(No Model.) 2 Sheets—Sheet 1.

W. E. HALL.

STEAM HEATING APPARATUS.

No. 451,929. Patented May 12, 1891.

FIG. 1.

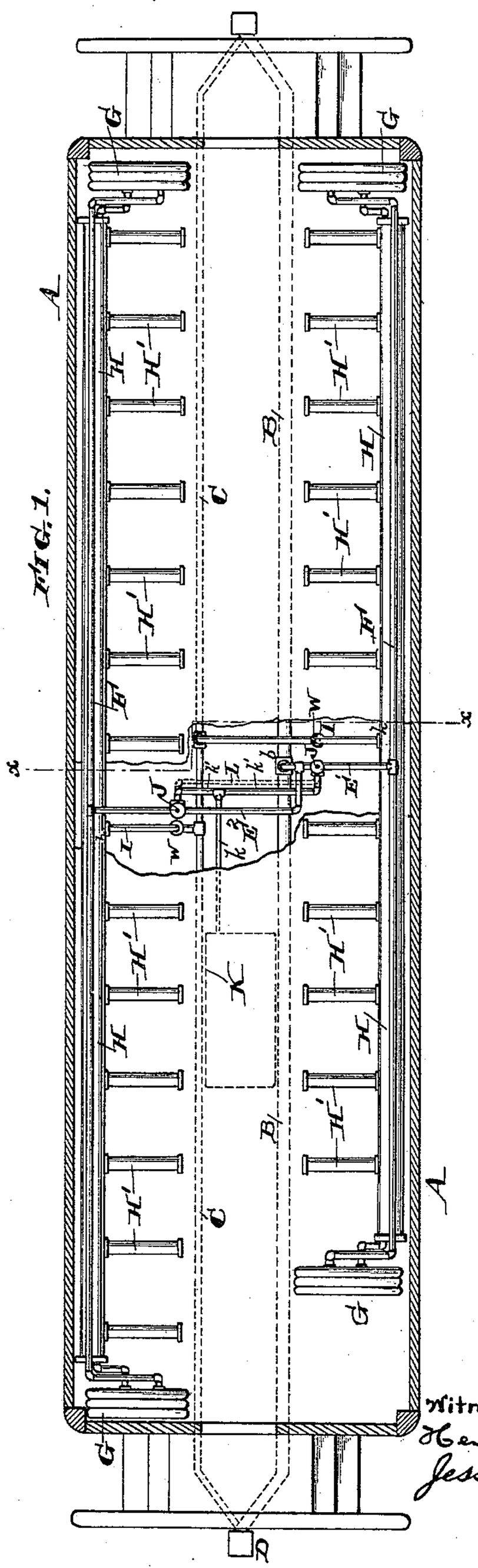
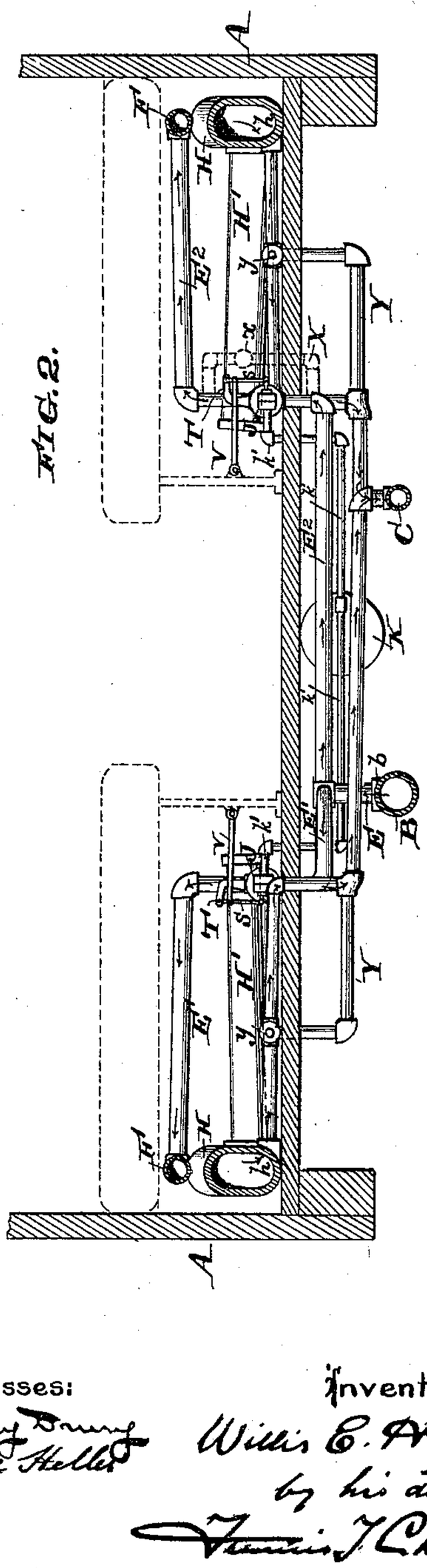


FIG. 2.



Witnesses:
Henry Bruning
Jesse Heller

Inventor:
Willis E. Hall
by his attorney
Francis J. Chambers

(No Model.) 2 Sheets—Sheet 2.

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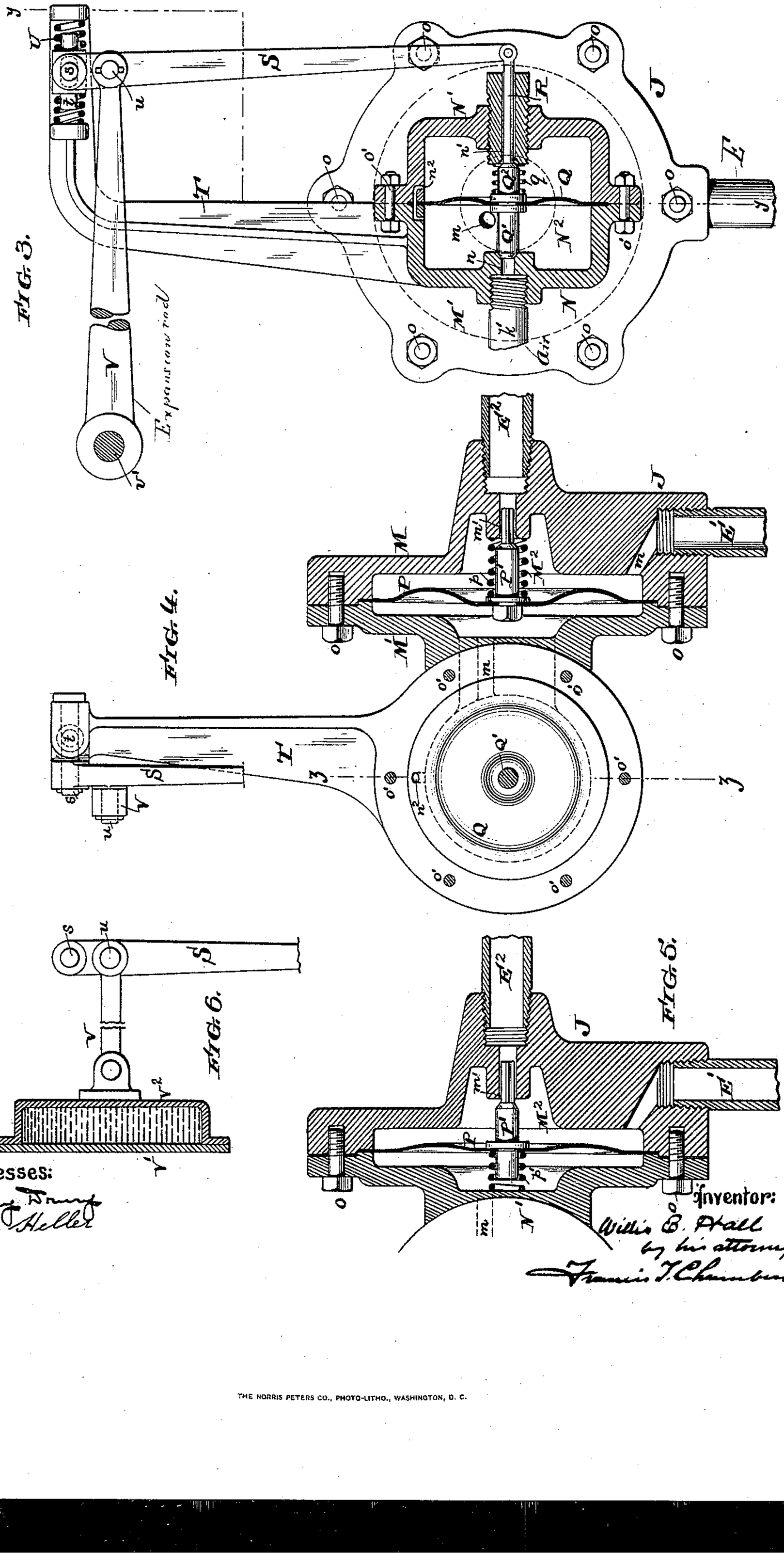

FIG. 3.

FIG. 4.

FIG. 6.

FIG. 5.

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UNITED STATES PATENT OFFICE.

WILLIS E. HALL, OF ALTOONA, PENNSYLVANIA.

STEAM-HEATING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 451,929, dated May 12, 1891.

Application filed May 22, 1890. Serial No. 352,771. (No model.)

To all whom it may concern:

Be it known that I, WILLIS E. HALL, of Altoona, county of Blair, State of Pennsylvania, have invented a certain new and useful Improvement in Steam-Heating Apparatus, of which the following is a true and accurate description, reference being had to the drawings which form a part of this specification.

My invention relates to steam-heating apparatus, and particularly to steam-heating apparatus such as is arranged in railway-cars and deriving its steam from the locomotive-boiler.

This apparatus as most successfully arranged consists of steam-supply and return pipes running the length of the car and provided with couplings by which they can be connected with similar pipes on other cars or on the locomotive, and a radiator system situated within the car and connected with the steam-supply and return pipes. The steam passes from the supply-pipe through the radiator system and from it to the return-pipe, through which the exhaust-steam or its water of condensation is drawn by means of a pump or other suction apparatus at the end of the return-pipe. The return system is advantageous, in that it draws the steam through the supply-pipe and radiator system, insuring a supply at the rear as well as the front of a train or other connected series of chambers and making it applicable to use steam at a low pressure, which is desirable both for economy of steam and to avoid the danger of high-pressure steam escaping into the cars in case of accident. To insure the efficient working of such a system, it is important that the steam-supply to the radiating system of each car or chamber should not exceed a determined pressure therein. The importance of this is not only because by limiting the pressure in the radiating system we economize steam and avoid the danger of steam escaping into the car in quantity, but also because in the return system the escape of steam at any appreciable pressure into the return-pipe has a tendency to interfere with the proper operation of the system, the steam expanding in the return-pipe and making a back-pressure therein, which in the case of a train containing many cars might be permanently or for a considerable time at a higher pressure than the steam contained in one or more of the radiator systems, in which case, of course, the flow through the system would cease.

The object of my invention is to provide a suitable appliance by which the supply of steam passing from the steam-supply pipe to the radiator system will be cut off when the temperature of the car exceeds a determined height and automatically turned on again when the temperature of the car falls below that point. In this way the supply of steam is made proportionate to the rate of condensation in the radiator system, because of course the rate of condensation depends upon the temperature of the car. In other applications for Letters Patent which I am about to file I have shown and described other appliances for use either in connection with the automatic temperature-regulator or alone, and which operate in other ways to secure the desired objects.

My present invention, while, as I have stated, peculiarly applicable to railway-cars, may also be advantageously applied in connection with the heating of other chambers.

Reference being now had to the drawings which illustrate my invention, Figure 1 is a plan view of a railway-car provided with a return steam-heating system and equipped with my improvement. Fig. 2 is a cross-section of the car on the line $x\,x$ of Fig. 1. Fig. 3 is a view showing my improved valve, partly sectioned, on the line Z Z of Fig. 4. Fig. 4 is a view of the same valve, shown partly in section, on the line Y Y of Fig. 3; and Figs. 5 and 6 illustrate modifications of the construction of the valve.

A is the railway-car; B, the steam-supply pipes; C, the return-pipe; D D, couplings by which said pipes are joined to simlar pipes on other cars.

E is a pipe leading from the steam-supply pipe B and divided, as shown, into two branches E′ and E², each leading to pipes F, situated at the side of the car. These pipes F connect at the ends of the car with radiating-coils G, and the coils G connect with heating-flues H H, which flues, as shown, are provided with projecting pipes or drums H′ and formed so that they will run downward from end to end to a point *h*. From these lowest

points *h* of the flues H pipes I I lead to the return-pipe C.

J J are my improved automatic regulating-valves, which, as shown, are placed in pipes E′ E², leading from the steam-supply pipe to the radiator system.

K indicates an air-cylinder, such as is connected with each car, provided with an air-brake system.

k is a pipe leading from the cylinder K and by means of its branches *k′ k′* connecting with the automatic regulating-valve J.

L L (shown in dotted lines on Fig. 1) are pipes leading from the steam-supply pipe to the automatic valve, and which, under conditions hereinafter described, may take the place of pipes leading from the compressed-air cylinder. A three-way cock is usually placed at the point *b*, so that the radiator system of the car can, if desired, be cut off from the steam-supply pipe, or so that the supply of steam in the pipe B may pass no farther than the connecting-pipe E.

At W W in pipes I I adjusting-valves are placed for regulating the flow of steam or water from the radiator system through the return-pipe.

Referring now to the construction of the automatic valve itself, M² is a chamber formed between the two castings M and M′, which are bolted together, as shown at *o o*.

m and *m* are ports leading from the chamber M², and by which connections are made with the two branches of the pipe E′, leading from the steam-pipe to the radiator system. The steam, as shown, enters through the pipe marked 1 E′ and port *m* and passes out through the port *m′*, and the pipe marked 2 E′. N² is another chamber formed between the two castings N and N′ and connecting with chamber M² by a passage *m n*.

P is a diaphragm secured in the chamber M² so as to divide it into two compartments, and having attached to it a valve P′, arranged so that it will close the port *m′* when the diaphragm moves toward the port.

p, Fig. 4, is a spring, which as there arranged acts to press the diaphragm P and valve P′ away from the port *m′*.

In the casing inclosing the chamber N² ports *n′* and *n* are formed, the port *n* connecting the interior of the chamber N² with a pipe *k′*, leading from the compressed-air cylinder K. As shown, a diaphragm Q divides the chamber N² into two compartments, which, however, are connected by a small by-pass *n²*, and on each side of the diaphragm Q are secured valves Q′ and Q², arranged to close the ports *n* and *n′*, respectively and alternatively, as the diaphragm moves in opposite directions.

R is a rod extending through the port *n′* and, as shown, attached to the center of valve Q².

S is a lever connected to the end of the rod R at one end and fulcrumed at its other end on a pivot-pin *s*, secured in a slot *t*, formed in the end of an arm T, extending out from the valve-casing.

U U are springs situated above and below the pivot-pin *s* and acting to hold it in position, while permitting it to move under pressure.

V is a rod situated within the car, secured permanently at one end *v′*, and secured to lever S at *v*—a point inside of the fulcrum *s* of the lever and preferably quite close to it.

The operation of the device as illustrated in the figures above referred to is as follows: Steam passes from the supply pipe into chamber M² through port *m* and out of it to the radiator system through port *m′*. As the temperature of the car increases, the rod V expands, increasing its length and pressing down upon the lever S and through it pulling outwardly the rod R and the attached valves Q² and Q′. When the pressure is sufficient to compress the spring *q*, which is placed so as to hold the valve Q′ against its seat on port *n*, said valve Q′ is lifted from its seat, and compressed air then passes from the cylinder K through pipes *k k′* into chamber N², and thence through the passage *m n* into the division of chamber M² farthest from the ports, where it acts against the diaphragm P, and, overcoming the pressure of spring *p*, causes the valve P′ to move down and seat itself on the port *m′*, thus cutting off the supply of steam to the radiator system. Diaphragm Q, which divides the portion of chamber N² containing the port *n* from that containing the port *n′*, serves to prevent air escaping from port *n* when the valve Q² is opening it and passing it freely through the port *n′* before the valve Q² has closed it, the narrow passage *n²* permitting the air to pass from one compartment to the other but gradually. The diaphragm also serves the purpose of counteracting the pressure of spring *q* and assisting in the opening of the port *n* and the closing of the port *n′*. As the temperature of the car falls the rod V contracts, drawing up the lever S and opening the port *n′*, and after that closing the port *n*. The compressed air in chamber M² then escapes back through the passage *m n*, and, passing through port *n²*, escapes through port *n′*. The release of pressure on the diaphragm P permits the spring *p* to move it away from the port *n′*, which is thus again opened and steam permitted to enter the radiator system.

The feature of my device of great practical value is the arrangement of the pivot or fulcrum pin *s* between the springs U U. These springs are stiff enough to hold it in position when neither of the valves Q′ or Q² are seated; but after said valves are seated the further lengthening or shortening of the rod V simply compresses one of the springs U, which thus relieves the valve and its connections from undue pressure.

It will be noticed that the presence of the diaphragm Q in chamber N² is not absolutely essential; nor is it of course essential that the

valves Q′ and Q² should be connected together, although that is the most convenient way of giving them the relative movements desired. The devices illustrated by which the expansion-rod V is connected with the valve-actuating rod R are important, in that they are, I believe, the best adapted for their purpose of any known to me; but they could be replaced by any convenient mechanism for transmitting the motion of the end of rod V to the rod R.

In place of a long rod V, as shown in Fig. 3, a box V′ (see Fig. 6) may be used filled with some fluid which expands or contracts readily with changes of temperature and having an expansible diaphragm v^2 connected by a short rod V with a lever S. This device is obviously equivalent for the long rod V.

In place of using compressed air to actuate the valve in the one described, steam from the steam-supply pipe B can be used with a slight modification of the apparatus, such as is indicated in Fig. 5.

In place of having a spring p placed, as in Fig. 4, to hold the diaphragm P away from the port m', a spring p' is placed on the opposite side of the diaphragm acting normally to hold the valve P′ upon its seat on port m'. The steam entering the chamber M² through port m, pressing against the diaphragm P, overcomes the pressure of this spring and opens the valve. Steam at the same pressure of course passes through the pipes L L to the port n of the chamber N², and when said port is opened passes from the chamber N² into the chamber M², where it presses on the diaphragm P and with the assistance of the spring p' overcomes the pressure tending to keep the valve P′ away from its seat and close the port m'. I prefer in all cases to connect a by-pass pipe Y with pipe I, so as to pass around the adjustable valve W, and I secure a three-way cock y at the point where pipe Y leaves pipe I, so as to enable me to turn the steam and water around the valve W. This is important, as it enables the radiating system to be cleared rapidly when it is desirable, as on first turning steam into it.

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

1. In combination with a steam-supply pipe and a radiator system situated in a car or other chamber, an automatic cut-off valve situated in a pipe connecting the supply-pipe and radiator system, consisting of a chamber M², having ports m and m' for the passage of steam, a diaphragm P, situated in said chamber and having a valve P′ secured to it in such position that it will close the outlet-port m' when the diaphragm is depressed, a chamber N², communicating with chamber M² above diaphragm P and having ports n and n', a pipe k', leading into chamber N² through port n and connecting it with a receptacle containing gaseous or vaporous matter under pressure, a valve Q′, arranged to close port n, an expansive rod V, or its equivalent, situated in the chamber containing the radiator system, mechanism connecting said rod with valve Q′, arranged to open the port n when the rod expands beyond a determined length, and a valve Q², connected with valve Q′, as described, so as to open the outlet-port n' when valve Q′ is closed, all substantially as and for the purpose specified.

2. In combination with a steam-supply pipe and a radiator system situated in a car or other chamber, an automatic cut-off valve situated in a pipe connecting the supply-pipe and radiator system, consisting of a chamber M², having ports m and m' for the passage of steam, a diaphragm P, situated in said chamber and having a valve P′ secured to it in such position that it will close the outlet-port m' when the diaphragm is depressed, a chamber N², communicating with chamber M² above diaphragm P and having ports n and n', a compressed-air chamber K, a pipe k', leading into chamber N² through port n and connecting it with chamber K, a valve Q′, arranged to close port n, an expansive rod V, or its equivalent, situated in the chamber containing the radiator system, mechanism connecting said rod with valve Q′, arranged to open the port n when the rod expands beyond a determined length, and a valve Q², connected with valve Q′, as described, so as to open the outlet-port n' when valve Q′ is closed, all substantially as and for the purpose specified.

3. In combination with a steam-supply pipe and a radiator system situated in a car or other chamber, an automatic cut-off valve situated in a pipe connecting the supply-pipe and radiator system, consisting of a chamber M², having ports m and m' for the passage of steam, a diaphragm P, situated in said chamber and having a valve P′ secured to it in such position that it will close the outlet-port m' when the diaphragm is depressed, a chamber N², communicating with chamber M² above diaphragm P and having ports n and n', a pipe k', leading into chamber N² through port n and connecting it with a receptacle containing gaseous or vaporous matter under pressure, a valve Q, arranged to close port n, an expansive rod V, or its equivalent, situated in the chamber containing the radiator system, a movable pivot s, springs U U, arranged above and below said pivot, a lever S, fulcrumed at one end to pivot s, connected with valve Q′ and rod V, as described, and a valve Q², connected with valve Q′, as described, so as to open the outlet-port n' when valve Q′ is closed, all substantially as and for the purpose specified.

4. In combination with a steam-supply pipe and a radiator system situated in a car or other chamber, an automatic cut-off valve situated in a pipe connecting the supply-pipe and radiator system, consisting of a chamber M², having ports m and m' for the passage of steam, a diaphragm P, situated in said cham-

ber and having a valve P′ secured to it in such position that it will close the outlet-port m' when the diaphragm is depressed, a chamber N^2, communicating with chamber M^2 above diaphragm P and having ports n and n', a pipe k', leading into chamber N^2 through port n and connecting it with a receptacle containing gaseous or vaporous matter under pressure, a diaphragm Q, dividing chamber N^2, a small passage n^2, leading around the diaphragm, valves Q′ and Q^2, secured to diaphragm Q and arranged to close ports n and n' as the diaphragm is respectively elevated or depressed, a valve-actuating rod R, extending through port n', an expansion-rod V, or its equivalent, situated in the chamber containing the radiator system, and mechanism connecting rod R and rod V, arranged, as described, to open valve Q′ when rod V expands beyond a determined length, all substantially as and for the purpose specified.

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