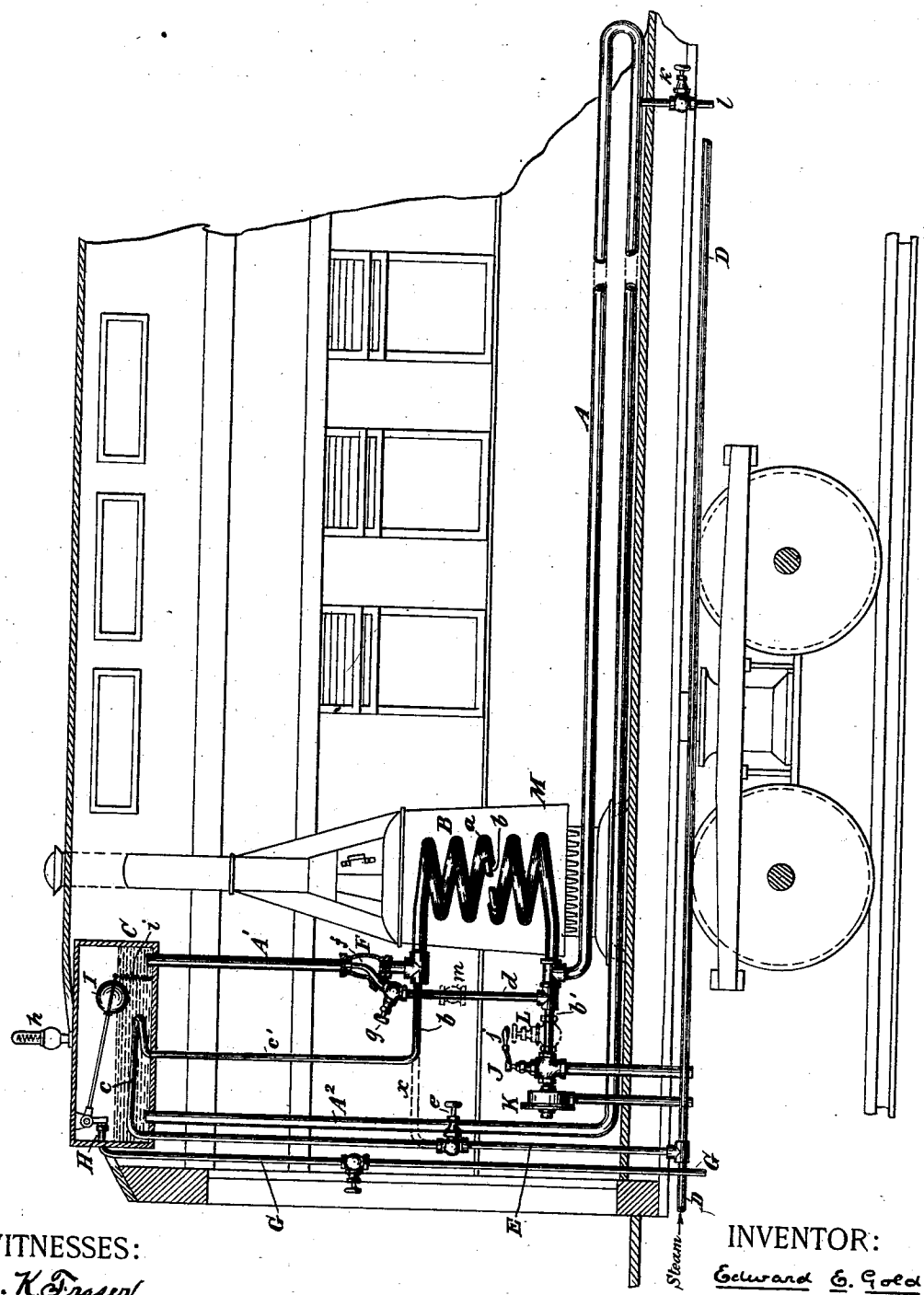
(No Model.)

E. E. GOLD.

STEAM HEATING SYSTEM FOR RAILWAY CARS.

No. 508,132. Patented Nov. 7, 1893.



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STEAM-HEATING SYSTEM FOR RAILWAY-CARS.

SPECIFICATION forming part of Letters Patent No. 508,132, dated November 7, 1893.

Application filed April 28, 1890. Serial No. 349,777. (No model.)

To all whom it may concern:

Be it known that I, EDWARD E. GOLD, a citizen of the United States, residing in New York city, in the county and State of New York, have invented certain new and useful Improvements in Steam-Heating Systems for Railway-Cars, of which the following is a specification.

This invention relates to heating systems intended particularly for railway cars, although adaptable also to dwellings and other buildings, of the class wherein the heat derived from steam is communicated to a liquid circuit, which in turn radiates the heat to the car or apartment. In such systems it has been proposed to heat the water in the liquid circuit by injecting steam directly into it. My invention provides an improved heating system or apparatus involving this principle in a modified form, whereby certain advantages are secured which will be hereinafter fully pointed out.

According to my invention I provide the car or other apartment with a pipe or sections of pipes arranged to form a complete circuit, and in some suitable part of this circuit I connect or apply a heater constructed to be heated by steam in order to communicate the heat of the steam to the water of the radiating circuit and thereby cause the latter to circulate to renew continually the heat which is lost by radiation. Steam is admitted to this heater from any suitable source of steam and through any suitable pipe, and in its passage through the heater it gives up so large a portion of its heat thereto that it is in part or wholly (as the case may be) condensed. The condensed steam, or mixture of steam and water of condensation, passing from the heater is conducted through a suitable pipe to an injector nozzle entering the water circuit, so that the condensed steam or water is thrown in a jet into the water circuit in such manner as to not only induce a circulation therein in co-operation with the circulation caused by the steam-heater, but also by being itself commingled with the water to augment the heat imparted to the water circuit. By preference the jet enters the water column immediately beyond the heater where it mingles with the hottest water, and being itself reduced to its lowest temperature by having given up its heat during its passage through the heater, the difference of temperature between the steam or condensed water on the one hand and the hot circulating water on the other is so reduced as to avoid the snapping or crackling of the pipes which has hitherto been a most insuperable objection to the introduction of systems wherein the water circuit is heated by the direct introduction into it of steam. To provide for the continual increase of the volume of water in the radiating circuit due to the injection of condensed steam, the ordinary expansion chamber provided with hot water circulating systems is furnished with a float-valve constructed when the water level rises above a certain height to open and permit the excess of water to escape.

My invention also comprehends means for cutting off the action of the steam jet or injector and for enabling the steam to be used in the same manner as in my previous car-heating systems, being discharged from the heater from time to time through a thermostatic trap or a dynamic relief valve.

The accompanying drawing is a longitudinal section of a portion of a railway car showing the preferred application of my invention.

Referring to the drawing, let A indicate the pipes of an ordinary water-heating or radiating circuit extending throughout the car, usually near the floor thereof, and arranged in any way known to the art. These pipes are shown in the drawing in a somewhat diagrammatic manner, their particular arrangement in bends beneath the seats, and the means for carrying them across from one side of the car to the other beneath the floor thereof, which is already well understood in the art, not being indicated.

B designates the steam-heater applied to this circuit, and consisting essentially of a liquid passage or space forming part of the water circuit and a steam passage or space arranged to impart the heat of the steam to the water. It consists in the particular construction shown of a double coil of pipe, a smaller or steam-pipe *b* being inserted within a larger or water pipe *a* and the two coiled together. The water pipe is joined at its ends

to the pipes of the water-circuit A, so as to form a part thereof, and the ends of the steam-pipe *b* pass outside thereof. The water circuit thus consists of radiating pipes on the floor of the car, the pipe *a* of the heater coil, the ascending water pipe A′ being an extension of the upper end of the coiled pipe *a* which reaches to an expansion chamber or tank C, and a descending pipe A^2 leading down from this tank to the floor of the car. The water circulates upwardly through the spiral heater coil and through the pipe A′, and downwardly through the pipe A^2, and thence back and forth through the going and returning radiating pipes, as indicated by the arrows.

The pipe D is the main steam supply pipe extending from end to end of the car. This pipe is designed to be fitted at its ends with couplings for uniting to the steam-pipes on the adjoining cars in order that the steam from the locomotive boiler may be passed through the train from car to car. From the pipe D leads a branch pipe E provided with a hand-valve *e* for controlling the flow of steam through it. This pipe E might pass directly, as indicated by the dotted lines at *x*, to the heater B so as to communicate with the steam-pipe *b* thereof, but by preference it is carried up into the expansion tank C and coiled once or more times, as shown at *c*, therein in order to impart heat to the water in said tank, after which it is carried down at *c′* and connects with the pipe *b* of the heater B.

The precise construction and arrangement of the pipes are not essential, it being only necessary that some means under the control of the train hands shall be provided for admitting steam from the main pipe D into the pipe *b* of the heater. The steam should be admitted at the upper end of this pipe so that the steam shall pass through the heater in the opposite direction to the water in order that the hottest steam shall act upon the hottest water, and the steam as it is cooled in its descent shall act upon the successively cooler portions of the water column. This arrangement also insures that the water of condensation as it forms shall descend within the heater coil so that it may be expelled from the bottom thereof, and so that its discharge shall be aided by the current of steam. The pipe *b* on its emergence from the lower end of the heater coil connects with a pipe *d* which ascends and terminates in the nozzle *f* of an injector F arranged in connection with the ascending water-pipe A′. This pipe *d* is provided with a valve or cock *g* by which the flow through it can be regulated or shut off.

The steam in its passage through the heater coil B will rapidly impart its heat to the water flowing past it in the annular space between the pipes *b* and *a*, and will usually be wholly or almost wholly condensed by the time it reaches the bottom of the coil. The condensed water will then flow by reason of the pressure of the steam behind it through the pipe *d* and will be injected through the nozzle *f* into the ascending column of water in the pipe A′, thereby adding its heat to that of the water. Thus every portion of the heat of the steam is utilized in imparting heat to the water, and the force of the jet is utilized to reinforce the current induced by the action of the heater. The water from the radiating pipes A entering the bottom of the heater-coil encounter first the coolest portion of the steam-pipe *b*, being that wherein the condensed water is accumulated, and passes upwardly through the coil, encountering continually a hotter portion of the steam-pipe, and being continually heated to a higher and higher degree, until finally, immediately after its emergence from the coil, it receives the jet of condensed water, or of mingled steam and condensed water, within the injector F, by commingling with which its temperature is still further raised.

The expansion chamber or tank C is a closed vessel designed to be filled with the water of the circulating system up to a certain level, and above that level to contain air or steam preferably under pressure. The pressure is limited by means of a safety valve *h* opening outwardly from the upper part of the tank, and which may be set to open at any desired pressure. From the tank an overflow pipe G extends outside the car, preferably passing down through it and discharging beneath the floor. The outflow of water through this pipe is determined by a valve H controlled by a float I. This valve may be any suitable construction of float valve arranged to be closed when the float is down and to open when the float is raised by the ascending water above a predetermined level. It is consequently an inversion of the float-valves commonly used for admitting a water supply. The purpose of this float-valve and overflow pipe is to automatically discharge from the water-circulating system the excess of water over the proper normal volume. The condensed water thus being continually added to this system while the apparatus is in operation in the manner already described, would soon entirely fill the chamber C and destroy its function as an expansion chamber were it not for the provision of this automatic overflow valve. To prevent the undue vibration of the float by reason of the movement of the car while running, it is drawn down by a spring *i* which thus takes the place of the weight commonly applied to floats to sink them to the proper depth into the water.

The lower end of the steam-coil *b* in the heater B is connected not only with the jet-pipe *d* but also with a pipe *b′* extending horizontally, and provided first with a dynamic trap-valve J, and second, with a thermostatic drainage trap K. Both these valves are now so well known in the art as to require no particular description. Suffice it to say that the valve J is constructed when its operating handle *j* is in one position to open automati-

cally by a spring when the steam pressure is relieved, and to be closed by the pressure of the steam against it; when the handle is in a second position, to be opened so as to cause the steam to flow through the valve; and when the handle is in a third position, to be closed tight so that no steam can pass through. The thermostatic trap K is constructed to open automatically when the temperature falls to a predetermined point to discharge the cooled water of condensation, and to close whenever steam or hot condensed water passes through it. By the use of these two valves, J and K, the steam-pipes *c c' b d* may be emptied of water of condensation after the steam has been turned off. This will be done by the relief valve J whenever the condensation and contraction of the steam becomes sufficient to relieve the pressure and enable the spring to open the valve; or if the valve J should chance to be closed the same result will be accomplished a little later by the thermostatic trap K when the condensed water has cooled sufficiently to contract and open this trap. Furthermore, by opening the valve J as a blow-off valve the steam may be caused to blow through the heater in order to thaw out or quickly heat up the water-circuit. If it be desired to cut the valves J and K out of action a separate hand-valve or stop-cock L may be provided, as shown in dotted lines, but this is not essential as the trap K will be closed, and the valve J may be closed, at all times when it is desired to circulate the steam or condensed water through the pipe *d* and injector F.

It may sometimes occur when the car is out of use for a considerable time that the water in the tank C will freeze, thus locking fast and choking the float-valve. It is desirable that when the car is connected in a train some means should be provided for thawing out the water in the tank in preference to any other part of the liquid circuit. It is for this purpose that the steam-pipe E is carried up into the tank and formed with the coil *c*. The passage of steam into the coils *c* and *b* upon the opening of the valve *e* is insured by the steam-pipes being emptied through the action of the trap-valves J and K, as above described. Hence by opening the valve *e*, and more or less opening the valve J, the steam is caused to blow through the steam-pipes until any ice in the tank C and heater B is thawed out, after which the thawing out of the rest of the circuit will soon ensue upon the warming up of the car.

If desired the water may be drawn from the liquid circuit A whenever the car is to be thrown out of service, by opening a valve *k* in the drainage pipe *l* leading from the lowest part of the circuit. In such case it will be necessary to refill the water circuit before the heating apparatus can be again used, which can be done either by connecting any part of the circuit with a city main to flow the water through, which is the preferable way, or the circuit can be recharged with condensed water by passing steam continuously into it, which, however, is disadvantageously slow.

The escape of water from the tank C through the pipe A', nozzle *f*, pipe *d* and valves J or K when the apparatus is out of service, is preferably prevented by constructing the valve *g* as a combined stop-cock and check-valve, of which numerous constructions are now known in the art. If a simple shut-off valve is used at *g* this valve should be closed when the steam is turned off; or a separate check-valve may be introduced in the pipe *d*, as shown in dotted lines at *m*.

I have shown the heater B as arranged within a car-stove M, after the construction shown in my Patent No. 388,772, dated August 28, 1888. This is in order that when the car is disconnected from the source of steam it may be heated by building a fire in the stove M, which will not only radiate the heat directly, as with all car-stoves, but will heat the water in the pipe *a* and thereby cause a circulation in the liquid circuit A radiating heat to all parts of the car after the manner of what is known as the "Baker system" of car heating. Thus the car may be heated up to receive passengers before being connected in the train, or kept warm after being diconnected from the locomotive.

By closing the valve *g* (and opening the hand-valve L, if such valve be provided), my improved apparatus may be operated in exactly the same manner as my previous apparatus shown in my said patent, that is to say, the feature of the injection of condensed or spent steam into the water column A' may be disused and the water-circuit heated solely through the medium of the heater B. In that case, as fast as the condensed water in the steam-coil cools it is automatically discharged through the trap K, thereby admitting from time to time fresh steam into the heater B.

My invention may be modified in numerous ways without departing from its essential features. For example, the heater B instead of being constructed of two pipes coiled together may be of any other suitable construction, of which many are known in the art, wherein steam confined in one space or chamber can transmit its heat through an intervening conducting wall or plate to water confined in an adjoining space or chamber, the steam space or chamber being connected through a suitable pipe with the source of steam, and the water space or chamber connected in the radiating circuit A. The injector F may be variously constructed, numerous types of injectors being known in the art. Either of the trap-valves J or K may be omitted, or both may be dispensed with, and any simple blow-off or discharge valve be used instead. Other means than the overflow valve H with its operating float I may be employed for discharging the accumulating excess of water from the chamber C. The radiating circuit A instead of consisting of pipes carried through a car

or apartment may consist of heating vessels or radiators of any other kind or construction, of which numerous different devices are known to the art of heating by steam or water circulation.

I am well aware that heating apparatus for cars, &c., have been constructed or proposed in which the water in the radiating circuit is heated by the direct injection of steam into it. In such cases, however, the steam has been injected directly into the water circuit instead of having been first reduced in temperature by giving up its heat to the water-circuit, and the resulting spent or condensed steam being then injected into the water. With the constructions heretofore proposed the snapping or crackling of the pipes has been so annoying as to practically preclude their introduction into use. My invention wholly avoids this difficulty, and combines the advantages of heaters operating by conduction alone and those operating by the injection of steam into the water.

I claim as my invention the following-defined novel features or improvements, substantially as hereinbefore specified, namely:

1. The combination of a radiating liquid circuit, a steam heater comprising a steam heated liquid passage forming part of said circuit, and adapted to both heat and circulate the liquid, and an injector connected to receive the spent or condensed steam from said heater and inject the same into the liquid circuit.

2. The combination of a radiating liquid circuit, a steam-heater in connection therewith adapted to both heat and circulate the liquid and an injector arranged in the hottest part of the liquid circuit in contact with the liquid which has just traversed the heater and connected to receive the spent or condensed steam that has traversed the heater.

3. The combination of a radiating liquid circuit, a heating stove in connection therewith to impart heat thereto, a steam-heater in connection therewith whereby the liquid may be heated and circulated through said circuit by either steam or fire or both, and an injector connected to the hottest part of said circuit and adapted to inject steam thereinto.

4. The combination of a radiating liquid circuit, a steam-heater in operative contact therewith, a steam-pipe for supplying said heater, an injector in said liquid circuit, a pipe for conducting spent or condensed steam from the heater to said injector, a valve in said pipe, and a valve or trap through which the condensed steam may be discharged from said heater, whereby the heating apparatus may be operated with or without the injection of spent or condensed steam into the liquid circuit.

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

EDWARD E. GOLD.

Witnesses:
GEORGE H. FRASER,
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