pipe is very limited in its effect, can again substantially decrease the pressure in the discharge-pipe, or, as it might be termed, substantially "restore" the vacuum therein, a large part of the water will have escaped from the bottom of the discharge-pipe. In this form of my invention a simpler and cheaper kind of exhauster can be used and the water and air are separated before being discharged, as a result of which the water can be returned to the boiler by gravity or any other suitable means free from air and gases.

In Fig. 7 another modification of my improvement is illustrated. In this case the supply-pipe and the pipe connecting the radiators with the tank *l* for the water of condensation unite at *x*, and from that point to the radiators there is but one common pipe *y*, which is at the same time a supply and return pipe. The discharge-pipe proper, *c*, has two branches *d* and *e*, as before. The branch *d* is connected with the tank *l* and is provided with an automatic steam-trap *f*, which consists of a suitable valve operated by a float in the well-known manner. The tank *l* may be open to the atmosphere. The branch pipe *d* preferably extends nearly to the bottom of the tank. The pipe connecting the tank *l* with the radiators is preferably provided with a check-valve Z. The branch pipe *e* is connected with each radiator by suitable branches. In other respects the apparatus is similar to that shown in the other figures. It will be apparent that the supply-pipe could be separately connected with the radiators, as in the other figures shown, instead of uniting with the return-pipe at *x*.

Many advantages are secured by my invention. The air and gases and the water of condensation are removed regularly and reliably, and the radiators are thus enabled to work at their full capacity and to work most efficiently and economically. There is no substantial waste of the heating vehicle. A single exhausting mechanism effects the discharge of both the water and the air. Their discharge is not dependent upon high pressure in the radiators or in the supply side, but is secured irrespective of the supply-pressure. These and other advantages make my invention a valuable improvement in the art.

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

1. The combination with a heating system, comprising a radiator or heater and a supply-pipe, of a discharge-pipe having a branch or passage connected with that part of the system where the water of condensation collects and an automatic steam-trap in said branch and a second branch or passage connected with the system on the supply side of the steam-trap above the point where the water of condensation ordinarily collects, and an exhausting device connected with the discharge-pipe whereby the water of condensation is intermittently discharged through the first branch and the air is discharged through the second branch, substantially as set forth.

2. The combination with a heating system, comprising a radiator or heater and a supply-pipe, of a discharge-pipe having a branch or passage connected with that part of the system where the water of condensation collects, and an automatic steam-trap in said branch

and a second branch or passage connected with the system on the supply side of the steam-trap above the point where the water of condensation ordinarily collects, and an automatic air-valve in said branch, and an exhausting device connected with the discharge-pipe, whereby the water of condensation is intermittently discharged through the first branch and the air is intermittently discharged through the second branch, substantially as set forth.

3. The combination with a heating system, comprising a radiator or heater and a supply-pipe, of a discharge-pipe having a branch connected with the lower part of the radiator or heater, an automatic steam-trap consisting of a valve device in said branch, and a second branch connected with the radiator or heater above the point where the water of condensation ordinarily collects, a trap consisting of a valve device in the discharge-pipe, a relief-pipe connected with the discharge-pipe, and an exhauster with which the relief-pipe is connected, substantially as set forth.

4. The combination with a heating system, comprising a radiator or heater and a supply-pipe, of a discharge-pipe having a branch connected with the lower part of the radiator or heater, an automatic steam-trap consisting of a valve device in said branch, and a second branch connected with the system on the supply side of the steam-trap above the point where the water of condensation ordinarily collects, an automatic air-valve in said branch, a trap consisting of a valve device in the discharge-pipe, a relief-pipe connected with the discharge-pipe and an exhauster with which the relief-pipe is connected, substantially as set forth.

5. The combination with a heating system, comprising a radiator or heater and a supply-pipe, of a discharge-pipe having a branch connected with the lower part of the radiator or heater, an automatic steam-trap consisting of a valve device in said branch, and a second branch connected with the system on the supply side of the steam-trap above the point where the water of condensation ordinarily collects, an automatic air-valve in said branch, a trap consisting of a valve device in the discharge-pipe, a relief-pipe connected with the discharge-pipe and provided with a restricted passage, and an exhauster with which the relief-pipe is connected, substantially as set forth.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

ANDREW G. PAUL.

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EDWIN SEGER.