(No Model.) 4 Sheets—Sheet 1.

T. J. SIMPSON.

HEATING BY COMPRESSED HOT OR SUPERHEATED AIR.

No. 381,589. Patented Apr. 24, 1888.

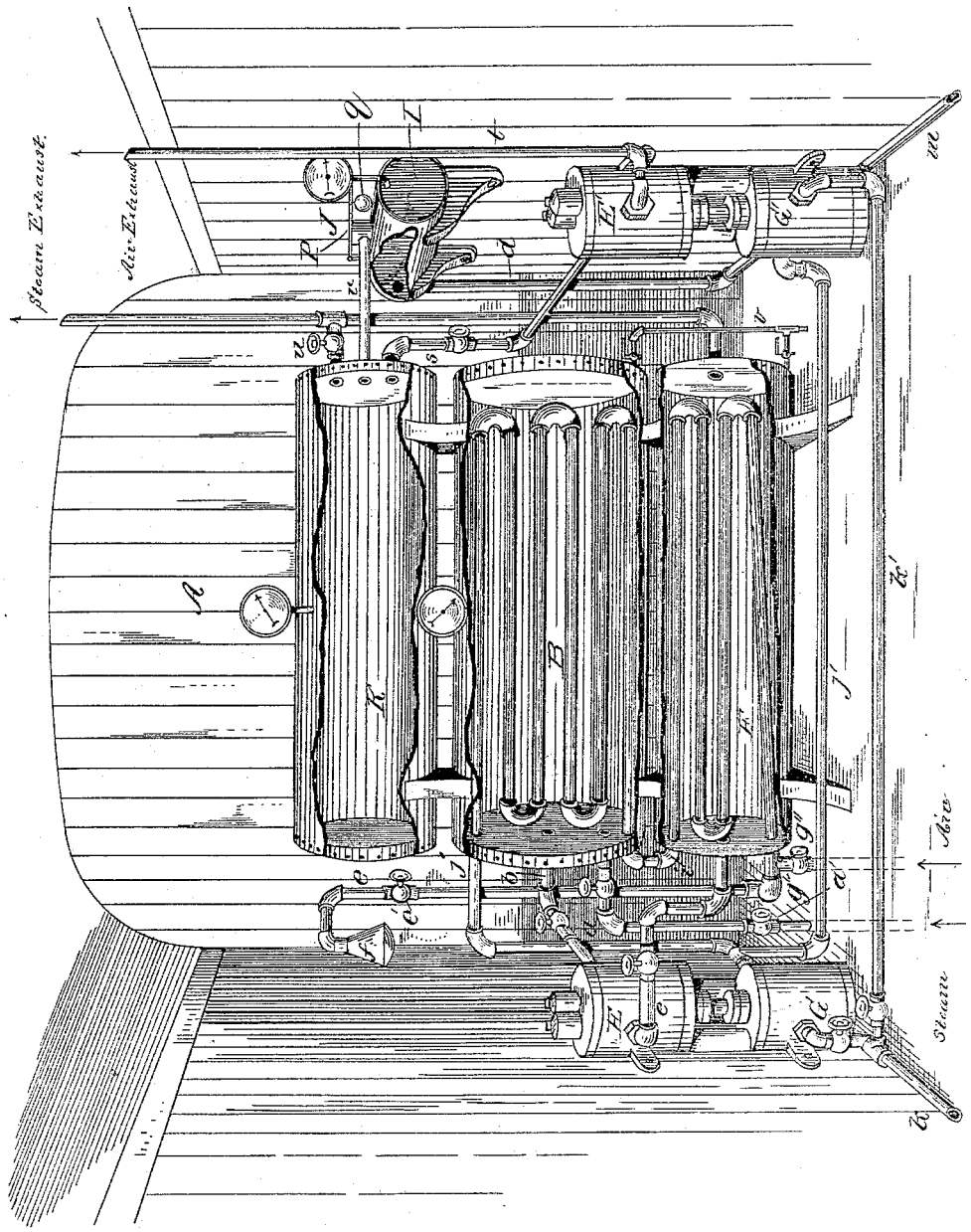

Fig. 1.

Witnesses.
Charles P. Lincoln.
Frank G. Mattingly.

Inventor.
Thomas J. Simpson.
By his Attorneys
Whittemore & Wright.

(No Model.) 4 Sheets—Sheet 2.

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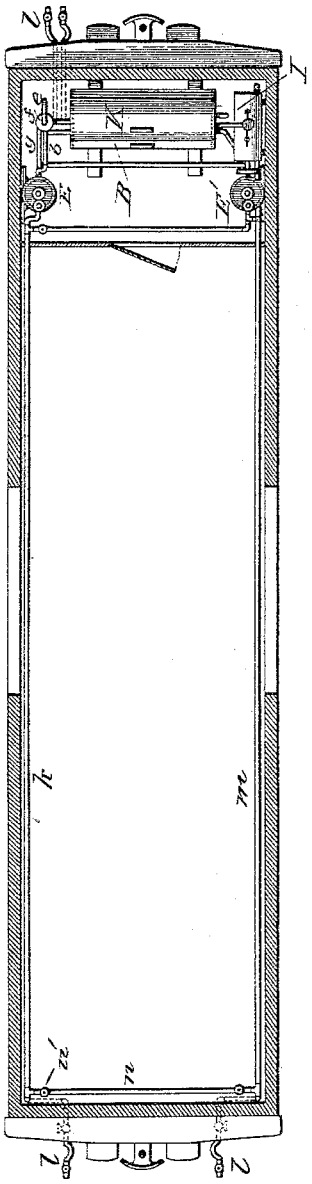

Fig. 2.

Witnesses.
Wm. Studer.
C. D. Tramard Jr.

Inventor.
Thomas J. Simpson.
By Iris Attorneys.
Whittlesey & Wright.

(No Model.) 4 Sheets—Sheet 3.

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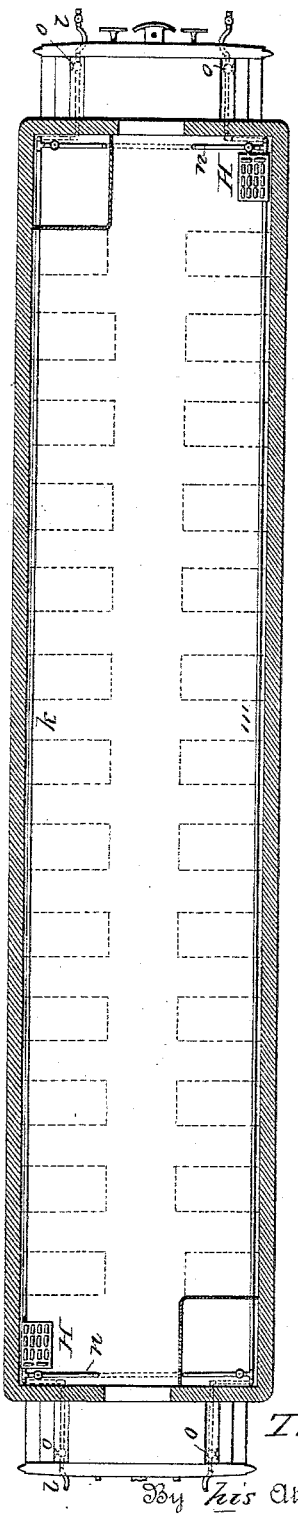

Fig. 3.

Witnesses
Wm. L. Sheldon,
W. S. Pramard Jr.

Inventor,
Thomas J. Simpson.
By his Attorneys.
Whittemore & Knight.

(No Model.) 4 Sheets—Sheet 4.

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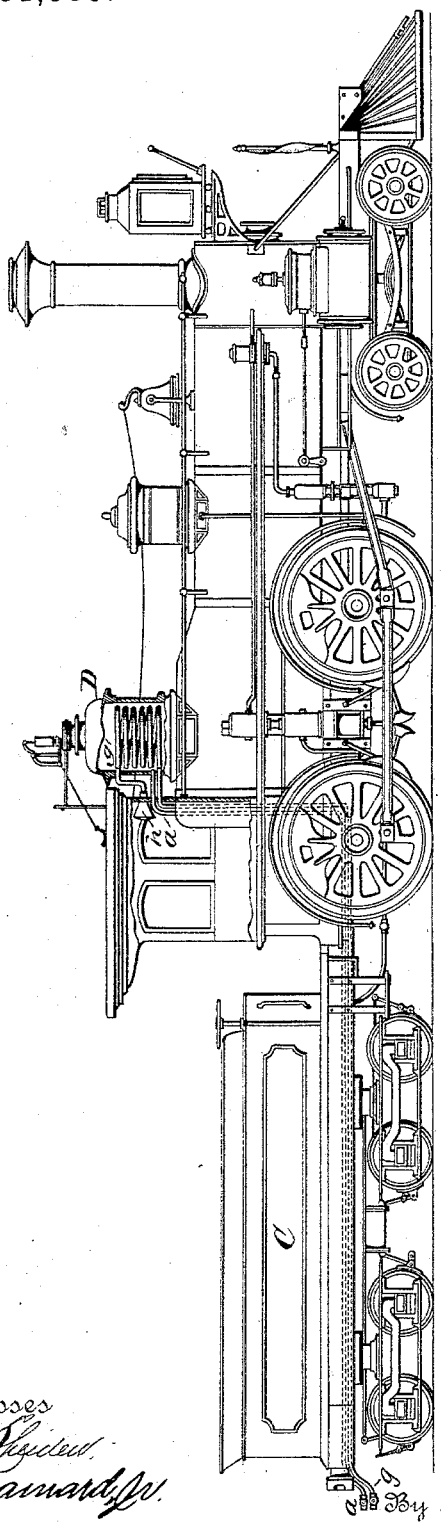

Fig. 4.

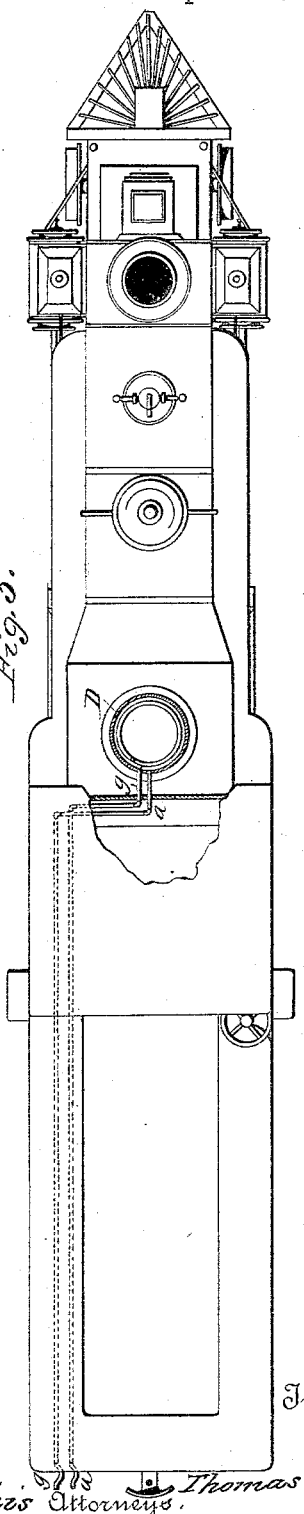

Fig. 5.

Witnesses
Wm. F. Shepherd.
Wm. Maynard, Jr.

Inventor,
Thomas J. Simpson.
By his Attorneys.
Whittemore & Wright.

UNITED STATES PATENT OFFICE.

THOMAS J. SIMPSON, OF WORTHINGTON, MINNESOTA.

HEATING BY COMPRESSED HOT OR SUPERHEATED AIR.

SPECIFICATION forming part of Letters Patent No. 381,589, dated April 24, 1888.

Application filed April 4, 1887. Serial No. 233,557. (No model.)

To all whom it may concern:

Be it known that I, THOMAS J. SIMPSON, a citizen of the United States, residing at Worthington, in the county of Nobles and State of Minnesota, have invented certain new and useful Improvements in Heating by Compressed Hot or Superheated Air; and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the letters and figures of reference marked thereon, which form a part of this specification.

This invention relates to an improved method of and apparatus for heating railway-cars, ships, dwelling-houses, hotels, hospitals, and, in short, all structures where heat is required by means of compressed hot or superheated air.

The nature of my invention will be best understood by first giving a general explanation of its mode of operation and then passing to a more detailed description of a specific arrangement of apparatus for carrying it into effect.

The system of heating which I employ is that of radiation, the compressed hot air serving merely to store up and carry the heat to suitable radiators, and not being itself admitted to the apartment or structure which is to be warmed. The air is heated in any desired manner, preferably by being drawn through coils of pipe exposed to the heat-imparting agent, which may be steam, either live or exhaust, confined in chambers through which the coils of air-pipe are carried. When the air has been sufficiently heated or superheated, it is then compressed by a suitable pump to any desired pressure, and thereby heated still further. It is then conducted through pipes to radiators, imparting its heat to said pipes and radiators, which in turn warm the air in the apartment in which they are placed. The air is kept moving under pressure, being pumped into the pipes until the pressure reaches a predetermined point, when it is admitted, preferably by means of an automatic valve, into a closed reservoir. As soon as the pressure in the reservoir becomes equal to that in the system of pipes, the steam-pump is stopped and disconnected, while an auxiliary pump is put in communication with the pipes. This second pump is driven by the accumulated air-pressure in the reservoir and serves to supply compressed hot air to the radiators until the pressure in the reservoir falls so low as to be unable to operate the pump, which is then supplanted by the steam-pump once more and the air-pressure is pumped up again. By thus utilizing the compressed hot or superheated air to operate a pump and keep the pressure from falling too rapidly I am able to save the steam which would otherwise be required to keep up the pressure.

From this statement of the manner in which my invention operates it will be seen that my invention consists, first, in a method of heating apartments by means of compressed hot air; second, a method of heating which consists in filling a system of pipes and radiators with hot air under pressure; third, a suitable apparatus for carrying this method into effect, and in certain combinations and arrangements of parts, hereinafter described, and particularly pointed out in the claims.

The accompanying drawings represent one form of the apparatus as applied to a railway-train.

Figure 1 is a perspective view of the air-heating chambers and the pumps arranged at one end of a car. Fig. 2 is a plan view of the car containing these appliances. Fig. 3 is a similar view of a passenger-car adapted to be warmed by the compressed hot air. Fig. 4 is a side elevation of a locomotive equipped with an air-heating coil, and Fig. 5 is a plan view of the same.

Similar letters refer to corresponding parts in all the views.

The steam for heating the air and actuating the compressing-pump is brought from the boiler of the locomotive through pipe *a* to the compartment at one end of the baggage-car A, where the apparatus is located. Valve *a'* controls the admission of steam through pipe *a* into the closed reservoir or live-steam chamber B, from which it emerges through pipe *b* and is conducted to the steam-cylinder E.

c is the exhaust-pipe, which conducts the steam from cylinder E to the closed reservoir

or exhaust-steam chamber F, from which it escapes through pipe *d*.

The steam-pump is of any suitable construction, though preferably of the Westinghouse air-brake type, as shown in the drawings.

The air to be heated and compressed enters the car through pipe *g*. It may pass first through strainer *h* and a coil of pipe, *g'*, located in the steam-dome D of the locomotive, and be carried, also, through the fire-box, if desired, and along under the tender C; or, if a less degree of heat will suffice, the air may be taken directly from the car through the strainer *f* and pipe *e*. The air-pipe first enters the exhaust-steam chamber F and is coiled therein, as shown, in order to expose a large heating-surface to the action of the steam. It then passes by means of a connection, *i*, into the live-steam chamber B, in which, also, it is coiled, as shown. Emerging at *j*, it connects with the air-compressing cylinder G of the pump, a branch, *j'*, connecting also with the corresponding cylinder, G', of the auxiliary pump. The discharge-pipes of these two pump-cylinders are provided with valves, as shown, and connect with the outgoing heat-pipe *k*, through which the compressed hot air is conveyed to the radiators H in the several cars of the train. Flexible couplings *l* are used between the cars similar to those which connect the air-brake pipes. The compressed hot air is led back through the return-pipes *m*, which are also provided with radiators H, to the receiving-tank I. An automatic valve, J, which by means of a lever, P, and sliding weight *q* can be set to open at any given pressure, opens communication between the tank I and the pipe *r* when the determined pressure is reached. Passing through the pipe *r*, the hot air enters the reservoir K and is stored therein until the pressure becomes nearly equal in the heating-pipes, the receiving-tank, and the reservoir. A pipe, *s*, provided with valves, leads from the reservoir to the driving-cylinder E' of the auxiliary pump and exhausts through the pipe *t* after it has expended its energy in moving the piston in cylinder E'.

The reservoir K is connected by a short valved pipe, *u*, with the steam-exhaust pipe *d*. The live-steam chamber B, the air-receiving tank I, and the air-reservoir K are each provided with a pressure-gage, and near the air-receiving tank should be placed a thermometer, arranged to indicate the temperature of the atmosphere outside of the car.

The exhaust and live steam chambers F and B and the air-reservoir K may be conveniently arranged as shown in Fig. 1, being supported in suitable chocks. The steam-chambers are fitted with drip-pipes *v*, to carry off the water of condensation.

Fig. 2 shows the general arrangement of the apparatus in a compartment at one end of a car. The outgoing hot-air pipe *k* runs along one side of the car and the return-pipe *m* along the other side. At the farther end of the car they are united by a branch pipe, *n*, which is provided with one or more valves, *n'*.

Fig. 3 shows the arrangement of pipes and radiators in a passenger-coach. The arrangement is the same at each end of the car, so that it can be reversed end for end without disturbing the system. A hot-air pipe runs along each side of the car and connects with the radiator H, of which there may be any desired number. A valved branch pipe, *n*, at each end of the car connects the hot-air pipes, which are themselves provided with valves *o* at each end of the car.

The operation of my apparatus has been partially set forth above, but a more detailed explanation of it will now be given.

When the valves in steam-pipe *a* are opened, the steam fills the live-steam chamber B and flows through pipe *b* into the steam-cylinder E of the pump. After performing its work in moving the piston in said cylinder, the steam exhausts into the exhaust-steam chamber F and escapes through exhaust-pipe *d*. The pump draws air through the air-pipe *g*. If taken from the coil in the dome of the locomotive, the valve *g''* in the car is opened and valve *e'* is closed. If taken from the car through strainer *f*, the valve *g''* is closed and valve *e'* is opened. In its passage through the coils of pipe in the steam-chamber the air becomes highly heated, and under the action of the compressing-cylinder G of the pump it becomes still further heated. It is forced into the pipe *k*, which communicates from car to car, until it reaches the rear end of the train, where the valves *o* are closed. All the branch pipes *n* in the system are closed except the one at the rear end of the train. The compressed hot air finds its way through this to the return-pipe *m*, through which it reaches the air-receiving tank I. When the apparatus is first started, the valve *u* should be opened and the automatic valve J opened by hand to allow the hot air to blow through and warm up all the parts of the system. Valve *u* may then be closed and the automatic valve J set to open at any given pressure, which may be determined in the following way: The temperature of the compressed hot air depends largely upon its pressure; the greater the degree of compression the higher the degree of temperature. If, then, the thermometer indicates a low temperature of the atmosphere, the valve J should be set to hold the hot air at considerable pressure, while if the day be comparatively mild a low pressure of air will be sufficient. It will thus be seen that the valve J governs the pressure that can be put upon the pipes by the steam-pump. As soon as the pressure exceeds the limit set, the valve J will open and relieve it, the escaping hot air being conducted into the air-reservoir K. In time the pressure in this reservoir will nearly equal that in the pipes, as will be shown by the pressure-gage on said reservoir. The steam is then shut off from the pump by closing the valve in pipe *b*. The

valve in pipe *k* between the air-compressing cylinder G and the junction of the latter pipe with the pipe *k'* should be closed. The valve in pipe S is then opened, and also valve in branch pipe *k'*, and the auxiliary pump is actuated by the compressed hot air stored in the reservoir K, the air escaping through pipe *t* after it has done its work. The air-compressing cylinder G' draws the hot air through pipe *g* and forces it through pipe *k'* into the heating-pipes *k*, where it follows the same course as when supplied by the steam-pump. As the air-compressing cylinder G' is of less diameter than the actuating-cylinder E', the amount of air forced into the pipes by this pump is less than that required to actuate the pump, so that the pressure in the reservoir K gradually lowers until the pump is no longer able to operate. It is then cut off from the reservoir and heating-pipes, and the steam-pump is again brought into requisition to fill the reservoir K again. In this way, by utilizing the energy stored up in the compressed hot air that has passed through the heating-pipes and reached the air-reservoir to drive an auxiliary compressing-pump, I am able to dispense with the steam pump at intervals.

It is evident that where railway-cars, ships, or buildings are already provided with steam-heating boilers, pipes, and radiators, I can, with slight alterations, use the same for heating with compressed hot or superheated air, connecting the steam generator with my steam-chambers and steam-pump and the pipes and radiators with the air-cylinders of my pumps, the return steam-pipe being connected with my air-receiving chamber.

Among the advantages of my invention may be mentioned the obviating of all noise in the pipes and radiators, so prevalent in steam-heating systems; the absence of drip-cocks and traps for condensed steam; the absolute safety from scalding or smothering in case a heating-pipe is broken or a coupling gets loose, and the like.

In applying my invention to the various purposes for which it may be used it will be necessary to vary the construction and arrangement to suit the occasion and the climate. In cold weather it will be necessary to use the coil in the dome of the locomotive, while in warmer climates this may be dispensed with and the air taken directly from the car. All this may be done within certain limits without departing from the spirit of my invention, as will readily be understood.

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

1. The combination, with an air-compressing device, of an air-supply pipe, steam-chambers through which said pipe passes for heating the air before it is compressed, suitable pipes and radiators for holding the compressed hot air, an automatic relief-valve for governing the pressure, a reservoir for receiving and storing the surplus compressed air, and an auxiliary air-compressing device arranged to be actuated by the compressed air stored up in the reservoir, substantially as and for the purpose set forth.

2. The combination, with a steam-actuated air-compressing pump, of a live steam chamber through which the steam is supplied to the pump, an exhaust-steam chamber for receiving the exhaust-steam from the pump, an air-supply pipe passing through said chambers, a system of heating-pipes and radiators, and an automatic and adjustable relief-valve for governing the pressure in said pipes, substantially as and for the purpose set forth.

3. The combination, with a steam-actuated air-compressing pump, of a live-steam chamber through which the steam is supplied to the pump, an exhaust-steam chamber for receiving the exhaust-steam from the pump, an air-supply pipe passing through said chambers, a system of heating-pipes and radiators, a reservoir for the surplus compressed air, an adjustable automatic valve for opening communication between the heating-pipes and the reservoir when a predetermined pressure has been reached, and an auxiliary air-compressing pump arranged to be driven by the surplus compressed air in the reservoir and to force hot air into the heating-pipes, substantially as and for the purpose set forth.

4. The combination, with the live-steam chamber B, exhaust-steam chamber F, and reservoir K, of a steam air-pump and an auxiliary air-pump, an air-supply pipe passing through the steam-chambers, and a heating-pipe connected with the air-cylinder of each pump and with the reservoir K, said reservoir also being connected with the driving-cylinder of the auxiliary pump, substantially as set forth.

5. A car-heating system comprising an air-heating coil in the dome of the locomotive, independent steam and air pipes, a pump having steam and air cylinders connected, respectively, with said pipes, live and exhaust steam chambers surrounding the air-pipe before it reaches the pump, a closed hot-air-supply pipe running from the pump through the car, a receiving tank to which said heating-pipe returns, a reservoir communicating with said tank, an automatic pressure-valve controlling the communication between said tank and reservoir, and an auxiliary compressing-pump connected with the reservoir and with the hot-air-supply pipe, substantially as and for the purpose set forth.

In testimony whereof I affix my signature in presence of two witnesses.

THOMAS J. SIMPSON.

Witnesses:
M. D. BRAINARD, Jr.,
E. L. WHITE.