

May 16, 1939.

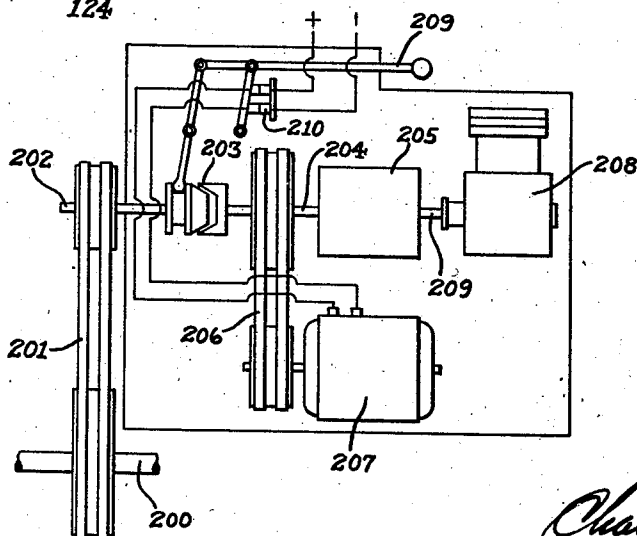
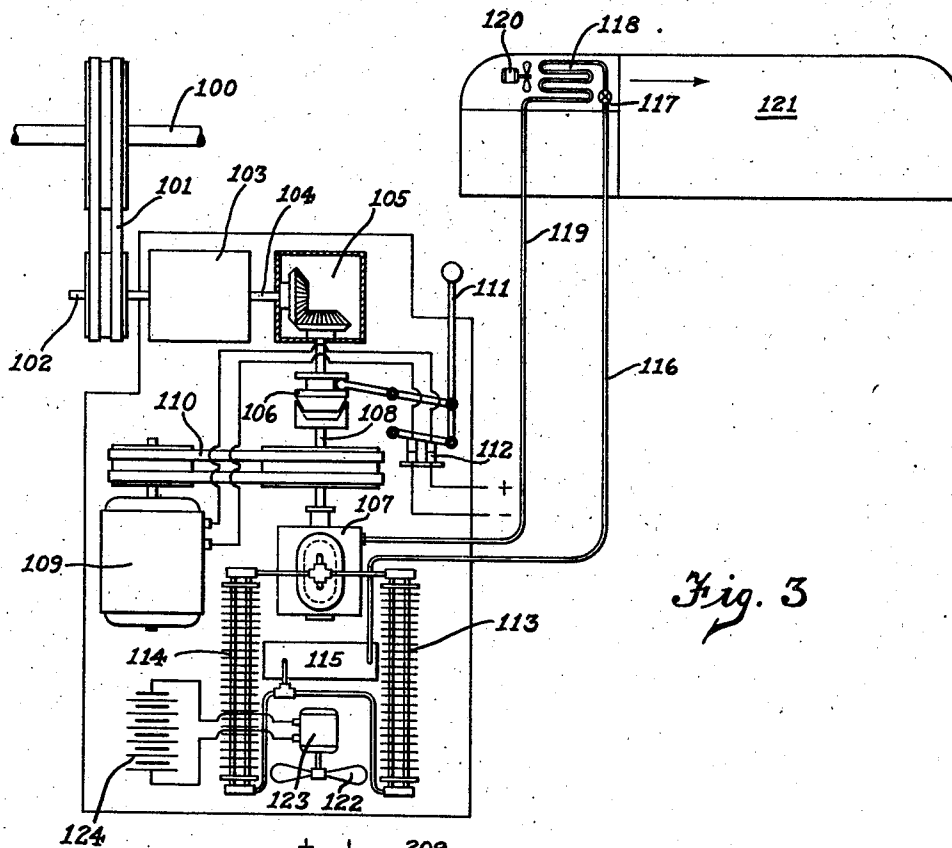
C. F. HENNEY

2,158,367

REFRIGERATING APPARATUS

Filed March 29, 1934

4 Sheets-Sheet 2



Inventor

Charles F. Hume

By Spencer Hardman & John
Attorneys

Attorneys

May 16, 1939.

C. F. HENNEY

2,158,367

REFRIGERATING APPARATUS

Filed March 29, 1934

4 Sheets-Sheet 3

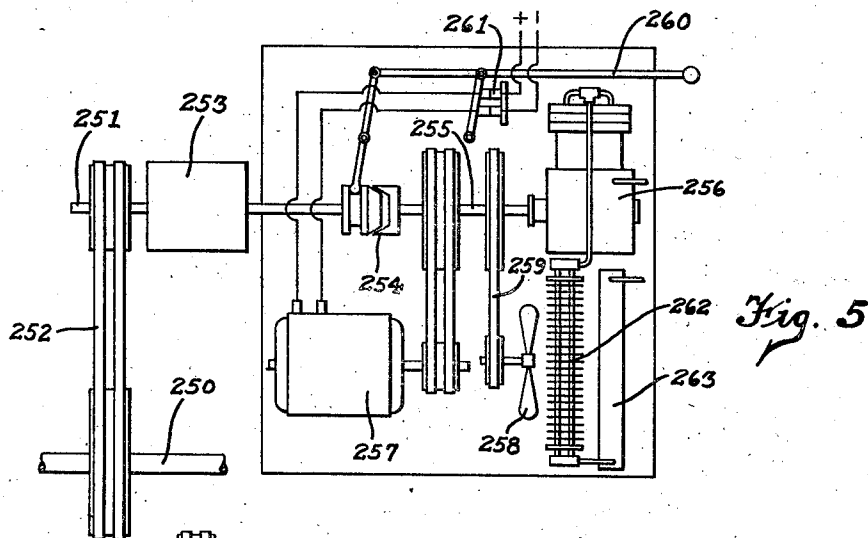


Fig. 5

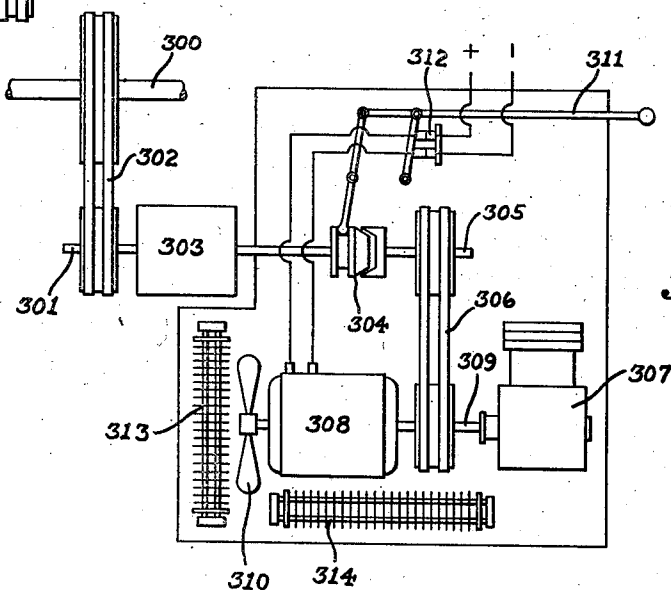


Fig. 6

Charles F. Henney Inventor

Spencer Hardman Kester By

Attorneys

May 16, 1939.

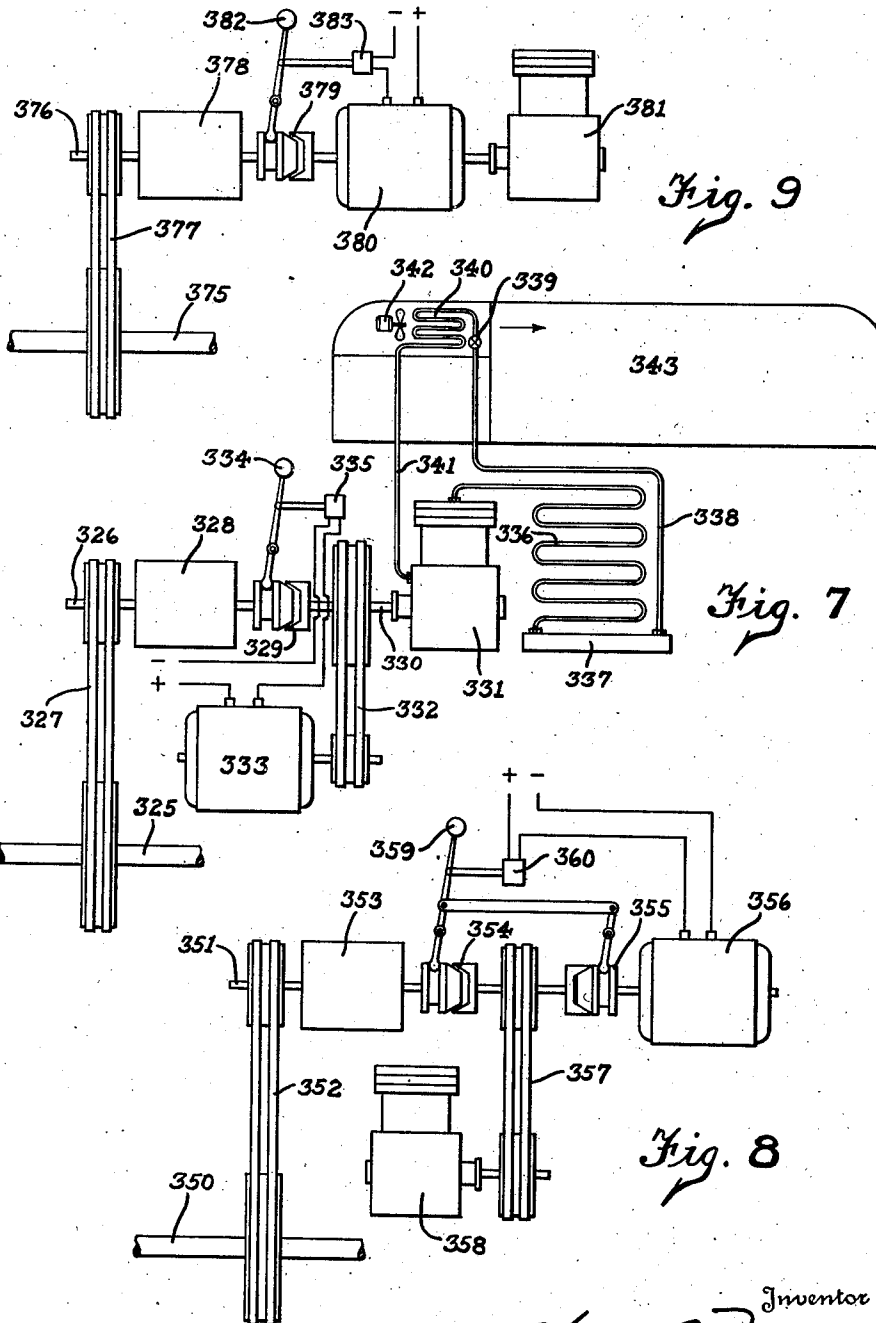
C. F. HENNEY

2,158,367

REFRIGERATING APPARATUS

Filed March 29, 1934

4 Sheets-Sheet 4



Inventor

Charles F. Henney

By *Spencer Henderson*
Attorney

UNITED STATES PATENT OFFICE

2,158,367

REFRIGERATING APPARATUS

Charles F. Henney, Dayton, Ohio, assignor to
General Motors Corporation, Dayton, Ohio, a
corporation of Delaware

Application March 29, 1934, Serial No. 717,987

3 Claims. (Cl. 74-230.17)

This invention relates to refrigeration and more particularly to the conditioning of air for vehicles such as railroad cars or the like.

It is among the objects of this invention to provide an improved means of driving the refrigerant liquefying unit of an air conditioning system for conditioning the air in a vehicle.

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.

In the drawings:

Fig. 1 is a diagrammatic representation of an air conditioning system embodying features of my invention;

Fig. 2 is a cross-sectional view of a portion of Fig. 1; and

Figs. 3 to 8 are diagrammatic representations showing modifications.

A vehicle embodying my invention may include a compartment 10, the air for which is to be conditioned. A refrigerant evaporator, or cooling device, 11 is placed in a position to condition the air for the compartment 10, for example, by placing it at one end of the compartment and by blowing air over the evaporator through the medium of an electrically driven fan 12 which forces air into the compartment. A refrigerant liquefying unit 13 is connected with the evaporator 11 by means of a liquid refrigerant line 14 and an evaporated refrigerant line 15. The liquefying unit 13 is preferably actuated by energy derived from the motion of the car. Thus a shaft 16 is connected to one of the wheels of the car to be driven at a speed proportionate to the speed of the car. If desired, this shaft 16 may be driven from the axle 17 of the car by a belt drive, or the like, 18. A variable ratio transmission 16a connects the shaft 16 with the compressor 19 of the liquefying unit 13 to drive it at a substantially constant speed regardless of the speed of the car. To this end, the variable ratio transmission 16a is provided with an automatic actuator or governor 20 which is responsive to the speed of the compressor 19 and controls the transmission 16a to maintain the speed thereof constant or within permissible limits during normal running speeds of the car.

In the particular form shown in Figs. 1 and 2 the variable transmission 16a includes a first V-pulley 21 connected to the shaft 16 and a second V-pulley 22 connected to the shaft 23 which in turn is connected to the compressor 19 through the medium of a belt drive or similar connec-

tion. The V-pulleys have means for varying the width of the V's in the pulleys to permit the belt 25 to travel radially inwardly or outwardly in the pulleys and thus vary the speed ratio at which the pulleys travel with respect to each other. Thus the pulley 21 may include a fixed flange 26 and an adjustable flange 27 which is pressed toward the flange 26 by means of a spring 28. The pulley 22 is likewise provided with a fixed flange 29 and an adjustable flange 30 which is pressed away from the flange 29 by means of the spring 31. These flanges are provided with means for preventing relative rotation therebetween. Thus in the case of flanges 29 or 30 a pin 32 fixed on the flange 30 permits axial movement between the flanges which prevents relative rotation therebetween. Similar means, not shown, are provided for flanges 26 and 27.

The automatic actuator or governor 20 is arranged to vary the width of the V's between the flanges 26, 27, 29 and 30 in the manner to maintain the speed of shaft 23 substantially constant or within permissible limits of speed at all normal running speeds of the car. Thus the automatic actuator 20 may be a centrifugal governor which is responsive to the speed of the shaft 23. The centrifugal weights 33, fulcrumed at 34, are provided with arms 35 in such a manner to outwardly travel of the weights 33 and move the flange 30 toward the flange 29. When this happens, the belt 25 is forced radially from the shaft 23 and consequently the belt is forced inwardly toward the shaft 16, thus spreading apart the flanges 26 and 27. This action reduces the relative speed between the shafts 16 and 23. By a proper relationship between the weights and the spring action of the springs 31 and 28, the speed of the shaft 23 may be maintained substantially constant or between permissible limits all normal speeds of the train.

The remainder of the refrigerating system may be of normal construction. Thus the liquefying unit 13 may include the compressor 19 which forwards compressed refrigerant to a condenser 40 provided with a liquid refrigerant receiver 41. Liquid refrigerant flows from the receiver 41, through the line 14 and expansion valve 11a, to the evaporator 11. Evaporated refrigerant returns to the compressor through line 15.

A "stand-by" motor 42 is provided for actuating the compressor when the car stops. Preferably the motor is of a type suitable for use with electric current available at the stations where the train stops. Thus it may be an AC motor of standard voltage and frequency. Clutch means

43 are provided for disconnecting the compressor from the wheel drive and for permitting the motor to drive a compressor while the car stands still. An electrical switch 44 is connected with the manual actuator 45 of the clutch means 43 in such a manner that the switch 44 is closed when the clutch 43 is opened, thus simultaneously disengaging the compressor from the wheel drive and starting the motor after the leads have been connected to the station current.

In the modification shown in Fig. 3 the horizontal shaft 100 is driven proportionally to the speed of the car and may be the axle thereof. This is connected by means of a belt drive 101 to a horizontal shaft 102. This shaft is connected to a variable ratio transmission 103 which may be similar to the transmission shown in Figs. 1 and 2 or may be any other type of automatically controlled variable ratio transmission. This transmission 103 is connected to a shaft 104 which drives a right angle gear train 105 connected to clutch means 106. The clutch means 106 drives a compressor 107 through the shaft 108 and is also connected to a "stand-by" motor 109 through the belt drive 110. The manual actuator 111 simultaneously declutches the means 106 and closes the switch 112 which controls the flow of current to the motor 109.

The compressor 107 discharges compressed refrigerant to the condenser sections 113 and 114 which discharge liquefied refrigerant into the receiver 115. Liquid refrigerant flows through the line 116 and through the automatic expansion device 117 to the evaporator 118 and the evaporated refrigerant returns through the line 119 to the compressor 107. An electrically driven fan 120 blows air to be conditioned over the evaporator 117 into the compartment 121 of the vehicle. Air is forced over the condenser sections 113 and 114 by means of an electrically driven fan or blower 122 driven by a motor 123 which is energized from a battery or generator 124. The arrangement is such that the speed of the compressor 107 is made substantially constant, or is maintained between permissible speed limits, by means of the transmission 103 while the car travels at all normal speeds.

In a modification shown in Fig. 4 the axle 200 is connected by means of a belt drive 201 with a shaft 202 connected to clutch means 203 which in turn is connected with the driving shaft 204 connected to the variable ratio transmission 205 and, by the belt drive 206 to the "stand-by" motor 207. A variable speed transmission 205, similar to that shown in Figs. 1 and 2, drives the compressor 208 through the shaft 209 at a substantially constant speed, or within permissible speed limits notwithstanding variations in speed of car axle 200. The compressor 208 is connected to an air conditioning system substantially similar to that shown in either Figs. 1 or 3. The handle 209 simultaneously actuates the clutch means 203 and the motor control 210 substantially as in Figs. 1 and 3.

In the modification shown in Fig. 5 the car axle 250 is connected to the horizontal shaft 251 through the belt drive 252. The shaft 251 is connected to a variable ratio transmission 253, similar to that disclosed in Figs. 1 and 2, which in turn is connected to clutch means 254. This latter means is connected by means of shaft 255 with the compressor 256 and the motor 257. The shaft 255 also drives a condenser fan 258 by means of the belt drive 259. The clutch means 254 is actuated by a handle 260 which also opens

and closes the switch 261 which controls the flow of current to the motor 257. The compressor 256 discharges refrigerant into a condenser 262 which in turn discharges into a receiver 263. The remainder refrigerant circuit may be substantially as shown in either Figs. 1 and 3.

In the modification shown in Fig. 6 the car axle 300 is connected to the horizontal shaft 301 through the belt drive 302. The shaft 301 is connected to a variable ratio transmission 303 which in turn is connected to clutch means 304. This latter means is connected by means of shaft 305 and belt drive 306 with the compressor 307 and the motor 308. The shaft 309 connecting the compressor and motor also drives a condenser fan 310. The clutch means 304 is actuated by a handle 311 which also opens and closes the switch 312 which controls the flow of current to the motor 308. The compressor 307 discharges refrigerant into condenser sections 313 and 314. The remainder refrigerant circuit may be substantially as shown in either Figs. 1 and 2.

In the modification shown in Fig. 7 the car axle 325 is connected to the horizontal shaft 326 through the belt drive 327. The shaft 326 is connected to a variable ratio transmission 328 which in turn is connected to clutch means 329. This latter means 329 is connected by means of shaft 330 with the compressor 331 and by belt drive 332 to the motor 332. The clutch means 329 is actuated by a handle 334 which also opens and closes the switch 335 which controls the flow of current to the motor 33. The compressor 331 discharges refrigerant into a condenser 336 which in turn discharges into a receiver 337. From thence the refrigerant flow path includes liquid line 338, expansion valve 339, evaporator 340, evaporated refrigerant line 341 and returns to compressor 331. An electrically driven fan 342 forces air over evaporator 340 into compartment 343.

In the modification shown in Fig. 8 the car axle 350 is connected to the horizontal shaft 351 through the belt drive 352. The shaft 351 is connected to a variable ratio transmission 353 which in turn is connected to clutch means 354. The clutch means 354 is connected to a second clutch means 355 which connects to the motor 356. Clutch means 354 also is connected by means of belt drive 357 with compressor 358. Common actuating handle 359 simultaneously opens clutch 354 and closes clutch 355 and switch 359 which controls the motor 356 or vice versa. Thus the wheel drive may be simultaneously disconnected and the motor drive may be connected and the motor started, or the converse operation may be also made. The remainder of the system may be as in Figs. 1 or 3.

In Fig. 9, the axle 375 drives shaft 376 through belt drive 377. Shaft 376 is connected to variable ratio transmission 378 which in turn is connected to clutch means 379, motor 380 and compressor 381. The handle 382 simultaneously actuates clutch means 379 and switch 383 which controls motor 380 in a manner heretofore described.

In all of the modifications, the variable ratio transmission may be of the type shown in Fig. 2 or may be any other type of transmission which automatically tends to maintain a substantially constant speed (within permissible limits) of the compressor at normal running speeds of the car. It is to be understood that such constant compressor speeds need not be maintained during the starting or stopping period of the car, as such period is relatively short and it is not detrimental

to run the compressor at a slow speed during such short intervals.

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, all coming within the scope of the claims which follow.

What is claimed is as follows:

1. In combination, a variable speed power source, a constant speed power source having a power transmitting shaft projecting at both ends, a driven member, means for transmitting power from one end of said shaft to said driven member, a driving V-pulley driven by said variable speed power source, a driven V-pulley on the other end of said shaft, spring means urging together the sides of said driving pulley, centrifugal means urging together the sides of said driven pulley with a tendency to increase the speed of said driven pulley, a V-belt between said pulleys, whereby said driving pulley may vary in speed and said driven pulley tends to rotate at a more constant speed, and means whereby either power source may be used for operating said driven member.

2. In combination, a variable speed power source, a constant speed power source having a power transmitting shaft projecting at both ends,

a driven member, means for transmitting power from one end of said shaft to said driven member, a driving V-pulley driven by said variable speed power source, a driven V-pulley on the other end of said shaft, spring means urging together the sides of one of said pulleys, centrifugal means urging together the sides of the other of said pulleys with a tendency to increase the speed of said driven pulley, a V-belt between said pulleys whereby said driving pulley may vary in speed and said driven pulley tends to rotate at a more constant speed, and means whereby either power source may be used for operating said driven member.

3. In combination, a variable speed power source, a constant speed power source having a power transmitting shaft projecting at both ends, a driven member, means for transmitting power from one end of said shaft to said driven member, a variable ratio transmission between said variable speed power source and the other end of said shaft whereby said driven member tends to rotate at a more constant speed than said variable speed power source, and means whereby either power source may be used for operating said driven member.

CHARLES F. HENNEY.