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2,181,436

THERMOSTATICALLY CONTROLLED HEATING SYSTEM FOR RAILWAY CARS

Filed June 19, 1937

3 Sheets-Sheet 1

FIG. I.

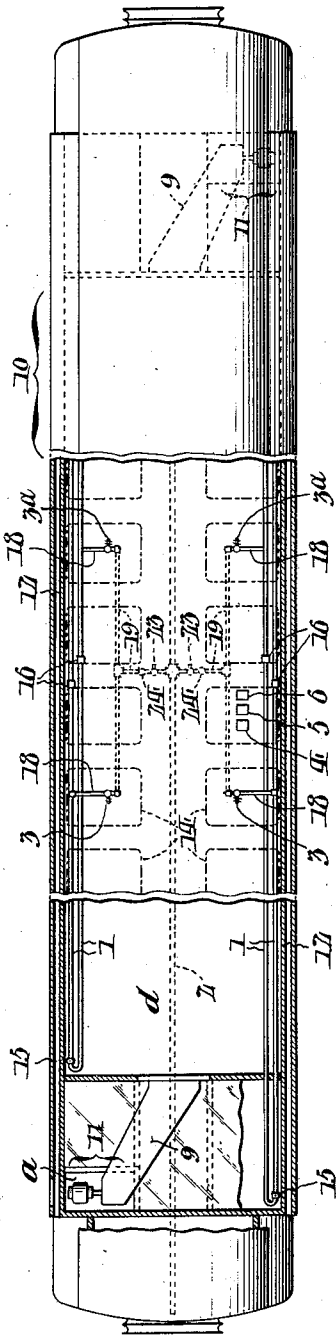
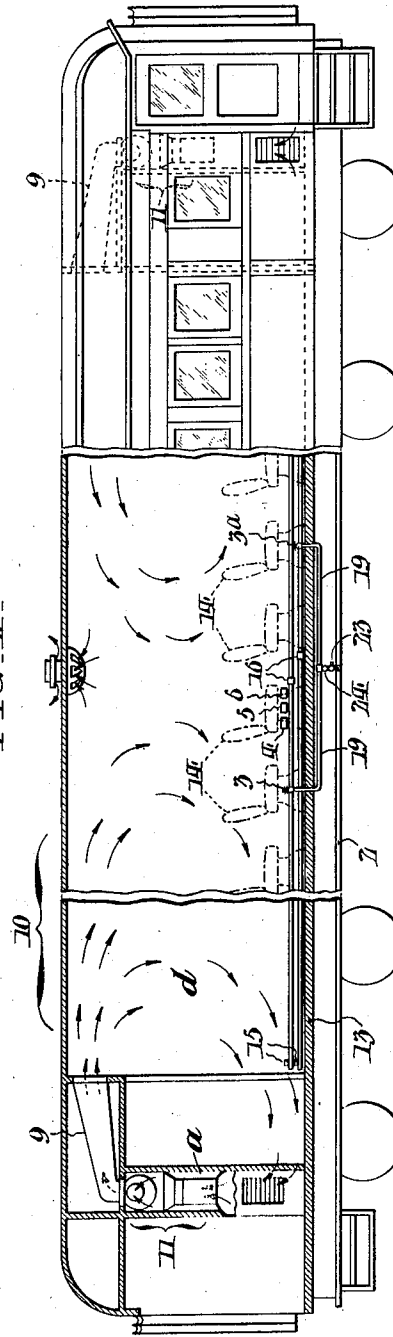


FIG. II.



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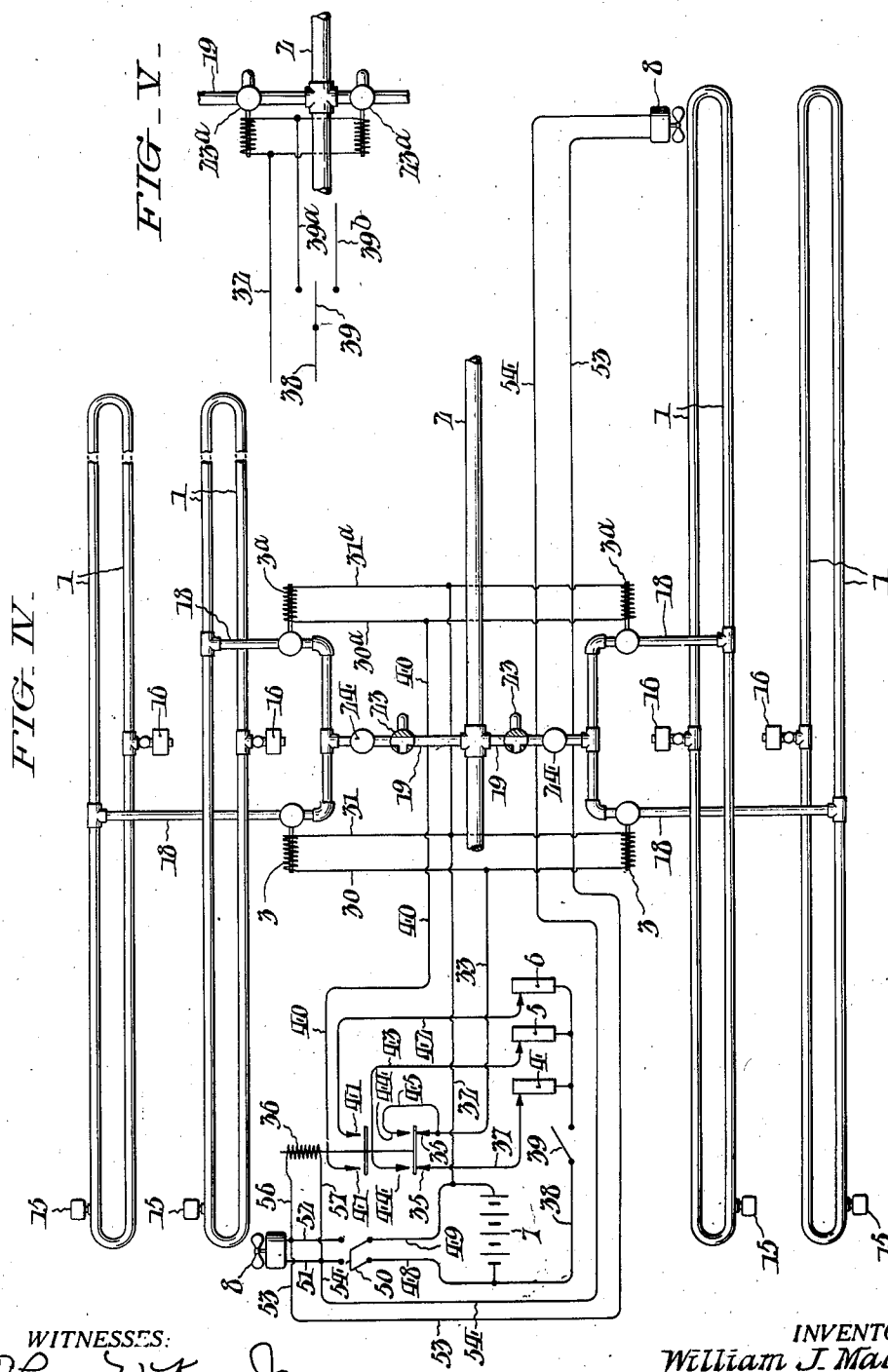
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UNITED STATES PATENT OFFICE

2,181,436

THERMOSTATICALLY CONTROLLED HEATING SYSTEM FOR RAILWAY CARS

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7 Claims. (Cl. 237—6)

My invention relates generally to thermostatically controlled heating systems for railway cars and more particularly to a thermostatically controlled heating system as an auxiliary to air conditioning in a car.

In the development of air conditioning for railway cars, it has become apparent that something must be done to control the conventional side wall radiation system of heating to function as an auxiliary to the air conditioning. At present, the air conditioning of railway cars is somewhat hampered by the usual wall radiation system which is lacking in automatic control. Further, the air conditioning system and the separate wall radiation system tend to interfere with each other because of a lack of coordination between them. The independent operation of these two systems result in unequal heating in the passenger space and certain fluctuations which are to be avoided if possible.

Consequently the main object of my invention is to provide a system of regulation for the conventional wall radiation system on passenger cars which will be automatic in character and coordinated with the air conditioning system of the car. Another object is the provision of such a regulatory system which will be simple, efficient and easily applicable to the present wall radiation systems now in use in passenger cars. Further objects and advantages of my invention will become apparent from the following detailed description of a preferred embodiment thereof, reference being had to the accompanying drawings.

Fig. I of the drawings shows a plan view of a passenger car, partially in section, equipped with my invention.

Fig. II is a side view, partially in section, of the same.

Fig. III is a partial transverse section of the car shown in Figs. I and II, showing the heating unit.

Fig. IV is a diagrammatic view of the wall radiation system of the car shown in the above figures, with the automatic regulatory feature provided by my invention.

Fig. V is a schematic diagram for electrical interlocking of heating and cooling.

For the purpose of a detailed description of the embodiment of my invention shown in the drawings, it may be analyzed into the following major elements: heating loops or coils 1, connected to a train steam line 2, electrical control valves 3 and 3a, thermostats 4, 5 and 6, source of electrical power 7, and air conditioning blower

8. The associated electrical wiring will be taken up after I have described the heating system proper.

The steam heating system is of the type now in general use but in my invention it becomes an auxiliary heating system in conjunction with the main air conditioning system. In Figs. I and II a conventional railway passenger car 10 is shown equipped with an air conditioning system, such as shown in my prior United States Patent No. 2,084,155, dated June 15, 1937. An air conditioning unit 11 positioned in one end of the car 10 is shown in the drawings and in Fig. III this unit 11 is shown in further detail. This unit 11 briefly comprises a vertical conduit *a*, Fig. III, having inlet ducts *b*, *c*, respectively, for admission of atmospheric air and air withdrawn from the passenger space *d*, said ducts opening into a common mixing chamber *e*, of the conduit *a*, with an intervening upwardly-active deflector *f* and a baffle or tray *g*, whereby the mixed air is swirled into a surface cooler *h*, with an associated heater unit *i* for use in cold weather, and from whence the conditioned air is drawn out into the blower 8 for discharge into the upper portion of the car 10 through a duct 9 as indicated by the arrows in Figs. II and III. Or any other type of efficient air conditioning unit may be employed with equal advantage. The auxiliary steam heating system of my invention is positioned at the bottom of the car 10 and in that way the two systems are complementary in operation so far as heat distribution is concerned. The actual electrical coordination resulting in a unity of control will be referred to in detail below.

The loops 1 are of the usual type and are placed at either side of the car 10 in pairs along inner wall 12 near floor 13 under seats 14. Thermostatic vents 15 of a usual type are provided to insure proper drainage of each loop 1 when the steam is shut off and to permit the escape of air from the loops 1 in order to insure rapid heating when steam is admitted. Each loop 1 has a trap or loop drain 16 of a usual type of steam trap by which the condensate in the loops 1 is vented to atmosphere. Steam is supplied to these loops 1 near the center of the car as is shown in the drawings, and these traps 16 are also positioned near the center of the car 10 so that uniform heat distribution is obtained in this manner. Each loop 1 has a connection 18 which is connected to a distribution pipe 19 leading from each side of the centrally positioned train steam line 2. The train steam line 2 is underneath the floor 13 and hence is lower than the loops 1 which

are above the floor 13. Proper drainage of each loop 1 is established by having the electrical operated control valves 3 and 3a at the high point in each distribution pipe 19, so that the system beyond the valves 3 and 3a drains through the trap 16 and the system on the near side of these valves 3 and 3a drains back through a three-way drain valve 23. This drain valve 23 permits of manually shutting off steam for repairs or inspection in addition to the drainage feature just mentioned. In Fig. V there is shown an arrangement for electrically controlled valves 23a which may be substituted for manually controlled valves 23. By this arrangement, full automatic control of the heating system and cooling system is obtained through the interlocking of seasonal switch 39. When switch 39 is in the up position and connecting wire 38 with wire 39a, the valves 23a are automatically closed to drain but opened to steam supply and the heating system is in operation and the cooling system is out of operation. When switch 39 is in the down position, the valves 23a are opened to drain but closed to steam supply and the heating system is out of operation and the electrical circuit is set up for cooling control through 39b.

A pressure regulator 24 is positioned in each distribution pipe 19 to maintain low pressure steam in the loops 1. The low pressure steam is desirable because the high pressure steam would be conducive to high surface temperatures in the wall radiation resulting in unequal heating of the car. This regulator 24 may be of any well-known type but is desirably of the angle type to insure proper drainage.

The coordination between this auxiliary steam heating system described above and the air conditioning system of the car is accomplished through the thermostatic-electric control of the control valves 3 and 3a. When the air conditioning system fails to maintain a proper heat distribution on the floor 13 of the car 10, the auxiliary steam heating system commences operation automatically until the unequal heat distribution has been eliminated.

This coordination is accomplished through the electrical control valves 3 and 3a which will now be taken up with their associated wiring.

Valves 3 are connected in parallel by wires 30 and 31, and valves 3a are connected in parallel by wires 30a and 31a. Wire 32 connects wire 31 to the source of power 7. Wire 30 connects to wire 33 which leads to one of the two back contact points 35 of relay 36. The other back contact point 35 connects to thermostat 4 by wire 37. Thermostat 4 connects to the source of power 7 by wire 38 which has a seasonal switch 39 for completely cutting out the auxiliary heating, as in summer. This circuit traces as follows: starting with the source of power 7, through wire 32, wire 31, electrical control valves 3, wire 30, wire 33, back contact points 35 of relay 36, wire 37, thermostat 4, wire 38 including switch 39 and back to the source of power 7.

Wires 30a and 31a connect the other electric control valves 3a in parallel. Wire 30a connects to wire 40 which leads over front contacts 41 of relay 36 to wire 42 which leads to thermostat 6, which is connected to the source of power 7 by wire 38 including the switch 39. Wire 32 then connects the other side of the source of power 7 to wire 31a thus completing the circuit. This circuit traces as follows: starting with the source of power 7, over wire 32, wire 31a, control valves 3a, wire 30a, wire 40, front contacts 41, wire 42,

thermostat 6, wire 38 and back to source of power 7.

Thermostat 5 connects by wire 43 to one of two front contacts 44 of relay 36, the other contact 44 being connected to wire 33 by wire 45. The circuit controlled by the thermostat 5 traces as follows: starting with source of power 7, wire 32, wire 31, valves 3, wire 30, wire 33, wire 45, over front contacts 44, wire 43, thermostat 5, wire 38 and back to source of power 7.

The blowers 8 are operated by the source of power 7, both being part of the air conditioning unit 11. Wires 48 and 49 connect the source of power 7 to blower switch 50 which is connected to the blower 8 by wires 51 and 52. Wires 53 and 54 connect wires 52 and 51 to a second blower 8 at the other end of the car 10. Wires 56 and 57 connect wires 52 and 51 to relay 36. These circuits may be traced as follows: starting with source of power 7, wire 49, over switch 50, wire 52, then dividing over wires 56 and 53 and to blowers 8 and relay 36, all in parallel, returning therefrom by wires 57, and 54 to wire 51, over switch 50, wire 48 back to source of power 7.

Thus it will be seen, valves 3 are under the control of thermostats 4 and 5, while valves 3a are under the control of thermostat 6. Thermostats 4 and 5 operate in the alternative; when one controls the valves 3, the other is cut out. Valves 3a are under the exclusive control of thermostat 6. Neither of thermostats 5 and 6 operate when the blower switch 50 is opened causing the deenergization of relay 36.

In the preferred form of my invention I have found that excellent results are obtained by having thermostat 4 set at 55 degrees F. for parking periods of the car, thermostat 5 at 69 degrees F. and thermostat 6 at 71 degrees F. When the floor temperature drops to 71 degrees F. during the air conditioning operation, two heating loops 1 are cut in. If the temperature further drops to 69 degrees F. two more heating loops 1 are cut in, doubling the heating effect of the auxiliary steam system. Thus an equal distribution of heat is maintained in all parts of the car 10.

A detailed description of the operation of the above device may be of use. Suppose the car 10 is parked in a yard. The switch 50 will then be opened and the air conditioning unit 11 will not be functioning. The seasonal switch 39 will be closed unless it is summer. If the temperature of the car 10 falls below 55 degrees F., thermostat 4 will open valves 3 and heat the car 10 until 55 degrees F. is reached. Suppose, now, that the car 10 goes into service and the air conditioning unit 11 is turned on by closing switch 50. This will energize relay 36 breaking back contacts 35 and cutting out thermostat 4. Contacts 41 and 44 are now closed and thermostats 5 and 6 are cut into operation. If the temperature is below 69 degrees F. thermostats 5 and 6 cause valves 3 and 3a all to open and the auxiliary heating system operates at full capacity in aiding the air conditioning unit to build up the temperature to its proper point. As 69 degrees F. is reached, thermostat 5 turns off valves 3 and the auxiliary heating system operates at half capacity. When 71 degrees F. is reached, the auxiliary heating system ceases to operate until the temperature again falls below 71 degrees F.

Thus my invention provides an efficient means for coordinating the usual steam heat system in passenger cars with an air conditioning system. The coldness and drafts on the floors of railway

cars is avoided. When a car equipped with my invention becomes cold, the heating takes place both at top and bottom and quicker results are obtained. It is clear that my invention makes for much more even distribution of heat in a passenger car.

There are many advantages in the use of my low pressure steam system. The utilization of low pressure steam lowers the steam consumption per car and thus permits the heating of longer trains from the existing steam train line. By my invention, the low pressure steam is utilized for automatically heating each car without recourse to the usual adjustments which are made in the pressure regulators from the front to the rear of the train. Further, the lower pressure steam system described above eliminates the loss of steam which occurs at the traps with the usual regulators which are difficult to adjust from the front to the rear of the train. Damage from freezing of the usual traps at the end of long trains due to the difficulty of adjusting the usual regulators is also avoided by my invention.

While I have described one embodiment of my invention in some detail, it is obvious that various changes and modifications could be made therein without departing from the spirit of the invention as hereinafter claimed. For example, the switches 50 and 39 could be consolidated to advantage as features of the unit control described in my prior United States Patent No. 2,095,881, dated October 12, 1937.

Having thus described my invention, I claim:

1. In combination with an air conditioned space, an air conditioning unit for discharging mixed atmospheric air and air withdrawn from said space into the upper region thereof, means controlling the functioning of said unit, a plurality of auxiliary heating units positioned at a low level in said space, separate connections from said heating units to a source of heat supply, control valves in each of said connections, said valves being in operative connection with the conditioning unit controlling means, and individual thermostats for automatically actuating said valves when the air conditioning unit is operating and the temperature in said space rises above or falls below predetermined points, said predetermined points being in stepped order.

2. The invention of claim 1, characterized by the further fact that a means is provided for automatically cutting in operation of one of the thermostats when the temperature in the air conditioned space falls below a predetermined degree to cause operation of some of the valves, and that one of the other thermostats is adapted to automatically cut-out operation of some of the other valves when a predetermined temperature point is attained which differs from those controlled by the first mentioned thermostat during the operation of said air conditioning unit.

3. In an air conditioned passenger car having a circulation of thermostatically controlled mixed atmospheric air and air withdrawn from the lower part of the car forced by an air conditioning blower motor out of ducts located in the upper portion of the car, auxiliary heating means in the form of low pressure steam coils at floor level, two loops at each side of the car, and a pair of loops comprising one loop at each side of the car having electrical valves arranged in a parallel electric circuit and controlled by a thermostat responsive to the temperature in the car at a predetermined point, the remaining pair of loops having electrical control valves arranged in a

parallel electrical circuit controlled by a thermostat responsive to the temperature in the car at a predetermined point below said first mentioned temperature point, a relay energized from the air conditioning blower motor for electrically interlocking the thermostats aforesaid, and a third thermostat responsive to and adapted to hold the temperature of the air entering the car at a third and still lower predetermined point when the air conditioning system is idle, said first and second mentioned thermostats being cut out of operation during the time the air conditioning system is idle.

4. In combination with an air conditioned space, an air conditioning unit for delivering mixed atmospheric air and air withdrawn from the lower part of said space into the upper region thereof, an electric control means for said unit, a plurality of heating loops positioned adjacent the floor level in said space, separate connections from said heating loops to a lower level source of steam heat supply, an electrically actuable valve in each of said connections and in circuit with the loop control means, and cooperative thermostats for automatically closing said valves when the temperature in the air conditioned space rises above different predetermined points, said predetermined points being in stepped order, whereby a continuous supply of heat at the proper temperature is provided for the space aforesaid.

5. In a railway passenger car the combination of a suitable air conditioning unit in each end portion for mixing atmospheric air with air drawn from the lower part of the passenger space and forcing the conditioned mixture through ducts located in the upper end portions of the car, heating coils in operative coordination with the air conditioning unit aforesaid and positioned in the car at the floor level thereof intermediate the end portions, individual connections from said heating coils to a common source of steam supply, a control valve in each said connection, and cooperative differently set thermostats for said valves for automatically closing the same when the temperature in the car rises above different predetermined temperature points, said temperature points being in stepped order.

6. In a railway passenger car the combination of an electrically operated air conditioning unit for mixing atmospheric air with air drawn from the passenger space and forcing the conditioned mixture through ducts located in the respective upper end portions of the car, auxiliary heating means in the form of low pressure steam coils at floor level and between the car end portions aforesaid, two loops at each side of the car, and a pair of loops comprising one loop at each side of the car having electrical valves arranged in a parallel electric circuit and controlled by a thermostat responsive to the temperature in the car at a predetermined point, the remaining pair of loops having electrical control valves arranged in a parallel electrical circuit controlled by a thermostat similarly responsive to another temperature in the car at a predetermined point below that of the said first mentioned point, the aforesaid thermostats being interlocked electrically with a third thermostat responsive to a further car temperature and to hold said temperature at a still lower predetermined point when the air conditioning system is idle, said first and second mentioned thermostats being cut out of operation during the time the air conditioning system is idle.

7. In an air conditioned passenger car, an electrically operable air conditioning unit including means for cooling and warming the air as desired, an auxiliary steam heating system comprising four heating loops positioned with two loops on each side of the car near the floor thereof, a connection from each loop to the steam line of the train, an electrically controlled drain valve positioned at a low point between the said steam line and one of the heating loops, valves controlling each of the heating loops, the valves of the loops on opposite sides of the car being connected electrically in parallel, separate ther-

mostats for controlling each pair of valves in electrical parallel, each said thermostat controlling the valves associated therewith at a different predetermined temperature point in stepped relation to the other thermostat, and a seasonal switch for control of the drain valve aforesaid and the operation of the auxiliary heating system, so that said drain valve is open to drain but closed to steam supply when the conditioning unit cooling system is operating, and closed to drain but open to steam supply when the unit heating system is operating.

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