March 30, 1954 C. F. HENNEY 2,673,512

AIR CONDITIONING APPARATUS

Filed Sept. 17, 1948

2 Sheets-Sheet 1

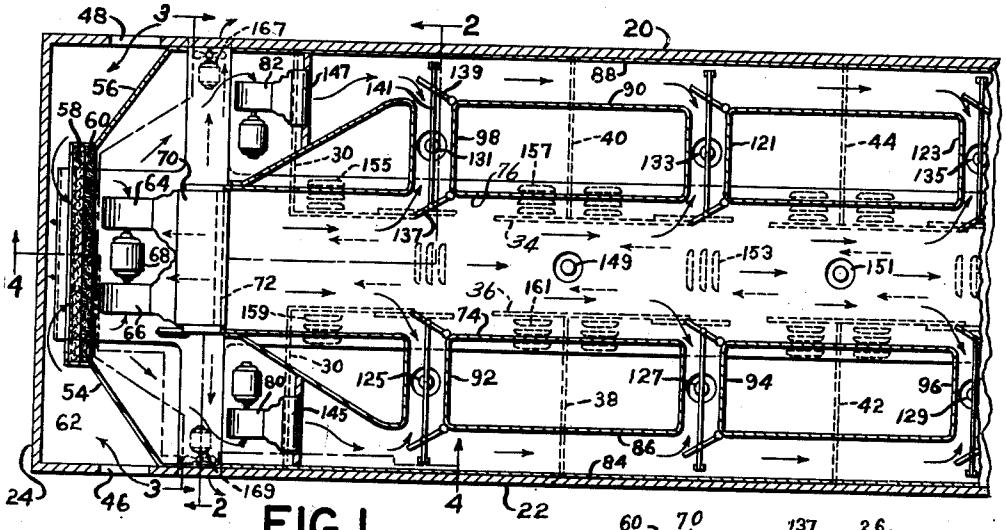

FIG. 1

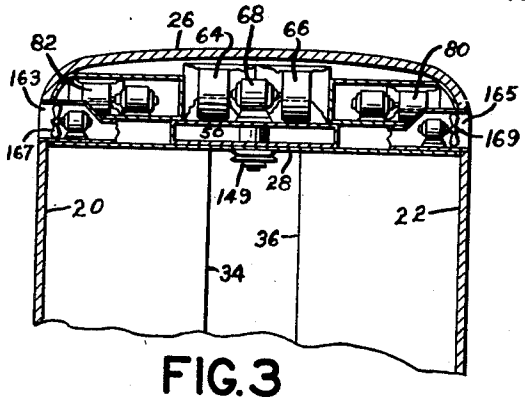

FIG. 3

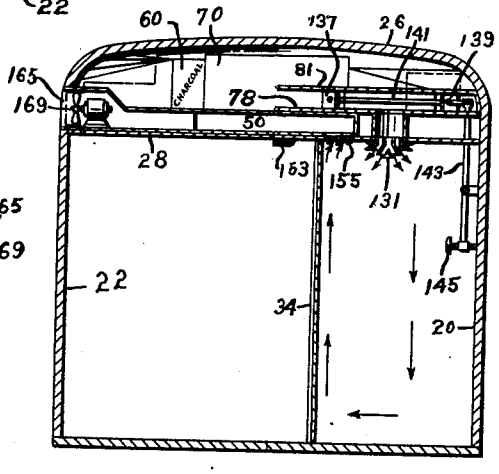

FIG. 2

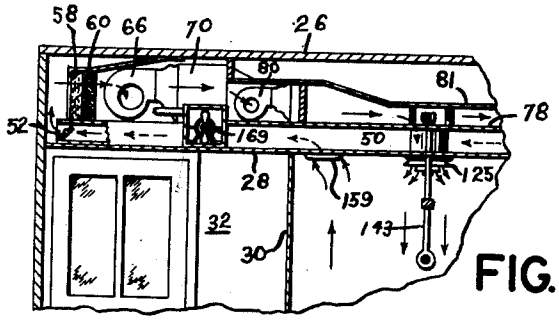

FIG. 4

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March 30, 1954 C. F. HENNEY 2,673,512

AIR CONDITIONING APPARATUS

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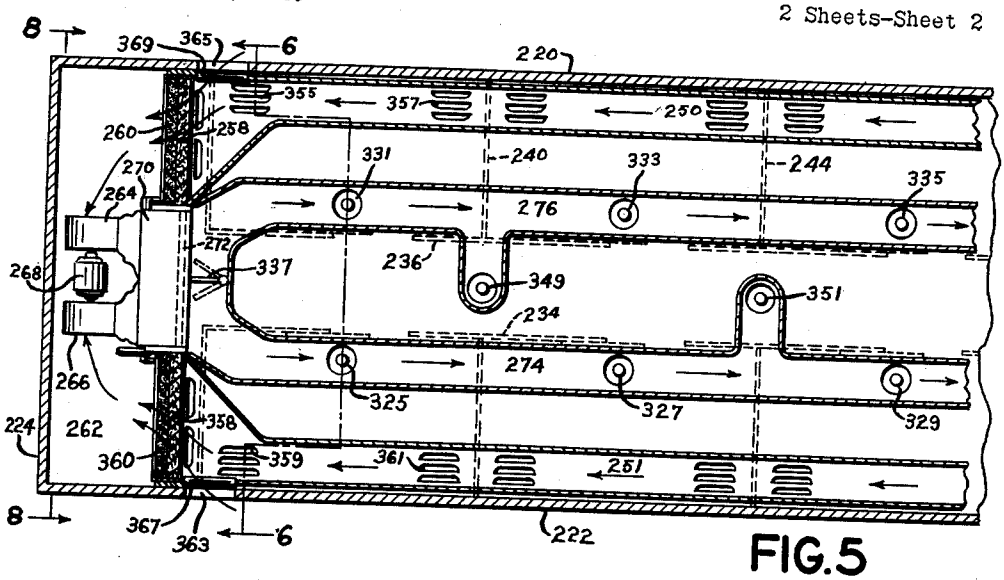

FIG.5

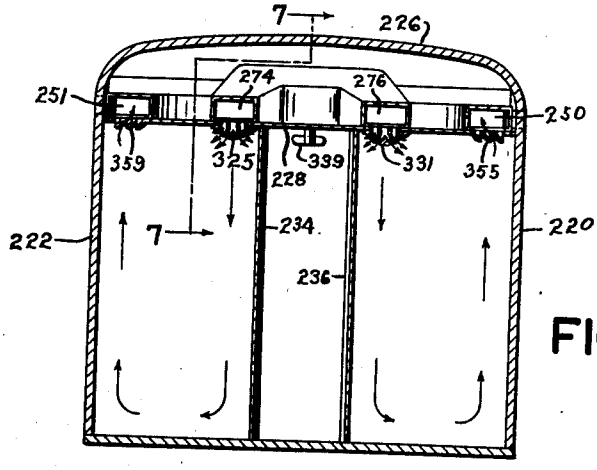

FIG.6

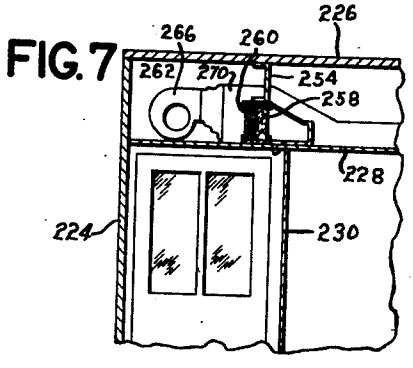

FIG.7

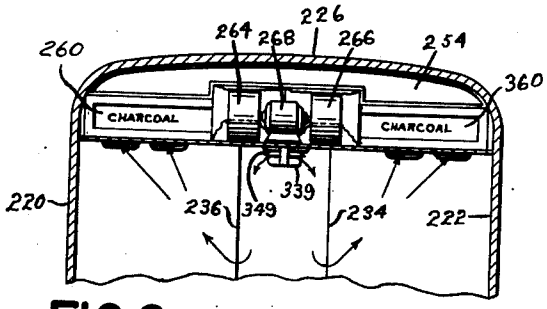

FIG.8

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AIR CONDITIONING APPARATUS

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Application September 17, 1948, Serial No. 49,773

4 Claims. (Cl. 98—10)

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This invention relates to refrigerating apparatus and more particularly to means for conditioning air in structures such as buses, railroad cars and buildings.

It is an object of my invention to condition air in an enclosure by a single, simple system in such a way that it can overcome shifting unbalanced heat loads.

It is another object of my invention to provide an air conditioning system wherein damper means through a simple adjustment can proportion the air delivery to provide increased cooling effect or lesser heating effect wherever it becomes warmest in the enclosure, and to provide a lesser cooling effect or an increased heating effect wherever it becomes coolest in the enclosure.

It is another object of my invention to condition air in an enclosure having a plurality of individual compartments or rooms by a single system in such a way that the temperature conditions in each compartment or room are individually adjustable by separate simple devices.

It is another object of my invention to provide an air conditioning system having simple means for obtaining various desired proportions of fresh air and recirculated air.

The attainment of these objects is illustrated in two forms of the invention. In one form of the invention air of different temperatures is separately conveyed throughout the enclosure and a simple two-way mixing valve arrangement may be adjusted to proportion the rate of flow from each separate air supply into each individual compartment. A return air duct is provided with two separate fan means for discharging air outside the enclosure and also with a discharge means for discharging air into the inlet of the air supply means to which fresh air may also be admitted. By using two, one or none of the fan discharge means the proportion of fresh air may be easily controlled.

In the more simple form of the invention, separate duct means discharging into each compartment on opposite sides of the enclosure is provided with a simple damper means which may be adjusted so as to vary the proportion of the air from the air tempering means which is delivered to the supply duct on either side of the enclosure, so that more air may be delivered if desired, on the side where the sun has the greatest heating effect.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings, wherein a preferred form of the present invention is clearly shown.

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In the drawings:

Fig. 1 is a top sectional view of an end portion of a railroad car embodying one form of my invention and including a plurality of individual compartments or rooms arranged upon each side of the car;

Fig. 2 is a sectional view taken substantially along the line 2—2 of Fig. 1;

Fig. 3 is a sectional view taken substantially along the line 3—3 of Fig. 1;

Fig. 4 is a sectional view taken substantially along the line 4—4 of Fig. 1;

Fig. 5 is a top sectional view of an end portion of a railway car illustrating the second form of the invention;

Fig. 6 is a sectional view taken substantially along the line 6—6 of Fig. 5;

Fig. 7 is a sectional view taken substantially along the line 7—7 of Fig. 6; and

Fig. 8 is a sectional view taken substantially along the line 8—8 of Fig. 5.

Referring now to the drawings and more particularly to Fig. 1, there is shown an end portion of a railroad car having side walls 20 and 22 and an end wall 24. As shown in Figs. 2, 3 and 4 the side walls 20 and 22 extend to form the roof 26 beneath which there is a false ceiling 28 extending throughout the length of the car. A partition wall 30 partitions off the space at one end of the car for the vestibule 32. Walls 34 and 36 provide a central aisle or corridor and with the transverse partitions 38, 40, 42 and 44 form individual compartments on each side of the car.

There is a considerable problem in providing the proper air conditioning for each compartment. The air conditioning requirements for the compartments are not balanced. For example, the sun may be shining upon one side of the car for a considerable length of time thus providing considerable additional heat for that side of the car. Also the wind may be blowing on the sunny side of the car or on the shady side of the car. If the wind is warm it will produce an additional heating effect, while if it is cool it will provide additional cooling. The compartments may be occupied by various numbers of people for different lengths of time and one or more may be unoccupied for various lengths of time. These and other factors therefore make the air conditioning requirements for each compartment somewhat different from any of the other compartments.

According to my invention, above the false

ceiling 28 I provide openings 46 and 48 in the upper portions of the side walls for admitting fresh air. A return air duct 50 also discharges at the end of the car above the false ceiling 28 and is provided with an adjustable damper 52 which may be closed to completely shut off the discharge of return air to use 100% fresh air or it may be opened to permit the discharge of various amounts of return air into this space or chamber 62. This air inlet space 62 is partitioned off from the remainder of the enclosure by the partition walls 54 and 56 as well as by a filter 58 and an air purifying device 60, both of which extend between the partition walls 54 and 50. The filter 58 may be a fine glass wool while the air purifier 60 may be a charcoal soda lime mixture, or an electrostatic precipitator.

The air inlet chamber 62 is therefore on one side of the partition walls 54 and 56 and the filter 58. Upon the other side of the air purifier 60 is a pair of blowers 64 and 66 which are driven by an electric motor 68 and deliver air through a refrigerating coil 70 and a steam coil 72 to a supply duct having side walls 74 and 16, a bottom wall 78 and a top wall 81. The fins of the steam coil are arranged to remove water from the air passing through the refrigerant evaporator or cooling unit. Thus when cooling is required, cool air is delivered to this central duct which is located directly above the return air duct 50 while during cold weather warm air is delivered to this central supply duct.

In addition to this air tempering unit formed of the motor 68, the blowers 64 and 66 of the cooling and heating coils 70 and 72, there is provided a second air supply means in the form of the motor-driven blowers 80 and 82 which are located in the same chamber as the air tempering unit and likewise draw air which has passed through the filter 58 and the air purifier 60. The blower 80 discharges into a supply duct formed by the walls 84 and 86 upon the extreme side of the car above the false ceiling 28. Upon the extreme opposite side of the car the blower 82 discharges into a supply duct formed by the walls 88 and 90.

Between the central supply duct and each of the side supply ducts there are provided the transverse ducts 92, 94, 96 on one side of the car, and 98, 121 and 123 upon the opposite side of the car. A circular discharge outlet 125 is provided for discharging air from the transverse duct 92 into the first compartment while a similar outlet 127 is provided in the transverse duct 94 for discharging air into the second compartment. The transverse duct 96 is provided with a discharge opening 129 for the third compartment, while the transverse ducts 98, 121 and 123 are provided with the discharge outlets 131, 133 and 135 discharging into the compartments upon the opposite side of the car.

Each of the transverse ducts, such as, for example, the transverse duct 98, is provided with a damper, such as the dampers 137 and 139, preferably hinged at the trailing edge in the flow of air so that the leading edge in the flow of air through the two supply ducts acts as a scoop to scoop in air for delivery through the discharge opening 131 into the compartment below. The two dampers are linked by an operating rod 141 which is connected to an adjustable lever 143 which can be adjusted by the handle 145 of a screw within the compartment. This adjustment makes it possible to move one damper toward closing position while the other damper is opened wider. This therefore decreases the flow of air from the one duct and increases the flow of air from another duct. The damper systems for the transverse ducts 92, 94, 96, 121 and 123 preferably are identical to the system described for the transverse duct 98.

During the winter time the central duct will be supplied with warm air while the outside ducts will be supplied with air from the blowers 80 and 82. The blowers 80 and 82 are preferably supplied with steam coils 145 and 147; but these steam coils are only made of a capacity sufficient to take the chill off the air and therefore the air delivered to the side ducts is relatively cool, while that of the central duct is warm. Therefore if more heat is desired in the compartment the handle 145 is turned so that the rod 141 is moved toward the center of the car to move the damper 139 nearer to closed position while the damper 137 is opened wider. This increases the flow of the warm air and therefore supplies more heat to the compartment. The same thing is done in the summer time when it is desired to make the compartment cooler. Then more cool air will be delivered from the central duct to the compartment. If it is too warm in winter or too cool in summer, the dampers are moved in the opposite direction. The dampers for each individual compartment can be adjusted individually as desired to provide individual adjustment of the air conditioning for each individual compartment. The steam coils of course are shut off during the summer time when cooling is required.

The central air duct also has discharge openings for the aisle or corridor distributed along the car. Two discharge openings 149 and 151 are shown in the portion of the car illustrated in Fig. 1.

The return air duct 50 has louvers 153 extending through the false ceiling 28 for returning air from the aisle. These louvers 153 are arranged between the discharge outlets such as the outlets 149 and 151. The return air duct 50 also has two sets of louvers 155 and 157 extending through the false ceiling 28 in the inner corner of each compartment. The circulation of the air in each of the compartments is illustrated by the arrows in Figs. 2 and 4. Louvers similar to louvers 155 and 157 upon the opposite side of the aisle are designated by the reference characters 159 and 161.

To discharge air from the return duct outside of the car there is provided a transverse duct 163 extending from the return air duct 50 to the outside of the car above the false ceiling 28 and a similar duct 165 upon the opposite side of the car. The damper 52 may be partially closed to force some of the air in the return duct out through the discharge ducts 163 and 165. In order to provide a means for increasing this discharge of air from the return duct to the outside the duct 163 is provided with a fan or blower 167 and the duct 165 is provided with a fan or blower 169. Either one or both of these fans 167 and 169 may be placed in operation. For complete fresh air operation the damper 52 is fully closed. Either one or both of the fans 167 and 169 may be turned on to further increase the flow of air. This gives an option of three different rates of fresh air flow. At other times the damper 52 may be opened and to obtain more air circulation and more air flow either one or both of the fans 167 or 169 may be operated.

Thus with this system complete control of the air conditioning for each individual compartment

is provided for the occupant of each individual compartment. Also improved control of the proportion of the fresh air to the return air is provided through the use of the damper 52 and the optional use of one or both of the fans 167 and 169.

In the form shown in Fig. 5, there is shown the side walls 220 and 222 and the end wall 224 of one end portion of a railway car. Above the false ceiling 228 directly above the vestibule there is provided an air inlet chamber 262 divided off from the rest of the area betwen the roof 226 and the false ceiling 228 by a partition wall 254 and two sets of air filters 258 and 358 and the two sets of air purifiers 260 and 360, which may be like those in the first form of the invention. Air in the inlet chamber 262 is drawn into the twin blowers 264 and 266 and discharged through a refrigerating coil 270 and a steam coil 272 constituting the air tempering unit which extends through the partition 254 and connects with the supply air duct means. The twin blowers 264 and 266 are driven by an electric motor 268. The supply air duct means includes the duct 276 on one side of the car which extends over the compartments formed by the aisle wall 236 and the partitions 240 and 244. This duct 276 has discharge openings 331, 333 and 335 discharging each into one compartment. Duct 276 also has arms provided with discharge openings, such as the opening 349 for delivering air to the aisle.

Extending over the compartments on the opposite side of the aisle is a complementary duct 274 having discharge openings 325, 327 and 329 for discharging air into three individual compartments beneath. The duct 274 likewise has an arm for supplying air to a discharge opening, such as the opening 351 which discharges into the central aisle. Adjacent the air tempering unit and particularly adjacent the steam coil 272, the ducts 274 and 276 join. At the junction a movable swinging damper 337 is adjusted by an operating handle 339 which protrudes beneath the false ceiling 228. This swinging damper 337 may be moved to one side or the other in order to increase the flow of air from the air tempering unit to the duct of the compartments upon the opposite side of the car in order to correct for unbalanced temperature conditions upon the opposite sides of the car, such as may be caused by sun or wind.

In this form, return air ducts 250 and 251 are provided upon the extreme opposite sides of the car. The duct 250 has louvers 355 and 357 which connect through the false ceiling 228 with one of the individual compartments upon that side of the car. Similar louvers are provided in the duct 250 for the remaining compartments on that side of the car. Also corresponding louvers 359 and 361 are provided in the return air duct 251 for removing air through the false ceiling from the compartment on the opposite side of the car. Similar louvers are provided in the duct 251 for each compartment on its side of the car. The duct 250 is provided with a fresh air inlet 365 which may be provided with a steam coil 369 for tempering the air admitted thereto. Likewise upon the opposite side the duct 251 may be provided with a fresh air opening 363 and similarly provided with a steam coil 367.

The air from the return air duct 250 as well as from the fresh air opening 365 is drawn through one of the filtering units 258 and one of the air purifying units 260 upon one side of the car while the return air from the duct 251 as well as the fresh air admitted through the opening 363 is passed through the filtering unit 358 and the air purifying unit 360 upon the opposite side of the car. Thus by the use of this simple system the unbalanced conditions upon opposite sides of the car can be overcome simply by adjusting the damper 337.

While I have described the two forms of the invention as applied to a railway passenger car having individual compartments it should be understood that the invention may similarly be applied to cars and other types of enclosures having similar problems even though they may differ in structural features.

Reference is made to the following application owned by the same assignee: S. N. 772,811 filed September 8, 1947, Charles F. Henney applicant, now Patent No. 2,605,690.

While the form of embodiment of the invention as herein disclosed, constitutes a preferred form, it is to be understood that other forms might be adopted, as may come within the scope of the claims which follow.

What is claimed is as follows:

1. An enclosure to be conditioned including means forming within the enclosure upon opposite sides of a corridor a plurality of completely enclosed compartments each for human occupancy, a first air supply duct system having separate supply ducts located above the compartments upon opposite sides of and generally parallel to the corridor, a second air supply duct system extending over and generally parallel to the corridor, individual branch supply means connecting each of the ducts of the first supply duct system and the second supply duct system with a plurality of said compartments, means for individually controlling the flow of air from said duct systems and branch supply means into each compartment, and means for conditioning the air conducted through one of the supply duct systems to a condition different than the condition of the air conducted through the other supply duct system.

2. An enclosure to be conditioned including means forming within the enclosure upon opposite sides of a corridor a plurality of completely enclosed compartments each for human occupancy, a first air supply duct system having separate supply ducts located above the compartments upon opposite sides of and generally parallel to the corridor, a second air supply duct system extending over and generally parallel to the corridor, individual branch supply means connecting each of the ducts of the first supply duct system and the second supply duct system with a plurality of said compartments, means for individually controlling the flow of air from said duct systems and branch supply means into each compartment, and means for conditioning the air conducted through one of the supply duct systems to a condition different than the condition of the air conducted through the other supply duct system, a return air duct system extending over said corridor and communicating with each compartment for removing air from the compartments.

3. An enclosure to be conditioned including means forming within the enclosure upon opposite sides of a corridor a plurality of completely enclosed compartments each for human occupancy, a first air supply duct system having separate supply ducts located above the compartments upon opposite sides of and generally parallel to the corridor, a second air supply duct system extending over and generally parallel to the corridor, individual branch supply means con-

necting each of the ducts of the first supply duct system and the second supply duct system with a plurality of said compartments, means for individually controlling the flow of air from said duct systems and branch supply means into each compartment, and means for conditioning the air conducted through one of the supply duct systems to a condition different than the condition of the air conducted through the other supply duct system, a return air duct system extending over said corridor and communicating with each compartment for removing air from the compartments, said return air duct system being located below said second supply air duct system and having openings communicating with said corridor for removing air from said corridor.

4. An enclosure to be conditioned including means forming within the enclosure upon opposite sides of a corridor a plurality of completely enclosed compartments each for human occupancy, a first air supply duct system having separate supply ducts located above the compartments upon opposite sides of and generally parallel to the corridor, a second air supply duct system extending over and generally parallel to the corridor, individual branch supply means connecting each of the ducts of the first supply duct system and the second supply duct system with a plurality of said compartments, means for individually controlling the flow of air from said duct systems and branch supply means into each compartment, and means for conditioning the air conducted through one of the supply duct systems to a condition different than the condition of the air conducted through the other supply duct system, a return air duct system extending over said corridor and communicating with each compartment for removing air from the compartments, said return air duct system being located below said second supply air duct system and having openings communicating with said corridor for removing air from said corridor, said second supply duct system having outlets extending to said corridor for supplying air to the corridors.

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