The invention relates to improvements in train heating systems utilizing heat boosters in the form of small automatically-fired evaporators fed with condensate from the train-heating line and returning the steam generated therein to the train-heating line.

The practical advantage of such a heat booster is understandable by analysing why the adequate heating of a long train of passenger cars from the boiler on a steam locomotive or other engine is, admittedly, a very difficult undertaking. For a given steam pressure at the locomotive end of the train heating line, the maximum amount of steam per hour which can enter the heating line, and therewith the total heat of condensation of that steam, is fixed by the internal area of the train-heating pipe; that maximum quantity of heat units is all that can get into the pipe regardless of whether the weather is mild or severe, or whether little or much steam is condensed in the heating of the train. Whenever the steam pressure at the locomotive heater valve is raised to the maximum which still insures trouble-free service of the car-heating equipment, one has reached the limit of heat supply which can be transmitted to the train from the locomotive. To increase it for meeting abnormal conditions of train length—and such abnormal conditions are fairly frequent in modern railroad operation, due to far reaching consolidations of trains—some railroads have increased the internal area of the train-heating pipe. This method of increasing the train-heating effect is, however, not the most economical one inasmuch as the condensation loss within the train-heating pipe is thus still further increased, in fact, in direct proportion to the heating pipe diameter. Condensation in the train line has always caused an undesirably large waste in train heating because this pipe is mounted under the car and as a rule inadequately insulated. Further, the use of a larger train-heating pipe represents no real advance from a system of train-heating which is inherently incapable of providing uniformity of heating effect in a long train. It should not be overlooked that when feeding heating steam into a long train-line extending under many cars and having many bends, twists, condensate pockets, etc., the pressure at which the steam in the car radiators condenses becomes lower as the distance from the locomotive increases, and therewith the temperature of condensation. Thus, with the maximum allowable steam pressure on the car next to the locomotive and the heating valves on all cars fully open, it is impossible to heat the last car to the temperature maintained in the car next to the locomotive.

My car heating booster could be made to maintain in every car the pressure existing at the locomotive end if the auxiliary boiler on a car were made to evaporate all the condensation of both the car radiators and the train-line and to discharge all evaporated condensate back into the train-line. This would, however, be paramount to having a big enough auxiliary boiler for every car to heat the car independently of the locomotive, besides making up for the incidental train-line loss. In practice, this would be too expensive, both for fuel and first cost of required apparatus. Therefore, as far as the car-heating auxiliary boiler is concerned, it would be economical only to the extent of rebuilding the train-line pressure as actually needed in order to keep people comfortable in the last cars of the train in severe weather.

The particular equipment described hereafter is quite flexible in this respect because the condensate from any number of the car radiators can be either drained to the ground, as in the present practice, or else drained into the train-line from where it enters the auxiliary boiler. Since, as will be seen, the fire in the furnace of the auxiliary boilers comes on and off automatically so as to keep the evaporator water level below a fixed height, fuel from the car supply is burnt only as actually required for the evaporation of the condensate allowed to drain into the evaporator.

A fuel saving will be an incidental advantage of the installation of auxiliary boilers. Without them more condensate has to be wasted to the track than with them, and, since an appreciable amount of heat is contained in the blown-off condensate, the loss is reduced. Also, it is not unusual for the train crew to leave the train-line at its rear end fairly open in severe weather, in order to keep it continuously freed of the condensate that rapidly forms in it. This occasions another considerable heat loss by steam flow from the end of the train-line which can be saved when auxiliary boilers take care of the train-line condensate. For the same reasons, the heating load to be carried by the boiler of a steam locomotive is reduced and more of its evaporative capacity may be devoted to the locomotive engines etc., and also help to create additional locomotive boiler draft.
In the accompanying drawing:
Figure 1 is a diagrammatic view of a train heating system embodying my invention;
Figure 2 is a transverse sectional view through an auxiliary boiler carried by one of the train cars.
Figure 3 is a partial longitudinal sectional view corresponding to Figure 2; and
Figure 4 is an enlarged sectional view of a thermostatic drain plug utilized in the auxiliary boiler.

Referring to Figure 1, the steam locomotive or other engine has a boiler supplying steam to the train heating line, each car having a pipe section 10 coupled in series with those of other cars. The space heating radiators on each car have shut off valves 12 and condensate drain pipes 13 discharging to the track at 14 or back into the line 10 as determined by the valves 15, 16. An auxiliary boiler 20 is mounted under the car and below the train-heating line and connected to the latter at points 21, 22, as described more fully hereinafter. A fuel supply line 23 connects the evaporator 20 with a fuel supply container 24. Valves 18 when opened, after closing valves 15, allow the condensate to drain from radiators 11 into the evaporator 20 at points 22 rather than to the track.

As appears in Figs. 2 and 3, the train-heating pipe 10 has interposed therein a casting 25 formed with the condensate drain outlets 22 which connect at 26 into the evaporator 20. Here also is steam outlet 21 connecting the dome 27 of the evaporator with the train line 10. Gaseous fuel is piped from fuel container 24 through gas valve 30 to one or more gas burners 31. Supply of auxiliary air is controlled by a damper 32 and the gas is ignited by a hot wire 33. Electrodes 34 extend into the steam and water space of the evaporator and are connected electrically to the battery 35 and a solenoid 36. When the water level in the evaporator rises high enough to contact the electrodes, the core of the solenoid moves damper 32 from closed to the open position. Through a rod 37 it opens gas valve 30 simultaneously. During the opening movement a cam 38 on rod 37 moves hot wire 33 further into the inside of the combustion chamber, thus causing ignition and compressing spring 39. When damper 32 is fully open, spring 39 withdraws the hot wire 33 from the combustion chamber into a pocket in its brick lining. As soon as the water sinks to a level below the ends of electrodes 34, the solenoid 31 is deenergized from the thruster and hot wire also is disconnected. A spring associated with the solenoid then moves the latter's core so as to close the damper 32 and gas valve 31 shutting off the fire.

I prefer to have no insulation on the train-heating pipe 10 and to encase the latter in sheet metal pipe 40 which extends the length of the car and ends in open, downwardly bent elbows 41. As indicated in Figs. 2 and 3, the space between pipes 10 and 40 communicates with the breeching of boiler 28 so that the gases of combustion issuing from its flues at a still elevated temperature flow through this annular space to the atmosphere at either or both ends of the car. The thus formed annular gas film serves not only as a good protection to the train-heating line against loss of heat but also provides an extension of the evaporator heating surface, thereby allowing the forcing of the flues of the evaporator proper without too great a residual heat loss in the escaping gases.

The working of the arrangement is believed clear from the foregoing description. Any condensate forming in or allowed to get into the train-heating line, drains into the evaporator at 22 and usually is of such temperature that an addition of heat to it will readily evaporate it. The steam generated enters the train-line at 21. Heating and evaporation only occur when the condensate level is above X-X and below that level the evaporator is shut down automatically. An electrical or mechanical timing device may be utilized if desired to keep the burners 31 in operation for a determined time after contact of water with electrodes 34 and thus avoid "hunting".

In order to prevent freezing of water in the auxiliary boiler when the car is disconnected from the main heating boiler on the locomotive or other engine, a thermostatic drain valve 42 (Figs. 3 and 4) is provided. In Fig. 4, showing this valve in enlarged section, a valve 43 is held to its seat against spring 44 by the pressure in the evaporator 20 and by the gas pressure within a diaphragm 45, which results from gas expansion due to heat. Whenever the car is disconnected from a source of steam, thereby causing the pressure and temperature in the evaporator to decrease sufficiently, the valve opens and drains the water contents of the evaporator slowly to the track.

What I claim is:

1. In a train heating system having a main boiler supplying steam to radiators in cars of the train through a train heating line, separately fired, auxiliary boilers carried by the cars provided with water chambers receiving condensate from said heating line and heaters, and fuel burning means individual to said auxiliary boilers; a direct connection from each auxiliary boiler to said train heating line for returning directly thereto the steam generated from said condensate means responsive to the amount of condensate in the water chamber of an auxiliary boiler for automatically placing its fuel burning means in operation when a predetermined amount of condensate from steam supplied with water chambers accumulates in said chamber and for discontinuing the operation of said fuel burning means upon evaporation of a determined amount of condensate and return thereof as steam to said train heating line.

2. In a train heating system having a main boiler supplying steam through a train heating line to radiators in each car, valved connections from said radiators through which the condensate within the radiators may be drained to the track, an auxiliary boiler consisting of a condensate evaporator connected into said train heating line, and additional valved connections from each radiator for discharging the radiator condensate into said train-line and evaporator instead of to the track; and a flue for said auxiliary boiler surrounding a part of said train heating line.