Jan. 26, 1937. H. D. EUWER 2,068,851

AIR CONDITIONING SYSTEM FOR RAILWAY PASSENGER CARS

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Fig. 1.

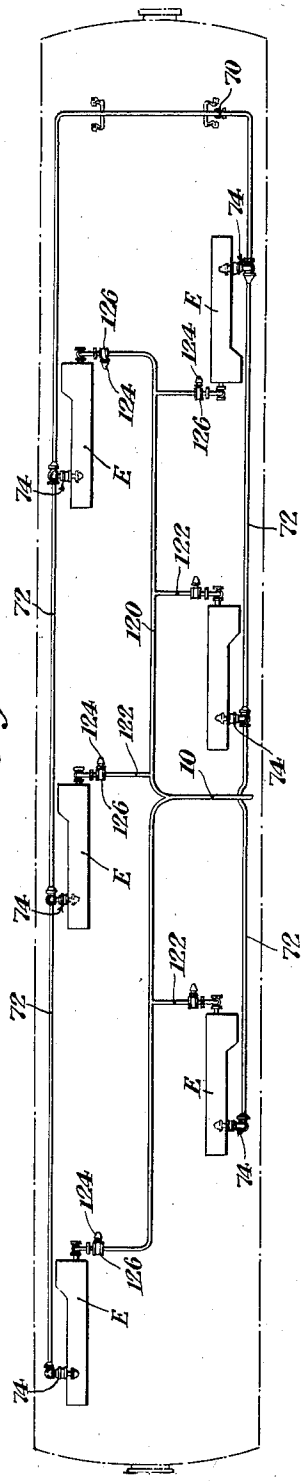
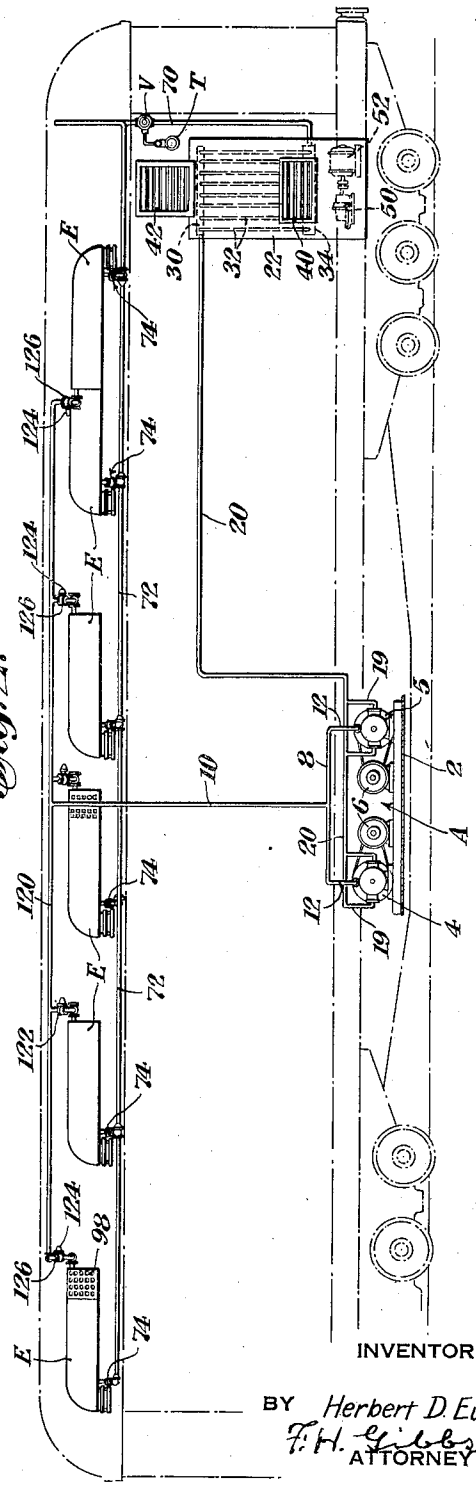


Fig. 2.



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AIR CONDITIONING SYSTEM FOR RAILWAY PASSENGER CARS

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Fig. 4.

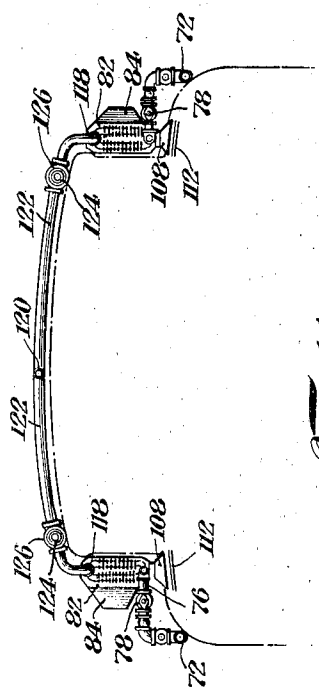


Fig. 14.

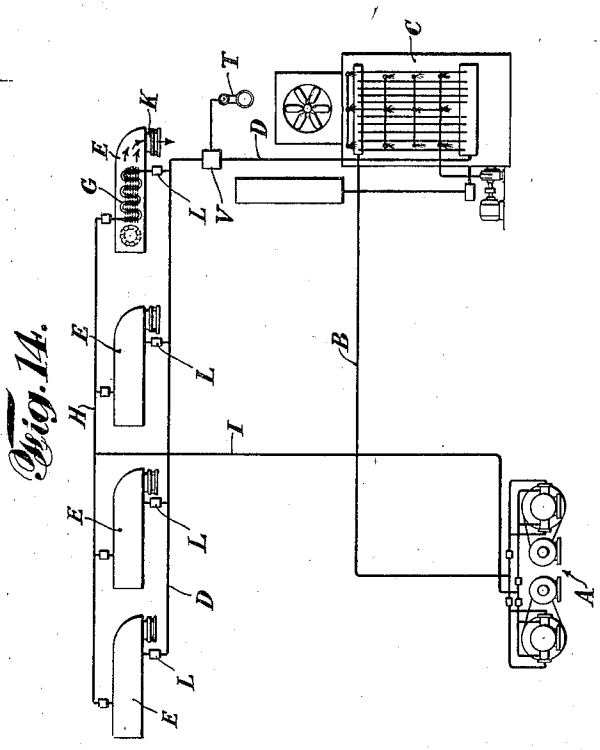
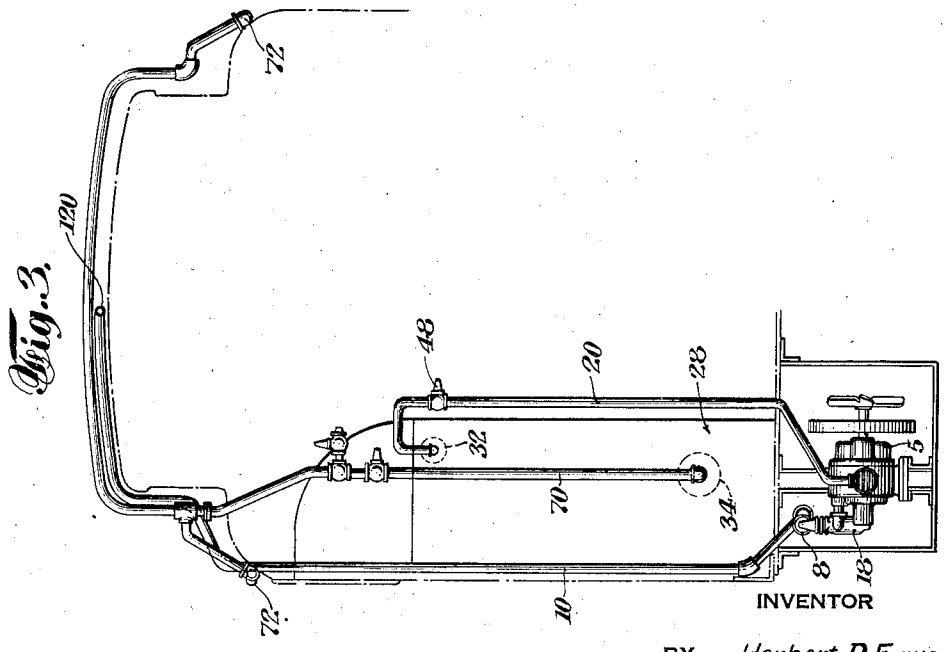


Fig. 3.



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AIR CONDITIONING SYSTEM FOR RAILWAY PASSENGER CARS

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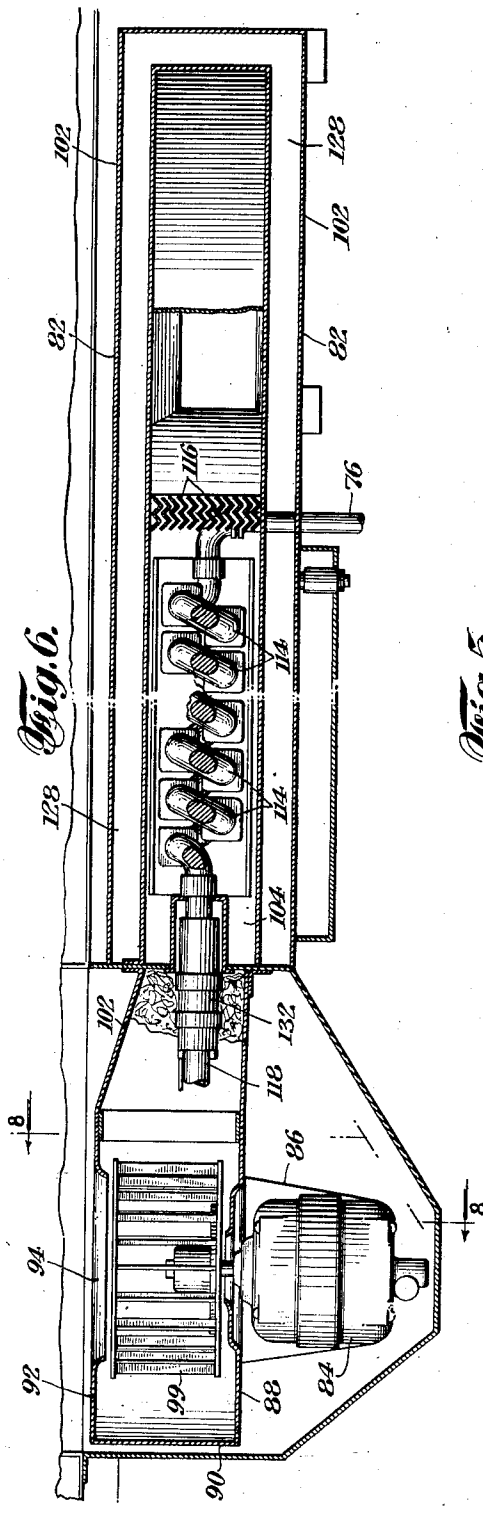

Fig. 6.

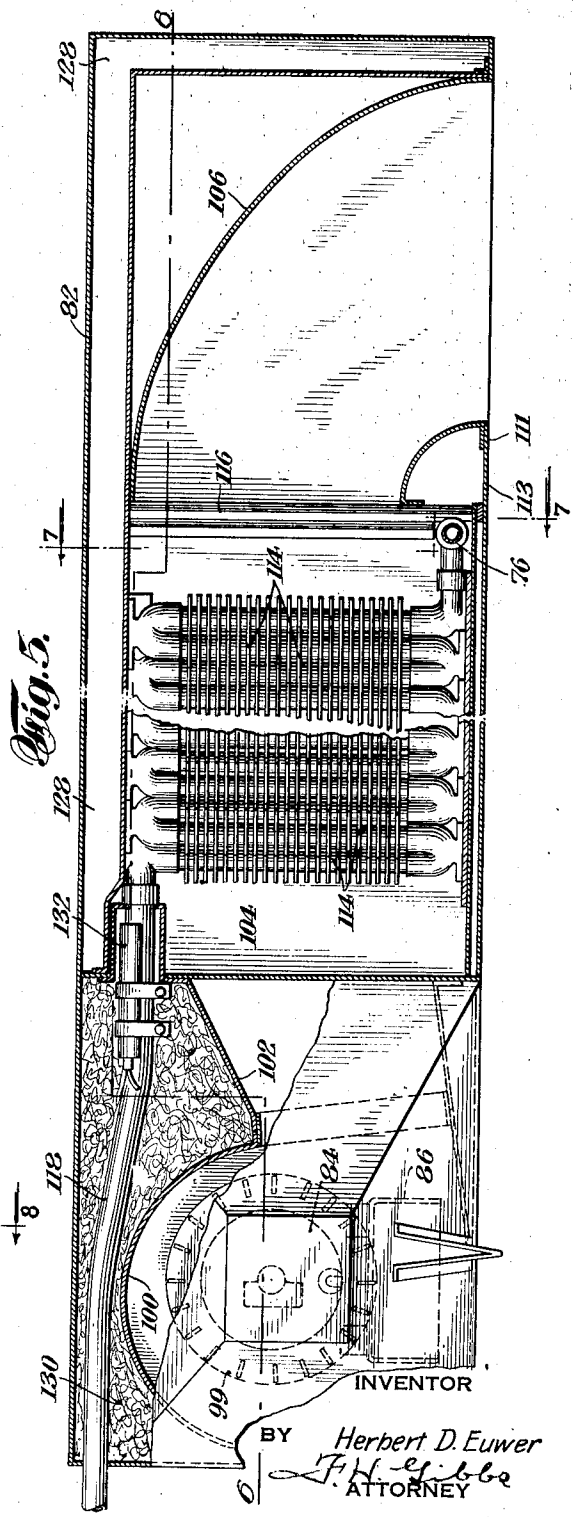

Fig. 5.

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Fig. 8.

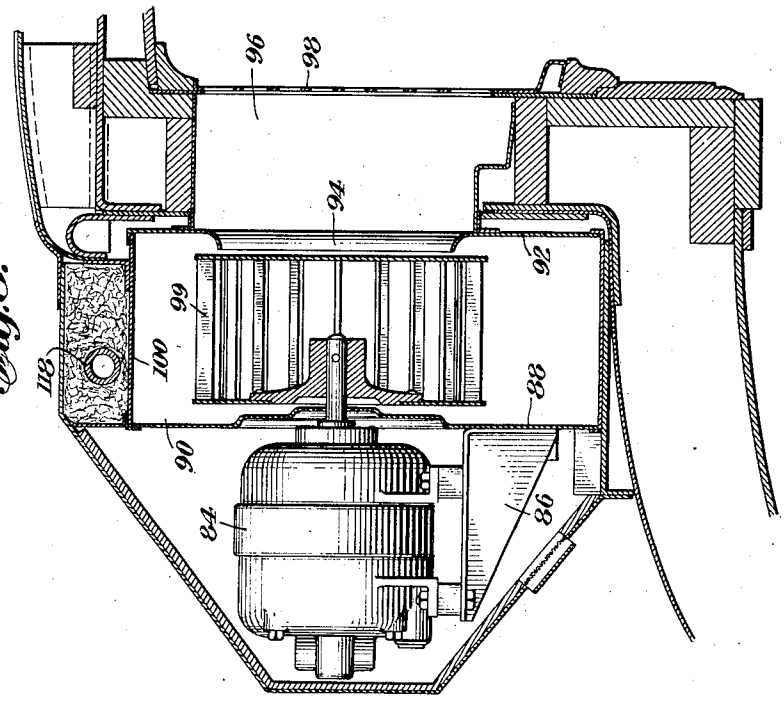

Fig. 7.

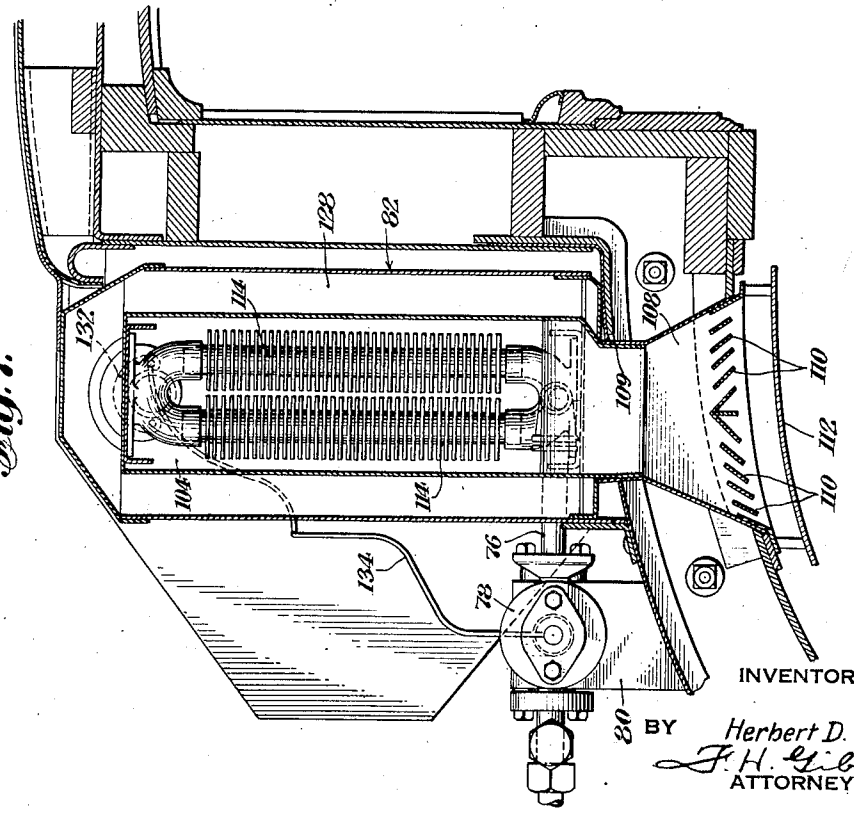

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Fig. 10.

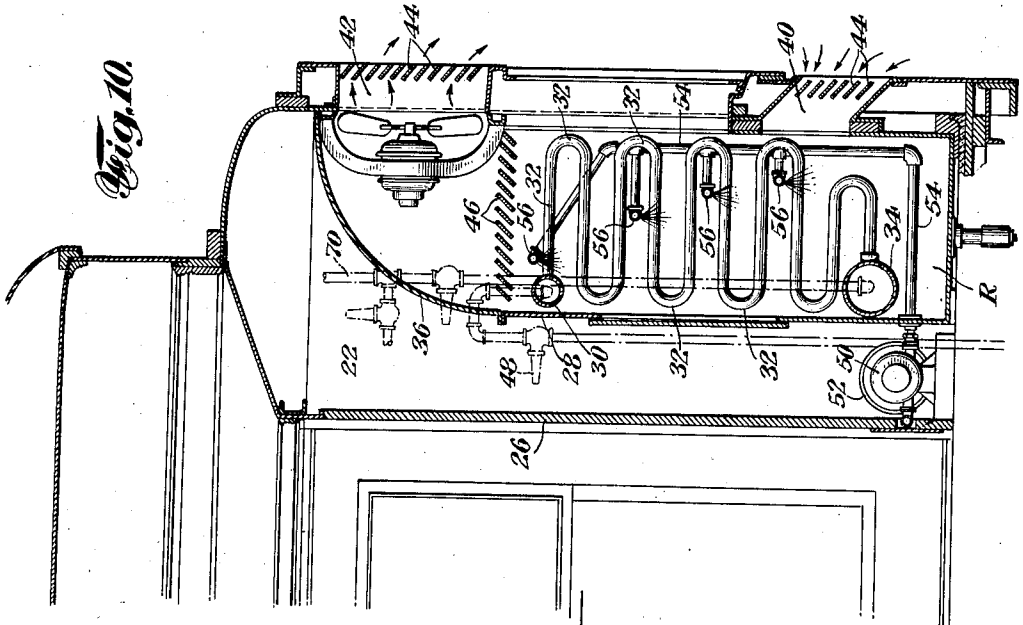
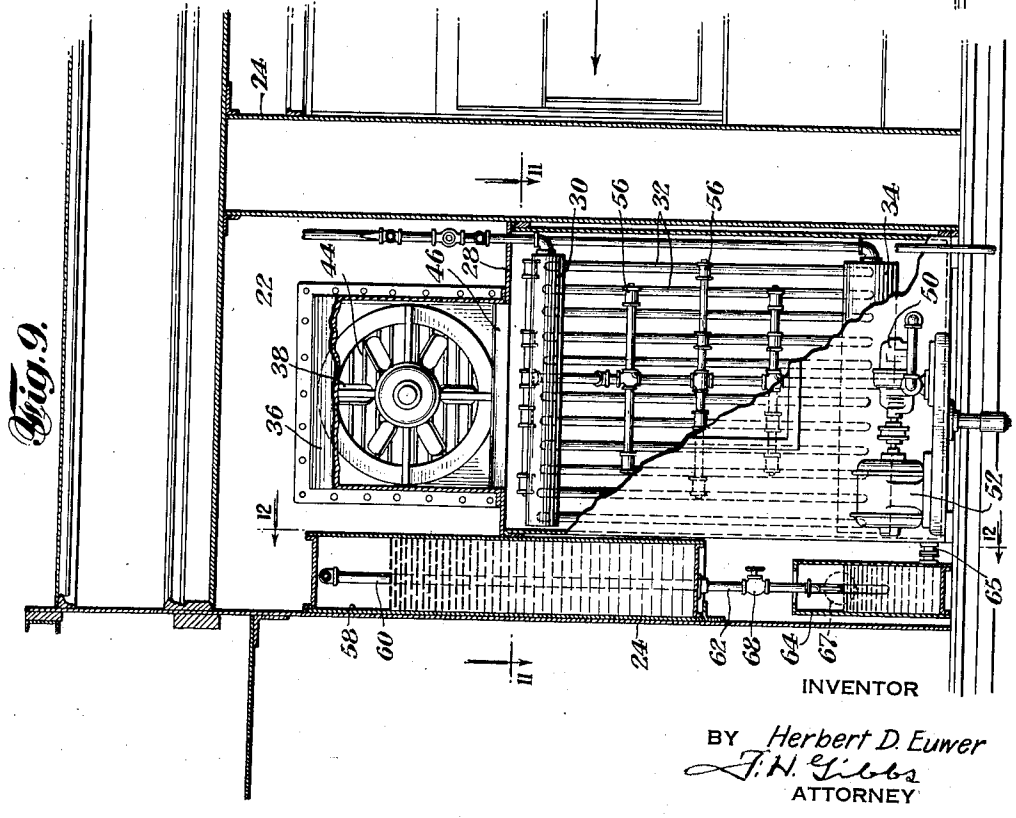


Fig. 9.



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AIR CONDITIONING SYSTEM FOR RAILWAY PASSENGER CARS

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Fig. 12.

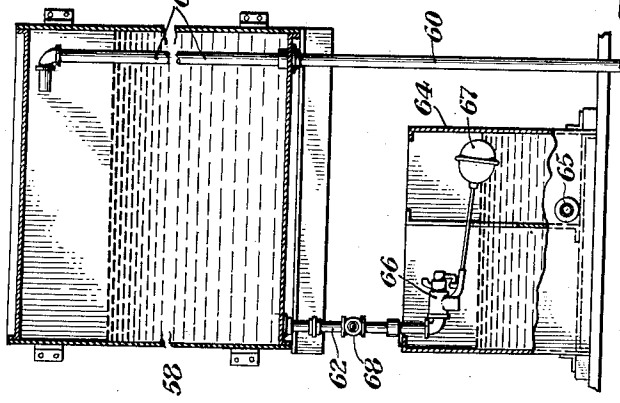


Fig. 13.

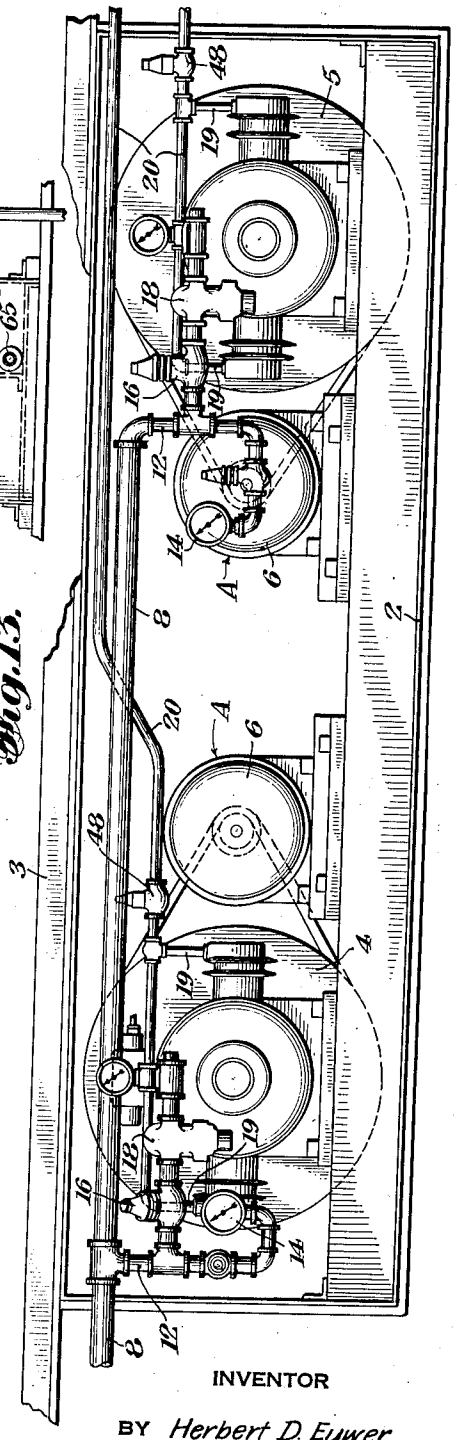
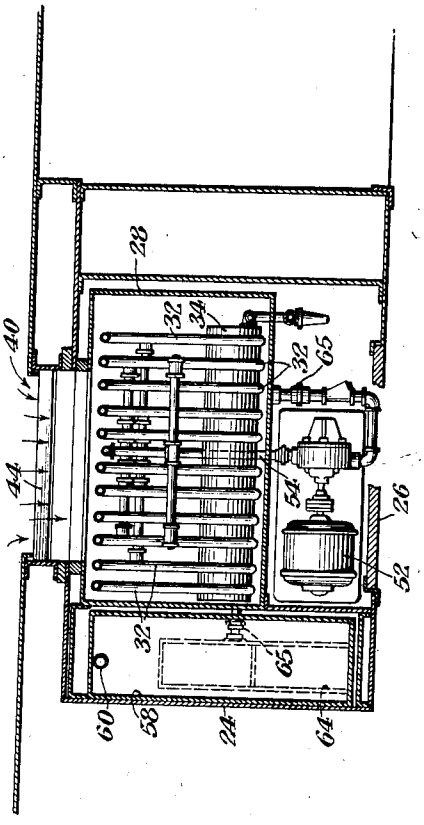


Fig. 11.



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Patented Jan. 26, 1937

2,068,851

UNITED STATES PATENT OFFICE

2,068,851

AIR CONDITIONING SYSTEM FOR RAILWAY PASSENGER CARS

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Application March 24, 1934, Serial No. 717,166

13 Claims. (Cl. 62—176)

This invention relates to air conditioning systems and apparatus and has particular reference to means to effect the conditioning of air in the passenger compartment of a railway car to free it from foreign matter such as dirt, soot, cinders, etc. and to control the temperature thereof.

The present invention, as will be more fully apparent hereinafter, contemplates an air conditioning system so designed and arranged as to be capable of installation in association with a railway passenger car without serious or extensive modifications of the car body or any modification of the interior of the car other than the provision of a compartment at the end portion of the car and the provision of suitable port openings through the lower deck.

The present invention has for another object the provision of an air conditioning system for railway cars embodying a plurality of independently functioning air conditioning units connected in parallel with a suitable compressor and condenser.

Another object of this invention is the provision of an air conditioning system for railway passenger cars of the monitor deck type which includes a circuit through which a refrigerant such, for example, as ammonia, methyl chloride or the like is circulated, the circuit having a compressor and a condenser therein and a plurality of air conditioning units or evaporators arranged adjacent the monitor deck exteriorly of the car and adapted to receive and condition air from the interior of the car, the units having means associated with each thereof which are responsive to temperature conditions within the units for regulating or controlling the functioning of said units or, more particularly, the passage of refrigerant thereto.

A further object of the invention is the provision of an air conditioning system for railway cars in which the conditioning units thereof are arranged at the monitor deck but on the exterior surface thereof.

A still further object of this invention is the provision of an air conditioning system for railway cars which is so designed that substantially all piping, fin coils, blowers and other parts are arranged on the exterior of the car, but well insulated, so that the system may be easily and quickly applied to any monitor deck car and so that the parts are easily accessible to permit quick replacement thereof should occasion arise.

Another object of this invention is the provision of an air conditioning system for railway cars in which air is withdrawn from the interior or passenger compartment of the car at a plurality of points throughout the length of the car, then cooled and injected into the car for recirculation; the system being devoid of air conveying ducts arranged within the body or passenger compartment of the car.

This invention also contemplates an air conditioning system and apparatus for railway cars which is easy to install, simple to operate and which consists of relatively few parts so arranged as to be capable of quick replacement and said system and the parts thereof are strong and durable in operation.

Other objects and advantages of this invention will be apparent from the following description taken in conjunction with the accompanying drawings in which:

Figure 1 shows diagrammatically a top plan view of a railway car, the latter having the present system applied thereto, and said view showing the individual air conditioning units.

Fig. 2 is a diagrammatic side elevation of a car showing the present system applied thereto.

Fig. 3 is a diagrammatic end view of a portion of a car with the present system applied thereto.

Fig. 4 is a transverse view through a car having the present invention applied thereto, the view being taken intermediate the ends of the car and showing the car body diagrammatically.

Fig. 5 is a longitudinal sectional view through one of the air conditioning units.

Fig. 6 is a sectional view taken on the line 6—6, Fig. 5.

Fig. 7 is a sectional view on the line 7—7, Fig. 5, and showing in addition the air inlet to the car.

Fig. 8 is a sectional view on the line 8—8, Fig. 6 and showing in addition the air outlet from the car to the unit.

Fig. 9 is a view of the condenser in its position in a car, certain parts of the view being broken away to disclose other parts more clearly.

Fig. 10 is a side view of the condenser shown in Fig. 9, the view being taken in the direction of the arrow, Fig. 9.

Fig. 11 is a sectional view on the line 11—11, Fig. 9.

Fig. 12 is a view on the line 12—12, Fig. 9.

Fig. 13 is a side elevational view of the compressor unit, and

Fig. 14 is a diagrammatic view of the system.

Before describing the specific construction of

the various parts employed in the present system, reference is now made to Fig. 14 in which the system is clearly illustrated as comprising a compressor unit A connected by a gas line B to a condenser C, the latter having a connection by means of a pipe line D to the several air conditioning or tempering units E; the pipe line D being adapted to conduct liquid refrigerant to the several units E and the refrigerant, after passing through the units, entering a suction line H connected to a return line I leading back to the compressor unit A. The units E have means for admitting air thereinto to pass through said units in the direction of the arrows shown in said Fig. 14 to be cooled by contact with fin coils G and then discharged out of the air conditioning units E through outlets K. Connecting each of the units E with the liquid line D are valve controlled branches indicated at L and the specific construction of the several parts will be pointed out hereinafter.

It can be seen that the present system includes a refrigerant circuit B, D, H and I in which is a compresser A and a condenser C and also a plurality of air conditioning or tempering units E; the latter being independently operable because each thereof has a valve controlled branch associated therewith through which the refrigerant passes. In line D of the circuit a magnetic shut-off valve V is provided which functions automatically by a thermostat T operative in response to temperature variations within the car body to control circulation of the refrigerant in the refrigerant circuit heretofore described.

Referring now more specifically to the remainder of the figures of the drawings, the compressor A is mounted within a box 2, suitably ventilated of course, depending from the underframe 3 of the car about midway between the ends thereof (see Figs. 2 and 13). In the instance shown the compressor unit comprises a pair of pumps 4 and 5 respectively, each having a motor 6 for driving purposes, the pumps receiving gas from a pipe 8 connected with the return line I (Fig. 14) indicated in Fig. 2 as a pipe 10.

As can be seen in Fig. 13, gas from pipe 8 is directed to the pumps through suitable piping 12 having a suction gauge 14, a valve 16 and strainer 18 therein for obvious purposes. The compressor unit, more particularly each pump thereof, is also provided with suitable cut-out switches operative automatically in response to pressure conditions for controlling the operation of unit A, but as these are more or less conventional they are not shown in detail. Suffice to say that a switch operative automatically upon increase in pressure beyond a certain point is provided for each pump and a switch operative automatically upon decrease in pressure below a certain limit is also provided, and that the switches of one compressor are set to operate within different pressure ranges than those of the other compressor.

Obviously the gas received from pipe 8 and passed in the pumps 4 and 5 is compressed by the pump and is discharged at a high pressure through branches 19 into the line B (Fig. 14) indicated as a pipe 20 in Figs. 2 and 13, the opposite end of said pipe 20 being connected to the condenser C as presently to be described.

The condenser C is positioned within a compartment 22 formed adjacent one end portion of the car body and defined by walls 24 and a door 26, and includes a cooling tower arranged within a box 28 formed within the compartment 22 and comprising an upper header or manifold 30 receiving gas under high pressure from the pipe 20, and a plurality of coils 32, the lower ends of which are connected to a liquid refrigerant header 34. At the upper wall of the box 28 a blower housing 36 is formed containing a suction fan 38 operative to draw air from outside the car through an opening 40 formed in the side wall of the car adjacent the lower portion of the cooling tower, through the box 28 and over the coils 32 and through the blower housing 36 to be discharged outside the car body through an opening 42. The openings 40 and 42 are provided with suitable shutters 44 which may be adjustably positioned within the openings if desired and the upper portion of the box 28 adjacent its juncture with the blower housing 36 is provided with a series of eliminators 46 for the purpose of separating moisture from the air prior to its discharge outside the car, as will be apparent hereinafter.

The high pressure connection line 20 is provided with suitable control valves indicated at 48, some of which are arranged adjacent the pumps and another being arranged just in advance of the entrance or discharge of the gas into the cooling tower (see Fig. 10).

The box 28, or at least the lower portion thereof constitutes a water reservoir R provided with a drain plug and in the compartment 22 is a pump 50 operated by a motor 52 for pumping the water from the reservoir through a spray pipe 54 having spray nozzles 56 so arranged as to discharge onto the coils 32, as shown clearly in Figs. 9 and 10. Due to the forced draft or circulation through the box 28 a certain amount of water will become entrained in the air and the eliminators 46 serve to remove the major portion thereof. The remainder of the entrained water passes out of the car through the opening 42 and it is apparent that water in the reservoir R must be replenished from time to time. To compensate for loss of water in the reservoir R, a storage tank 58 is arranged in the compartment 22 and is provided with a filling pipe 60 and a discharge pipe 62, the latter having its discharge end positioned within a make-up tank 64 and provided with a float control valve 66. As shown clearly in Fig. 9, the make-up tank 64 is just adjacent the reservoir R and is connected thereto by pipe 65, consequently the water levels in the reservoir R and make-up tank 64 will remain uniform at all times. Loss of water from reservoir R will be compensated by water from the make-up tank 64 and as the float 67 lowers in tank 64 the valve 66 will be operated to replenish the water in tank 64 from the storage tank 58. In the discharge pipe 62 a valve 68 is provided for an obvious purpose.

The present invention is designed to use a liquid refrigerant which upon absorption of heat passes to a gaseous state. Such refrigerants are well known in the art and any one thereof may be employed. The refrigerant, having absorbed heat, is gasified and the compressors obviously force this gas, at high pressure and in its heated condition, to the cooling tower. Passage through the cooling tower condenses this gas and the liquid refrigerant passes to the liquid refrigerant receiver 34 from where it is forced, due to pressure, through the liquid pipe line D (Fig. 14) indicated as a pipe 70. The pipe 70, as clearly shown in Fig. 2, extends upwardly along the side wall of the

car and is connected with feeding pipes 72 extending longitudinally of the car body in parallel relation on opposite sides of the monitor deck and arranged on the ceiling of the lower deck. As clearly shown in Fig. 1, the feeding pipes 72 are connected to the air conditioning units E by means of connections indicated generally in Figs. 1 and 2 at 74 and each thereof including a connection pipe 76 having an expansion valve 78 therein; the valves being supported on brackets 80 secured to the ceiling of the lower deck of the car as clearly shown in Fig. 7. The pipes 72 and the connections 74 are designed to direct the liquid refrigerant to the air conditioning units E for the purpose of conditioning air from the interior or passenger compartment of the car as now to be described.

As clearly shown in Figs. 5–8 inclusive, the air-conditioning units E are supported on the ceiling or top portion of the lower deck of the car and are arranged immediately adjacent the monitor deck and are each formed to include a double walled housing indicated generally at 82, one end portion of which is enlarged to constitute a motor chamber within which is positioned a motor 84 supported on a bracket 86 secured to the rear wall 88 of a blower chamber 90; the latter having a front wall 92 provided with an air inlet opening 94 in communication with a metal lined opening 96 formed in the side wall of the monitor deck and provided with a screen or filter 98 at the air entrance end thereof.

The motor is adapted to drive a fan 99 arranged within the blower chamber 90 and the top wall 100 of said blower chamber may be curved as shown in Fig. 5. The blower chamber also includes an air discharge neck 102 which directs air drawn into the blower chamber by the fan 99 into a cooling chamber 104 formed longitudinally within the housing 82 and having a downwardly deflected discharge end 106 (see Fig. 5) connected to the upper end of a discharge port 108 extending vertically downward through the ceiling of the lower deck of the car. As clearly shown in Fig. 7, the port 108 increases in diameter from its point of attachment with the discharge end 106 of the cooling chamber whereby the velocity of the air passing therethrough is reduced. In the instance shown in Fig. 7 the discharge end of the cooling chamber is indicated as being provided with depending flange portions 109 which are fitted within the upper end portion of the port 108, while in Fig. 5 the air discharge portion 106 is flanged and secured as at 111 to the lower wall 113 of the housing 82 and in this construction the housing 82, more particularly the cooling chamber therewithin, may be connected in any suitable manner with the port 108 such, for example, as by means of a suitable coupling or other connection. The lower end portion of the port 108 is provided with a series of baffles 110 which may be adjustably supported to vary the rate of discharge and the direction of flow of the air from the cooling chamber into the passenger compartment of the car. As will be apparent hereinafter, due to the low temperature of the cooling coils, water of condensation is formed which may be entrained with the air passing through the cooling chamber. This air may also contain a moisture content in excess of that desirable for admission into the passenger compartment of the car and to avoid this disadvantage the present construction provides a screen or filter 112 positioned beneath the port 108 for the purpose of removing excess moisture and foreign matter from the air immediately upon its discharge from the port.

The connection 76 directs liquid refrigerant to a cooling coil 114 supported within the cooling chamber 104 in the path of the air passing through the latter and the rear end wall of the cooling chamber is formed by a series of eliminator plates 116 adapted to dehumidify the air after it has been cooled by contact with the coil 114. Suitable gutters may be arranged beneath the coil 114 and the eliminators 116 to take water of condensation and obviously, suitable drains may be provided to conduct this water from the gutters to a point of discharge. The refrigerant, in absorbing heat units from the air passing through the cooling chamber, passes from a liquid to a gaseous state and into a pipe 118 from where it passes to a suction line indicated in Fig. 14 as H and designated as a pipe 120 in Figs. 1, 3 and 4, said suction pipe 120 being connected to the return line I (Fig. 14) heretofore described as a pipe 10 and shown clearly in Figs. 2 and 3. The connections between the individual air conditioning units E and suction line 120 are by means of pipes or conduits 122 and each thereof is provided with a valve 124 to isolate any desired unit E from the system and these pipes 122 may include a trap 126 to retain any refrigerant which may have passed through the units without being changed to a gaseous state whereby to prevent return of liquid refrigerant to the compressor A.

The air conditioning units or evaporators 82, as will be obvious from the above description, comprise, in effect, inner and outer shells arranged in spaced relation and the space between said shells, indicated at 128, is preferably filled with suitable insulation but inasmuch as any preferred type of insulation may be used it has not been indicated in the drawings. The discharge line 118 from the upper portion of each cooling coil 114 is preferably embedded in insulation shown clearly in Fig. 5 at 130 and, in practice, the piping shown in Figs. 3 and 4 on the upper portion of the car is preferably covered with suitable insulation.

The passage of refrigerant to the coils 114 is preferably automatically controlled by means of the beforementioned valve 78, the operation of which is thermally controlled by means of a temperature responsive device 132 mounted on pipe 118 adjacent the coil 114 and having thermal connection with the valve 78 through a pipe 134. Obviously differences in the temperature of the refrigerant as it leaves the coils 114 influence the action of the device 132 to regulate the admission of liquid refrigerant through the valve 78 to the coils 114.

From the above description it is believed that those skilled in the art will recognize that with the system charged with a liquid refrigerant such as methyl chloride, ammonia or any other of the well-known refrigerants, operation of the compressor unit will force gas under high pressure to the condenser where it is liquefied and then passed to the cooling coils 114 of the several air conditioning units E. These coils 114, being in the path of air withdrawn from the interior of the car at a plurality of points, serve to remove the heat units from the air, thus cooling or tempering the same. Contact of this warm air with the cold coils 114 obviously removes heat and moisture from the air thus tempering and dehumidifying the air. Foreign matter such as dust particles, or excess moisture remaining in the air are

removed by the eliminators 116 before the air is passed into the body of the car. The refrigerant, upon absorption of heat, passes to a gaseous state and from the cooling coils 114 back to the compressor by the pipes 118, 122, 120 and 10 where it is compressed and recirculated. Suitable electric connections are provided for operating the several motors described herein and the electric circuit may be controlled automatically by thermostatic means arranged within the car and subject to variations in temperature within the car body. Inasmuch as the specific electric circuit forms no part of the present invention the same is not illustrated. As shown in Fig. 2, the thermostat T is arranged within the passenger compartment of the car and is operative to control the valve V; the latter being arranged in the pipe 70 whereby passage of the refrigerant in the circuit is controlled.

The drawings herein illustrate one embodiment of this invention but it is to be understood that they are for illustrative purposes only and various changes in the form and proportions of the construction may be made within the scope of the appended claims without departing from the spirit of the invention.

What is claimed is:

1. In combination with a railway passenger car of the monitor deck type, an air conditioning system comprising a refrigerant circuit having a compressor and a condenser therein, a plurality of air conditioning units in the circuit arranged exteriorly of the car adjacent the monitor deck, said units having air intakes and air outlets in communication with the interior of the car, and means associated with each of said units operative in response to temperature conditions in the units for individually controlling the passage of refrigerant to said units.

2. In combination with a railway passenger car of the monitor deck type, an air conditioning system comprising a refrigerant circuit having a compressor and a condenser therein, a plurality of air conditioning units in the circuit arranged exteriorly of the car adjacent the monitor deck, said units having air intakes and air outlets in communication with the interior of the car, thermally controlled means associated with each of said units for controlling passage of refrigerant to the individual units, and a thermostatically controlled valve in said circuit for controlling circulation of refrigerant through the circuit.

3. The method of conditioning and distributing air for railway passenger cars of the monitor deck type having a lower deck which comprises withdrawing the air from the car at a plurality of points at the monitor deck, cooling the air, and introducing the cooled air through the ceiling of the lower deck of the car into the car at a plurality of points.

4. The method of conditioning and distributing air for railway passenger cars of the monitor deck type which comprises withdrawing the air from the car at a relatively high point in the monitor deck and at a plurality of points spaced longitudinally of the car, cooling the air, dehumidifying said cooled air, and finally introducing the cooled air into the interior of the car at a plurality of points relatively lower than the points of withdrawal and spaced longitudinally of the car.

5. The method of conditioning and distributing air for railway passenger cars of the monitor deck type having a lower deck which comprises withdrawing the air from the car at the monitor deck at a plurality of points spaced longitudinally of the car, cooling the air, dehumidifying said cooled air, and introducing said cooled air into the car through the ceiling of the lower deck thereof at a plurality of points spaced longitudinally of the car and arranged adjacent the side walls of the latter.

6. The method of conditioning and distributing air for railway passenger cars which comprises withdrawing the air from the car at the upper portion thereof at a plurality of points spaced longitudinally of the car and arranged substantially immediately adjacent the longitudinal center line of the car and between the side walls of the latter, cooling the air withdrawn outside the body of the car, and finally introducing the cooled air into the car at a plurality of points spaced longitudinally of the car and arranged adjacent the side walls of the latter.

7. The method of conditioning and distributing air for railway passenger cars of the monitor deck type having a lower deck which includes withdrawing the air from the car at the monitor deck at a plurality of points spaced longitudinally of the car, cooling the air withdrawn and then introducing said cooled air directly into the car adjacent the side walls thereof through the ceiling of the lower deck whereby said air is circulated transversely relative to the longer axis of the car.

8. In an air conditioning system for monitor deck type passenger cars, a plurality of air conditioning units arranged exteriorly of the car adjacent the monitor deck and provided with air intake and discharge ports in communication with the interior of the car, a refrigerant line to which each of said units is individually connected, a compressor receiving refrigerant subsequent to its passage through said units, and a condenser connected between said units and compressor.

9. In combination with a monitor deck type railway passenger car, an air conditioning system comprising a compressor supported by the car underframe, a condenser within the car body adjacent one end portion thereof, a refrigerant line between the compressor and condenser, a plurality of air conditioning units supported by the ceiling of the lower deck of the car and arranged exteriorly of and adjacent the monitor deck, said units each having an air inlet and an air outlet communicating with the interior of the car and each having a cooling coil therein, and means connecting the cooling coils with the condenser and compressor.

10. In combination with a railway car having a monitor deck, a lower deck, an air tempering and conditioning unit arranged exteriorly of the car adjacent the monitor deck and supported by the ceiling of the lower deck, said unit having an air inlet and an air outlet communicating with the interior of the car.

11. In combination with a railway car having a monitor deck, a lower deck, and a plurality of air tempering and conditioning units arranged exteriorly of the car adjacent the monitor deck and supported by the ceiling of the lower deck, said units each having an air inlet and an air outlet communicating with the interior of the car.

12. The method of conditioning and distributing air for railway passenger cars of the monitor deck type having a lower deck, which comprises withdrawing the air from the car at a plurality

of points at the monitor deck, cooling the air, introducing the cooled air through the ceiling of the lower deck of the car into the car at a plurality of points and regulating the cooling of the air in response to temperature variations within the car.

13. The method of conditioning and distributing air for railway passenger cars of the monitor deck type, having a lower deck which includes withdrawing the air from the car at the monitor deck at a plurality of points spaced longitudinally of the car, cooling the withdrawn air and then introducing said cooled air directly into the car adjacent the side walls thereof through the ceiling of the lower deck in such a manner that air is circulated transversely relative to the lower axis of the car, and regulating the cooling of said air in response to temperature variations within the car.

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