Aug. 22, 1939. E. W. TEST ET AL 2,170,101

AIR CONDITIONING SYSTEM FOR RAILWAY CARS

Original Filed July 15, 1931 6 Sheets-Sheet 1

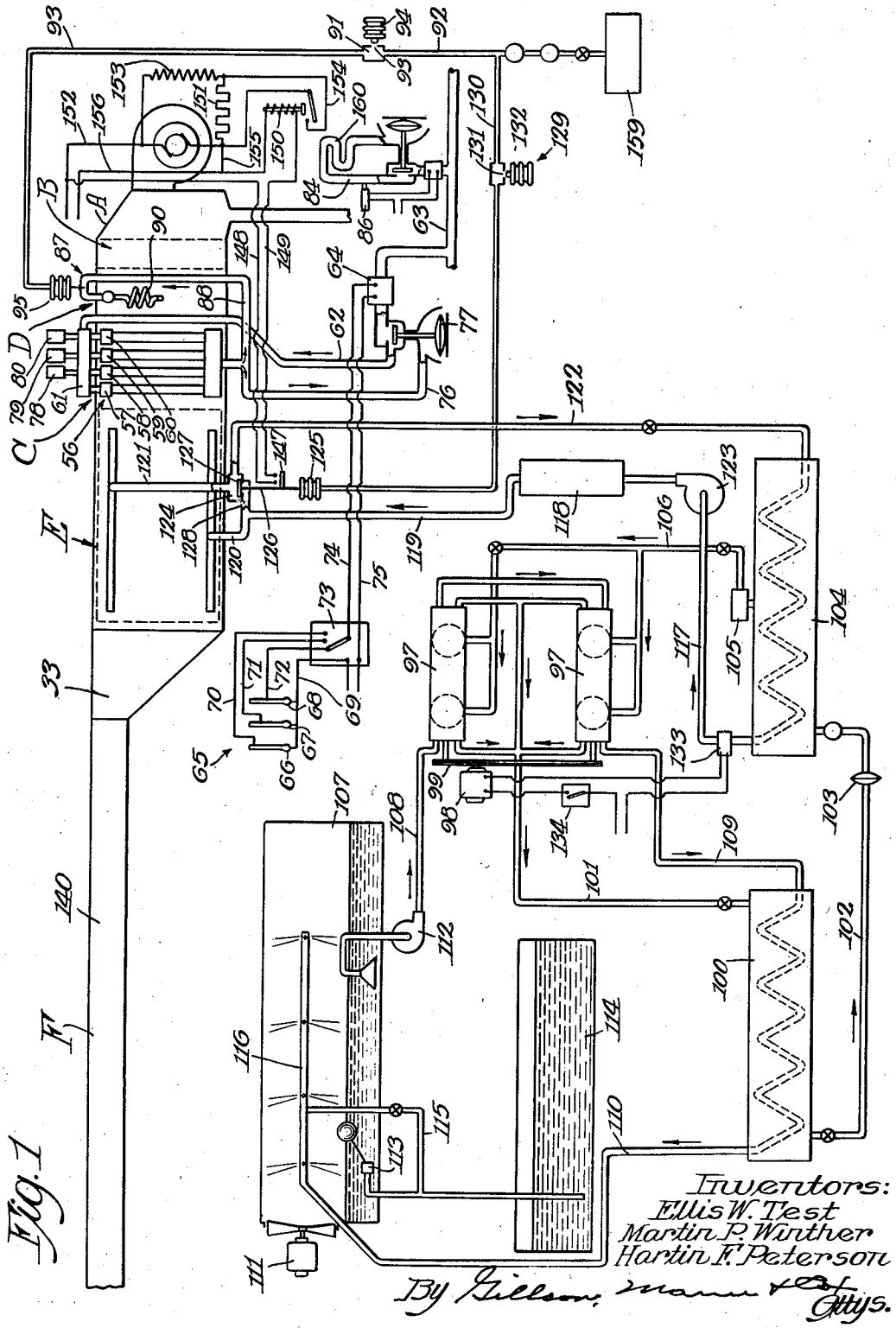

Fig. 1

Inventors:
Ellis W. Test
Martin P. Winther
Martin F. Peterson
By Gillson, Mann & Cat
Attys.

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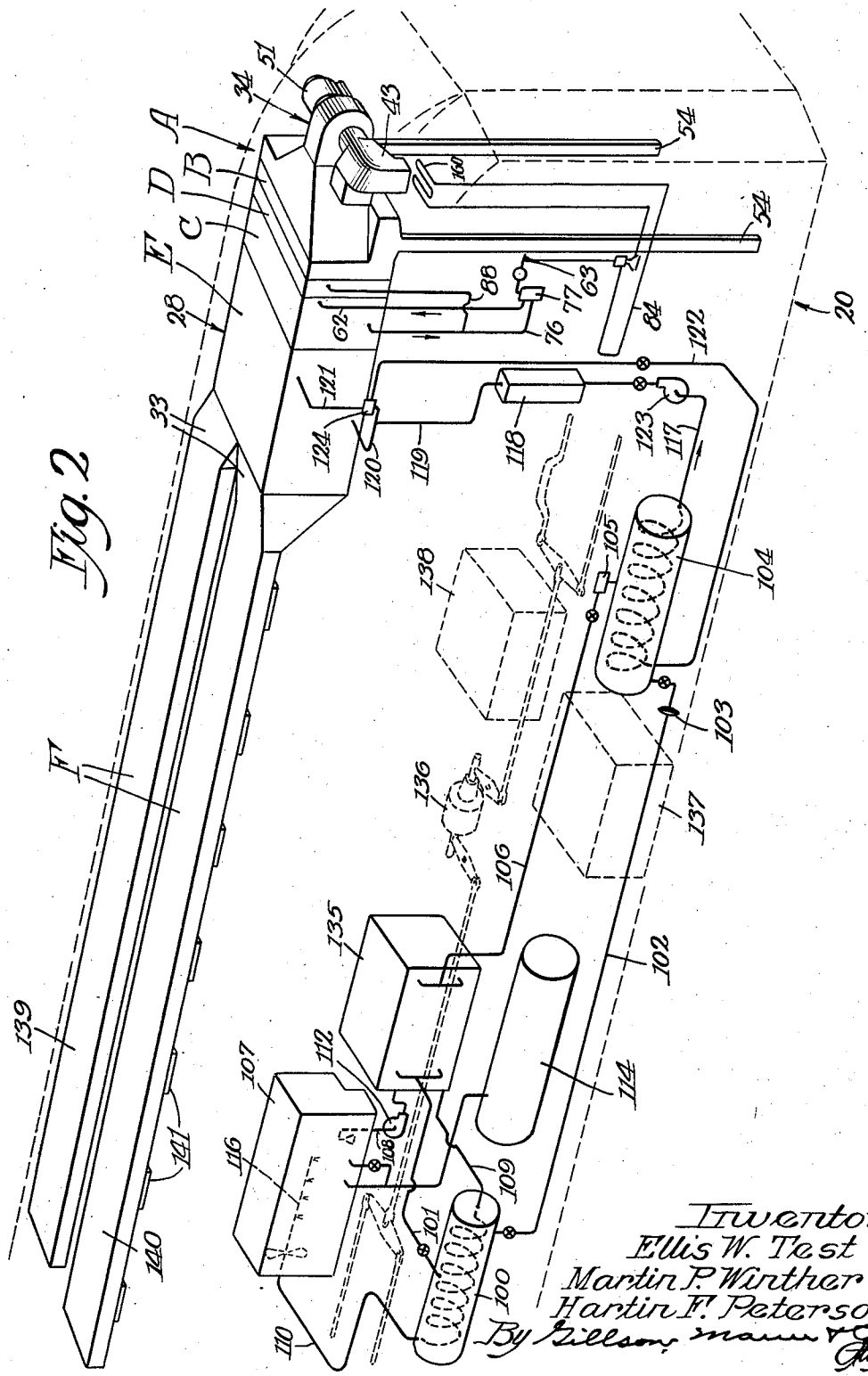
Fig. 2



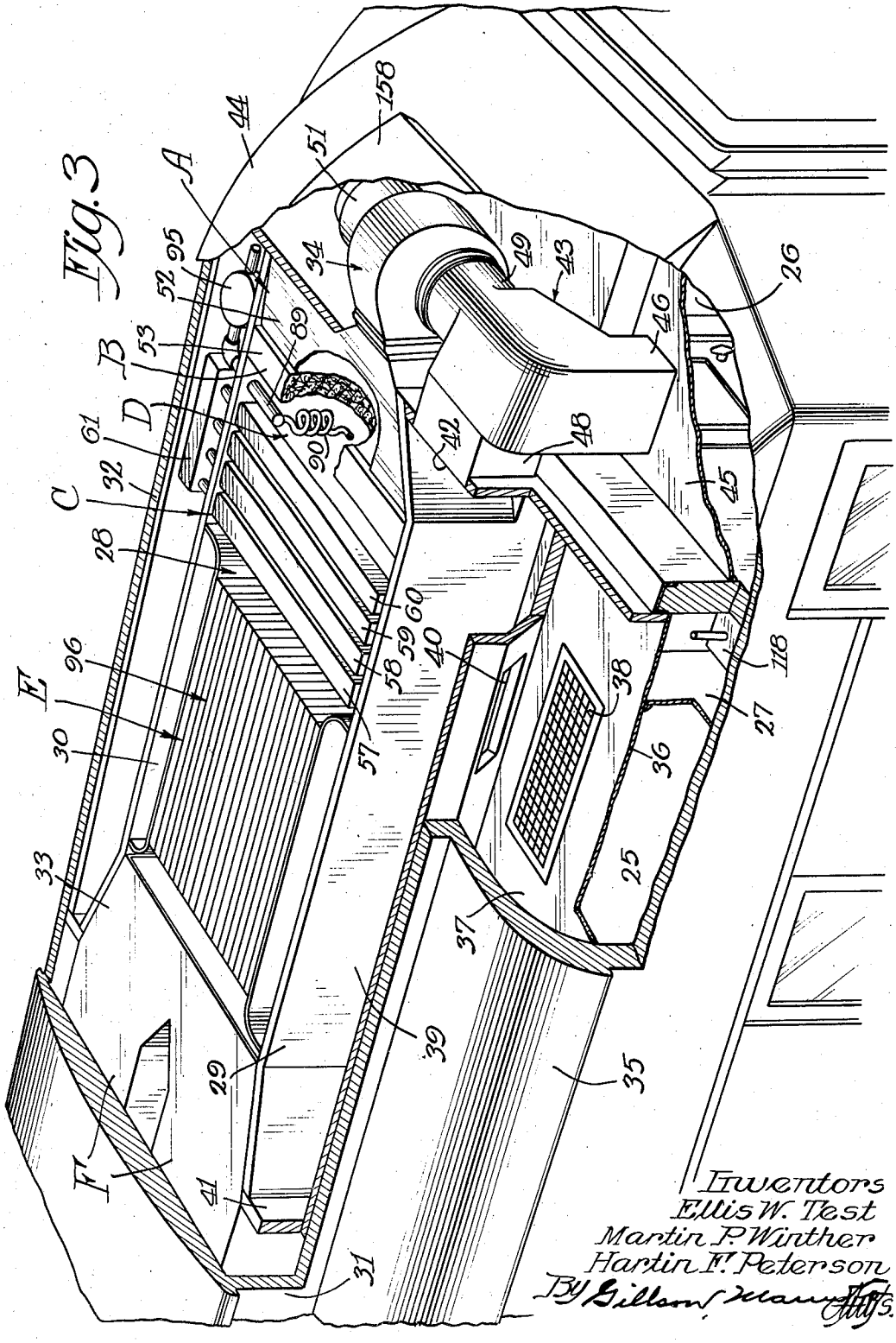
Inventors
Ellis W. Test
Martin P. Winther
Martin F. Peterson
By Gillson, Manning & Gillson
Attys.

Aug. 22, 1939. E. W. TEST ET AL 2,170,101

AIR CONDITIONING SYSTEM FOR RAILWAY CARS

Original Filed July 15, 1931 6 Sheets-Sheet 3

Fig. 3



Inventors
Ellis W. Test
Martin P. Winther
Martin F. Peterson
By Gillson Mann & Hall
Attys.

Aug. 22, 1939. E. W. TEST ET AL 2,170,101

AIR CONDITIONING SYSTEM FOR RAILWAY CARS

Original Filed July 15, 1931 6 Sheets-Sheet 4

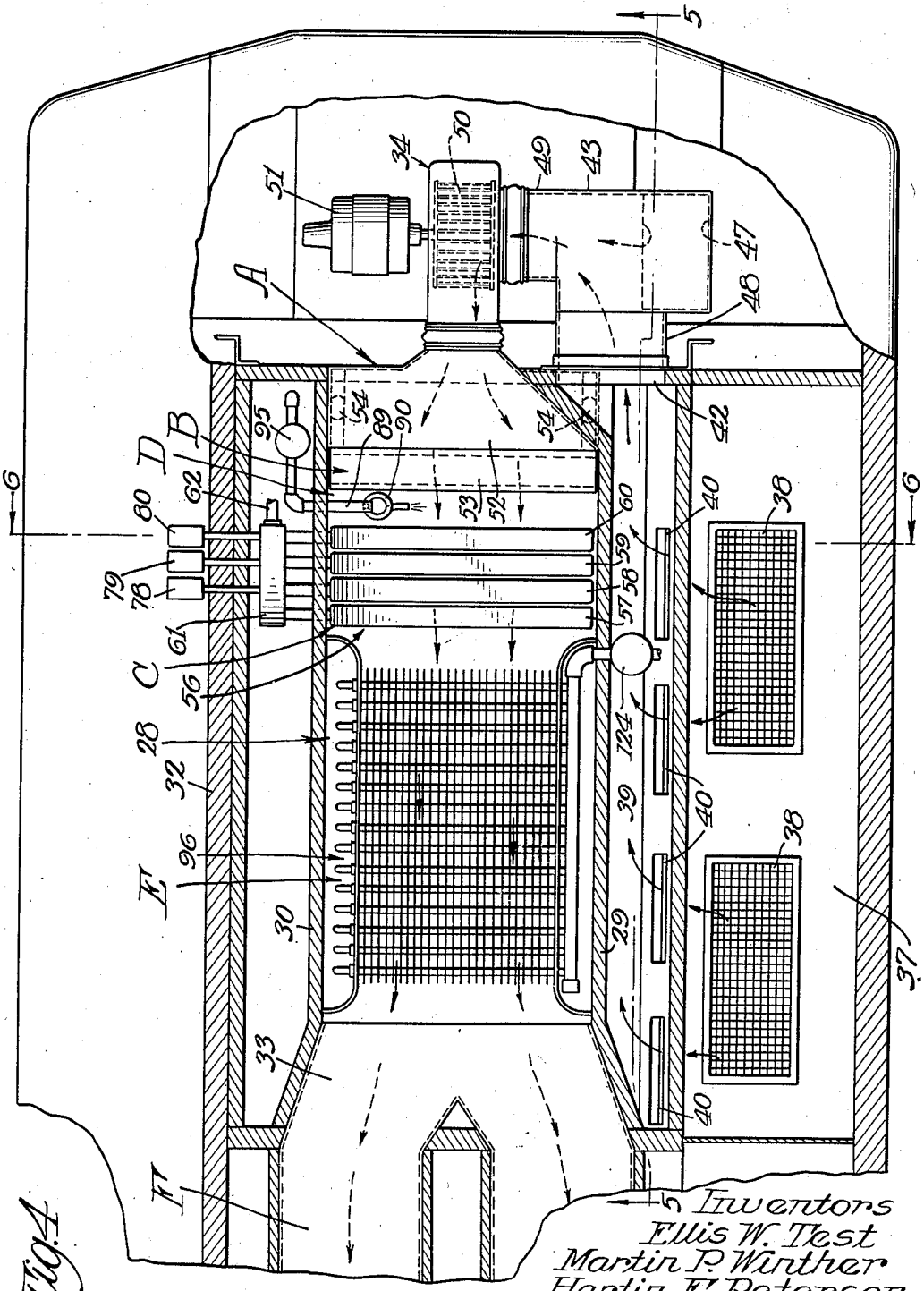


Fig. 4

Aug. 22, 1939. E. W. TEST ET AL 2,170,101

AIR CONDITIONING SYSTEM FOR RAILWAY CARS

Original Filed July 15, 1931 6 Sheets-Sheet 5

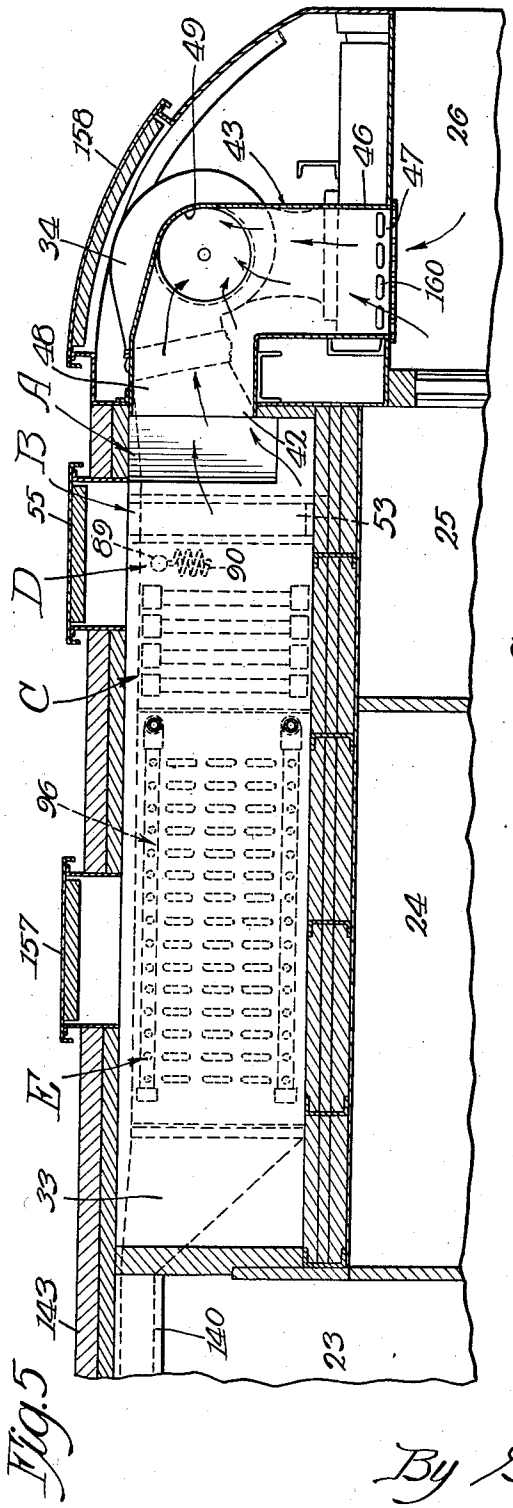


Fig. 5

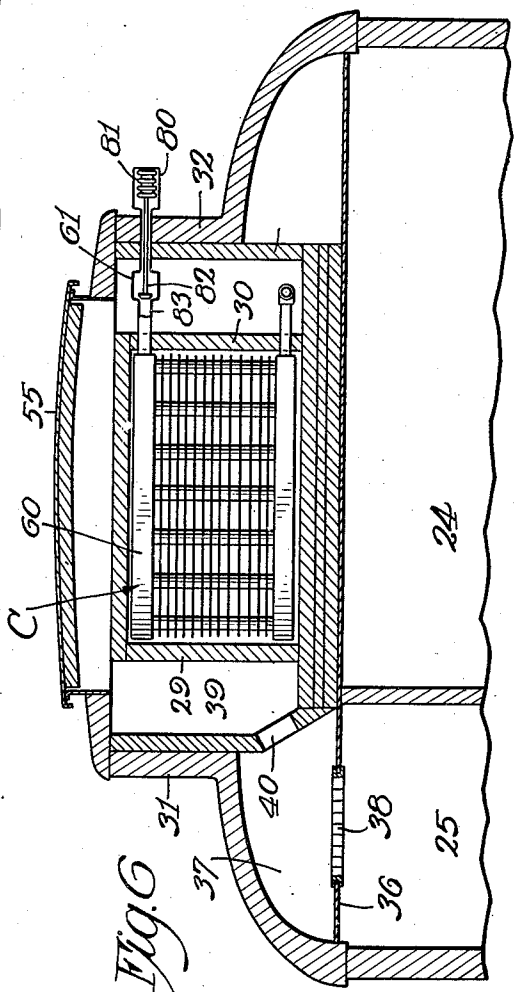


Fig. 6

Inventors:
Ellis W. Test
Martin P. Winther
Martin F. Peterson
By Gilson, Mann & Coffey
Attys

Aug. 22, 1939. E. W. TEST ET AL 2,170,101

AIR CONDITIONING SYSTEM FOR RAILWAY CARS

Original Filed July 15, 1931 6 Sheets-Sheet 6

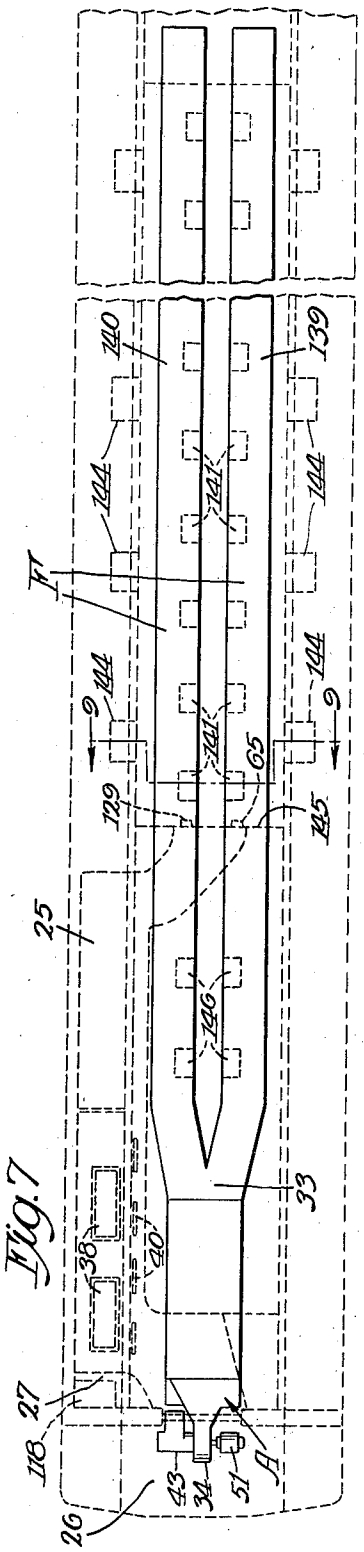


Fig. 7

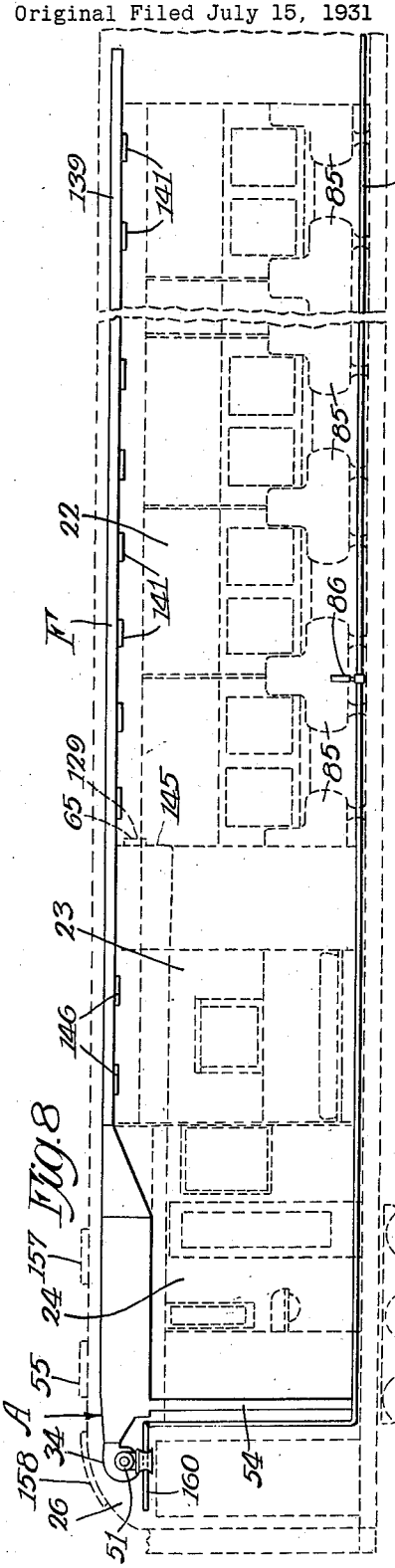


Fig. 8

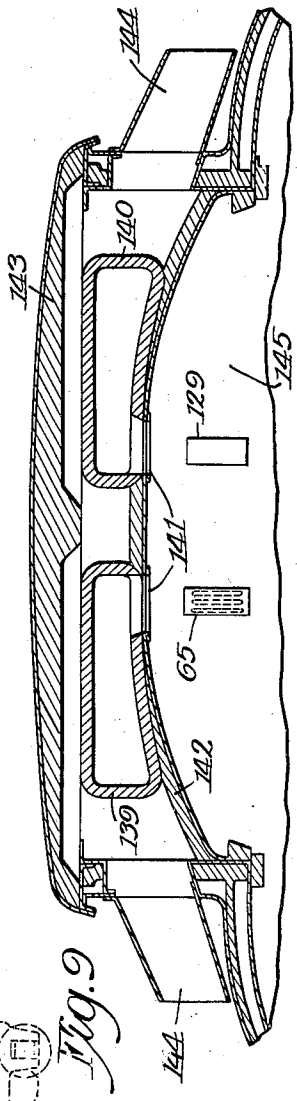


Fig. 9

Inventors
Ellis W. Test
Martin P. Winther
Martin F. Peterson
By
Gillson, Mann & Co
Attys.

Patented Aug. 22, 1939 2,170,101

UNITED STATES PATENT OFFICE

2,170,101

AIR CONDITIONING SYSTEM FOR RAILWAY CARS

Ellis W. Test, Hinsdale, Martin P. Winther, Waukegan, and Hartin F. Peterson, Chicago, Ill., assignors, by mesne assignments, to Pullman-Standard Car Manufacturing Company, a corporation of Delaware

Application July 15, 1931, Serial No. 550,904
Renewed May 2, 1938

8 Claims. (Cl. 257—3)

This invention relates to an air conditioning system for railway cars and is especially designed for application to a standard Pullman car.

Contrary to common belief, there is no set temperature at which a room should be maintained for those inside to be comfortable. It has been found by experiment that in cold weather a room may remain comfortable when kept at a constant minimum temperature, but that in hot weather, the comfortable temperature will vary in relation to the temperature of the outside air.

For example, in the winter time, a room may be held at a temperature of 70° and will be thought comfortable by all those who enter it regardless of the severity of the outside cold. In the summer time, however, if the outside air registers 95°, a person entering a room in which the temperature is 70° would feel chilled and comfortable temperature would be said not to exist. When the temperature of the outside air, therefore, is higher than that of the room which is being ventilated, the mean interior temperature must vary so as to lessen the differential between the two temperatures.

This invention, therefore, has for its primary objects to automatically maintain appropriate temperature and humidity in the interior of a railway car at all times functionally related to the outside temperature; to thoroughly cleanse, humidify, heat, cool and otherwise treat the air passing into the passenger space; to vary the mean temperature within the car to correspond with the comfort temperature as influenced and affected by the temperature of the outside air; to combine an overhead ventilating system with an auxiliary independently operated heating coil so as to produce and maintain uniform temperature in all portions of the car interior, and to so arrange and locate the various elements that they may be economically applied to existing cars.

Further and other objects and advantages will become apparent as the description is read in conjunction with the accompanying drawings, in which

Fig. 1 is a schematic drawing of the complete system including the control units;

Fig. 2 is a diagrammatic, perspective view of a car equipped with this invention, showing particularly the arrangement of the various elements on the car underframe;

Fig. 3 is a perspective view of one end of the car with parts broken away to expose the air conditioning chamber;

Fig. 4 is a horizontal sectional view looking down on the air conditioning chamber;

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

Fig. 6 is a transverse, sectional view taken on the line 6—6 of Fig. 4;

Fig. 7 is a plan view of the car, the fan conditioning chamber and duct system being shown in full lines;

Fig. 8 is a longitudinal, sectional view of the car showing the location of the conditioning chamber over the ladies' lavatory; and

Fig. 9 is a transverse, sectional view through the ceiling ducts, taken on the line 9—9 of Fig. 7.

The invention may be applied to all types of railway cars, and it is for the purpose of disclosure only that a standard Pullman sleeping car has been chosen to illustrate one embodiment of the invention. The invention is, therefore, not to be limited by the specific disclosure except as required by the prior art.

The car shown in the drawings is of the closed vestibule monitor top type, and comprises a body generally designated 20 mounted on car trucks 21 in the usual manner. The car is divided into a passenger space 22, drawing room 23, ladies' lavatory and salon 24, and a passageway 25 leading from the passenger space to the vestibule 26 adjacent the ladies' end of the car. The other end of the car, which is not shown in the drawings, contains the men's lavatory and smoking room and has a closed vestibule similar to the vestibule 26.

The air conditioning chamber of the present invention is located above the ladies' lavatory and salon where there is adequate space for the necessary apparatus. At this end of the car is a locker 27 which can be conveniently used to house the various pipe connections extending between the air conditioning chamber and the apparatus mounted on the car underframe. The corresponding locker at the other end of the car is customarily used for an electrical control box, making it less convenient for using that end of the car for the air conditioning apparatus.

The conditioning apparatus is designed to filter, humidify, heat and cool all air which is delivered to the passenger space and may be divided into the following units:

A. The conditioning chamber including the fan and fan casing, but exclusive of the dual ceiling ducts;

B. The filters;

C. The heating system;

D. The humidifier;

E. The cooling system.

F. The ceiling ducts.

For convenience of disclosure, the units making up the air conditioning system will be described as classified above.

A. *The conditioning chamber including the fan and fan casing, but exclusive of the dual ceiling ducts*

Referring to Fig. 3, which shows a perspective view of the air conditioning chamber and the apparatus which it houses, it will be seen that the chamber, generally designated **28**, is defined by side walls **29** and **30**, spaced away from the side decks **31** and **32** of the car and opening at one end, for convenience called the forward end, into the bifurcated ceiling duct **33** and at the other, or rearward, end communicating with the fan casing generally designated **34**.

Between the lower deck **35** and the false ceiling **36** over the passageway **25** is an open space **37** communicating through grilles **38** with the passageway. This air space opens into a channel **39** between the side deck **31** and a side wall **29** of the conditioning chamber through a plurality of openings **40** in the lower side deck. The forward end of the channel **39** is closed by a partition **41** so that air admitted to the channel **39** through the openings **40** must find its outlet through an opening **42** (Fig. 4) at the rear end of the channel.

A fan intake casing **43** is situated between the sloping roof or upper deck **44** of the car and the ceiling **45** of the vestibule, and comprises a downwardly extending branch **46** opening into the vestibule through an adjustable grille **47**, a forwardly extending branch **48** communicating with the opening **42** at the rear end of the channel **39**, and a horizontal tubular portion **49** connecting the branches **46** and **48** with the fan casing **34**. Air is drawn into the casing **34** by a fan **50** which then forces the air into the conditioning chamber **28**. A suitable motor **51** drives the fan.

It is of particular advantage to take the fresh air, which is to be conditioned and then delivered to the passenger space, from the car vestibule since the air therein is comparatively still allowing the larger particles of dirt and cinders to settle to the floor of the vestibule and not be drawn through the fan. The cracks and crevices around the vestibule diaphragms and the vestibule doors admit sufficient fresh air to the vestibule to satisfy the needs of the conditioning system.

The grille **47** in the vestibule ceiling may be regulated to control the amount of fresh air admitted to the circulation. Ordinarily, it is allowed to remain fully open, in which state approximately 30% of the air drawn into the conditioning chamber is fresh air. This ratio may be changed as desired by adjustment of the vestibule ceiling grille.

B. *The filters*

The air forced into the conditioning chamber **28** by the fan first expands in a cinder or dirt trap where the larger particles of foreign material strike the walls of the trap and the filters **53** placed transversely of the conditioning chamber and drop through cinder drains **54** to the road bed below. The dirt which fails to separate from the air in the cinder trap **52** is removed from the air as it passes through the filters **53** which preferably constitute separate units that can be quickly removed for cleaning or replacement. The type employing a fibrous material interposed between the metal screens is well suited for this purpose.

In order to facilitate the removal of the filters when desired, the upper deck is provided with a hatch **55** directly above the filters.

C. *The heating system*

The heating system is designed to maintain a temperature of 70° during cold weather which may be increased to 75° to satisfy the individual preference of certain passengers. At night, the mean temperature is lowered to about 60° to provide comfortable sleeping temperature.

The varying mean temperatures of which this apparatus is capable are controlled by a three-way thermostat which will later be described and is an added feature of the present invention. The normal heating of the car to a particular desired temperature is accomplished automatically in the manner now to be described.

A vapor heating coil, or any other suitable heating means, generally designated **56**, comprising a plurality of sections **57**, **58**, **59** and **60** is placed transversely in the conditioning chamber **28** in the path of the circulating air. The four sections are connected by a header **61**, having a connection **62** with the train steam line **63** (Fig. 1).

Referring to Fig. 1 wherein the entire system is diagrammatically shown, it will be seen that there are two valves which control the admission of steam to the heating coil. One of these valves, designated **64**, is electrically controlled by a three-way thermostat **65** having thermometers **66**, **67** and **68**.

The thermometers are mercury filled and have their bases connected to a positive wire **69**. Wires **70**, **71**, and **72** protrude into the thermometer bulbs **66**, **67** and **68**, respectively, at heights corresponding to desired temperatures, and lead to a remote control box **73** which selectively engages the appropriate wire.

The remote control in Fig. 1 is set for 60°, the temperature at which the car is maintained at night, and the current may be traced from a suitable source not shown through positive wire **69**, mercury thermometer **68**, conductor **72**, remote control **73**, conductor **74**, valve **64**, and return conductor **75**.

When the temperature in the passenger space falls sufficiently to break the circuit in the thermometer **68**, the valve **64** is opened and vapor is admitted to the steam coil **56** to heat the incoming air. The steam vapor passes through the coil after which it is led to the atmosphere through a pipe **76**. At the atmospheric opening of this pipe is a thermally controlled Sylphon valve **77** adapted to close the intake pipe **62** whenver the temperature at the exhaust is above a predetermined value. The purpose of this valve is to conserve steam.

Sections **58**, **59** and **60** of the heating coil are provided with Sylphon bellows valves **78**, **79** and **80**, respectively, exposed to the outside air. These valves are adapted to vary the heating surface of the coil by automatically cutting out sections of the heater when they are not required. For example, the valve **78** may be set to open at 40°, the valve **79** at 20° and the valve **80** at −10°. Above 40°, only the section **57** carries the steam vapor.

Referring to Fig. 6, wherein the valve **80** is shown in cross section, it will be seen that contraction of the Sylphon **81** of the valve withdraws the valve stem **82** from its seat in the vapor pipe

83 thereby allowing the steam vapor to pass from the header 61 into the heating section 60. Valves 78 and 79 are similar to valve 80, differing only in the temperature at which they are set to function.

The purpose of these three valves is to make the heating surface bear some relationship with the temperature of the outside air. It is quite obvious that when extremely cold air is being admitted into the conditioning chamber from the vestibule that more heating surface is needed to effectuate a proper heating of the air than when air of more moderate temperature is being circulated. Consequently, the three valves act to automatically provide the necessary heating surface.

The heating arrangement which is used in this apparatus inherently serves to increase the rate of steam flow through the radiator sections in proportion to the temperature of the circulated air. If the air passing through the coils is relatively cold, part of the steam will condense and thereby reduce the pressure within the radiator coils. The pressure differential between the steam coil and the steam line will result in a faster inflow of steam into the coil, and proper heating of the air is thereby assured. The valve 77 serves as an automatic regulator to close the heater intake when the temperature at the exhaust reaches a predetermined amount, and is of standard construction.

The remote control unit 65 enables the car attendant to fix the mean temperature at which the car is to be kept. With the switch in the position shown in Fig. 1, the car will be maintained at approximately 60°; when moved to the right to establish connection between conductor 71 and conductor 74, the mean temperature will be approximately 70°; and when moved further to the right to include the thermometer 66 in the circuit, the mean temperature will be approximately 75°. These mean temperatures may, of course, be varied by suitably positioning the protruding wires in the thermometer stems.

An auxiliary heating coil 84 runs along each side of the car beneath the car seats 85 and is connected directly to the main steam line. The auxiliary coil is controlled by a thermostat 86 which operates entirely independently of the control for the heating coil in the air conditioning chamber. Although the floor thermostat operates independently of the control for the overhead heating coil, there is a relationship in the cycle of operation of the two controls, since the floor thermostat responds to the effect of the heat issuing from the overhead duct, and the thermostat controlling the overhead coil responds to the heat issuing from the floor coil. It has been found that the combination of an overhead air duct system with the auxiliary independently operated heating coil near the base of the floor enables a uniform temperature to be maintained in all portions of the car.

In series with the auxiliary coil 84 is a tempering coil 160 situated just inside of the grille 47 of the vestibule. This tempering coil serves to slightly increase the temperature of fresh air drawn into the conditioning chamber when the main heating coil in the conditioning chamber is thermostatically cut out, making the elimination of the main heating coil unnoticeable to the passengers.

D. *The humidifier*

Since the capacity of air for moisture varies in proportion to its temperature, there is no necessity for humidifying air drawn into the conditioning chamber except during cold weather. Accordingly, the humidifier of this invention is attached directly to the heating coil and functions only when it is in operation.

Referring to Fig. 1, the humidifier, generally designated 87, is shown connected with the outlet 76 of the heating coil by a pipe 88 running upwardly to the top of the car and then projecting into the conditioning chamber at 89. The protruding portion 89 terminates in a coiled delivery tube 90 which sprays the vapor into the path of the circulating air, and by its shape silences the humidifier.

In the same way that the delivery of steam to the heating coil is automatically increased in proportion to the temperature of the circulating air, so also is the rate of humidifying affected by the temperature of the incoming air. This is an especially desirable feature of the humidifier, as it serves to automatically increase the input of moisture to the air in proportion to the normal need for greater moisture content.

In order to safeguard against too high relative humidity prevailing within the car interior, a hygrostat 91 may be placed in the passenger space to shut off the humidifier when the relative humidity has reached a predetermined maximum. The hygrostat is of the bleeder type wherein a compressed air line 92 is open to atmosphere at 93 until closed by the Sylphon 94 at which time the compressed air builds up a pressure in the tube 93 to actuate a Sylphon bellows valve 95 in the main pipe 88 of the humidifier. It has been found by experiment, however, that a hygrostat is normally not required because of the inherent automatic regulation of the humidifier.

E. *The cooling system*

The cooling of the air in the summer time is accomplished by a cooling coil, generally designated 96, containing a secondary refrigerant such as brine, and arranged to be cut off from the brine circulating system when the cooling coil is not in operation.

For the purpose of this disclosure, an ammonia compression refrigeration system has been shown for cooling the secondary refrigerant system, but this invention is not limited to a particular type of refrigerating system as an absorption or other system could be used to accomplish the same purpose. Many of the advantages of this invention could also be attained with a direct expansion system, eliminating the secondary refrigerating system entirely.

The general layout of the refrigerating system is shown in Fig. 1 in which the ammonia compressors are indicated at 97 driven by an electric motor 98 through a suitable drive 99. The ammonia gas after being compressed in the compressors 97 is delivered to a condenser 100 through pipe 101 where the gaseous ammonia is condensed. From the bottom of the condenser, the liquid ammonia is drawn through pipe 102 to an expansion valve 103 communicating with a shell and tube evaporator 104. The liquid ammonia expands in the evaporator, cooling all surfaces with which it comes in contact, and the evaporated ammonia is drawn from the top of the evaporator through an accumulator 105 and connection 106 back to the compressors.

The cooling water for the compressors and the condenser is drawn from a cooling tower 107 through connection 108 leading to the water

jackets of the two compressors. After passing through the water jackets, the water is taken through pipe 109 to the condenser 100 where it serves to condense the gaseous ammonia. The water then passes through pipe 110 back to the cooling tower 107 where it is sprayed into the interior and cooled by a fan 111 located at one end of the tower. Circulation of the cooling and condensing water is effected by a pump 112 interposed in the water circuit and the water in the cooling tower is maintained at a constant level by a float valve 113 serving to draw water from a water reservoir 114 when necessary. A branch feed 115 connected to the sprays in the cooling tower enables the spraying tube 116 to be flushed in case of stoppage.

The indirect system of refrigeration is used in preference to the direct system to avoid all possibility of ammonia fumes entering the car interior. The secondary refrigerant system comprises a closed brine circuit passing through the evaporator 104. Upon being cooled by the expanding ammonia, the brine is conducted through a pipe 117 to a brine reservoir 118 preferably located in the locker 27 at the head of the passageway 25. A pipe 119 connects the auxiliary tank 118 with the cooling coil 96 through a passage 120. After passing through the cooling coil, the brine returns to the evaporator thru pipes 121 and 122. Circulation of the brine in the system is maintained by a pump 123 interposed in the circuit.

A by-pass 124 is provided between the inlet and outlet of the cooling coil for the purpose of shunting the brine circuit around the cooling coil when the latter is not needed for cooling purposes. The by-pass is provided with a Sylphon bellows valve 125, the stem 126 of which is adapted to move the valve head 127 to and from the bottom end of the pipe 121. When the valve is in the position shown in Fig. 1, the brine passing upwardly in the pipe 119 is directed through the pipe 120 into the cooling coil, the return of the brine being made through pipes 121 and 122. When the valve is in its shunt position, that is in the position closing the pipe 121, the brine is by-passed around the cooling coil from pipe 119 to pipe 122 through pipe 128.

The by-pass valve is controlled by a thermostat 129 of the bleeder type. The thermostat corresponds to the hygrostat associated with the humidifier and comprises a compressed air line 130 having an opening 131 adapted to be closed by a thermally responsive Sylphon bellows 132. The compressed air lines 92 and 130 both receive their compressed air from an air reservoir 159.

The by-passing of the brine around the cooling coil when cooling of the air is not required enables the brine system to be maintained at a low temperature in instant readiness for use. This is especially important when cars are left standing in the yards or at a station for a considerable period of time as the brine system with its relatively large capacity by reason of the auxiliary tank 118 stores up sufficient cold while the car is running (the motor 98 receiving its energy directly from the rotation of the car axles) to supply the cooling needs of the car when not in motion, or when ascending steep grades. In this way, use of heavy and expensive batteries is dispensed with.

A thermostat 133 is placed in the brine circuit to shut off the compressor motor 98 when the temperature of the brine reaches a predetermined minimum. A diagrammatic representation of the electrical circuit involving the thermostat 133 is shown in Fig. 1, the switch 134 being provided to shut off the motor 98 by hand.

There is a distinct advantage in placing the cooling coil 96 after the heating coil 56 in the conditioning chamber. The principal advantage comes from the tempering effect of the brine in the cooling coil. When the heating coil is in operation, its temperature is approximately 200° and the temperature differential between the incoming air and the heating coil causes a rapid transfer of heat to the air. The cool brine in the cooling coil 96 absorbs part of the heat given up by the heating coil to the air so that the air delivered to the car interior will gradually raise the temperature within the car to its desired value. The total effect of the warm air passing over the cooling coil (which, of course, is shunted from the circulating brine system when the heating coil is in operation) as felt in the car interior is a gradual heating of the incoming air and passengers do not sense any change in the temperature. If the order of the heating coil and cooling coil were reversed, as soon as the heating coil was placed in operation, the passengers would be aware of a warm blast of air being delivered to the car interior.

The placing of the cooling coil after the heating coil furnishes a third way for tempering the warm air introduced into the car interior. The other two means of effecting the gradual increase of temperature in the passenger space comprise the three Sylphon valves 78, 79, and 80 and the automatic regulation of steam flow in the radiator coil by the condensation of steam in the coil.

In order to increase the cooling surface of the coil 96, the pipes may be connected by fins in a manner well known to the refrigeration art.

It is possible that the warm air drawn into the conditioning chamber in the summer time contains too much moisture and the cooling coil in such cases will dehumidify the air by the condensation on the pipe and fin surfaces.

The ammonia compression refrigerating system requires the placing of the compressors and motor, the condenser, the evaporator and cooling tower beneath the car body and the arrangement of these various elements with respect to the present equipment carried by standard cars presents a formidable problem. It has been found that existing train equipment can be left in its customary position beneath the car body if the compressors and motor be mounted in a box 135 (Fig. 2) adjacent the air brake cylinder 136, and the cooling tower 107 be suspended from the car underframe adjacent thereto. The condenser 100 is placed on the other side of the car adjacent the water storage tank 114 which has its customary location near the center of the car across from the air brake cylinder. The two battery boxes 137 and 138 on opposite sides of the car need not be disturbed if the evaporator 104 is located between the battery box 137 and the end of the car on the same side as the condensor 100 and the water tank 114. This arrangement of the elements of the car underframe does not interfere with the foundation brake gear and requires very little rearrangement of the train equipment now carried on standard Pullman cars.

F. *The ceiling ducts*

After the air has been properly conditioned in passing through the conditioning chamber 28, it is delivered to the car interior through dual ceiling ducts 139 and 140 provided with a plurality

of grilles 141 opening into the car interior. The two ducts run the length of the car between the false ceiling 142 and the upper deck 143. Ventilators 144 are provided at intervals in the side decks 31 and 32 to provide a cross circulation over the ducts 139 and 140, there being sufficient space between the ducts and the upper deck to permit the passage of air. In this way the dead air space between the upper deck and the false ceiling is done away with, the result being that the temperature of the air in the ducts can be kept more uniform and less cooling is required in the summer time.

The triple thermostat 65 that controls the heating coil and the thermostat 129 which controls the cooling coil are preferably placed on the bulkhead 145 in the direct path of the circulating air so as to in effect control the temperature of the circulating air rather than the temperature in the car itself. By so arranging the thermostats, a more uniform mean temperature can be obtained due to the virtual elimination of lag which is inescapable when the thermostats are placed in their customary positions at eye level.

As shown in Fig. 8, suitable grilles 146 in the ceiling ducts provide ventilation in the drawing room 23 and like grilles are provided in the ladies' lavatory 24 and in the men's smoking room (not shown).

Summary of the system and its operation

It will be seen from the above description that a constant circulation of air is maintained in the passenger space in which approximately 70% of the air in the car interior is recirculated and 30% is taken from the car vestibule. All the air delivered to the car interior, whether it be air taken from the passenger space or fresh air, is thoroughly conditioned in the chamber 28 so as to provide maximum comfort to the passengers.

The constant drawing in of fresh air into the conditioning chamber without expelling any of the vitiated air builds up a slight pressure in the car interior which causes a constant seepage of air to the outside through the cracks and crevices in the car body such as at the window sashes. This prevents outside air with its dirt and cinders from finding ingress into the car interior.

The heating coil in the conditioning chamber is of sufficient capacity to at all times maintain the temperature of the car interior at as high a temperature as may be required. The capacity of the cooling coil, however, is limited so that the mean interior temperature of the car bears a functional relationship with the mean exterior temperature in warm weather. For example, if the temperature of the outside air is 85°, it is impossible for the cooling coil to sufficiently lower the temperature of the car interior to cause the thermostat 129 to operate the by-pass valve 125. As a result, the temperature within the car is somewhat higher than it would be in more moderate weather.

It may be said that the apparatus is so designed to maintain a uniform temperature up to a certain maximum outside temperature, after which the limited capacity of the cooling coil automatically raises the mean interior temperatures so as to lessen the temperature differential between the inside and the outside air. This feature of the apparatus gives greater comfort to the occupants of the car than if the car temperature was maintained constant throughout all ranges of outside temperature.

It is desirable that the speed of the fan 50 be greater when the cooling coil is functioning than when the heating coil is in operation. Means are, therefore, provided associated with the cooling coil by-pass valve 125 for accomplishing this function. The valve-stem 125 carries an arm 147 adapted to close a circuit between wires 148 and 149.

The closing of the circuit operates a relay 150 which takes the resistance 151 from the field of the fan motor 51 and thereby decreases its speed. The field circuit can then be traced from a suitable source of current not shown through conductor 152, resistance 153, conductors 154, 155 and 156 back to the source of current. When the by-pass valve is in the position shown in Fig. 1 and the circuit between conductors 148 and 149 is open, since there is a break in the conductor 154, the field current can be traced through conductor 152, resistance 153, resistance 151, conductors 155 and 156, back to the source of current.

Access to the conditioning apparatus may be had through suitable hatches provided in the roof of the car. The hatch 157 permits inspection of the cooling coil; the hatch 55 enables the filters 53 to be removed for cleaning and also exposes the humidifier and a part of the heating coil, and the hatch 158 gives access to the fan and fan motor.

The cooling and heating elements in the conditioning chamber may be manually cut out so that with the blower operating alone, the apparatus serves as a forced ventilating system continually filtering the air drawn into the conditioning chamber.

The air conditioning system of this invention is inherently capable of maintaining a uniform desired temperature, the desired temperature being determined by the temperature of the outside air. It also cleanses all air admitted to the car interior and supplies it with moisture if necessary.

The system is entirely automatic in its operation, but the desired mean temperature may be varied manually by a remote control adapted to be operated by the car attendant.

What we claim is:

1. A system for conditioning the air of a railway car and the like comprising an air conditioning chamber, a fan at one end of the chamber delivering a predetermined ratio of circulated air and fresh air to the chamber, an air filter adjacent the fan in the path of the mixed air, a thermostatically controlled steam heating coil in the chamber, a humidifier intermediate the filter and the heating coil normally operable whenever the heating coil is in operation but hygrostatically controlled to prevent excessive humidity and a thermostatically controlled cooling coil adjacent the heating coil, said cooling coil serving to temper the air upon receiving heat from the heating coil.

2. A system for conditioning the air of a railway car and the like comprising an air conditioning chamber, a fan at one end of the chamber delivering a predetermined ratio of circulated air and fresh air to the chamber, an air filter adjacent the fan in the path of the mixed air, a thermostatically controlled steam heating coil in the chamber, a humidifier intermediate the filter and the heating coil normally operable whenever the heating coil is in operation but hygrostatically controlled to prevent excessive humidity, a thermostatically controlled cooling coil adjacent the heating coil, containing a secondary refrig-

erant, a primary refrigerant system for cooling the secondary refrigerant, and means for isolating the cooling coil with its secondary refrigerant from the primary system when cooling is unnecessary, said cooling coil serving to temper the air upon receiving heat from the heating coil.

3. A system for conditioning the air in railway cars and the like comprising an air conditioning chamber, a fan at one end of the chamber delivering a predetermined ratio of circulated air and fresh air to the chamber, a heater in the chamber having a plurality of heating sections, means for controlling the operation of the heater, means responsive to car temperature for controlling said first named means, auxiliary means adapted to control the operation of the individual sections, said auxiliary means being responsive to the temperature conditions exterior of the car.

4. A system for conditioning the air in railway cars and the like comprising an air conditioning chamber, a fan at one end of the chamber delivering a predetermined ratio of circulated air and fresh air to the chamber, a heater in the chamber having a plurality of heating sections, means for controlling the operation of the heater, auxiliary means adapted to control the operation of the individual sections, a thermostat within the car for controlling said first named means, and thermostats on the exterior of the car associated with the auxiliary means for determining the number of heating sections to be in effective operation when the first named means is calling for heat from the heater.

5. In a railway car of the type including a car body, passenger space in the car body, and a closed space at one end of the car, the combination of means for conditioning the air of the passenger space including an air chamber over the closed spaced having inlet and outlet openings, a heater in the chamber, means for circulating air through the chamber over said heater and thence to the passenger space through overhead ducts, a thermostatic control for the heater, an auxiliary heater adjacent the car floor in the passenger space controlled by separate thermostatic means, and a tempering heater adjacent the air chamber inlet opening in series with the said auxiliary heater.

6. In an air conditioning system, the combination of a heating coil, a cooling coil, a fan for delivering air to said coils, and automatic means for increasing the speed of the fan when the cooling coil is in operation.

7. A system for conditioning the air in railway cars and the like comprising an air conditioning chamber, a fan for delivering a predetermined ratio of circulated air and fresh air to the chamber, a heater in the chamber having a plurality of heating sections, means for controlling the operation of the heater, means responsive to car temperatures controlling said first named means, auxiliary means adapted to control the operation of the individual sections, said auxiliary means being responsive to the temperature conditions exterior of the car.

8. In a ventilating system including air conditioning apparatus, the combination of an air chamber, means for delivering air to the chamber for treatment, a vapor humidifier in the chamber and a coiled delivery nozzle for the humidifier.

ELLIS W. TEST.
MARTIN P. WINTHER.
HARTIN F. PETERSON.