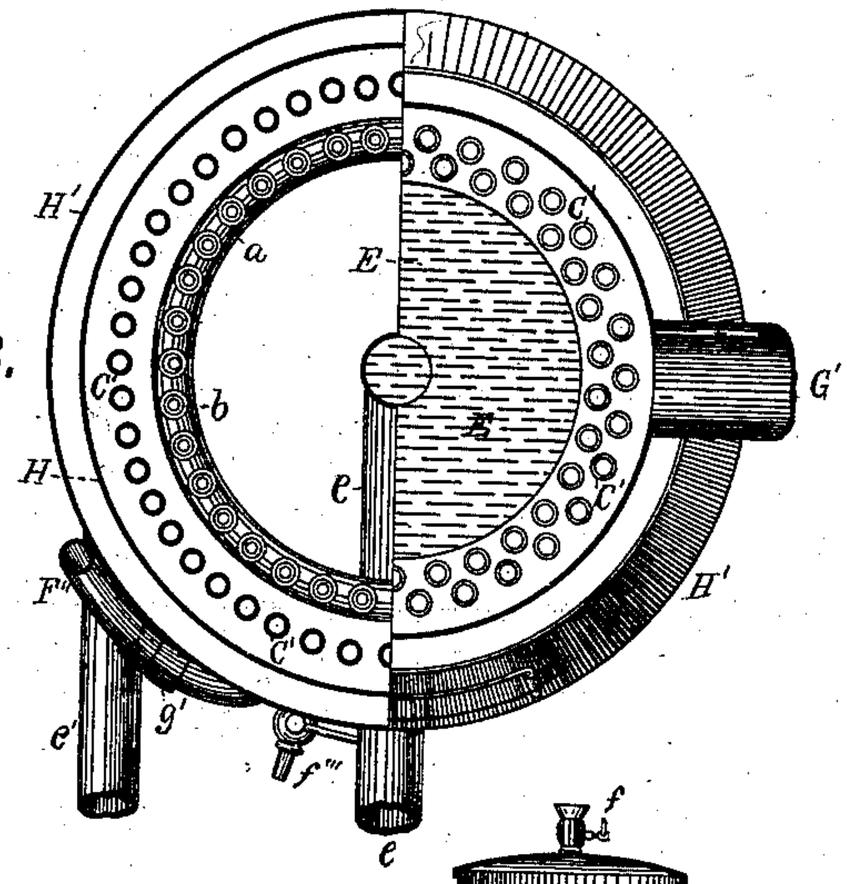
3 Sheets—Sheet 1.

I. A. SALMON.

Car-Heater.

No. 227,997. Patented May 25, 1880.

Fig: 3.



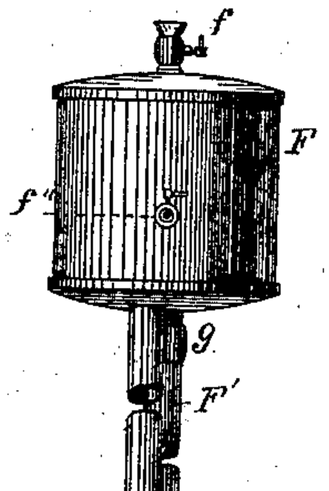
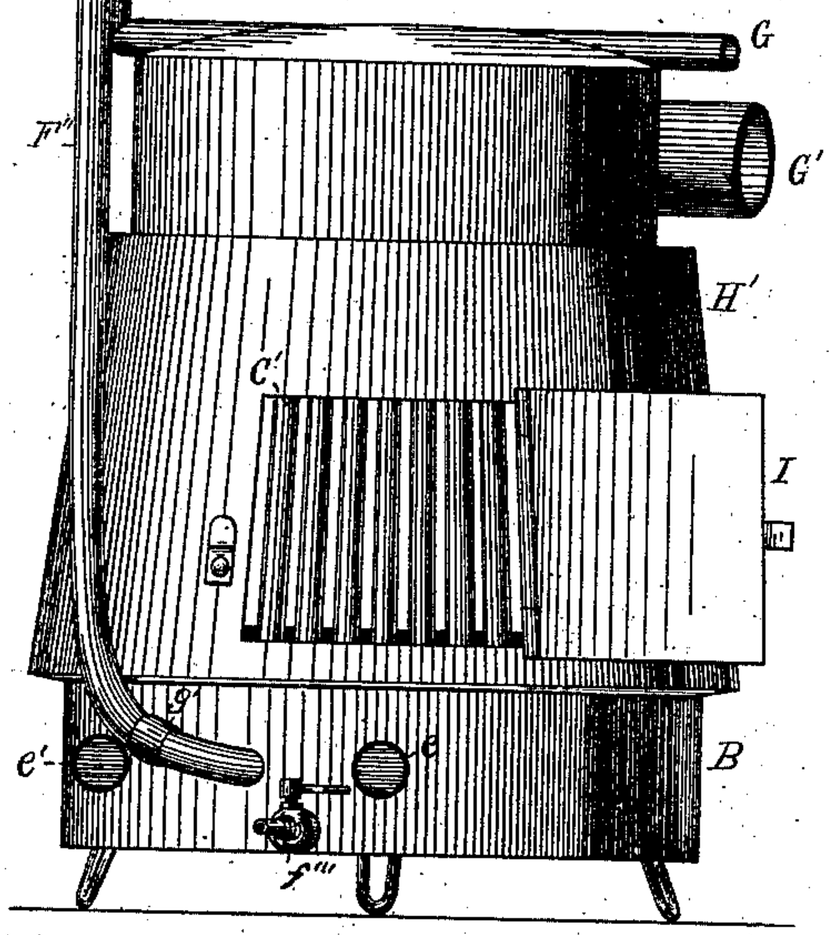


Fig: 1.



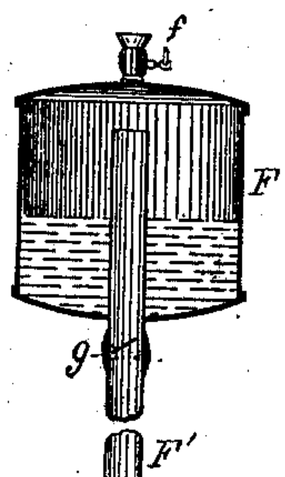
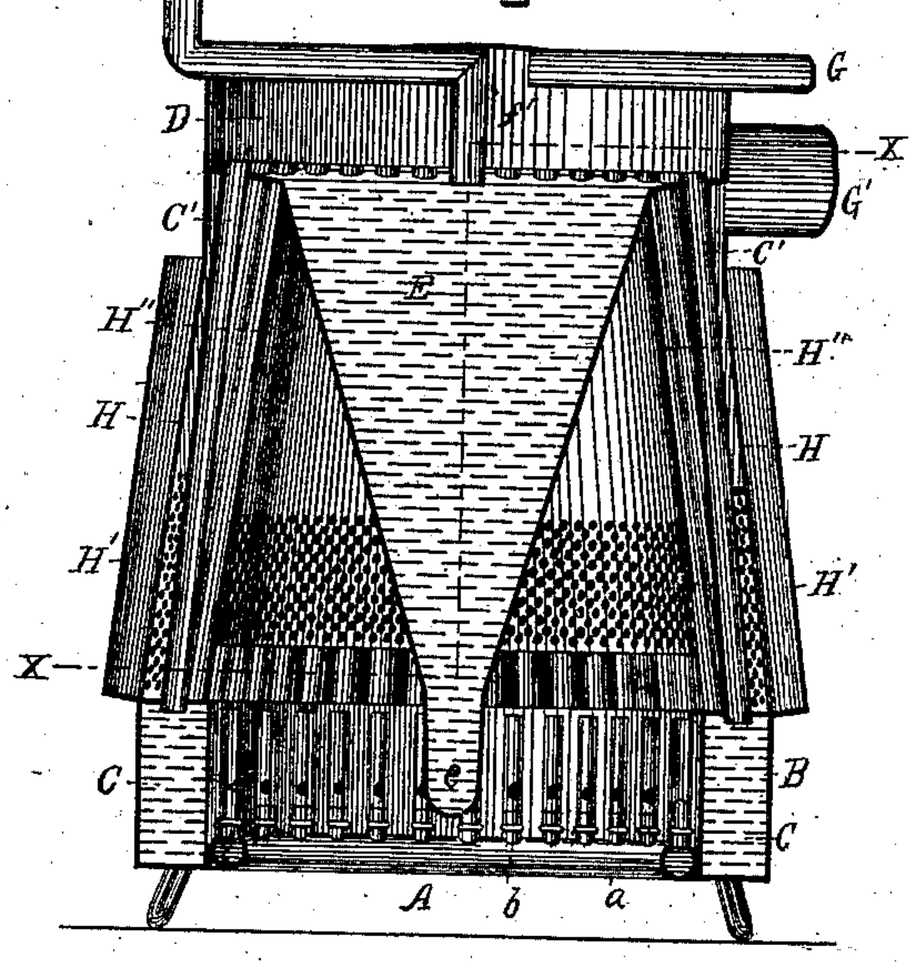


Fig: 2.



Witnesses.

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E. K. McLarnie

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3 Sheets—Sheet 2.

I. A. SALMON
Car-Heater.

No. 227,997. Patented May 25, 1880.

Fig: 5.

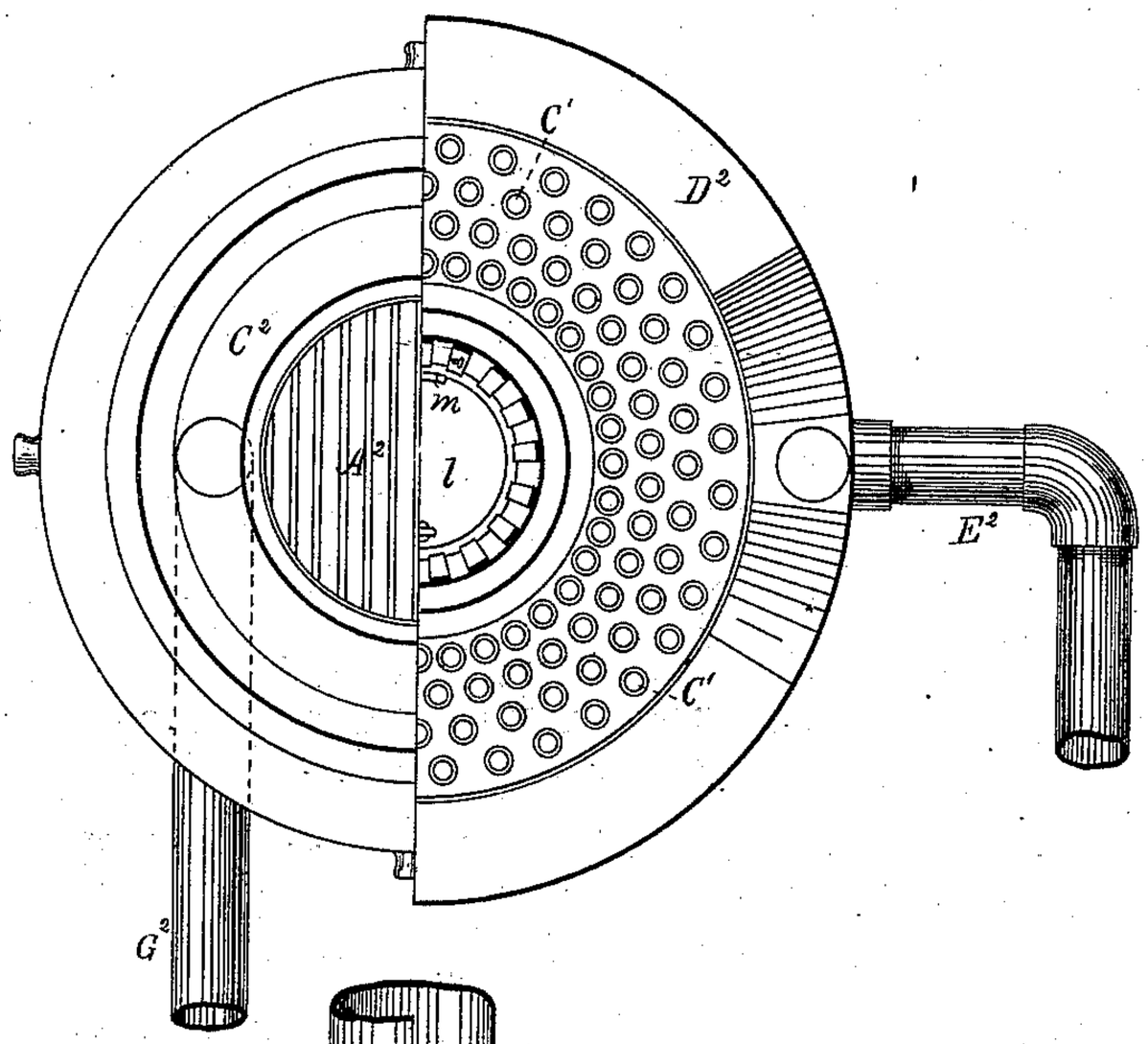
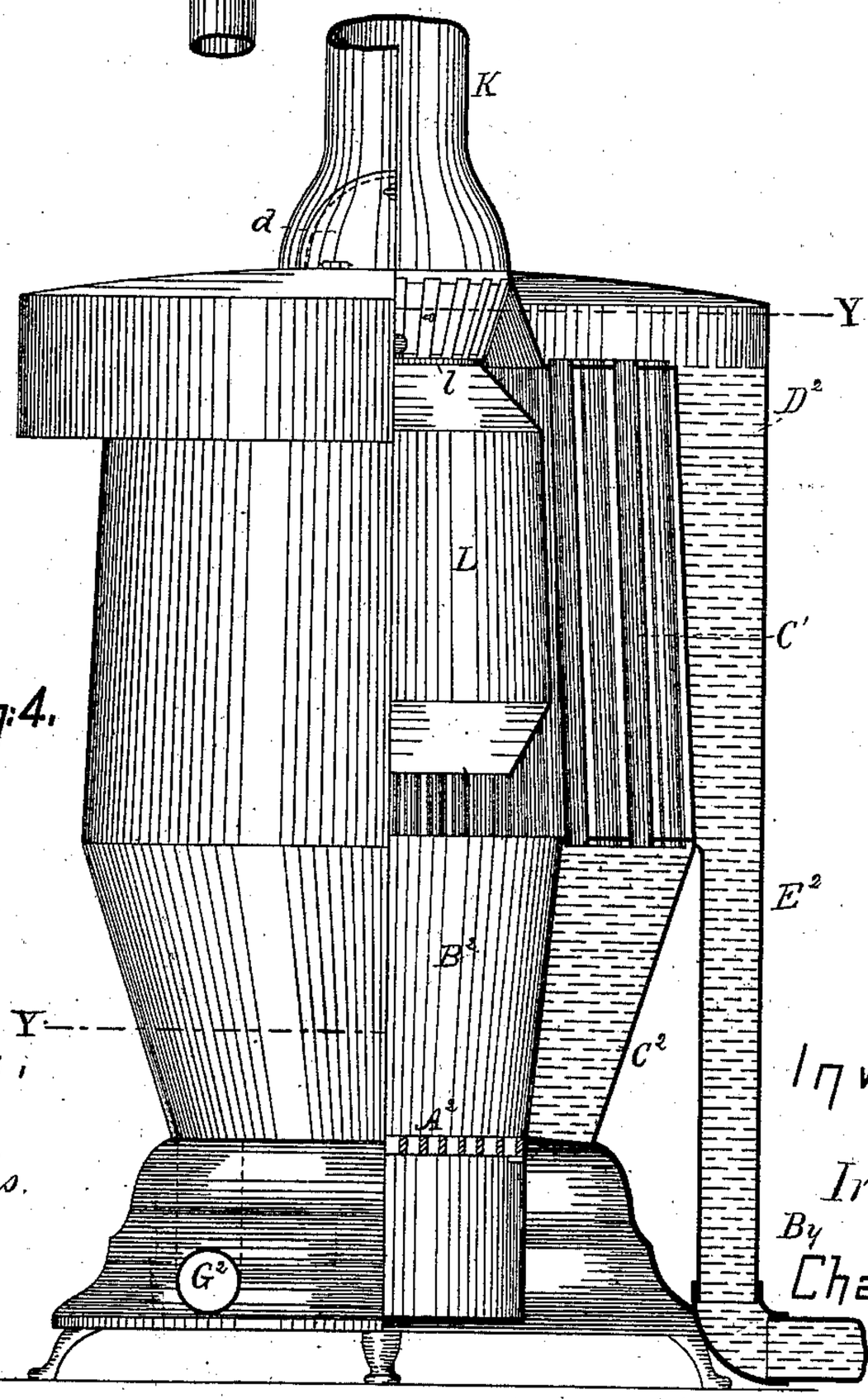


Fig: 4.



Witnesses:
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3 Sheets—Sheet 3

I. A. SALMON.
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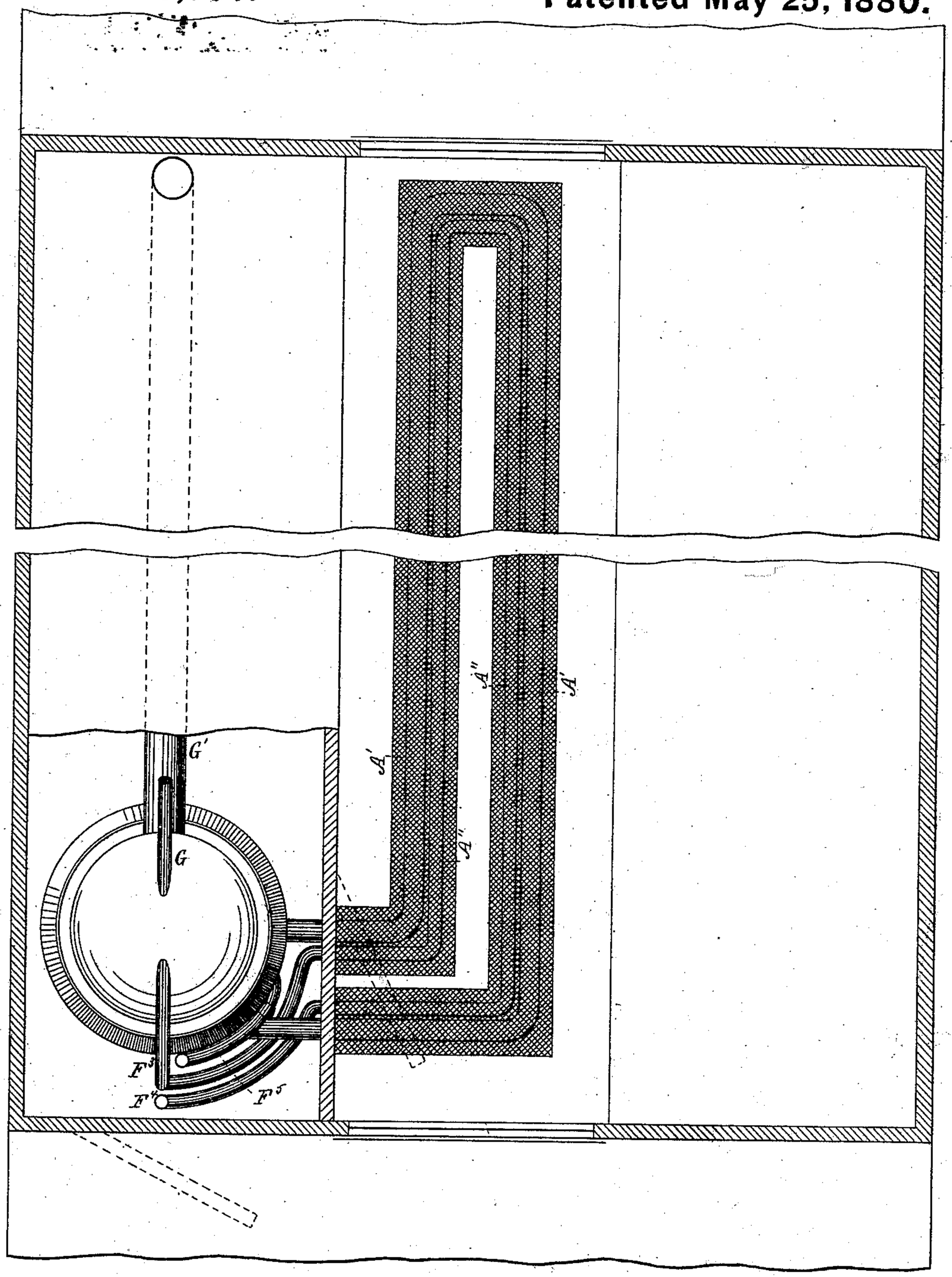

Fig: 6.

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UNITED STATES PATENT OFFICE.

REISSUED

IRA A. SALMON, OF BOSTON, MASSACHUSETTS.

CAR-HEATER.

SPECIFICATION forming part of Letters Patent No. 227,997, dated May 25, 1880.

Application filed January 6, 1880.

To all whom it may concern:

Be it known that I, IRA A. SALMON, of Boston, in the county of Suffolk and State of Massachusetts, have invented certain new and useful Improvements in Apparatus for Heating Cars, of which the following is a specification.

My invention relates especially to heaters for horse-railway cars, although a similar apparatus may be used with great advantage upon a steam-railway car; and it consists in a certain novel construction and combination of parts, which will first be fully described, and then specifically pointed out and determined in the claims.

My object is to provide upon the flooring of an ordinary street-railway car a section or space upon which the feet of passengers occupying the seats may rest, and from which a suitable degree of heat may be imparted to keep the lower extremities comfortably warm without attempting to raise the general temperature of the interior of the car. In fact, this has already been attempted; but, owing to the peculiar circumstances of street-railway traffic, it has invariably failed, since the repeated opening and closing of the doors admits constant supplies of cold air, causing a great expenditure of fuel, and rendering the immediate neighborhood of the stove extremely uncomfortable by reason of the high degree of heat necessary in order to retain an equable degree of warmth. Besides, the introduction of even the smallest size of coal-stove causes a great sacrifice of seat-space, and on this account alone the use of stoves is highly objectionable.

It will be seen from the following description that I accomplish my purpose without sacrificing a single inch of the interior space of the car, and I base my invention upon the well-known fact that when the person is exposed to low temperatures the preservation of a suitable warmth in the extremities of the body will not only prevent any suffering from the cold, but will insure absolute comfort, and obviate all danger of taking cold. As the venous and arterial circulation approaches closely to the surface of the body at the extremities, it is almost invariably at these points that sudden lowering of temperature and consequent chilling of the whole body takes place. Now, if the lower extremities are kept warm by an artificial heat and the upper extremities are protected by ordinary clothing, the result will be that the entire body will enjoy the same comfortable temperature that is produced by a heater which raises the general temperature of the interior of the cars.

It is unnecessary to state the comparison between my invention and such a device as that just named in point of economy and consumption of fuel, since it is evident that the difference must be vastly in favor of the former.

In the drawings forming part of this specification, Figure 1 is a perspective view. Fig. 2 is a vertical section of Fig. 1. Fig. 3 is a cross-section of Fig. 2, taken upon the line X X in Fig. 2. Fig. 4 is a view, partly in elevation and partly in section, taken, as to the sectional portion, upon a central vertical plane, said figure showing certain modifications in construction. Fig. 5 is a cross-section of Fig. 4, the section being taken upon the line *y y* of said Fig. 4. Fig. 6 is a plan view, showing the floor of an ordinary street-car, with the arrangement of seats, the center of the car-body being broken out in order to show both ends, while the seats are shown somewhat broader in proportion to the width of the aisle than is usual. This change in proportion, however, is simply for the purposes of illustration, since in practice my invention is perfectly adapted to the ordinary street-railway cars now in use without change.

A in the drawings represents the apparatus I employ to obtain combustion when using the hydrocarbon oils or gas as a heating agent. This apparatus consists of a coil, *a*, of gas-tubing, passing around the base of the fire-chamber B, and provided at short intervals with ordinary Bunsen burners, *b*, the tube being connected with a suitable gas-reservoir. This combustion-chamber B is surrounded by an annular water-chamber, C, which is connected, by means of a series of short independent tubes, with an upper chamber, D, said tubes being arranged in alternating series, as shown in Fig. 5, whereby I am able to introduce a much larger number of said tubes than would be possible under any other arrangement.

In the center of the fire-pot, and extending

downward into the combustion-chamber, is placed a water-chamber, E, having the shape of an inverted cone, which extends downward until its lower and contracted end is slightly below the plane of combustion in the Bunsen burners. At this point the chamber E terminates in a pipe, *e*, which passes outward through the chamber B.

F is a condenser, consisting of a drum having a filling-valve, *f*, with a pipe, F′, which projects upward into the interior of the drum F, as shown in Fig. 2, and thence passes downward, entering the chamber D, and having a short arm, *f′*, which opens into the conical chamber E at a point a little below the level of the upper ends of the tubes C′ C′ C′.

G is a flue for the smoke and products of combustion to escape to the outer air, said flue being either led upward to the roof or caused to discharge beneath the body of the car.

H is a jacket immediately surrounding the tubes C′, and perforated throughout a portion of its surface, as shown in Fig. 2, in order to permit free access of air from the exterior, and thereby support combustion above the fire-chamber B, causing the flames to surround the series of water-tubes C′ C′. Outside this perforated jacket H is a second imperforate jacket, H′, open at top or bottom, or both, to permit access of draft-currents to the jacket H, the object of which is to prevent undue loss of heat by radiation. A third jacket, H″, having its lower portion perforated like H′, is placed within the fire-chamber. This jacket extends down nearly to the foot of the tubes C′, and its purpose is to direct the draft from the interior of the heater in such a manner as to direct the flames mainly upon and around the tubes C′. It will be seen that in Fig. 2 these tubes are arranged between the outer and inner jackets, H and H′, both perforated to admit the air, the object being to cause the draft-currents from outside and inside to rise to the flue between the jackets, thus causing the flames to surround the tubes C′ on all sides.

f″ and *f‴* are petcocks, the former being placed in the condensing-drum F, and the latter in the water-chamber B.

e is the eduction-pipe, and *e′* is the induction-pipe, the former passing from the exterior into the combustion-chamber B and entering the lower end of the conical water-chamber E. The induction-tube *e′* opens directly into the water-chamber C.

F″ is a pipe connecting the condenser F with the lower water-chamber, C. The pipe F′, already described, is provided with a check-valve, *g*, and the pipe F″ has a similar valve, *g′*, opening in the opposite direction, to admit a flow of water downward, but cutting off all upward currents.

I will now set forth the operation of this form of apparatus before proceeding to describe the modifications shown in the remaining figures of the drawings.

The filling or tunnel cock *f* in the condensing-drum F being opened, the water-chamber C is filled until the water rises in the tubes C′ and overflows into the chamber E, filling the latter also. The proper quantity to be introduced is indicated by the discharge of surplusage through the petcock *f″*, which should be kept open for that purpose until the heater is filled. This cock is then closed, a door, I, leading into the interior of the casing, is opened, and a stream of gas is admitted to the coil *a* and ignited at the Bunsen burner *b*. The flames rising between the outer and inner perforated jackets surround the tubes C′ C′ and heat the water contained in them with great speed. As its temperature increases the water rises in these tubes and overflows into the chamber E, and as steam is generated it drives the excess of water in this chamber up through the pipe F′ into the condensing-drum F, the lower end of the pipe being in a plane somewhat below the upper ends of the tubes C′. In this manner the water is always kept at the same level in the chamber E.

The moment the water rises in the tube C′ and overflows into the chamber E circulation begins in the tubes which pass from the heater over the space to be warmed, and thence return to the apparatus. In other words, the fluid, as it rises in temperature, flows upward, (its specific gravity being decreased by expansion,) and as the movement commences the water begins to enter the chamber C from the return-pipe *e′*. This sets up a circulation throughout the whole length of the radiating-pipes, since the moment water begins to enter the chamber C from the pipe *e′* it must also flow out of the inner chamber, E, through the educt-pipe *e*. As the heat increases this movement becomes more rapid, the water in the tubes C′ overflowing into the chamber E, passing down and out at its lower end, thence through the lines of radiating-pipe A′, (seen in Fig. 6,) and back through the pipe *e′* into the water-chamber C. When the temperature rises to 210° or 212° Fahrenheit and ebullition begins, the current pours through these pipes with great velocity, passing back into the heater so rapidly that no difficulty is experienced in keeping the temperature of the radiating-pipes at a high point throughout their entire length.

From the nature of this operation I might properly term the central chamber, E, the "overflow-chamber," since it receives the water poured into its upper end by the tubes C′. The circulation in these tubes must be invariably in one direction—viz., upward. The draft is so directed that the flames are driven toward and around the series of tubes C′ and away from the central or overflow chamber, concentrating the heat upon the tubes, while at the same time the draft-currents are sufficient to prevent ebullition in chamber E, as they retain the temperature surrounding said chamber at a point just below the boiling-point. Undue pressure, and consequent danger of explosion, is thus avoided.

As steam is generated it is condensed in the drum F; but should there be any portion not condensed it will operate in the following manner: As the vapor passes upward through the pipe F′ it will condense in the drum until the temperature of the water is raised to the point of vaporization. It will then act to drive the water in the drum down through the pipe F″ into the chamber C, the check-valve *g′* in said pipe permitting the downward flow, while the check-valve *g* in the pipe F′ prevents it from backing into the chamber E. This excess of water in the chamber C passes up through the tubes C′ and overflows into the chamber E, whence it is again driven up into the drum through the pipe F′. It will be easily seen, therefore, that the moment sufficient vapor is generated in and above the chamber E to drive the excess of water up into the drum the whole weight of the column of water in the pipe F″ will rest upon and be balanced by the pressure of the vapor upon the surface of the water in the chamber E. As fast as this water is evaporated the loss will be supplied by water from the condenser F flowing downward into the chamber C, whence it will pass again through the tubes C′ up into the chamber E, out through the radiating-pipes, and thence back into the heater. It is evident, therefore, that the condensing-drum F serves to check the excessive generation of steam, by which danger of explosion might be incurred. Being situated, as it is, at a distance from the heater, it will slowly radiate any excess of temperature, and will thereby cause a constant condensation of the steam, which is driven from the chamber E up the pipe F′. Moreover, it will operate as a safety-reservoir, to prevent the water in the heater from falling too low, or, in fact, sinking at all, since as long as any water remains in the drum it will flow into the water-chamber C and retain the level at the point where the pipe F opens into said chamber. The pipe F″ may, however, be connected to and run into the chamber E instead of the jacket C, and this form of arrangement is preferable, since the cooler water from the drum is then mingled at once with the hot water in the chamber E and passes at once into the pipes without checking the circulation.

If desired, I may employ the steam generated in the apparatus as a heating agent, in connection with the water-pipes, in the following manner: Fig. 6 represents a horizontal elevation of a heater organized in the manner described, with the following exceptions: The pipe F′, leading from the chamber E, instead of rising directly to the drum F, is carried downward and passes around the surface to be heated, where it may be laid side by side with the water-pipes, or otherwise located, as desired. Thence it returns to the drum, to which it is connected in the same manner as the pipe F′, (shown in Fig. 2 and already described.)

The pipe leading from the condensing-drum to the chamber C is arranged in the manner seen in Fig. 2. This arrangement is seen in said Fig. 6, F^3 being the steam-pipe passing from the dome of the heater downward and around the flooring of the car, as shown at A″, lying beside the water-pipe A′. After leaving the floor the return-pipe ascends to the drum at F^4, the pipe seen in Fig. 1 at F″ being shown in Fig. 6 at F^5. By this arrangement I retain all the benefits derived from the drum F as a condenser, and at the same time utilize a large percentage of the heat which would be radiated from the condensing-drum.

The heater described in the foregoing pages is more particularly intended for the consumption of gas as an agent of combustion.

In Figs. 4 and 5 of the drawings I have shown an apparatus in which hard coal may be burned. The substitution of coal for gas or oil necessarily involves important modifications in construction.

A^2 is the grate, immediately above which is the fire-pot B^2. The latter is wholly surrounded by a water-jacket, C^2, corresponding with the chamber C in Fig. 2. The tubes C′ rise from this lower water-chamber, C^2; but instead of overflowing toward the center, as in Fig. 2, they empty into an annular water-chamber, D^2, outside. The radiating-pipe through which the outward flow takes place connects with this outer chamber at E^2, and the return-pipe is seen entering the water-jacket C^2 at G^2. A condensing-drum is used in this form of heater, of the same form and arrangement already described, and therefore not shown in these figures, and the fuel is introduced at the top through a sliding door, *d*, in the flue. At the bottom of this flue is a sectional trap, *l*, one-half of which slides horitally upon the other portion, the two being connected by pins running in slots, as partly shown in Fig. 5 at *m*. This trap closes the opening at the top of the reservoir L, through which coal is introduced, the fire-pot is filled, and a further quantity is poured into the cylindrical reservoir L, filling it full. This coal rests upon that in the fire-pot, and is consumed in the same manner as in the well-known base-burning coal-stove.

It should be distinctly understood that in this form of heater the same condensing-drum and the same general arrangement of pipes is required as in that shown in Figs. 1 and 2. I have therefore not shown in Figs. 4 and 5 those parts which are merely duplications of the condenser and its pipes. At the same time I may remark that, except as a precaution against leakage, the condenser is not absolutely necessary. Theoretically there is no waste of fluid from my apparatus; but in practice some slight leakage does take place, and I employ the condensing-drum to guard against danger by preserving the water constantly at the same level in the chamber E, as already described.

In arranging this apparatus on a car according to my invention, I propose to locate the heater at one end beneath the seat, as shown in Fig. 6. It may, however, be found preferable to place it in the center of the

car, as being subjected to less motion, and, consequently, greatly diminishing the "swash" of the water in the interior of the chamber E. If placed at the end, however, the chamber E may be covered by a diaphragm having a central depression and opening, which will allow the free circulation of fluid, and at the same time prevent the violent agitation of the surface. Its extremely small size and the fact that its organization renders all danger from heat, smoke, or scorching impossible enable me to employ the space beneath the seat for this purpose, and thus avoid the necessity of sacrificing space needed for other purposes. From the heater the pipes run to the flooring, and thence outward and down the entire length of the car, passing up both sides, and finally returning to the heater. I have shown them as sunk below the plane of the platform and covered by a grating, through which the heat may radiate upward. Any other construction by which the same results may be gained may be substituted—as, for example, instead of a grating, a shallow metal jacket may be sunk in the flooring and the pipes laid in it. Being thus wholly inclosed, in some cases this may prove a desirable change, as the loss of heat by radiation will not be quite as rapid as when a grating is employed.

The flue for the smoke and other products of combustion passes beneath the seat of the car to the end, and may be either carried up to the roof or turned downward and discharge beneath the car. Access is obtained to the heater by panels, (shown in broken lines in Fig. 6.) One may open at the end and upon the outside of the car, and one in front of the seat and inside of the car. If desired, it would be easy, in place of one of these, to hinge a section of the seat directly above the heater, and thus obtain access from above.

As I have already remarked, my apparatus is so contrived that it may be made of less dimensions than any other heater of which I have knowledge, while at the same time it is so powerful that it will develop and maintain the full degree of heat required throughout the entire length of the radiating-pipes even in the coldest weather. These pipes may be so laid as to cover a space in the flooring of four, six, or even eight inches in width, running directly in front of the seats occupied by passengers. The diameter of the pipes will in a measure determine the number of coils. It may be found advantageous also to employ a pipe specially constructed for this form of heater, and having a flattened or oval shape, in order to increase the extent of the upper radiating-surface.

I am aware of United States Letters Patent No. 210,563, granted to me December 3, 1878, also No. 218,685, granted to W. E. Prall August 19, 1879, and make no claim in this application to anything shown in said Letters Patent.

Having thus fully described my invention, what I claim, and desire to secure by Letters Patent of the United States, is—

1. A water-heater for railway-cars having combined therein the following elements, to wit: a fire-chamber, an annular water-chamber surrounding said fire-chamber, an overflow-chamber, E, extending from the plane of the annular chamber upward, and tubes connecting these two chambers and adapted to conduct the water from the annular chamber to the overflow-chamber E, the radiating-pipes passing from the overflow-chamber E through the space to be heated, and thence returning to the annular water-chamber, all substantially as and for the purpose set forth.

2. The combination, with the annular water chamber or jacket, of a series of tubes connecting it with an overflow-chamber, and an outer and inner perforated jacket inclosing the tubes between them, to permit the passage of the draft from the exterior and interior, substantially as and for the purpose set forth.

3. The combination, with an overflow-chamber, E, and a separate water-chamber, of a series of tubes connecting the two chambers, and heating apparatus adapted to act upon or apply heat to the said tubes, for the purpose of causing circulation from the water-chamber through the tubes to the overflow-chamber E, substantially as and for the purpose set forth.

4. The combination, with two separate water-chambers opening into each other through a series of tubes, of a condensing-drum connected by two independent pipes with said water-chambers, the pipe F having a check-valve to permit the circulation from said water chamber or chambers in one direction only, substantially in the manner and for the purposes set forth.

5. The combination, with the fire-chamber, of an annular water-jacket surrounding the same, short tubes rising from said jacket, an overflow-chamber into the upper end of which said tubes discharge, radiating-pipes leading from said overflow-chamber through the space to be heated and back to the annular jacket, a condensing-drum having a pipe opening into the overflow-chamber below the upper ends of the short tubes, its other end extending into the condenser, and a second pipe leading from the bottom of the condenser to the annular water-jacket, the former pipe having a suitable check-valve to permit circulation from the overflow-chamber E to the condenser, substantially as and for the purpose set forth.

6. The combination, with the gas-coil *a*, having a series of Bunsen burners, *b*, of the annular jacket C, the conical chamber E, the tubes C′, and the radiating-pipes *e e′*, substantially as and for the purpose set forth.

7. The combination, with the jacket C and chamber E, of the tubes C′, the drum F, pipes F′ F″, and check-valves *g g′*, substantially as and for the purpose set forth.

8. The combination, with the jacket H, of the inner and shorter jacket, H″, both being

perforated throughout their lower part, a series of water-tubes arranged between said jackets, and a heating apparatus, substantially as and for the purpose set forth.

9. The combination, with the jackets H and H″, of a series of water-conducting tubes, C′, arranged between said jackets and the outer jacket, H′, substantially as and for the purpose set forth.

10. The combination, with the heater having two water-chambers, arranged as described, of a condensing-drum, its connecting-pipe passing from the heater directly through the space to be heated and thence back to the condenser, substantially as and for the purpose set forth.

11. The combination, with the flooring of a street-railway car, of the heater consisting of the water-chambers C E, tubes C′, a suitable heating apparatus, condenser F, and pipes F′ F″, and the radiating-pipes *e e′*, laid in said flooring and arranged within a space in front of and parallel with the lines of seats, substantially as and for the purpose set forth.

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

IRA A. SALMON.

Witnesses:

CHAS. B. TILDEN,

OSCAR LOW.