(No Model.) 3 Sheets—Sheet 1.

G. WESTINGHOUSE, Jr.

STEAM HEATING APPARATUS FOR RAILWAY CARS.

No. 420,132. Patented Jan. 28, 1890.

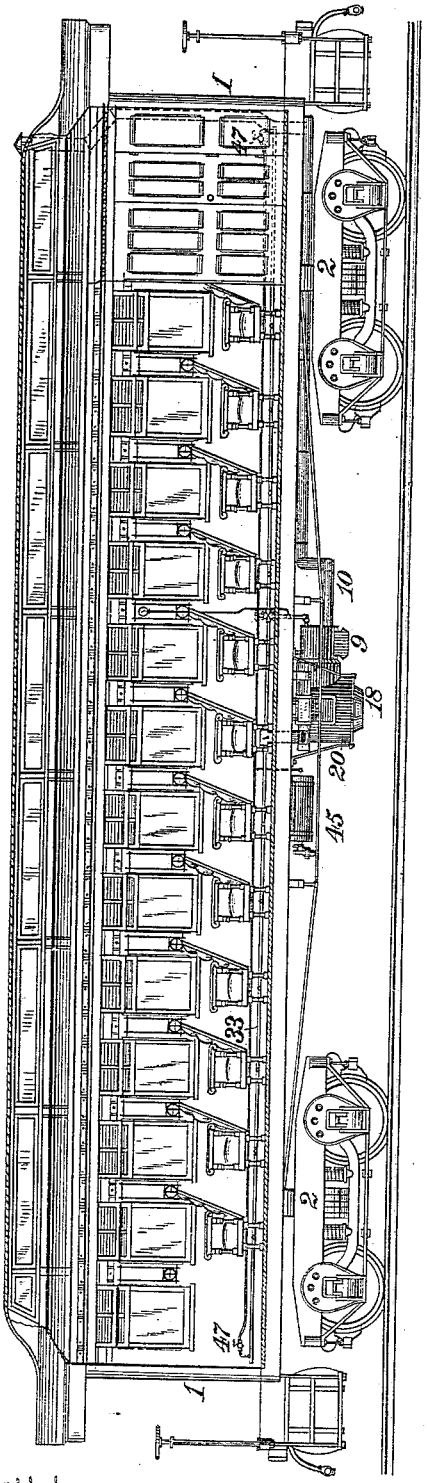

Fig. 1.

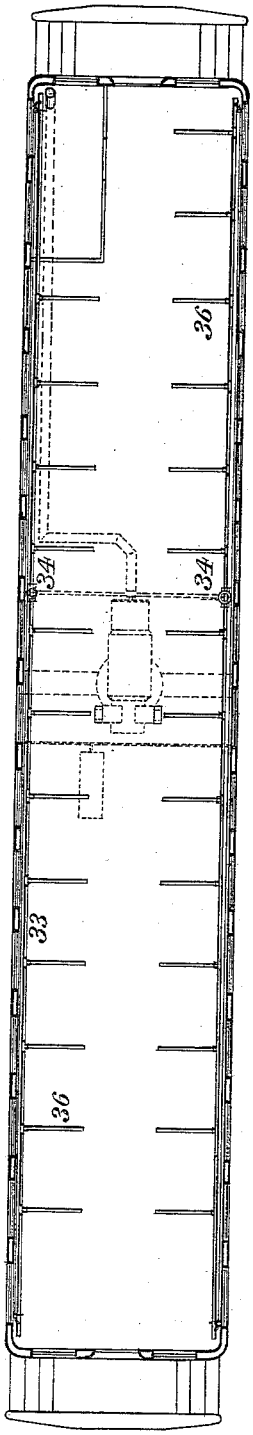

Fig. 2.

Witnesses.
R. H. Whidden
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(No Model.) 3 Sheets—Sheet 2.

G. WESTINGHOUSE, Jr.

STEAM HEATING APPARATUS FOR RAILWAY CARS.

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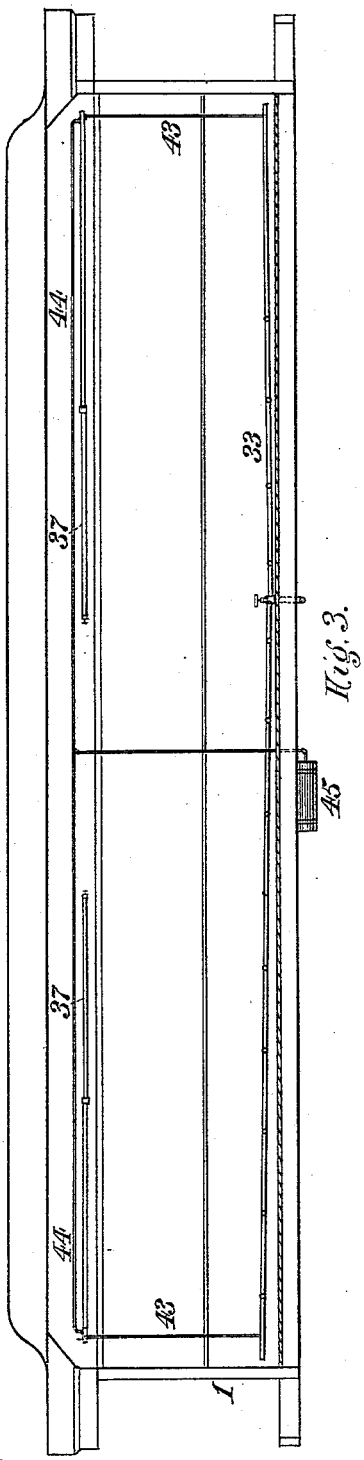

Fig. 3.

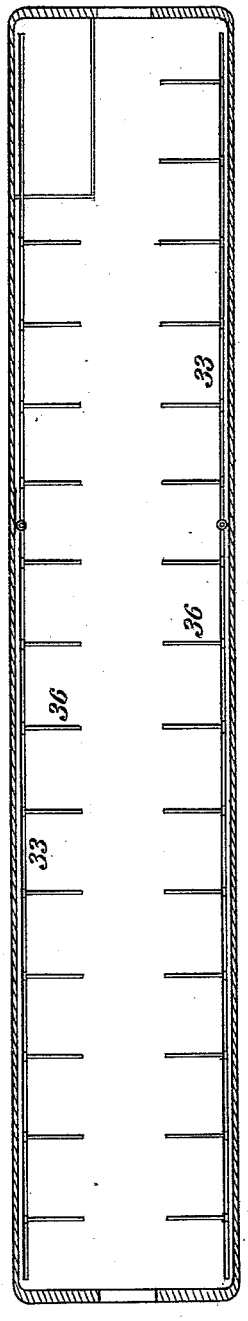

Fig. 4.

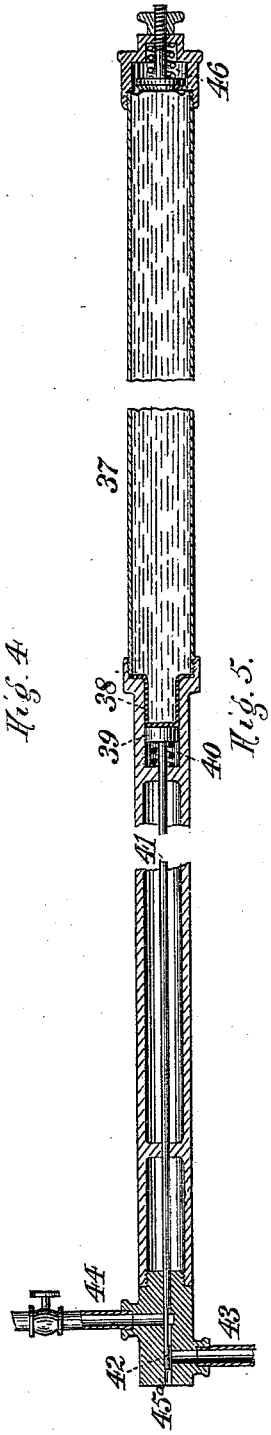

Fig. 5.

Witnesses.
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(No Model.) 3 Sheets—Sheet 3.

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STEAM HEATING APPARATUS FOR RAILWAY CARS.

No. 420,132. Patented Jan. 28, 1890.

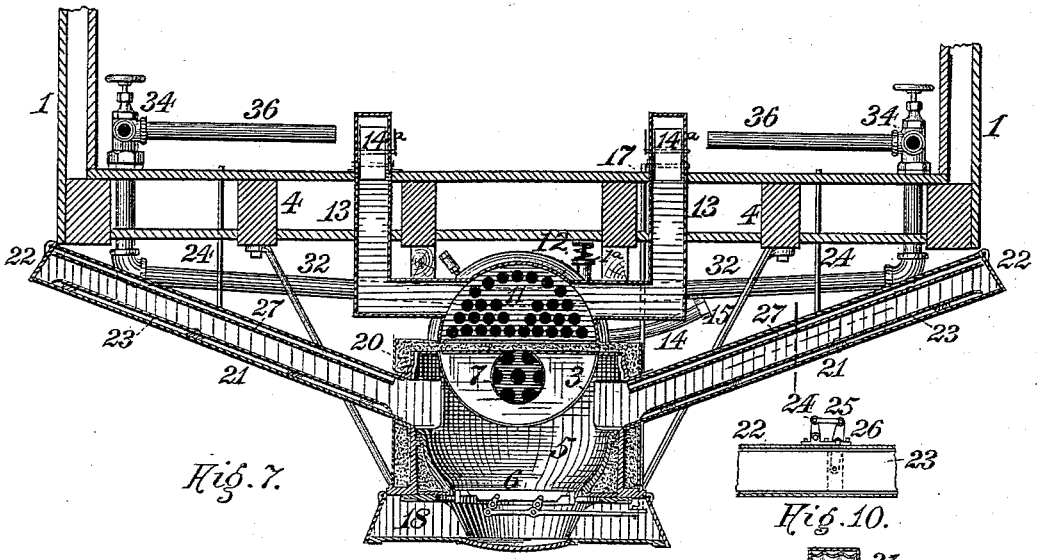

Fig. 7.

Fig. 10.

Fig. 9.

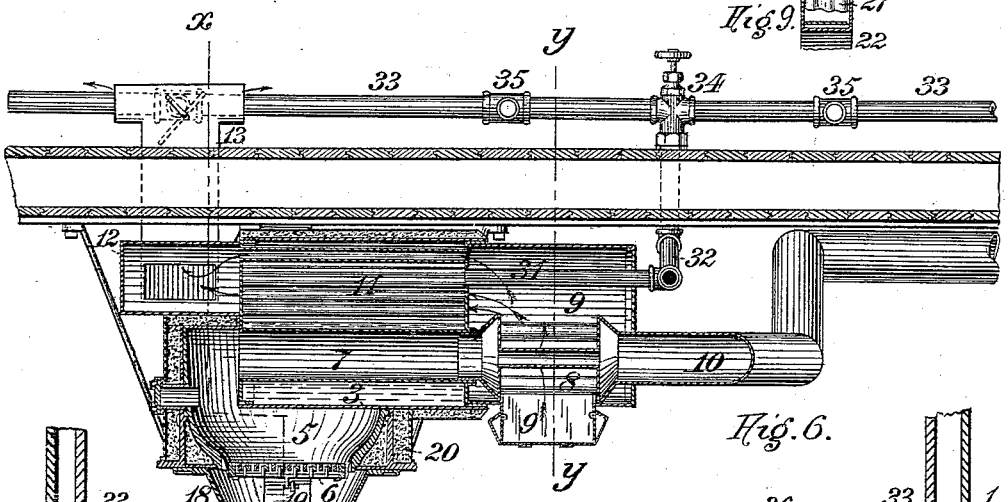

Fig. 6.

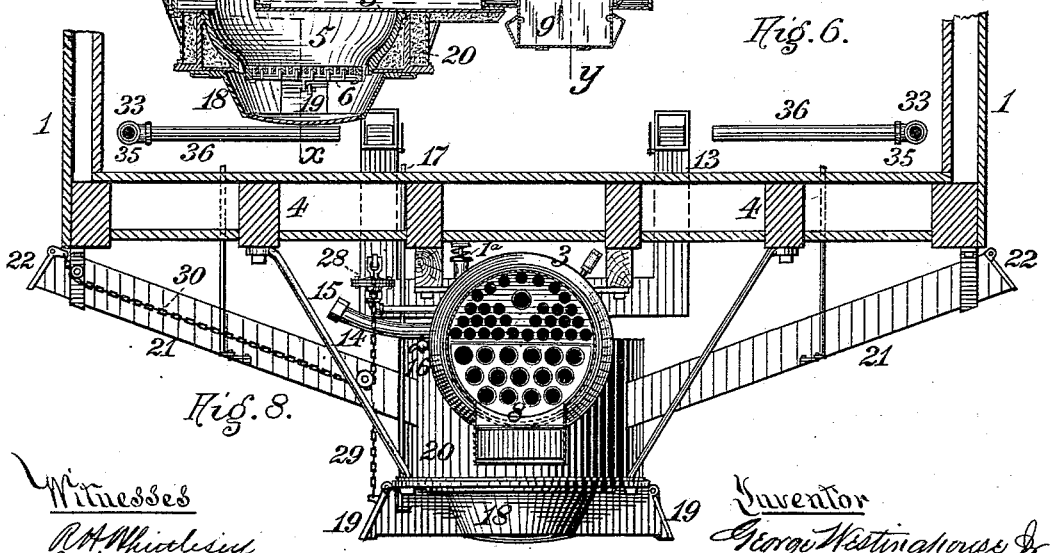

Fig. 8.

Witnesses
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C. M. Clarke

Inventor
George Westinghouse Jr
By Attorney
J. Snowden Bell

UNITED STATES PATENT OFFICE.

GEORGE WESTINGHOUSE, JR., OF PITTSBURG, PENNSYLVANIA.

STEAM-HEATING APPARATUS FOR RAILWAY-CARS.

SPECIFICATION forming part of Letters Patent No. 420,132, dated January 28, 1890.

Application filed November 19, 1886. Serial No. 219,354. (No model.)

To all whom it may concern:

Be it known that I, GEORGE WESTINGHOUSE, Jr., residing at Pittsburg, in the county of Allegheny and State of Pennsylvania, a citizen of the United States, have invented or discovered certain new and useful Improvements in Steam-Heating Apparatus for Railway-Cars, of which improvements the following is a specification.

The object of my invention, which is more particularly designed for application to railway-cars, is to provide a heating apparatus whereby any desired temperature within a wide range of variation may be maintained with substantial uniformity throughout the interior of a railway-car or other closed space for the reception and accommodation of a number of persons, such apparatus being readily and conveniently applicable to the ordinary standard constructions, and having the capacity of speedily raising the temperature to the proper degree, and of automatic as well as hand regulation for the maintenance of a desired and determined temperature.

To this end my invention, generally stated, consists in certain novel devices and combinations including a steam-boiler of special construction located exterior to a railway-car or other compartment, a series of air-heating pipes receiving heat therefrom, a series of steam-heating pipes supplied with steam therefrom, mechanism for supplying fuel to the steam-generator, and a thermostatic device for regulating the supply of the steam-heating pipes.

The improvements claimed are hereinafter fully set forth.

The difficulty, if not the substantial impracticability, of maintaining a proper and desirable degree of heat in railway-cars with the devices heretofore employed is a matter of common knowledge and a continual source of discomfort and complaint with the large proportion of the community which constitutes the traveling public. Stoves or other heating devices placed in the inside of a car are objectionable, among other reasons, because of the space which they occupy and of the fact that they render the portion of the car adjacent to them unduly warm if the remainder is sufficiently heated; and the prominent objection which has obtained to car-heating apparatus of all descriptions is that if made of sufficient capacity to answer the requirements of service in the coldest weather it proves too large for use in mild or moderate weather, and in such periods renders traveling extremely uncomfortable.

My invention is designed to obviate the objections heretofore experienced in providing an apparatus which, while of sufficient capacity to afford the maximum heating effect required, can be operated equally effectively to maintain lower degrees of temperature as from time to time are desired, and under all conditions of action can be regulated with practical accuracy to the service required.

In the accompanying drawings, Figure 1 is a side view of a railway-car, illustrating the application of my invention, the car-body being shown in section; Fig. 2, a horizontal section of the same and plan view of the floor with the seats removed; Fig. 3, a sectional view of the car-body illustrating more particularly the arrangement of the thermostatic devices; Fig. 4, a horizontal section through the same; Fig. 5, a longitudinal central section through one of the thermostats; Fig. 6, a similar section through the steam-boiler and its accessories; Figs. 7 and 8, transverse sections through the same at the lines $x\,x$ and $y\,y$, respectively, of Fig. 6; Fig. 9, a transverse section through one of the coal-chutes, and Fig. 10 a horizontal section through a portion of the same.

In the practice of my invention, which is herein shown as applied to a passenger-car of the construction which is standard on the railroads of the United States, the steam-boiler by which heat is generated is located below the car-body 1 and in any convenient position between the trucks 2. The boiler 3, which is properly secured to the sills 4 of the car, is preferably of cylindrical form, and is provided with a fire-pot or furnace 5, which is substantially similar to that set forth in Letters Patent No. 214,522, granted to W. C. Baker July 19, 1881, and does not of itself constitute part of my present invention. The fire-pot 5, which is fitted with a proper grate

6, incloses the lower half of the boiler 3 for the major portion of its length, and the products of combustion pass from the fire-pot through a water-heating flue 7, extending horizontally through the boiler below its center line, and thence into a preliminary air-heater 8, which is inclosed in a casing 9, adjoining or attached to the end of the boiler 3 farthest from the fire-pot, and consists of a series of tubes of thin metal communicating at one end with the boiler-flue 7, through which the heated products of combustion pass out of the fire-pot, and at the other with a smoke-pipe 10, by which they are discharged at any convenient point above the roof of the car. The air required to supply the car is admitted through openings in the lower end of the casing 9, and passes upwardly around the tubes of the preliminary air-heater 8, into and through a supplemental air-heater 11, which consists of a series of tubes passing through the steam-space of the boiler and serves to impart heat to the air by what is commonly called "indirect" heating. Instead of taking in air directly at the bottom of the casing 9, as shown, a pipe-connection may be made to the casing and air be admitted thereto from the roof or other preferred location, suitable screens or filtering devices being provided for the exclusion of dust and cinders. From the tubes of the heater 8 the air passes into a box or case 12, communicating with their delivery ends, and thence passes into the car by an upwardly-extending flue or flues 13, having discharge-openings below the seats governed by suitable doors or valves 14^a.

The boiler 3 is provided with a safety-valve 1^a, loaded to a determined safe pressure, and is supplied with water through a lateral filling-tube 14, having a screw-cap 15 on its outer end, and a water-cock 16, which is opened when the boiler is being filled, is located at or slightly below the center line of the boiler, it being desirable that water should not be carried above that level in order to obviate liability to damage from freezing. The pressure of steam is indicated by a gage placed in any convenient position in the car.

The grate 6, which may be of any suitable and preferred construction, is adapted to be rocked or shaken by a rod 17, extending to the interior of the car, and is located above a closed ash-pan 18, having hinged doors 19 for the admission of air and removal of ashes. The fire-pot and boiler are inclosed in a suitable non-conducting casing 20, to prevent radiation of heat, and the supply of fuel to the fire-pot is effected through a pair of inclined coal-chutes 21, leading from the fire-pot to the sides of the car and provided with doors 22 at their outer and upper ends. A sliding plate or frame 23 rests upon the bottom of each of the coal-chutes 21, and partly supports the fuel which is placed therein, said plate or frame being adapted to be shaken or moved back and forth, to feed coal into the fire-pot as required, by a rod 24, extending into the car and operated by a handle or wrench. The rod 24 is coupled by links 25 26 to the plate or frame 23, as shown in Fig. 10, or in any similar manner. A corrugated plate 27 is fitted against the inside of the top of each coal-chute, the corrugations of the plate providing passages from the outer ends of the chutes to the fire-pot, through which air may be admitted above the body of coal in the chutes when their outer end doors are opened. A damper-regulator 28 of any suitable construction is connected by a pipe with the steam-space of the boiler, and the weighted arm of said regulator is coupled by a cord or chain 29 to one of the doors 19 of the ash-pan 18. It is also connected by a cord or chain 30, passing around a guide-pulley, or by a rod mechanism to the door 22 of one of the coal-chutes 21. As the steam-pressure in the boiler 3 rises or falls, as the case may be, above or below a determined point, the weighted regulator-arm closes or opens the ash pan door to shut off or admit air below the grate and the coal-chute door to shut off or admit air above the fire, and correspondingly varies as required the degree of combustion and consequent generation of steam. The standard pressure carried in the boiler may be varied, as from time to time desired, by proper adjustments of the weight on the arm of the regulator, said weight acting in opposite direction to the pressure of the steam upon the piston or diaphragm of the regulator. Instead of the ash-pan door, other suitable openings may be governed by the damper-regulator.

The steam generated in the boiler passes therefrom by a steam-supply pipe 31, leading out of the steam-space of the boiler through the casing 9 into transverse pipes 32, connected to the pipe 31 and extending across the car below its bottom, said pipes being turned upwardly at their outer ends and entering the car adjacent to its sides, where they are connected each to a longitudinal steam-heating pipe 33, extending the entire length of the car a short distance above the floor. The connection of the supply-pipes 32 and heating-pipes 33 is preferably effected, as shown, by means of stop-valves 34, each having a lower opening in its case communicating with one of the supply-pipes 32, and two lateral openings, each communicating with a section of one of the heating-pipes 33. Steam may be shut off from either or both of the heating-pipes by the stop-valves whenever desired. A T-piece 35, into which a section of heating-pipe 36 is secured, may be connected to each of the heating-pipes 33 below each seat of the car in order to increase, as far as practicable, the area of heating-surface. The supply and heating pipes are all arranged to drain in the direc-

the preliminary and supplemental air-heaters. In moderate weather, when the heated air admitted through the air-flue is found to be sufficient to warm the car, the stop-valves of the steam-heating pipes may be closed, thereby eliminating the heating action of the steam. Instead of one stop-valve on each side of the car, as shown, two may be employed, so that one-quarter only of the entire area of steam-heating surface may be rendered operative, as at the front end of the car, which is ordinarily the coldest portion.

The application of my improvements embodies the advantages of utilizing the direct calorific action of the products of combustion in the manner of a common hot-air heater with a regulated admission of heat, the reduction of the temperature of the waste products greatly lessening danger from fire, and of also equally heating all portions of the car by means of steam, which, as is well known, can be readily distributed throughout every portion of a car or apartment. Provision is made for utilizing all or a desired portion or portions of the steam-heating surface, and the action of the heating appliances may be automatically regulated by the temperature of the car, and is also subject to regulation by hand whenever and to such extent as may be deemed necessary or desirable. The boiler, fire-pot, and preliminary air-heater should be thoroughly protected against loss of heat by radiation by non-conducting coverings as commonly employed for that purpose, and the smoke-pipe 10, which, for convenience of illustration is shown as a single pipe, is ordinarily made double with an air-space, and is then thoroughly protected by a fire-proof covering. It has been found in practice that by reason of the thorough utilization of the calorific power of the fuel a very low rate of combustion and small consumption of fuel suffice to warm a car on the coldest day. The pressure carried in the boiler may be a comparatively high and constant one—say from twenty to thirty pounds—and this may be maintained even in the most moderate weather without causing the temperature of the car to be in excess of the required degree.

In the application of the apparatus to hotel and buffet cars, a separate steam-pipe is connected below the stop-valves 34 for the purpose of enabling the cooking, roasting, &c., to be done by steam heat, as is now commonly practiced, such auxiliary pipe and the cooking devices being arranged to return the water of condensation to the boiler, and as all the steam devices can be thoroughly protected against loss from radiation there will be no undue heat in the car even in summer.

The filling-pipe 14 may be provided with a branch, whereby the boiler can be filled from the inside of the car, and a hand-pump may be used for filling, or water may be forced into the boiler under pressure when desired by means of a separate filling-tank having a connection to the boiler with an interposed check-valve. In such case the filling-tank can be supplied with water at convenient points, and the water forced into the boiler as required by means of air-pressure taken from the brake mechanism.

I am aware that stoves adapted for supplying heated air to the interior of railroad-cars and boilers for heating the same by steam or hot water have heretofore been located below the body of the car, and am further aware that it has been proposed to inclose a hot-water heating-furnace so located in a box or casing provided with radiators for the admission of hot air from said box to the car. Such devices, broadly, I therefore disclaim.

I claim as my invention and desire to secure by Letters Patent—

1. The combination, with a railway-car, of a steam-boiler located below the body of the car, a series of steam-heating pipes arranged within the car for heating by radiation, a valve-connection to the boiler, a preliminary air-heater connected with the boiler in position to be traversed by the products of combustion of the boiler-furnace, a supplemental air-heater located within the steam-space of the boiler, and an air-supply flue leading from the supplemental heater to the interior of the car, substantially as set forth.

2. The combination, with a railway-car or other apartment, of a steam-boiler, a series of steam-heating pipes communicating with the boiler, a compressed-air reservoir, one or more thermostat devices, each actuating a valve controlling the admission of air to and its discharge from the steam-heating pipes, and pipes connecting the thermostat-valve chamber with the air-reservoir and steam-heating pipes, substantially as set forth.

3. The combination, with a railway-car, of an auxiliary reservoir or other portion of an air-brake mechanism adapted to contain air under pressure, a steam-boiler, a series of steam-heating pipes extending through the interior of the car and communicating with the steam-space of the boiler, a thermostat-valve working in a case having an air-discharge opening, a passage communicating with the steam-heating pipes, and a passage communicating with the auxiliary reservoir or other portion of the air-brake mechanism containing air under pressure, said valve governing the admission of air from the brake mechanism to the steam-heating pipes and the discharge of air therefrom, and a thermostat having a piston or diaphragm which imparts movement to the thermostat-valve, substantially as set forth.

4. The combination, with a railway-car, of a steam-boiler located below the body of the car, a coal-chute having a capacity beyond that required for one charge of the boiler

tion of the boiler, so that water of condensation may freely return thereto as condensation of steam takes place in the pipes. To admit of the escape of air from the steam-heating pipes suitable self-closing emission-valves, adapted to be closed by increase of temperature, may be fitted upon the ends of the heating-pipes farthest from the supply-pipes; or the air may be discharged by ordinary valves or cocks 47, to be opened and closed by hand.

In order to automatically regulate the degree of heat imparted from the heating-pipes by the standard temperature of the interior of the car a thermostat 37 is employed, which accords substantially in principle and structure with that set forth in Letters Patent of the United States No. 353,186, dated November 23, 1886, and which is shown in Fig. 5. The thermostat 37 consists of a chamber or vessel, which is filled with alcohol, benzine, or other non-freezing liquid possessing a comparatively high degree of expansibility under variations of temperature, and closed at one end by a piston or diaphragm 38, abutting against a follower 39, which is moved in one direction by the expansion of the liquid in the chamber and in the other by the tension of a spring 40. The follower 39 is fixed upon a stem 41, the opposite end of which carries a valve 42, governing a pipe 43, leading to one of the steam-heating pipes 33 and controlling communication between the pipe 43 and a pipe 44, leading to the auxiliary reservoir 45 of the air-brake mechanism or to any other convenient portion thereof containing air under pressure, as well as between the pipe 43 and an air-discharge passage 45^a. The thermostat is provided with a regulating device 46, by which it may be adjusted to maintain any desired temperature, and for the purpose of preventing the liquid in its closed chamber from being effected by the direct action of the steam in the heater-pipes the valve 42 is located as far as practicable from the chamber. A check-valve is placed in the pipe 44, leading to the auxiliary reservoir, to prevent access of water of condensation from the steam-heating pipes to the air-brake mechanism, and an ordinary self-closing discharging device may also be connected to the pipe 44, and a stop-cock may be also provided for shutting off the supply of air from the pipes.

Two or more thermostats, as above described, are placed in different portions of the car, each actuating a valve 42, by which compressed air is admitted to or shut off from one of the steam-heating pipes and air confined in or released from the heater-pipe to diminish or increase, as the case may be, the degree of heat imparted to the car therefrom, the admission or retention of air acting to force back the steam from the higher portions of the heating-pipes to the boiler, and the discharge of air from the pipes being accompanied by the passage thereinto of an equivalent volume of steam from the boiler. The thermostat is adjusted for the temperature desired—as, say, 70° Fahrenheit—and in such position the valve 42 closes communication between the heater-pipes and the compressed-air pipe and discharge-passage, so that air can neither enter the heater-pipes nor be discharged therefrom. In the event of a change of temperature the thermostat-valve 42 is moved in one or the other direction, the effect of a fall of temperature being to move it toward the liquid-chamber of the thermostat and allow a portion of the air to escape from the heater-pipe, thereby giving room for steam to take its place. Upon increase of temperature the valve 42 is moved in the opposite direction, admitting air from the auxiliary reservoir 45 to the heater-pipe and forcing back the steam to the boiler until the temperature is sufficiently reduced to cause the valve to be moved back into the position required to maintain the desired temperature in the car.

In the operation of the apparatus a fire of charcoal or kindling wood is built upon the grate or the fire-pot, and the coal-chutes are filled with fuel, which is preferably anthracite coal or coke. The products of combustion surround the lower portion of the boiler and pass through its lower fire-tube and through the tubes of the preliminary air-heater in the air-receiving casing to the smoke-pipe, which discharges in any convenient location. As soon as the fire is started, heat is imparted to the tubes of the preliminary air-heater and from their surfaces to the air passing into the car, such heating action being exerted before there is any perceptible elevation of the temperature of the water in the boiler, so that the car begins to receive a moderate degree of warmth immediately upon the starting of the fire. As the boiler becomes further heated, and before steam is generated, a correspondingly-greater degree of heat is imparted to the air in its passage through the tubes of the supplemental heater, which extend through the steam-space of the boiler. As steam is generated, it flows from the boiler to the steam-heating pipes in the car, and, if the stop-valves are opened, enters said pipes, filling them to their ends as soon as the air is expelled. When the steam-pressure in the boiler reaches its determined limit, the damper-regulator automatically closes the ash-pan door, and, if the closure of draft thereby does not sufficiently reduce the pressure, subsequently opens one of the coal-chute doors and admits a current of cold air above the fire, these operations being reversed in accordance with reduction of pressure. During such period as the stop-valves are opened and steam fills the entire system of steam-heating pipes a moderate pressure in the boiler will suffice to furnish heat in the coldest weather, and this may be supplemented by air heated in its passage through

furnace and extending from the boiler-furnace to a point at or near the side of the car, a movable plate or frame supported on the bottom of the coal-chute, and a rod coupled to said plate or frame and extending to the interior of the car, substantially as set forth.

In testimony whereof I have hereunto set my hand.

GEO. WESTINGHOUSE, JR.

Witnesses:
J. SNOWDEN BELL,
R. H. WHITTLESEY.