

May 21, 1940.

H. D. EUWER

2,201,765

ALL SEASON AIR CONDITIONING FOR RAILWAY CARS

Filed Nov. 23, 1936

4 Sheets-Sheet 1

Fig. 1.

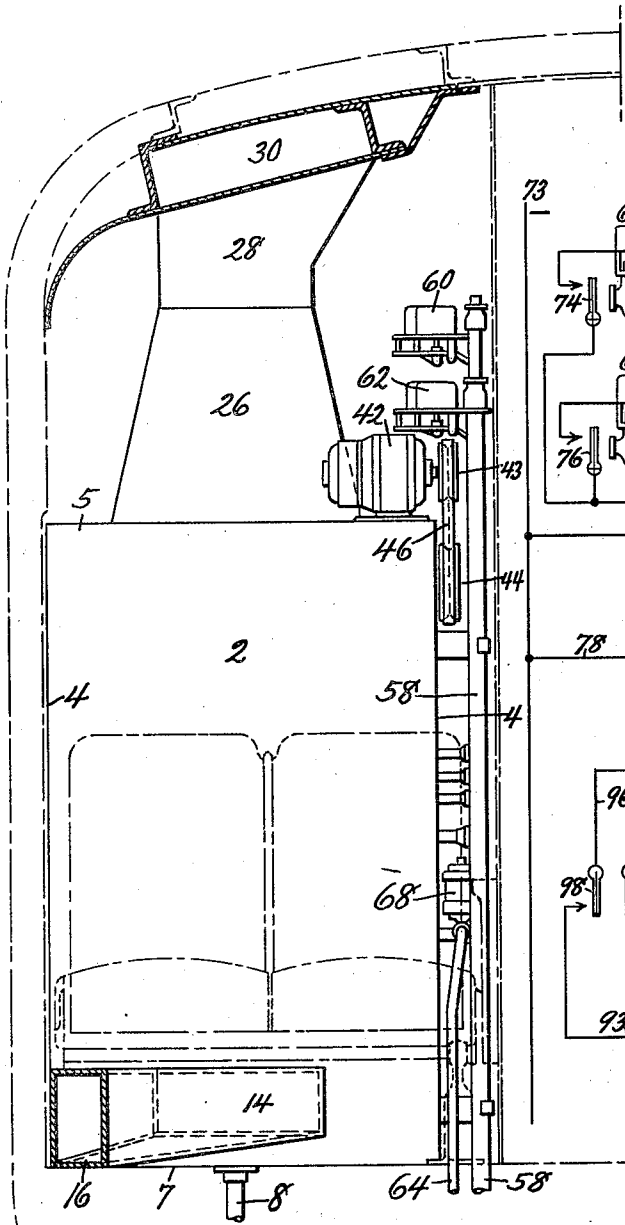
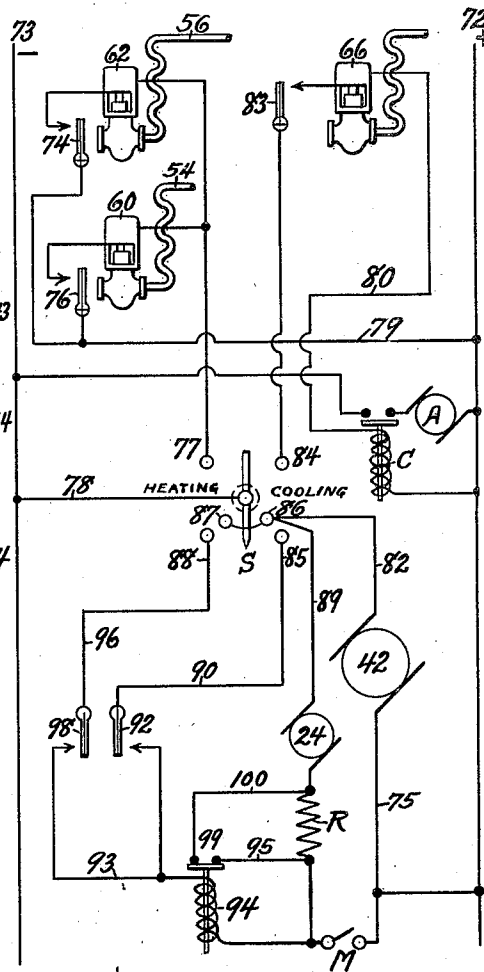


Fig. 7.



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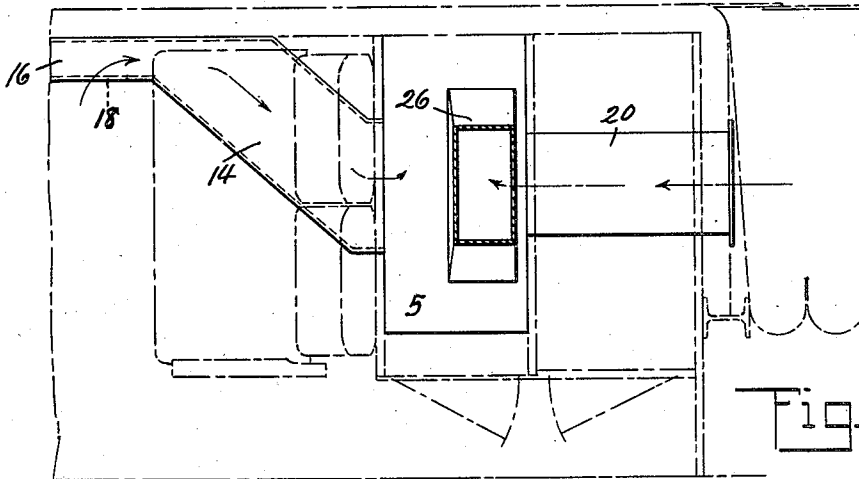


Fig. 3.

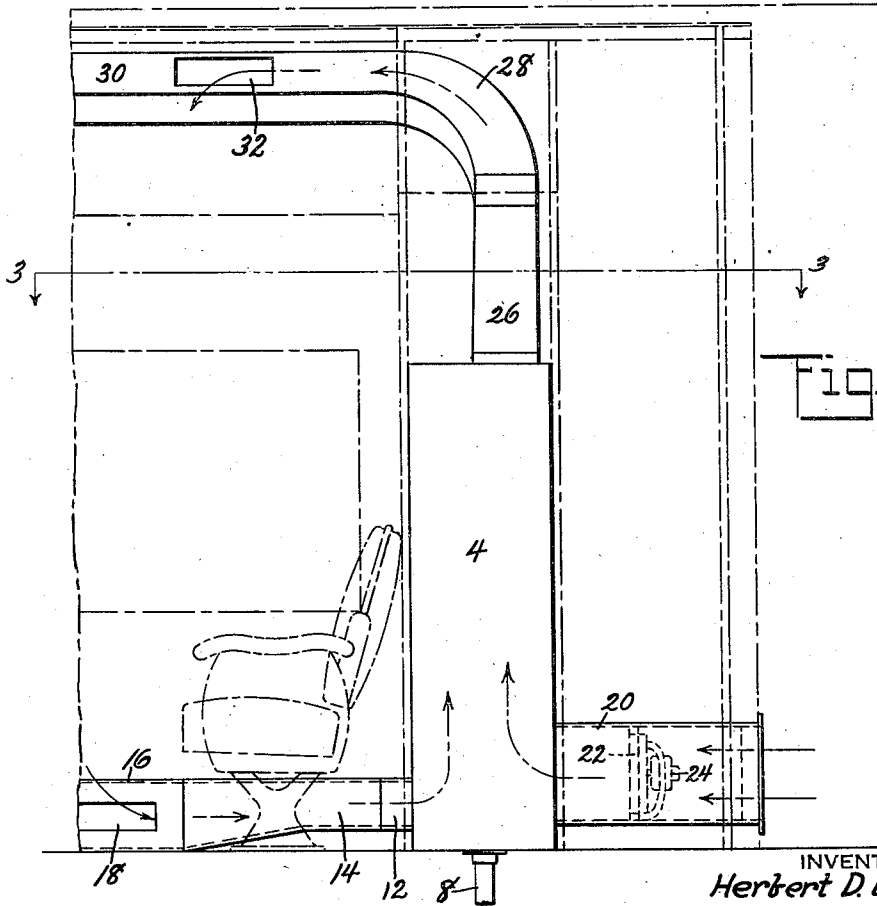


Fig. 2.

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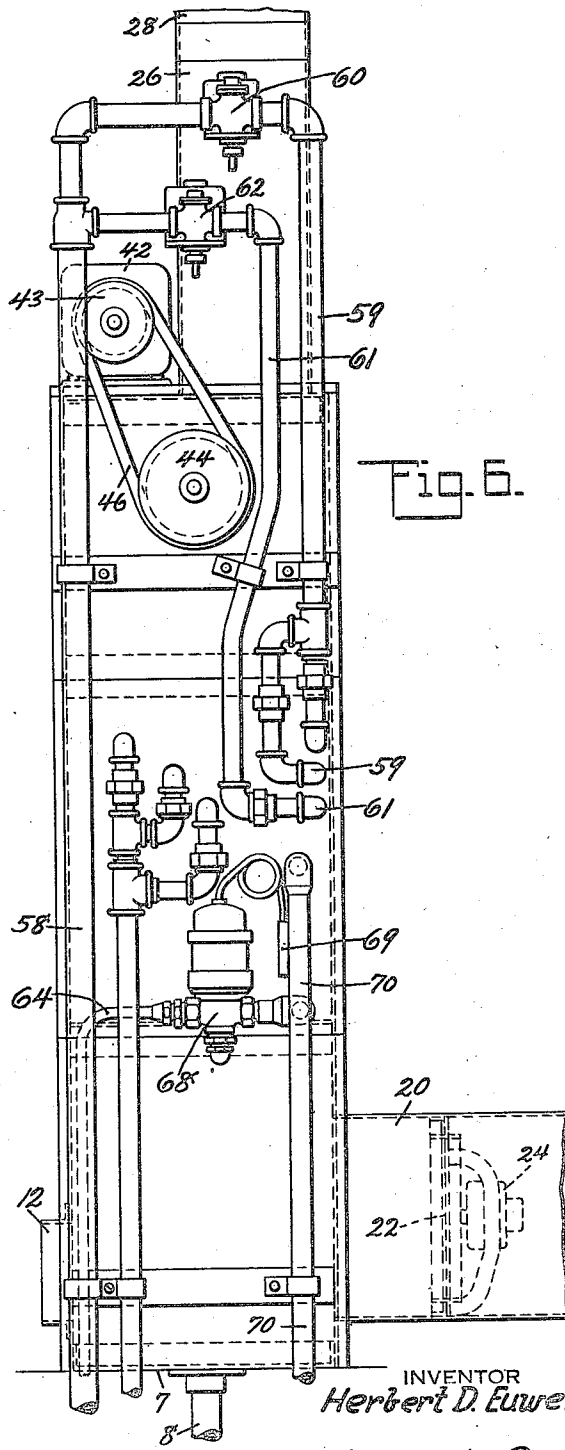
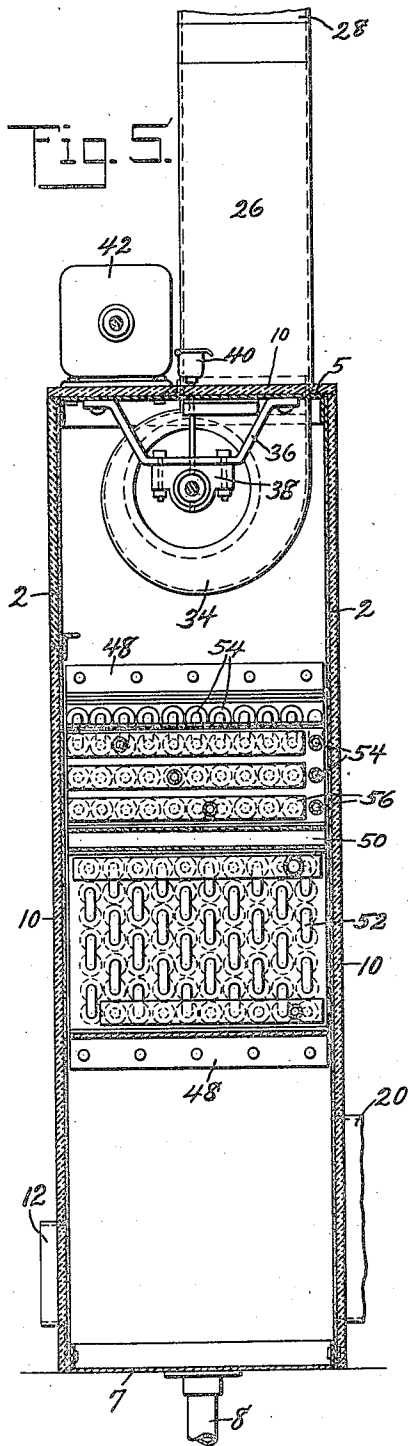
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ALL SEASON AIR CONDITIONING FOR RAILWAY CARS

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4 Sheets-Sheet 4



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ALL SEASON AIR CONDITIONING FOR RAILWAY CARS

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Application November 23, 1936, Serial No. 112,421

17 Claims. (Cl. 257—3)

This invention relates to air conditioning systems in general and in particular to air conditioning systems for use on railway vehicles during all seasons of the year.

Previous air conditioning systems have been intended primarily for use either in summer or winter, that is, for extreme differences between the outside and the inside temperatures and have not been properly designed to be readily shiftable from heating to cooling or back to heating. As a result there was a considerable period during the spring and fall months or during abnormal days when the car temperature was either improperly maintained or the car was improperly ventilated.

In the previous constructions the cooling unit and blowers have been placed over the vestibule ceiling or other equally inaccessible positions, while the controls have been located in a cabinet at some point remote from the unit. Likewise the majority of systems made no provision for heating at all with the railroads relying on the old antiquated and highly objectionable use of long heating pipes underneath the seats or along the side walls.

It is an object, therefore, of the invention to provide a combined heating and cooling unit which is located in a readily accessible position within the car.

It is a further object of the invention to provide a combined heating and cooling unit or all-seasons' unit which, together with its controls, will occupy a readily accessible yet out-of-the-way position in the car and which entire unit may be readily removed for repair or replacement if necessary.

A still further object of the invention is the provision of an all-seasons' unit in which an equal distribution of air is obtained throughout the car and without drafts or stratification.

Another object of the invention is the provision of an all-seasons' conditioning unit in which an adequate supply of fresh air is insured at all times with a decreased supply being furnished under certain extreme conditions.

Yet another object of the invention is the provision of an all-season conditioning unit in which fresh air may be supplied in sufficient quantities to obviate the use of either the heating or cooling coils under certain temperature conditions.

These and other objects of the invention will be apparent to one skilled in the art from a study of the following description and the accompanying drawings, in which:

Figure 1 is a transverse sectional view of ap-

proximately one-half of the car showing the unit in position;

Fig. 2 is a longitudinal sectional view of the car showing the unit and the flow of air therethrough, the car outline being indicated by dot and dash lines;

Fig. 3 is a sectional view of the unit taken substantially on line 3—3 of Fig. 2;

Fig. 4 is an enlarged view similar to Fig. 1 but of the unit itself with parts broken away to more fully disclose the coil arrangement;

Fig. 5 is a sectional view taken on line 5—5 of Fig. 4;

Fig. 6 is an end view of the unit taken in the direction of the arrows 6 of Fig. 4, and

Fig. 7 is a diagrammatic wiring layout of a portion of the control system.

Referring now to the drawings in detail, it is seen from Figs. 1, 2 and 3 that the unit is arranged in a vertical position within the car and at one side of the longitudinal center of the car. The unit is preferably placed within a compartment or an unused portion of a saloon, or if such location is not available then it may be placed in the position usually occupied by the uncomfortable and rarely used end seat. As shown the unit is placed on one side of the car and supplies only one-half of the car, but it is to be understood that it could supply the other half although it is preferred that the system now to be described be duplicated upon the opposite side of the car using a single set of controls.

The unit itself consists of a metallic box having side walls 2, end walls 4, top 5 and bottom 7, the latter being provided with a drain 8 for the condensate or excess moisture in case humidification is used. The walls and top are properly covered by insulation and sound-deadening material 10.

One of the side walls is provided adjacent the lower portion with an opening having a flanged outlet 12 to which may be coupled the flared end 14 of longitudinal floor duct 16 which extends throughout the length of the car in the position now occupied by the heating pipes. This duct for the recirculated air is provided with openings 18 controlled by vanes or shutters (not shown) permitting the proper adjustment to obtain uniform air removal from the floor zone of the car. The other side wall is provided with an opening having a flanged outlet to which is connected fresh air duct 20 within which is mounted the fan 22 with its driving motor 24 and a fresh air filter (not shown). The driving motor is of a type whose speed may be readily controlled, thus controlling the amount of air forced through the fl-

ter and into the casing and may positively supply fresh air independently of the operation of the main blowers later to be described. These ducts have been shown as connected to certain walls of the unit but it is, of course, obvious that their position may be changed as structural conditions demand. The fresh air is shown (Fig. 3) as drawn from the vestibule but this arrangement may also be varied as desired or as may become necessary.

The top of the unit is provided with a connected plenum chamber 26 to which is connected a curved riser 28 connecting the plenum chamber to the longitudinal ceiling duct 30 provided with the spaced discharged ports 32 suitably controlled to obtain equal discharge of the conditioned air. Fans 34 of the noiseless type are suspended within the casing by brackets 36 carrying bearings 38 supplied by oil cups 40 located exterior of the casing. The fans may be driven by a motor located between the fans but in order to make the motor more accessible as well as to eliminate the motor heat from the air circuit, it is preferably located as shown exterior of the casing. The motor 42 is provided with a pulley 43 which drives the pulley 44 mounted on the fan shaft by means of V-belt 46. It is thus seen that all bearings may be lubricated easily and without disturbing the unit.

As shown in Figs. 4 and 5 the end walls of the casing have spaced apart angles 48 and channels 50 attached thereto and these angles and channels form supports for the various heat exchange coils. The bank of finned cooling coils 52 have their ends carried by channel plates 53 received between the angles and channels of the casing as clearly shown, while the finned heating coils 54 likewise have their ends carried by channel plates 55 received between the spaced angles and channels of the casing. It is to be noted that one of the channel plates 53 and 55 is attached to the casing supporting members, while the other of the channel plates is readily slidable upon the casing supporting members in order to take care of the expansion and contraction of the piping. The heating coils are divided into separately controlled banks, one of which may be used as a tempering coil 56.

Heat is supplied to the heating coils by pipes 58 and 59 with the passage of heating fluid controlled by the magnetic stop valve 60; while heat is supplied to the tempering coil through branch pipe 61 controlled by magnetic stop valve 62.

Refrigerant fluid is supplied to the cooling coils from a suitable source, located wherever desired but preferably beneath the car floor, through pipe 64 controlled by magnetic stop valve 66 (Fig. 7) and by expansion valve 68 (Fig. 6) the action of which is controlled by an element 69 secured to the refrigerant return pipe 70. This type of expansion valve insures that the flow of gas through the coils will not be greater than will permit the full absorption of heat units from the car, thus obtaining maximum efficiency from the coils.

The air flow in the car is indicated by arrows in Figs. 2 and 3 and it is seen that with the motors driving the fans air for recirculation is sucked in at the floor area throughout the length of the car, pulled through the heat exchange coils into the fans and forced through the ceiling duct to be distributed throughout the length of the car. Fresh air as required is forced into the system by means of the fresh air fan independently of the main blower and mingles with the

recirculated air prior to passage through the heat exchange coils. With the air supplied to the car at a plurality of points at the ceiling and removed for reconditioning at a plurality of points at the floor, it is seen that a very low velocity of air within the car may be obtained, thus eliminating objectionable drafts. The air circulates within the car in planes transverse to the car length and of an extent substantially equal to one-half of the car width, thus eliminating the objectionable longitudinal drift of air which carries smoke, and the body heat from passenger to passenger. This transverse air flow on the sides of the car insures the practical isolation of the occupants of one seat from those of adjoining seats and also insures equal temperature distribution throughout the car length with a minimum air velocity.

Reference is now had to Fig. 7 which discloses diagrammatically the manner in which the fresh air supply and heat exchange means are controlled. Current supply wires 72 and 73 are connected to a suitable source, such as a battery or generator and supply current for the operation of the various devices. The fan motor 42 is connected to wire 72 by wire 75 and to wire 73 by wires 78 and 82 and selector switch S. High heat solenoid valve 60 is connected to the wire 72 by wire 79 and snap-type thermostat 76, and to wire 73 by wire 78 and contact 77 of selector switch S. The heat tempering solenoid valve 62 is connected to wire 72 by wire 79 and snap-type thermostat 74, and to wire 73 by contact 77 of selector switch S and wire 78. Whenever current is flowing through the solenoid valves 60 or 62 the plungers are held up and the valves opened, but whenever the current ceases to flow, due to the opening movement of the thermostats upon the car temperature reaching a predetermined high value the plunger drops and the valves are closed cutting off the flow of heat to the coils. With the selector switch S in the cooling position and the thermostat contact closed calling for cooling, current flows from wire 72 through contactor C, wire 80, cooling solenoid valve 66, thermostat 83, switch contact 84 and wire 78 to the wire 73. This flow of current opens the solenoid valve and causes contactor C to be energized which automatically turns on the refrigerant circulating means A.

The seasonal selector switch S is provided with contacts 85 and 86 which are connected by the switch blade to wire 73 through wire 78 whenever the switch is on heating and is also provided with contacts 87 and 88 which are similarly connected to 73 when the switch is in cooling position. The contacts 85 and 86 are insulated from each other as are contacts 87 and 88, but the contacts 86 and 87 are connected to each other in order that current may flow whether the switch is on heating or cooling. The contacts 86 and 87 are connected by wire 89 to fresh air motor 24 which is normally connected to wire 72 by wires 95, 100, bridged contacts 99 and manual cut-off switch M, thus supplying full voltage to the fresh air motor which will accordingly operate at full speed.

The contact 85 is connected by wire 90 to thermostat 92 controlling the flow of current through wire 93, relay 94, and switch M from supply line 72. The contact 88 is connected by wire 96 to thermostat 98, likewise controlling the flow of current through the relay, the contacts 99 of which are normally bridged, but when the relay is energized by either of the thermostats

92 or 98 the plunger is moved opening the normal circuit at 99 and causing the current to flow through the resistance, thus slowing up the fresh air fan motor.

The operation of the device is as follows: Assuming the selector switch to be set in the heating position connecting contacts 77, 85 and 86 to the supply line 73 and the car sufficiently warm so that the snap thermostats 74 and 79 are open breaking the circuit through the solenoid valves 60 and 62, thus cutting off the heat supply. It will also be assumed that thermostat 79 is set to turn on the added heat at substantially 70 degrees and turn it off substantially at 72 degrees, and that the thermostat 74 will turn on the heat at substantially 75 degrees and off at substantially 77 degrees, while the thermostat 92 is set to close at substantially 65 degrees.

It should be noted that the blower motor 42 and fresh air motor 24 are operating at full speed at all times that the selector switch is in either heating or cooling position and that the switch must be in this position for the remainder of the apparatus to function. When the car temperature drops to 75 degrees the snap thermostat 74 will close opening the solenoid valve 62 and turning steam into the coils 56 which coils will normally be able to maintain the car at the proper temperature. If, however, the car be subjected to colder temperatures and the coils 56 cannot maintain the car comfortable and its temperature drops to 70 degrees then the high heat coils 54 are supplied heat by the opening of the solenoid valve 60 occasioned by the closing of snap thermostat 79 which remains closed until the car temperature is raised to substantially 72 degrees. The two heat coils 54 and 56 thus assist in cold weather to maintain the car comfortable with the fresh air fan operating at full speed but in abnormally cold weather the two coils may not be capable of so maintaining the car and its temperature might drop to 65 degrees in which case relay 94 would be energized, contacts 99 opened and the motor 24 shunted through resistance R thus cutting down the supply of fresh cold air but without affecting the main blower speed. As soon as the car temperature is raised above 65 degrees the fresh air motor will again assume full speed operation and supply the predetermined requisite amount of fresh air necessary to keep the car in a fresh condition and under proper higher-than-atmospheric pressure to exclude dust or smoke. As soon as the car reaches a temperature of 72 degrees the solenoid 60 will close while when the temperature reaches 77 the solenoid 62 will close cutting off all heat to the car but the blower 42 and fresh air motor 24 will continue operation. This fresh air motor will supply all the car requirements for change of air and will keep the car in a fresh and comfortable condition during fall and spring months or at all times when the outside temperature is substantially equal to the desired interior temperature. However, when the capacity of the heating system is exceeded or for any other reason the car temperature reaches an abnormal value the fresh air supply is diminished. It is, of course, obvious that the temperature settings mentioned for the thermostats are purely representative as they may be varied at will.

During months when cooling is necessary the selector switch will be turned so as to connect contacts 84, 87 and 88 to supply line 73 automatically turning on blower fan motor 42 and fresh air intake motor 24, thus making it im-

possible to operate either heating or cooling devices unless air circulating means 42 and fresh air intake motor 24 are operating. Assuming the thermostat 83 is set to close at a temperature of 80 degrees and the thermostat 98 at 84 degrees, then if the car temperature rises above 80 degrees the thermostat 83 closes opening the valve 66 allowing refrigerant to enter the cooling coil 52 and at the same time automatically turning on refrigerant circulating means A through relay C. As soon as the car temperature is lowered the thermostat opens turning off the flow of refrigerant and automatically stopping refrigerant circulating means A. As before the fresh air fan operates at all times under full voltage, that is, increased speed, but if for any reason the car temperature rises above 84 degrees, then the resistance is cut in by the closing of thermostat 98 with the consequent energization of relay 94 and the opening of contacts 99 as previously described. Thus again fresh air in decreased volume is supplied at such extreme times as the car temperature varies any substantial amount from that desired and at all other times the maximum volume of outside fresh air is delivered to the car.

It is, of course, obvious that the temperatures mentioned are merely chosen to describe the operation and may be varied at will, or their relation changed without departing from the scope of the invention. It is also obvious that the wiring diagram described is purely diagrammatic and that various protective devices, switches, relays, etc., will be needed in an actual installation, but the use of such devices is so well known to electricians that it is believed unnecessary to describe the full working circuit.

Various arrangements and combinations of parts will be obvious to persons skilled in the art from a study of the preceding description, but all such changes are contemplated as fall within the scope of the following claims.

What is claimed is:

1. In an air conditioning system for railway vehicles, heat exchange coils, means controlling the flow of heat transferring medium to the coils, thermostatic devices controlling the operation of said means, a main motor driven blower to move air past said coils in heat exchange relation, a motor driven fresh air blower to force fresh air into the system, and thermostatic means controlling the operation of said fresh air blower independently of said main blower.

2. In an air conditioning system for railway vehicles, heat exchange coils, means controlling the flow of heat transferring medium to the coils, thermostatic devices controlling the operation of said means, a main motor driven blower to move air past said coils in heat exchange relation, a motor driven fresh air blower to force fresh air into the system, and thermostatic means controlling the operation of said fresh air blower independently of said main blower, said thermostatic means operating to decrease the supply of fresh air upon change of temperature within the vehicle toward that existing outside the vehicle and beyond that at which the thermostatic devices are set to operate.

3. In an air conditioning system for railway vehicles, a plurality of independent heat exchange coils, independent means connected to each coil for controlling the flow of heat transferring medium to the coils, thermostatic controlling devices connected to each of said means, a main motor driven blower to move air past

said coils in heat exchange relation, the operation of each of said means being controlled by the respective connected thermostatic device, a motor driven fresh air blower to force fresh air into the vehicle, and thermostatic means controlling the operation of said fresh air blower independently of said main blower.

4. In an air conditioning system for railway vehicles, a plurality of independent heat exchange coils, independent means connected to each coil for controlling the flow of heat transferring medium to the coils, thermostatic devices connected to each of said means and controlling the operation thereof, a main motor driven blower to move air past said coils in heat exchange relation, a motor driven fresh air blower to force fresh air into the vehicle, and thermostatic means controlling the operation of said fresh air blower independently of said main blower, said thermostatic means operating to decrease the supply of fresh air upon change of temperature within the vehicle toward that existing outside the vehicle and beyond that at which the thermostatic devices are set to operate.

5. In an air conditioning system for railway vehicles, a plurality of independent heat exchange coils, independent means connected to each coil for controlling the flow of heat transferring medium to the coils, thermostatic devices connected to each of said means for controlling the operation thereof, a main motor driven blower to move air past said coils in heat exchange relation, a switch for selecting the thermostatic device to be used, a motor driven fresh air blower to force fresh air into the vehicle, and thermostatic means controlling the operation of said fresh air blower independent of said main blower.

6. In an air conditioning system for railway vehicles, a plurality of independent heat exchange coils, independent means connected to each coil for controlling the flow of heat transferring medium to the coils, thermostatic devices connected to each of said means for controlling the operation thereof, a main motor driven blower to move air past said coils in heat exchange relation, a switch for selecting the thermostatic device to be used, a motor driven fresh air blower to force fresh air into the vehicle, and thermostatic means controlling the operation of said fresh air blower independently of said main blower, said thermostatic means operating to decrease the supply of fresh air upon change of temperature within the vehicle toward that existing outside the vehicle and beyond that at which the selected thermostatic device is set to operate.

7. In an air conditioning system for railway vehicles, a plurality of independent heat exchange coils, independent means connected to each coil for controlling the flow of heat transferring medium to the coils, thermostatic devices connected to each of said means for controlling the operation thereof, a main motor driven blower to move air past said coils in heat exchange relation, a motor driven fresh air blower to force fresh air into the vehicle, and thermostatic means controlling the operation of said fresh air blower independently of said main blower and said thermostatic devices.

8. In an air conditioning system for railway vehicles, a plurality of independent heat exchange coils, independent means connected to each coil for controlling the flow of heat transferring medium to the coils, thermostatic devices connected to each of said means for controlling

the operation thereof, a main motor driven blower to move air past said coils in heat exchange relation, a switch for selecting the thermostatic device to be used, a motor driven fresh air blower to force fresh air into the vehicle, and thermostatic means controlling the operation of said fresh air blower independently of said main blower and thermostatic devices, said thermostatic means operating to decrease the supply of fresh air upon change of temperature within the vehicle toward that existing outside the vehicle and beyond that at which the selected thermostatic device is set to operate.

9. In an air conditioning system for railway vehicles, temperature controlled heat exchange coils, a thermostatic device connected to control the operation of the coils, a continuously operating blower for circulating air within the vehicle, a continuously operating fresh air motor driven blower for forcing fresh air into the vehicle, and thermostatic means operating independently of the first named blower to decrease the supply of fresh air to the car upon change of temperature within the vehicle toward that existing outside the vehicle and beyond that at which the thermostatic device is set to operate.

10. In an air conditioning system for railway vehicles, temperature controlled heat exchange coils, temperature controlling means connected to the coils to control the operation thereof, a blower for circulating air within the vehicle, a fresh air blower for forcing fresh air into the vehicle, and temperature controlling means operating independently of the first named blower to decrease the supply of fresh air to the car interior upon change of the temperature within the vehicle toward that existing outside the vehicle and beyond that at which the last named temperature controlling means is set to operate.

11. In an air conditioning system for railway vehicles having a passenger space and a recirculating air duct, a supply duct for conditioned air, openings in the ducts for exchange of air through the passenger space, connecting means for said ducts, said connecting means housing heat exchange coils and a main blower to move the air through the system, and an additional blower normally and continuously operating at all times that the main blower is operating for forcing fresh air into the system, and means controlling the operation of said additional blower to vary the volume of fresh air forced into the system by said additional blower, said means operating in response to temperature changes in the passenger space and to which temperature changes the main blower will be unresponsive.

12. In an air conditioning system for railway vehicles having a passenger space and a recirculating air duct, a supply duct for conditioned air, openings in the ducts for exchange of air through the passenger space, connecting means for said ducts, said connecting means housing heat exchange coils and a main blower to move the air through the system, an additional blower continuously operating at all times that the main blower is operating for forcing fresh air into the system, said additional blower being operable at variable speeds to vary the volume of fresh air forced into the passenger space in accordance with variations in temperature in the passenger space, and thermostatic means controlling the operation of said additional blower in accordance with variations of temperature within the passenger space.

13. In an air conditioning system for railway

vehicles having a passenger space, a recirculated air duct adjacent the lower portion of the vehicle, a supply duct for conditioned air adjacent the upper portion of the vehicle, said ducts extending substantially the full length of the car, lateral openings in said ducts for the substantially vertical exchange of air between the ducts, vertically disposed means adjacent an end of the vehicle for connecting said ducts together, said means housing heat exchange coils and a main blower to move the air through the ducts and through the heat exchange coils and passenger space, and a continuously operating additional blower forcing fresh air at higher than atmospheric pressure into the system in varying volumes and independently of the main blower.

14. In an air conditioning system for railway vehicles having a passenger space, a recirculated air duct adjacent the lower portion of the vehicle, a supply duct for conditioned air adjacent the upper portion of the vehicle, said ducts extending substantially the full length of the car, lateral openings in said ducts for the exchange of air between the ducts, and means connecting said ducts together, said means comprising a vertically disposed casing, heat exchange means within the casing, a main blower means within the casing to move the air through the heat exchange means and ducts, and through the passenger space, and a substantially continuously operating auxiliary blower means for forcing fresh air under pressure into the casing in varying volumes and independently of the main blower means.

15. In an air conditioning system for railway vehicles having a passenger space, a recirculated air duct adjacent the lower portion of the vehicle, a supply duct for conditioned air adjacent the upper portion of the vehicle, said ducts extending substantially the full length of the car, lateral openings in said ducts for the exchange of air between the ducts, and means connecting said ducts together, said means comprising a vertically disposed casing, heat exchange means

within the casing, a fresh air inlet entering the casing, blower means in the inlet to force fresh air under pressure into the vehicle thereby maintaining superatmospheric pressure within the passenger space, and a continuously operating additional blower means mounted within the casing to move air through the heat exchange means and through the ducts and passenger space, said first mentioned blower means being operable at varying speeds and independently of said additional blower means.

16. In an air conditioning system for railway vehicles having a passenger space, a recirculated air duct adjacent the lower portion of the vehicle, a supply duct for conditioned air adjacent the upper portion of the vehicle, said ducts extending substantially the full length of the car, lateral openings in said ducts for the exchange of air between the ducts, and means connecting said ducts together, said means comprising a vertically disposed casing, heat exchange means within the casing, a fresh air inlet entering the casing, a continuously operating variable speed blower means in the inlet to force varying quantities of fresh air into the vehicle and substantially fixed speed blower means within the casing to move air through the heat exchange means and through the ducts and passenger space in quantities varying substantially in accordance with the speed of the variable speed blower means.

17. A vertically disposed air conditioning unit for railway vehicles comprising, a casing, heat exchange means within the casing, an outlet at the top of the casing, a recirculated air inlet adjacent the bottom of the casing, a fresh air inlet adjacent the bottom of the casing, a variable speed blower within the fresh air inlet and an additional substantially constant speed continuously operating blower located between said inlet and outlet for moving air through the casing in volumes varying substantially in accordance with the speed of the variable speed blower.

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