(No Model.) 2 Sheets—Sheet 1.

C. H. ROBINSON.

HEATING APPARATUS FOR RAILWAY CARS.

No. 462,740. Patented Nov. 10, 1891.

Fig. 1.

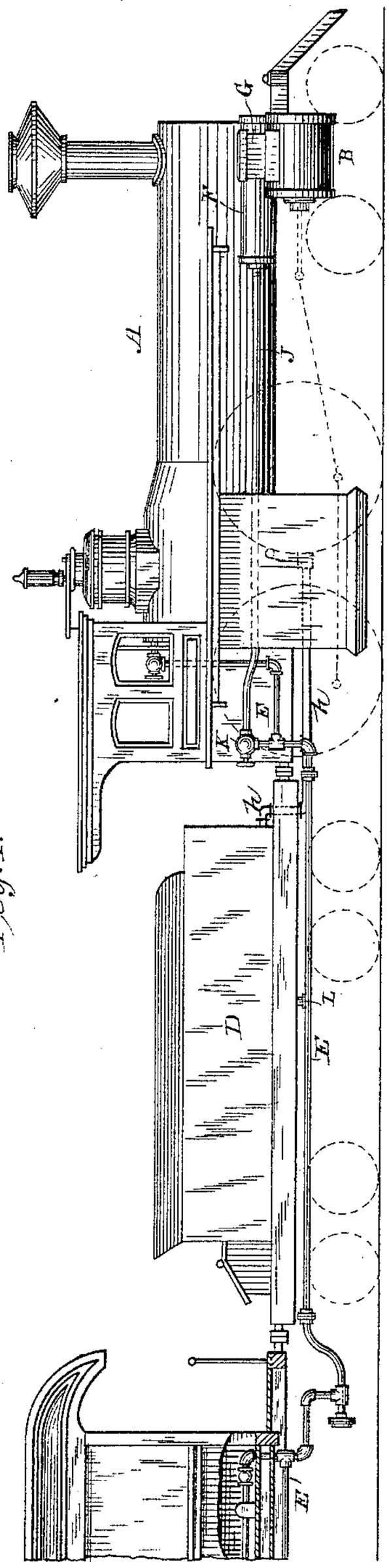
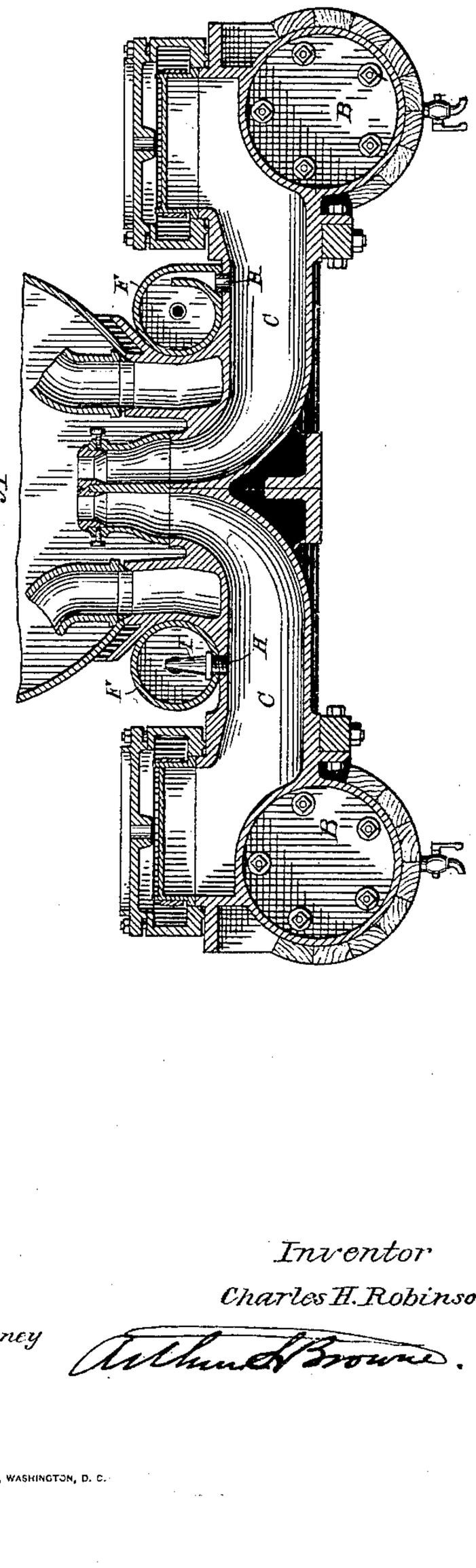


Fig. 2.



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(No Model.) 2 Sheets—Sheet 2.

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Fig. 3.

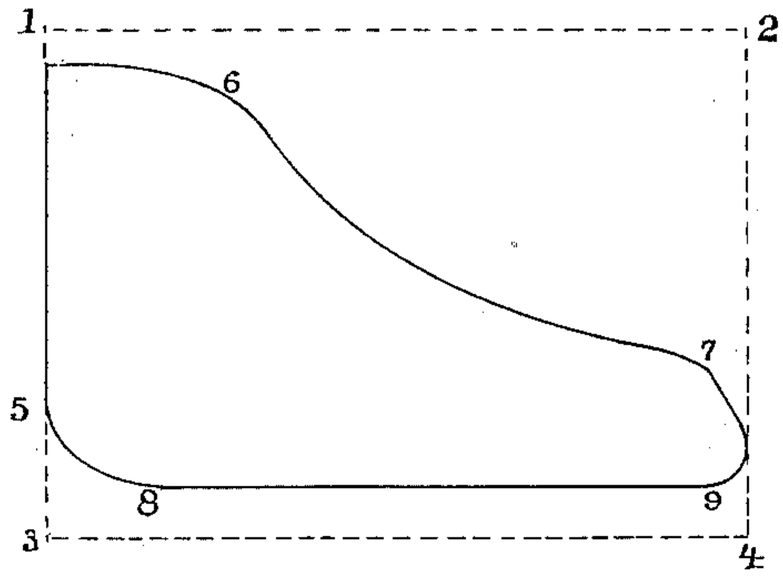
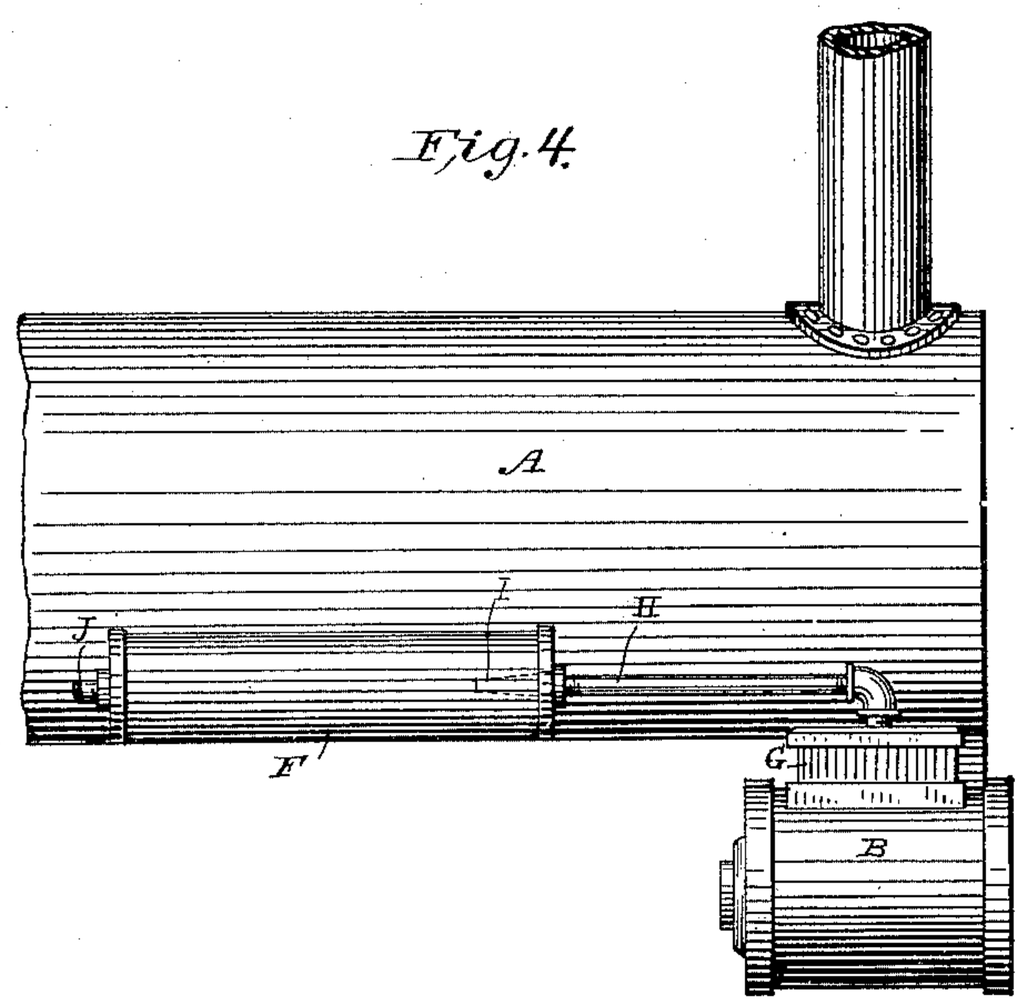


Fig. 4.



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UNITED STATES PATENT OFFICE.

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HEATING APPARATUS FOR RAILWAY-CARS.

SPECIFICATION forming part of Letters Patent No. 462,740, dated November 10, 1891.

Application filed January 30, 1888. Serial No. 262,425. (No model.)

To all whom it may concern:

Be it known that I, CHARLES H. ROBINSON, of St. Paul, in the county of Ramsey and State of Minnesota, have invented a new and Improved Heating Apparatus for Railway-Cars, of which the following is a specification.

This invention has for its object the heating of railway-trains by the exhaust-steam from the locomotive, the steam thus obtained being conducted throughout the train by a radiating system. In attempting to utilize the exhaust-steam, there are certain conditions which must be complied with in order to render the application practicable. The exhaust-steam is now relied upon to create the proper draft in the smoke-stack, and any attempt to utilize the exhaust-steam for other purposes must not interfere with this. The necessary appliances for utilizing the exhaust-steam must be automatic in operation, so as to require no attention from the engineer, should require no extraneous motor for their operation, should be simple and inexpensive in construction, and should be applicable to existing locomotives without necessitating any material change or alteration in their construction. In the various apparatus and systems which have hitherto been designed some one or more of these conditions have been disregarded, and as a consequence the general adoption of such apparatus which the exigencies of modern travel imperatively demand for the safety and comfort of the public has been prevented. The exhaust-steam utilized must be obtained under sufficient pressure to insure its circulation throughout the train, and to effect this it has been proposed to throttle or otherwise obstruct the exhaust-pipe so as to compel the exhaust-steam to find an outlet through the radiating system, a method which is objectionable, in that if a permanent obstruction is formed in the exhaust-passage the draft is permanently interfered with, and if a throttle-valve is used the draft is partly and occasionally obstructed, and the attention of the engineer is required for its manipulation. In other systems which attempt to utilize the exhaust-steam without interfering with the draft, some extraneous motor has been employed to draw the exhaust-steam into the radiating system, such as a small pump, rotary fan, or injector-nozzle, supplied with steam from the generator. Such systems are defective, in that they take steam from the generator which may be needed, require extraneous mechanism for their operation, and moreover, take the exhaust-steam continuously without reference to when it can best be spared. As is well known, the exhaust-steam from high-pressure cylinders—such as are employed on railway-locomotives—is under a considerable pressure during a small portion of the duration of the exhaust, which, however, rapidly diminishes after it escapes through the exhaust-port, so that its additional pressure is of little beneficial consequence as affecting the draft.

The object of the present invention is to utilize the exhaust-steam while it is still under this pressure for the purpose of supplying the radiating system, and also to convey the steam throughout the radiating system by its own impulse or pressure. In this manner the circulation of the steam is insured without recourse to extraneous motors, and only a small fraction of the exhaust-steam is taken during a portion of each stroke of the piston, so that the draft is not interfered with, and moreover the steam is taken at exactly the moment when it can best be spared.

In a pending application for Letters Patent, filed by me April 5, 1887, Serial No. 233,804, I have illustrated and described a system and apparatus operating upon the same general principles as the present invention. In said apparatus a fraction of the exhaust-steam is forced by its own pressure at each stroke of the piston into the radiating system, and in order to take the steam the radiating supply-pipe opens into the exhaust-passage as close as practicable to the exhaust-port. The connection is made without affecting any change in the shape or proportion of the exhaust-pipe and without making any obstruction therein, so that the exhaust escapes in its normal manner, with the exception of the small proportion which enters the radiating system. In said apparatus, however, an automatic steam-balanced valve is located in

the pipe connecting the exhaust-passage with the radiating system for the purpose of preventing the escape of the steam admitted into the radiating system back into the exhaust-passage when the pressure of the exhaust-steam therein ceases. The present invention differs from said prior apparatus mainly in dispensing with the automatic steam-actuated valve and in interposing between the exhaust-passage and the radiating system an expansion-chamber which is placed on the locomotive as close as practicable to the exhaust-passage, and into which opens a pipe connecting the same to the exhaust-passage, which connecting-pipe is connected with the exhaust-pipe in the same manner as in the prior application. It has been demonstrated by practice that the expansion of the steam from the exhaust within the expansion-chamber will prevent the escape back into the exhaust-passage of any material proportion of the steam, and that with a properly proportioned expansion-chamber the steam will be delivered therefrom into the radiating system at a pressure amply sufficient for all conditions and in pulsations at each stroke of the piston, so that a constant circulation through the radiating system is insured.

The radiating system preferably employed is one which has return-pipes through the train so that the steam may circulate continuously throughout the system.

The improved apparatus and system is illustrated in the accompanying drawings, in which—

Figure 1 is a side view of a railway-locomotive and a portion of a railway-train, showing the general location and arrangement of the improved apparatus in its preferred form. Fig. 2 is a vertical cross-section of the locomotive through the exhaust-pipes. Fig. 3 is a diagram showing the conditions of steam-pressure during the stroke of the piston; and Fig. 4 is a side view of a locomotive, showing a modified arrangement of the expansion-chamber.

A is a locomotive of the usual style for passenger traffic. B B are the steam-cylinders thereof. C C are the exhaust passages or pipes leading therefrom as usually constructed and arranged.

D is the tender of the locomotive, and E E is the system of radiating pipes which convey the steam to the train.

F is the expansion-chamber, from which the radiating system starts, and which receives the exhaust-steam. It consists in a cylinder of suitable dimensions and is located on the locomotive. Its preferred location on the locomotive, where the construction of the locomotive will permit, is immediately above the exhaust-passage, between the steam-chest G and the belly of the locomotive, as shown in Figs. 1 and 2, with its front end extending forward nearly as far as the body of the locomotive extends. It is thus brought as close to the exhaust-passage and as close to the exhaust-port of the cylinder as possible.

H is the pipe connecting the exhaust passage or pipe with the expansion-chamber. It opens into the exhaust-pipe without projecting therein immediately behind the steam-chest and enters the bottom of the expansion-chamber, its contracted nozzle I opening into the upper part of the chamber or at a point within the chamber remote from the entrance side of the chamber. The connecting-pipe is thus a short straight pipe extending at substantially right angles to the exhaust-pipe and opening directly without a bend into the expansion-chamber.

For the effective operation of the apparatus the expansion-chamber should be properly proportioned in dimensions with those of the steam-cylinder. In the ordinary passenger-locomotives the cylinder is sixteen inches in diameter and twenty-four inches stroke, and the diameter of the exhaust-nozzle about three inches. With such an engine the expansion chamber or cylinder should be from six to eight inches in diameter and from four to six feet in length, and the diameter of the connecting-pipe H should be about one and a half inches, and of its nozzle about three-fourths of an inch. While these proportional sizes admit of considerable variation and the invention is in nowise limited within the range specified, the dimensions are stated which give excellent practical results. If the expansion-chamber is too small, it will not take enough steam to supply the radiating system, and if it is too large it will take too much steam from the exhaust, and will act merely as a storage-reservoir and will not cause the circulation of the steam throughout the radiating system by the pulsations due to the successive strokes of the piston.

The operation of the apparatus will be best understood by reference to the diagram shown in Fig. 3, which illustrates the conditions of pressure within the cylinder. 1 2 represents the line of boiler-pressure, and 3 4 represents the line of atmospheric pressure. As locomotive-engines are non-condensing, the pressure never falls below the atmospheric pressure. 5 is the point of steam-admission, 6 the point of cut-off, 7 the point of the opening of the exhaust, and 8 the point of the closing of the exhaust. The curved line 5 6 7 8 represents the pressure during a complete stroke of the piston, the line 1 3 representing the limit of the piston's movement in one direction and the line 2 4 its limit in the other direction. During the backward movement of the piston from the line 2 4 to 1 3, while the exhaust is open, the pressure remains nearly constant; but at the point of the opening of the exhaust 7, which is effected just before the piston reaches the line 2 4 the pressure is considerably above the normal exhaust-pressure; but this high exhaust-pressure quickly falls to the normal exhaust-

pressure at the point 9 during the first part of the backward movement of the piston. The present apparatus is designed to take advantage of this period of high pressure, and it takes the steam only during this pressure, and during this period, while the piston is moving from 7 to 9, the expansion-chamber is supplied from the excess of steam which produces the excess of pressure. The usual exhaust-nozzles are proportioned so as to carry off the normal exhaust-pressure, and they do not carry off at once the excess of steam, so that a part of this excess of steam above the normal pressure finds its outlet through the connecting-pipe H into the expansion-chamber. The expansion-chamber thus takes only a portion of the exhaust-steam during only a portion of the exhaust and as only the excess of steam is utilized, it in no way interferes with the draft due to the exhaust. The location and relative arrangement of the exhaust and connecting pipes is of great importance to the successful operation of the system. The exhaust-passages are left, as usual, with no obstruction, and the connecting-pipe extends at right angles thereto and enters therein as close as practicable to the exhaust-port, so as to take the steam while at its greatest pressure. The steam is conveyed by the connecting-pipe through its contracted nozzle directly into the expansion-chamber, wherein the steam admitted expands, and so reduces the pressure. This reduction of pressure in connection with the contracted nozzle and its location within the chamber prevents the back escape of the steam into the exhaust-passage to any detrimental extent. The steam thus caught by the expansion-chamber is delivered by it to the steam-radiating system whose initial pipe J enters the expansion-chamber at its rear end. The expansion-chamber when of the proper size delivers the steam to the radiating system in pulsations at each stroke of the piston, and these pulsations cause the steam to circulate throughout the radiating system.

The apparatus as thus described, which embraces the essential and important features of the invention is of great simplicity in construction, and is perfectly efficient in operation, delivering the steam into the radiating system at an ample and sufficient pressure. It fulfills all the conditions essential for practical purposes, and its economy in construction and automatic operation add greatly to its utility and practicableness.

The expansion-chambers have so far been described as being located on only one side of the locomotive, but they may be and preferably are located on both sides, as shown in Fig. 2, so that double the amount of steam may be supplied.

In cases where the apparatus is applied to locomotives now in use, whose construction does not admit of the location of the expansion-cylinder immediately alongside the steam-chest, it may be located behind the same, and the nozzle I will enter the head of the cylinder in a horizontal direction, there being an elbow in the connecting-pipe, as shown in Fig. 5.

In order to regulate the pressure in the radiating system, a pressure-regulator or a regulating or reducing valve of any suitable construction, of which there are many known, may be located at any convenient point between the expansion-chamber and the first car, as indicated at K.

I claim as my invention—

1. In a railway-car-heating apparatus, the usual exhaust-pipe of the locomotive communicating at all times in the usual manner with the locomotive smoke-stack to create a draft therein, in combination with an expansion-chamber located upon the locomotive, a pipe connecting said chamber and exhaust-pipe, said connecting-pipe establishing communication at all times between said expansion-chamber and said exhaust-pipe, and a radiating system connected to said expansion-chamber, substantially as set forth.

2. In a railway-car-heating apparatus, the radiating system, the usual exhaust-pipe of the locomotive communicating at all times in the usual manner with the locomotive smoke-stack to create a draft therein, in combination with an expansion-chamber located upon the locomotive which communicates with said radiating system, and a connecting-pipe which establishes communication at all times between said exhaust-pipe and said expansion-chamber, said connecting-pipe having a discharge-nozzle centrally located in said chamber, substantially as set forth.

3. The radiating system of a railway-car-heating apparatus and the usual exhaust-pipe of the locomotive communicating at all times in the usual manner with the locomotive smoke-stack to create a draft therein, in combination with an expansion-chamber, located upon the locomotive in close proximity to the steam-cylinder, which supplies steam to said radiating system, and a connecting-pipe which establishes communication at all times between said exhaust-pipe and said expansion-chamber, said connecting-pipe opening into said exhaust-pipe in close proximity to the exhaust-port, substantially as set forth.

4. The radiating system of a railway-car-heating apparatus and the usual exhaust-pipe of the locomotive communicating at all times in the usual manner with the locomotive smoke-stack to create a draft therein, in combination with an expansion-chamber, located upon the locomotive in close proximity with the steam-cylinder, which supplies steam to the said radiating system, and a connecting-pipe which establishes communication at all times between said exhaust-pipe and said expansion-chamber, said connecting-

pipe opening into said exhaust-pipe in close proximity to the exhaust-port, and said connecting-pipe offering no obstruction to the exhaust-passage and extending therefrom at substantially right angles thereto, substantially as set forth.

5. The radiating system of a railway-car-heating apparatus and the usual exhaust-pipe of the locomotive communicating at all times in the usual manner with the locomotive smoke-stack to create a draft therein, in combination with an expansion-chamber, located upon the locomotive alongside the steam-chest and immediately above the exhaust-pipe, which supplies steam to the radiating system, said expansion-chamber being always in communication with said exhaust-pipe, substantially as set forth.

6. The radiating system of a railway-car-heating apparatus and the usual exhaust-pipe of the locomotive communicating at all times in the usual manner with the locomotive smoke-stack to create a draft therein, in combination with an expansion-chamber, located upon the locomotive alongside the steam-chest and immediately above the exhaust-pipe, which supplies steam to said radiating system, and a connecting-pipe having a contracted nozzle within said expansion-chamber, which establishes communication at all times between said expansion-chamber and said exhaust-pipe, substantially as set forth.

7. The radiating system of a railway-car-heating apparatus and the usual exhaust-pipe of the locomotive communicating at all times in the usual manner with the locomotive smoke-stack to create a draft therein, in combination with an expansion-chamber located upon the locomotive alongside the steam-chest and immediately above the exhaust-pipe, which chamber supplies steam to said radiating system, and a connecting-pipe having a contracted nozzle within said expansion-chamber, which establishes communication at all times between said expansion-chamber and said exhaust-pipe, said connecting-pipe opening into said exhaust-pipe in close proximity to the exhaust-port, and said connecting-pipe offering no obstruction to the exhaust-passage and extending therefrom at substantially right angles thereto, substantially as set forth.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

CHARLES H. ROBINSON.

Witnesses:

R. B. WHITACRE,

JOHN GRUBER.