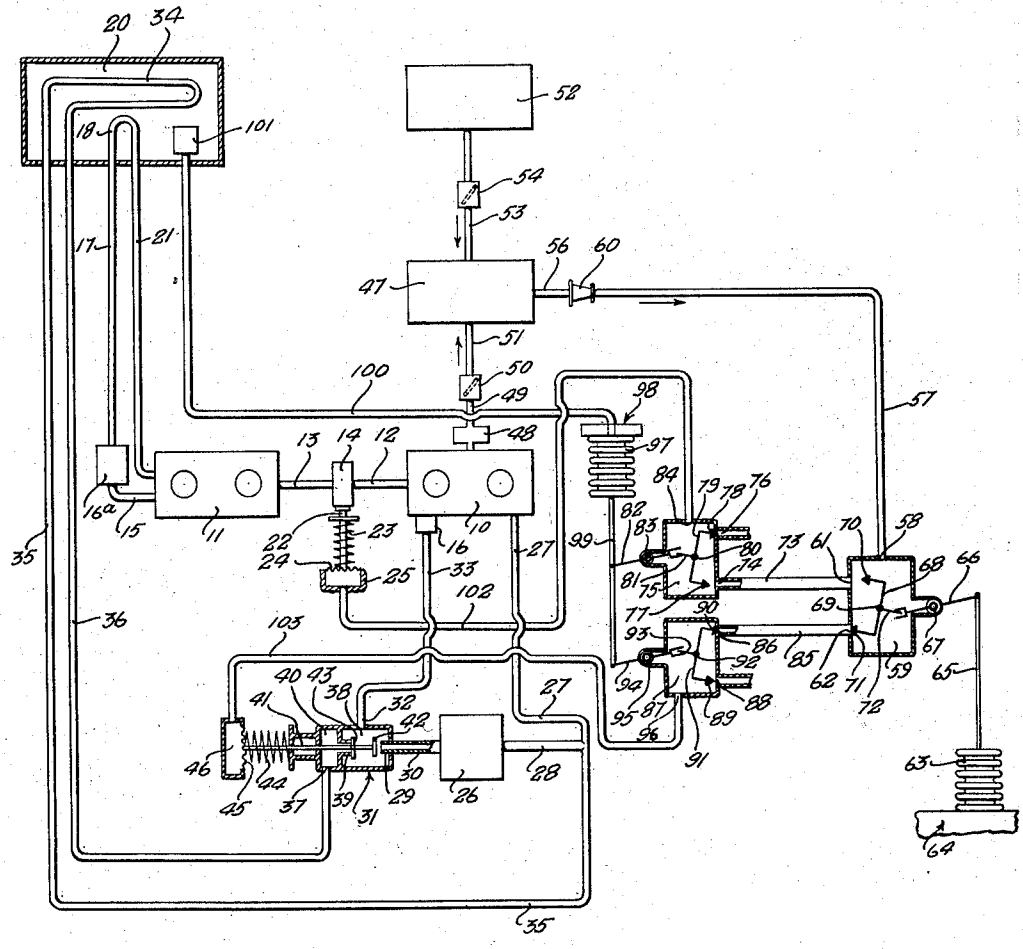
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TEMPERATURE REGULATING SYSTEM AND APPARATUS

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TEMPERATURE REGULATING SYSTEM AND APPARATUS

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This invention relates to a temperature regulating system and apparatus.

One of the objects of this invention is to provide a refrigeration system and apparatus of simple and practical arrangement and of thoroughly lasting and dependable action. Another object is to provide a system of the above character which will require a minimum amount of attention, and whose parts will be well adapted to withstand hard usage while operating for substantial periods of time. Another object is to provide a system of the above character which will be substantially fool-proof, and which may be maintained in operation by unskilled attendants without the hazard of harming the apparatus. Another object is to provide a system of the above character which will be extremely economical in operation and which because of its durable construction will require little repair or adjustment. Another object of this invention is to provide a system of the above character which will be highly efficient in operation while adequately withstanding certain peculiar conditions met with in practice. Another object is to provide a system of the above character adapted to utilize a source of energy readily obtainable in practice. Another object of this invention is to provide a system of the above character well suited to operate effectively under variable conditions of climate and weather. Other objects will be in part obvious and in part pointed out hereinafter.

The invention accordingly consists in the features of construction, combinations of elements, and arrangements of parts as will be exemplified in the structure to be hereinafter described, and the scope of the application of which will be indicated in the following claims.

The accompanying drawing shows in diagrammatic plan, certain parts being shown in section, one of the various possible embodiments of this invention.

Referring now to the drawing in detail, there is shown an internal combustion engine 10 adapted to run continuously for substantial periods of time. Engine 10 when operating drives a compressor 11 of a suitable compression-expansion refrigeration unit through driving shafts 12 and 13, and disposed between shafts 12 and 13 is a clutch 14 whose action will be described hereinafter. A conduit 15 runs from compressor 11 to the other parts 16a of the refrigeration unit, which is, as above noted, preferably of the compression-expansion type. These parts may include a condenser and an expansion valve, a conduit 17 leading therefrom to a suitable evaporating or cooling coil 18 disposed within a compartment 20. Compartment 20 may be the interior of a railroad refrigeration car for transporting goods to be maintained between certain temperature limits. A conduit 21 carries the evaporated refrigerant from coil 18 back to compressor 11. Thus when engine 10 is operating and the parts of clutch 14 are so positioned as to connect the engine to compressor 11, refrigeration takes place in compartment 20 for expansion coil 18 extracts heat therefrom until clutch 14 disconnects engine 10 from compressor 11.

Clutch 14 is so constructed that it closes to connect engine 10 to compressor 11 when rod 22 moves in an upward direction as viewed in the drawing. A spring 23 is secured to rod 22 and the tension thereof holds rod 22 and the parts of clutch 14 attached thereto in a neutral position so that engine 10 is disconnected from compressor 11. The base of rod 22 is secured to a diaphragm 24 forming a wall of a container 25. When pressure is applied to container 25 and consequently diaphragm 24, the diaphragm acts against the tension of spring 23 to force rod 22 in an upward direction and bring the parts of clutch 14 into engagement, connecting engine 10 with compressor 11.

Engine 10 is water-jacketed for cooling purposes in any suitable manner, and the exit and entry ports of this jacket are connected to a radiator 26. More specifically one port of the jacket is connected by pipes 27 and 28 to one port of radiator 26, and the other port of radiator 26 is connected by pipe 30 to a port 29 of a valve, generally indicated at 31; a port 32 of valve 31 is connected in turn to the other port of the jacket by a pipe 33 through a pump 16 of any desired construction. Thus a path of circulation is established between radiator 26 and the jacket of engine 10.

After engine 10 has been in operation for a short while water contained in the above described circulation system is heated, and this water, in accordance with one of the features of my invention, I utilize for heating compartment 20 if the temperature of this compartment should fall below that preferred. For accomplishing this I provide a series of tubes or a radiator 34 of any suitable construction disposed within compartment 20, one side of which is connected by a pipe 35 to pipe 27 leading from one side of the jacket in engine 10. As described above, pipe 33 leads from pump 16 to valve 31; a pipe 36 is connected to a port 37 of valve 31

and in turn connected to the opposite side of radiator 34. In this manner, when the parts in valve 31 are placed in one position in a manner to be described hereinafter, heated water may be forced by pump 16 through pipes 27 and 35 to radiator 34 and thence back to the jacket through pipe 36, valve 31, and pipe 33. The continuation of this circulation now set up heats compartment 20 to raise the temperature therein to that preferred. It should be understood that the circulation of water through the jackets and either heat-exchange device 26 or 34 might be accomplished by means other than pump 16 and might be achieved for example by thermo-siphonic action.

Valve 31 is of a two-way construction so that a fluid entering port 32 may make its exit through either port 29 or port 37. Fluid passing through port 32 enters a space 38, and it may leave this space by port 29 or a port 39 leading into a space 40 connected to port 37. A rod 41 passes through port 39 in substantial alignment with port 29 and has secured thereon two spaced valve heads 42 and 43 respectively. When rod 41 is forced to the right, as viewed in the drawing, head 42 is seated against port 29, thus closing this outlet to space 38, and head 43 is out of engagement with port 39, thus to allow a liquid to pass therethrough into space 40, and from there to radiator 34. In a similar manner, when rod 41 is in its left-hand position, as viewed in the drawing, port 39 is closed but a fluid may pass from port 32 through space 38 and out through port 29 to radiator 26. Rod 41 is held in its right-hand position with head 43 closing port 39 by the tension of a spring 44 secured thereto, and a diaphragm 45 is secured to the end thereof opposite heads 42 and 43. This diaphragm forms a wall of a container 46 of a construction adapted to withstand and retain a fluid under pressure in order that this pressure may be transmitted to diaphragm 45. Upon the application of pressure to diaphragm 45, the tension of spring 44 is overcome and rod 41 assumes its right-hand position, as viewed in the drawing, closing port 29 by head 42 and opening port 39 as head 43 moves out of engagement therewith to allow the heated water to pass from space 38 into space 40, thence through port 37 and, by pipe 36, to radiator 34.

The controlling parts of this system are actuated by a compressed fluid such as air under pressure, and a tank 47 is provided for storing this fluid. Air for this purpose may be obtained from a compressor of any suitable construction, diagrammatically indicated at 48, and conveniently driven by engine 10, or if engine 10 is of the Diesel type, the air may be taken directly from the compression cylinder of the engine. Air under pressure is led thence by pipe 49 to a one-way valve 50, this valve being of such a construction that it allows air to pass therethrough only in the direction indicated by the arrow in the drawing. Passing through valve 50, the air enters tank 47, by pipe 51, to be stored therein.

As my system and apparatus have many advantages and conveniences admirably adapted to meet the unusual and varying conditions required by refrigerated vehicles, such as railroad refrigeration cars, and as there is usually an abundant supply of compressed air on these vehicles for braking systems and other purposes, I have provided an auxiliary means for insuring a suitable and efficient operating supply of air under pressure in tank 47 at all times. Tank 47 is connected to the air brake auxiliary reservoir 52 by a pipe 53 through a one-way or check-valve which is so adjusted that it does not pass air into tank 47 unless the pressure therein has fallen below a certain value.

For purposes of illustration it may be assumed that auxiliary reservoir 52 contains air at a pressure of approximately 125 pounds per square inch. Valve 54 is so weighted with a spring that an effective pressure of 100 pounds per square inch thereon is required to open it and pass air from reservoir 52 to tank 47. When the pressure of the air in tank 47 falls below 25 pounds per square inch, the effective pressure on valve 54 is greater than 100 pounds and this valve opens to pass air into tank 47 until the pressure therein therein reaches 25 pounds. Thus valve 54 remains closed against the 125 pound pressure in auxiliary reservoir 52 because of the 25 pound pressure in tank 47 plus the 100 pound pressure of the spring in the valve. In this manner, interference with the operation of the air brake system is prevented, since it is impossible to drain that system below 100 pounds pressure, a pressure that may, by way of example, be assumed to be the minimum operating pressure for the air brake system.

In this manner tank 47 is maintained at a constant pressure by two sources of compressed air, and in case compressor 48 should fail in operation or engine 10 is stopped for a considerable period of time, compressed air is supplied to tank 47 from auxiliary tank 52 in the above described manner. Thus the reliable operation of my system is insured at all times.

The compressed air in tank 47 to be used to actuate the controlling parts of my system is conducted by pipes 56 and 57 through a port 58 of a two-way valve 59, and disposed between pipes 56 and 57 is a pressure reducing valve 60 of any desired construction. Thus a constant pressure is maintained within the interior of valve 59, and this air under pressure may leave the valve through a port 61 or a port 62 to be conducted to other parts operating to control my system. Valve 59 operates in response to the temperature outside compartment 20 and to accomplish this I provide a bellows 63 having contained therein a suitable volatile liquid adapted to vaporize and condense rapidly according to the changes in temperature outside the compartment, such as atmospheric temperature changes. Bellows 63 is anchored to any suitable means generally indicated at 64 so that an increase in the outside temperature causes an evaporation of the volatile liquid contained therein and a consequent exertion of pressure on the unanchored end thereof to move this end in an upward direction as viewed in the drawing. In a similar manner, a decrease in temperature causes a condensation of this vapor with a resultant decrease of pressure to cause the unanchored end of bellows 63 to move in a downward direction as viewed in the drawing.

Secured to this unanchored end of the bellows is a rod 65 connected in turn to a lever 66, and lever 66 is pivoted at a point 67 on valve 59. A rocker arm 68 is pivoted at 69 and has at its opposite ends valve members 70 and 71 adapted to control ports 61 and 62 respectively according to the angular position of the rocker arm. Rigidly connected to arm 68 at its pivotal point 69 is a lever arm 72 pivotally connected or in engagement with lever arm 66 to coact therewith. If rod 65 moves in an upward direction in response

to a rise in temperature as described above, arm 66 moves in a counter-clockwise direction, as viewed in drawing, to swing lever arm 72 and force rocker arm 68 into the position shown in the drawing in which valve member 70 is out of engagement with port 61 to allow air under pressure to pass therethrough, and valve member 71 is in engagement with port 62 to prevent any escape of air therethrough.

Port 61 of valve 59 is connected by a pipe 73 to a port 74 of a valve 75. A port 76 of this valve leads to the atmosphere and ports 74 and 76 are controlled by two valve members 77 and 78 respectively in turn secured to the opposite ends of a rocker arm 79 pivoted at 80. A lever arm 81 is rigidly secured to rocker arm 79 at its pivotal point and is in engagement with or pivotally connected to a lever 82. Lever 82 is pivoted at a point 83 on valve 75, and if it is forced in a counterclockwise direction, as viewed in the drawing, lever arm 81 is forced in an upward direction to bring valve member 78 into engagement with port 76 and valve member 77 out of engagement with port 74, thus allowing the passage of air from port 74 through the valve and out through a port 84. In a similar manner if lever 82 is forced in clockwise direction, as viewed in the drawing, port 74 is closed and port 76 is opened, allowing air to pass from port 84 through port 76 to the atmosphere.

A pipe 85 connects port 62 of valve 59 with a port 86 of a valve 87, the latter having a port 88 leading to the atmosphere. Ports 86 and 88 are controlled by valve members 90 and 89, respectively, connected to the opposite ends of a rocker arm 91 pivoted at 92. A lever arm 93 is rigidly secured to rocker arm 91 at pivotal point 92 and is in engagement with or pivotally connected to a lever 94. Lever 94 is pivoted at 95. If lever 94 is forced in a counterclockwise direction as viewed in the drawing, rocker arm 91 is moved into the position shown in the drawing with valve member 90 closing port 86 and port 88 being open to allow passage of air from a port 96 through the valve to the atmosphere. Similarly if lever 94 is swung in clockwise direction as viewed in the drawing, rocker arm 91 is moved into an angular position opposite that shown in the drawing to close port 88 and open port 90.

A bellows 97 is anchored by any suitable means generally indicated at 98 and has its free end extending downwardly as viewed in the drawing, and a rod 99 is secured to this end. Rod 99 is in turn secured to levers 82 and 94 of valves 75 and 87 respectively. Thus a vertical motion in either direction of the free end of bellows 97 is transmitted by rod 99 to these levers. A pipe 100 is connected to bellows 97 and leads to a bulb 101 positioned in compartment 20.

A volatile liquid is contained in bulb 101 similar to that employed in bellows 63. Thus a rise in temperature in compartment 20 causes an evaporation of this liquid, the pressure of which is transmitted in turn by pipe 100 to bellows 97. There this pressure moves the free end of bellows 97 to force rod 99 in a downward direction as viewed in the drawing. Conversely if the temperature in compartment 20 falls, a condensation takes place in bulb 101 to decrease the pressure on the free end of bellows 97 and consequently to move rod 99 in an upward direction as viewed in the drawing. If the temperature in compartment 20 rises above that preferred, so that refrigeration is required, rod 99 assumes the position shown in the drawing, opening port 74 of valve 75 to allow compressed air to pass therethrough, thence through port 84 and into a pipe 102 connected to container 25 where the pressure of this air may act on diaphragm 24 in a manner to be described hereinafter. If the temperature in compartment 20 should fall below that preferred, however, rod 99 is moved into its upper position to open port 90 of valve 87 and permit air to pass through this port and port 96 into a pipe 103 leading to container 46. Thus the pressure of this air may actuate diaphragm 45 and cause the parts of valve 31 to assume their left-hand positions, as will be described hereinafter.

Considering now the action of my system, let it be assumed, for purposes of illustration, that compartment 20 is the interior of a refrigerating railroad car, this interior to be maintained between certain definite temperature limits. Furthermore, let it be assumed that this car has just been loaded with goods of a perishable nature in preparation for the transportation thereof to some distant point, thus creating a substantial period of time during which the goods must be maintained between these temperature limits consistently and reliably. Let it also be assumed that, after the goods have been loaded into compartment 20, the temperature thereof is above that preferred, and that the temperature outside the compartment is also above that preferred.

Engine 10 is started, as by cranking, and within a short time, by means of the apparatus 48, a quantity of air under pressure is stored in tank 47. Any deficiency in pressure in tank 47 is overcome by the supply of air under pressure contained in tank 52 having access to tank 47 by a pipe 53 and one-way valve 54 as described above. With engine 10 running and tank 47 containing a substantial supply of air under pressure, my system is ready for reliable and efficient operation. It may further be assumed that, while this car is in transit, conditions are not conducive for ready and reliable attention and adjustment of the working parts thereof, as is generally the case, and thus it becomes important that these parts operate automatically and dependably.

As the temperature outside of compartment 20 is above that preferred, the volatile liquid contained in bellows 63 produces a vapor pressure to exert a pressure against the unanchored end thereof and to force rod 65 in an upward direction as viewed in the drawing. Lever 66 swings lever arm 72 to force rocker arm 68 into the position shown in the drawing. Thus valve member 71 is in engagement with port 62 to stop passage of air therethrough and port 61 is open. Compartment 20 is also above the preferred temperature and therefore the volatile liquid contained in bulb 101 evaporates to exert a pressure on the unanchored end of the bellows to force rod 99 in a downward direction. Lever 82 of valve 75 then swings lever arm 81 and rocker arm 79 assumes the position shown in the drawing to close port 76 by valve member 78 and open port 74. In a similar manner lever 94 swings lever arm 93 to force rocker arm 91 of valve 87 into the position shown in the drawing, thus closing port 86 by valve member 90 and opening port 88 leading to the atmosphere.

Air from tank 47 is now conducted to container 25 to exert a pressure on diaphragm 24 by means of the following path:—the air leaves tank 47 through pipe 46, passes through pressure reducer 60 and pipe 57 to enter valve 59 through port 58, leaves valve 59 through port 61, to pass into valve 75 by means of pipe 73 and port 74, and enters

pipe 102 by port 84 of valve 75 to pass into container 25. Pressure is now exerted upon diaphragm 24 to actuate rod 22 against the tension of spring 23 and causes the parts of clutch 14 to close, connecting shaft 12 of engine 10 with shaft 13 of compressor 11, as described above.

Compressor 11 is now driven by engine 10 and together with the other parts 16*a* of the refrigeration unit acts to provide liquid refrigerant to expansion coil 18 in compartment 20. The liquid refrigerant evaporates in coil 18 to extract heat from the compartment and is returned to the compressor by pipe 21.

Overheating of the engine 10 is prevented by the dissipation, in radiator 26, of heat from the water being forced by pipe 16 through the water jackets; the path of flow of water will be seen to extend from engine 10, pump 16, pipe 33, port 32, valve 31, port 29, pipe 30, radiator 26 and back to water jackets of engine 10 by pipes 28 and 27.

The above-described refrigerating action continues until the temperature of compartment 20 falls to that preferred when, by the heretofore described action of the volatile liquid contained in bulb 101, the free end of bellows 97 and consequently rod 99 assume their uppermost position, as viewed in the drawing. Levers 82 and 94 of valves 75 and 87 respectively swing lever arms 81 and 93 to snap rocker arms 79 and 91 into the opposite angular position from that shown in the drawing; thus in valve 75, port 74 is closed and port 76 is opened, and in valve 87, port 88 is closed and port 90 is opened. Air under pressure in pipe 73 is prevented from entering valve 75 and continuing its path to container 25. Furthermore, the air under pressure in container 25, pipe 102 and valve 75 may leave these parts and escape to the atmosphere through port 76 which is now open as described above. Thus the pressure in container 25 is lowered to that of the atmosphere and diaphragm 24 no longer overcomes the tension of spring 23. Consequently the tension of spring 23 forces rod 22 in a direction away from clutch 14 to disconnect the parts therein. This action in turn disconnects shaft 12 of engine 10 from shaft 13 of engine 11 and compressor 11 comes to rest. Cooling of jacket water through radiator 26 continues.

The cessation of operation of compressor 11 causes refrigeration to cease in compartment 20 and the parts remain in this condition until the temperature therein rises above that preferred when the above described cycle of actions is repeated. As long as the temperature outside of compartment 20 is above that preferred, compartment 20 is maintained at a certain definite temperature by the action described above, and this is achieved moreover in a thoroughly practical and reliable manner, because of the simplicity, ease and fool-proof character of operation of the various working parts hereinabove described. Furthermore, because of this simplicity and also the automatic nature of operation, this action may continue for considerable periods of time while the perishable goods contained in compartment 20 are in transit without necessity of care and outside adjustment by attendants.

If the temperature outside of compartment 20 is below that preferred, pressure exerted by the vapor of the volatile liquid in bellows 63 is diminished and consequently rod 65 assumes its downward position. Lever 66 in turn swings lever arm 72 to snap rocker arm 68 into the opposite angular position from that shown in the drawing. Thus valve member 70 closes port 61 and valve member 71 springs away from port 62 to permit the passage of air therethrough. If the temperature of compartment 20 falls below that preferred, the action of the volatile liquid contained in bulb 101 and its associated parts causes the unanchored end of bellows 97 to exert a pull through rod 99 on levers 82 and 94 in the manner described above: this action closes port 74 and opens port 76 of valve 75, and also opens port 86 and closes port 88 of valve 87.

The air from tank 47 now exerts a pressure on diaphragm 45 of container 46. The path of this air under pressure from tank 47 to container 46 is as follows:—the air passes from tank 47, through pipe 56 and pressure reducer 60 to valve 59, through pipe 57 and port 58; it then leaves valve 59 through port 62 and enters valve 87 through port 86 by pipe 85, and leaves valve 87 through port 96 to enter container 46 by pipe 103. The resultant pressure exerted on diaphragm 45 and accruing from the air in container 46 exerts a force toward the right as viewed in the drawing, on rod 41 of valve 31 against the tension of spring 44. This diaphragm pressure imparted to rod 41 forces head 42 against port 29 to close this port and permit the passage of fluid, such as water, from space 38 in valve 31 to space 40. Up to this time, heat dissipation from jacket-water has been carried on through radiator 26.

But upon the above-described actuation of valve 31, heated jacket water is forced by pump 16 or by a thermosiphonic action through ports 39 and 37 into pipe 36, and from there it is conducted to radiator or heat-exchange device 34 in compartment 20. After passing through radiator 34, the now cooled water returns to the jacket of engine 10 by pipes 35 and 27. The circulation of warm water through heat-exchange device 34 heats compartment 20 to raise the temperature therein and this action continues until compartment 20 reaches the preferred temperature.

Upon reaching the preferred temperature, the volatile liquid contained in bulb 101 through the action of its increased vapor pressure upon bellows 97, causes rod 99 to assume its downward position as viewed in the drawing. The vertical motion of rod 99 is transmitted by levers 82 and 94 to rocker arms 79 and 91 of valves 75 and 87. As described above this action closes ports 76 and 86 respectively and opens ports 74 and 88. The closing of port 86 cuts off the supply of air under pressure from tank 47 to container 46 and the air under pressure in container 46 may escape to the atmosphere through pipe 103, port 96 and port 88.

As no pressure is now exerted on diaphragm 45, the tension of spring 44 forces rod 41 in a left-hand direction as viewed in the drawing to close port 39 and open port 29. The radiator 26 of engine 10 now forms a by-pass for the circulation system described above and the water passing down pipe 33 into valve 31 by port 32 continues its circulation by passing into radiator 26 by port 29 and pipe 30, thence to return to the jacket of engine 10 by pipes 28 and 27. The circulation of warm water in heat-exchange device 34 has now come to a halt and the heating action of this radiator stops. The parts remain in this position until the temperature of compartment 20 falls below that preferred when the above described action repeats itself. Thus a thoroughly simple and practical system and apparatus for heating compartment 20 is provided which combines economy with reliability by em-

ploying a source of heat therefor which might otherwise be completely wasted.

Regardless of weather conditions, changes in climate or any other changes of temperature met with while this car and the perishable goods contained therein are in transit between distant points, this system for heating and cooling compartment 20 provides ample protection against damage or deterioration of the goods. For example, suppose this car is loaded with perishable fruit such as oranges and grapefruit in California to be transported to the northeastern seaboard for consumption. When the car is loaded in the higher temperature of the California climate, the temperature may be far above that preferred, thus requiring immediate refrigeration during the first part of the trip. Such refrigeration is, as will now be clear, amply provided for by my apparatus. As the car climbs the Rocky Mountains or like high altitudes, the temperature may become extremely low, falling below that preferred for maintaining the fruit in proper condition. To meet this new condition, my refrigeration system automatically initiates the requisite heating action described above and maintains the compartment at the preferred temperature. This heating and cooling action continues to operate according to the various climatic conditions through which the car is passing until the fruit reaches its destination. In this manner, during the entire trip across the continent regardless of the varied conditions of climate and temperature met with, the fruit is amply protected against deterioration.

It will thus be seen that I have provided a thoroughly practical and efficient apparatus and system for accomplishing the objects above set forth.

As many possible embodiments may be made of the above invention, and as many changes may be made in the embodiment above set forth, it is to be understood that all matter hereinbefore set forth or shown in the accompanying drawing is to be interpreted as illustrative and not in a limiting sense.

I claim:

1. In a temperature regulating system, in combination, means forming a space whose temperature is to be regulated, a refrigeration unit for said space, motive means for driving an element of said refrigeration unit, means for passing a fluid into thermal contact with said motive means to absorb heat therefrom, means for transferring heat from said fluid to said space, and means responsive to the temperature inside of said space and outside of said space for controlling said last mentioned means.

2. In a temperature regulating system, in combination, means forming a space whose temperature is to be regulated, a refrigeration unit for said space, motive means for driving an element of said refrigeration unit, means for passing a fluid into thermal contact with said motive means to absorb heat therefrom, means for transferring heat from said fluid to said space, and means responsive to the difference between the temperatures inside of said space and outside of said space for controlling said last mentioned means.

3. In a temperature regulating system, in combination, means forming a space whose temperature is to be regulated, a refrigeration unit for said space, motive means for driving an element of said refrigeration unit, means for passing a fluid into thermal relation to said motive means to absorb heat therefrom, means for transferring heat from said fluid to said space, thermostatic means in said space for controlling said last mentioned means, and temperature responsive means outside of said space for regulating the action of said thermostatic means.

4. In a temperature regulating system, in combination, means forming a space whose temperature is to be regulated, a refrigeration unit for said space, motive means for driving an element of said refrigeration unit, means for passing a fluid into thermal contact with said motive means to absorb heat therefrom, means for transferring heat from said fluid to said space, fluid-operated means for controlling said transferring means, thermostatic means in said space for controlling said transferring means, and temperature responsive means outside said space for regulating the action of said thermostatic means.

5. In a temperature regulating system, in combination, means forming a space whose temperature is to be regulated, a refrigeration unit for said space, motive means for driving an element of said refrigeration unit, means for passing a fluid into thermal relation with said motive means to abstract heat therefrom, means for passing heated fluid into thermal contact with said space, means actuated by compressed fluid for controlling said last-mentioned means, means forming a source of compressed fluid, means for controlling the application of compressed fluid from said source to said controlling means, thermostatic means in said space for controlling said second-mentioned controlling means, and temperature-responsive means outside said space for affecting said thermostatic means.

6. In a temperature regulating system, in combination, means forming a space whose temperature is to be regulated, a refrigeration unit for said space, motive means for driving an element of said refrigeration unit, means for passing a fluid into thermal relation with said motive means to abstract heat therefrom, means for passing heated fluid into thermal contact with said space, means actuated by compressed fluid for controlling said last-mentioned means, means forming a source of compressed fluid, means for controlling the application of compressed fluid from said source to said controlling means, and means responsive to the difference between the temperatures inside said space and outside said space for controlling said second-mentioned controlling means.

7. In a temperature regulating system, in combination, means forming a space whose temperature is to be regulated, a refrigeration unit for said space, a jacketed engine for driving an element of said refrigeration unit, means for passing a heat-absorbing liquid through the jacket of said engine, means for passing heated liquid from the jacket of said engine into thermal contact with said space to impart heat thereto, and means responsive to the difference between the temperatures inside said space and outside said space for controlling the action of said last mentioned means and said refrigeration unit.

8. In a temperature regulating system, in combination, means forming a space whose temperature is to be regulated, a refrigeration unit for said space, a jacketed engine for driving an element of said refrigeration unit, a means for passing a heat-absorbing liquid through the jacket of said engine, means for passing heated liquid from the jacket of said engine into thermal contact with said space, means adapted to be actuated by fluid under pressure for control-

ling said last-mentioned means, means for deriving fluid under pressure from said motive means, and thermostatic means for controlling the application of fluid to said controlling means and for controlling said refrigeration unit.

9. In a temperature regulating system, in combination, means forming a space whose temperature is to be regulated, a refrigeration unit for said space, a jacketed engine for driving an element of said refrigeration unit, means for passing a heat-absorbing liquid through the jacket of said engine, means for passing heated liquid from the jacket of said engine into thermal contact with said space, means adapted to be actuated by fluid under pressure for controlling said last-mentioned means, means for deriving fluid under pressure from said motive means, and means responsive to the difference of the temperatures within said space and outside said space for controlling the application of fluid to said controlling means and for controlling refrigeration unit.

10. In a temperature regulating system, in combination, means forming a space whose temperature is to be regulated, a refrigeration unit for said space, an engine for driving an element of said refrigeration unit, means for passing a heat-abstracting fluid into thermal contact with a heated part of said engine, means for transferring heat from said fluid to said space to impart heat thereto, controlling means for said heat-transferring means and adapted to be actuated upon the application of fluid under pressure, storing means for a fluid under pressure, means effective upon the operation of said engine for supplying fluid under pressure to said storing means, and thermostatic means for controlling the operation of said refrigeration unit and the application of fluid under pressure from said storing means to said controlling means.

11. In a temperature regulating system, in combination, means forming a space whose temperature is to be regulated, a refrigeration unit for said space, an engine for driving an element of said refrigeration unit, means for passing a heat-abstracting fluid into thermal contact with a heated part of said engine, means for transferring heat from said fluid to said space to impart heat thereto, controlling means for said heat-transferring means and adapted to be actuated upon the application of fluid under pressure, storing means for a fluid under pressure, means effective upon the operation of said engine for supplying fluid under pressure to said storing means, and means responsive to the difference between the temperature inside of said space and outside of said space for controlling the operation of said refrigeration unit and the application of fluid under pressure from said storing means to said controlling means.

12. In a temperature regulating system, in combination, means forming a space whose temperature is to be regulated, a refrigeration unit for said space, motive means for driving an element of said refrigeration unit, fluid-operated means for connecting said motive means to said element, and means responsive to the difference in temperatures inside and outside said space for controlling the fluid supplied to said fluid-operated connecting means.

13. In a temperature regulating system, in combination, means forming a space whose temperature is to be regulated, a refrigeration unit for said space, motive means for driving an element of said refrigeration unit, fluid-operated means for connecting said motive means to said element, thermostatic means inside said space for controlling the fluid supplied to said fluid-operated connecting means, and means responsive to the temperature outside said space for regulating the action of said thermostatic means.

14. In a temperature regulating system, in combination, means forming a space whose temperature is to be regulated, a refrigeration unit for said space, motive means for driving an element of said refrigeration unit, fluid-operated means for placing said motive means in operative relation to an element of said unit, and means for applying said fluid to said fluid-operated means responsive to the difference in the temperatures within said space and outside said space.

15. In a temperature regulating system, in combination, means forming a space whose temperature is to be regulated, a refrigeration unit for said space, an internal combustion engine adapted to run continuously for substantial periods of time and adapted to drive an element of said unit, a fluid-operated clutch between said element and said engine adapted to connect said engine to said element upon the application of pressure thereto, means forming a supply of fluid under pressure and responsive to operation of said engine, and means responsive to the difference in the temperatures within said space and outside said space for controlling the application of fluid from said source to said fluid-operated clutch.

16. In a temperature regulating system, in combination, means forming a space whose temperature is to be regulated, a refrigeration unit for said space, an internal combustion engine adapted to run continuously for substantial periods of time and adapted to drive an element of said unit. a fluid-operated clutch between said element and said engine adapted to connect said engine to said element upon the application of pressure thereto, means forming a supply of fluid under pressure and responsive to the operation of said engine, means responsive to the temperature within said space, and means responsive to the temperature outside of said space, said last two means coacting to control the application of fluid from said source to said fluid-operated clutch.

17. In a temperature regulating system, in combination, means forming a space whose temperature is to be regulated, a refrigeration unit for said space, motive means for actuating an element of said refrigeration unit, means for connecting said motive means to said element dependent for actuation upon the application of fluid under pressure thereto, means for heating said space and deriving its heat energy from said motive means, means for controlling the operation of said heating means and responsive to the application of fluid under pressure thereto, and temperature responsive means for selectively applying fluid under pressure to said connecting means or said controlling means.

18. In a temperature regulating system, in combination, means forming a space whose temperature is to be regulated, a refrigeration unit for said space, motive means for driving an element of said refrigeration unit, heating means for said space and deriving its heat energy from said motive means, means for connecting said motive means with said element dependent for operation upon the application of a fluid under pressure thereto, and temperature responsive

means for controlling the application of fluid under pressure to said last-mentioned means.

19. In a temperature regulating system, in combination, means forming a space whose temperature is to be regulated, a refrigeration unit for said space, motive means for driving an element of said unit, connecting means for placing said motive means in operative relation to said element upon the application of a fluid under pressure thereto, means operatively related to said motive means for heating said space, means responsive to the application of pressure for controlling the operation of said heating means, means operatively related to said motive means forming a source of compressed fluid, and temperature responsive means for selectively applying said fluid to said connecting means or said controlling means.

20. In a temperature regulating system, in combination, means forming a space whose temperature is to be regulated, a refrigeration unit for said space, motive means for driving an element of said unit, connecting means for placing said motive means in operative relation to said element upon the application of a fluid under pressure thereto, means operatively related to said motive means for heating said space, means operatively related to said motive means for forming a source of compressed fluid, and means responsive to the difference between the temperature within said space and outside of said space for selectively applying said fluid to said connecting means or said heating means.

21. In a temperature regulating system, in combination, means forming a space whose temperature is to be regulated, a refrigeration unit for said space, motive means for actuating an element of said refrigeration unit, means for passing heat-abstracting fluid into thermal relation to said motive means to prevent abnormal rises in temperature therein, means for passing said fluid from said motive means into thermal contact with said space to impart heat thereto, connecting means for placing said motive means in operative relation with said element, and means responsive to the temperature within said space and outside said space for controlling the actuation of said connecting means and said heating means.

22. In a temperature regulating system, in combination, means forming a space whose temperature is to be regulated, a refrigeration unit for said space, a water-cooled combustion engine for driving an element of said refrigeration unit, a clutch disposed between said engine and said element adapted to connect said engine to said element upon the application of pressure thereto, means for passing cooling water heated by said engine into thermal relation to said space to impart heat thereto, pressure-responsive means for controlling said last named means, means operatively related to said engine forming a source of air under pressure, means responsive to the temperature within said space for selectively controlling the flow of said air to said pressure responsive means, means responsive to the temperature within said space for controlling the flow of said air to said clutch, and means responsive to the temperature outside said space for controlling the flow of air to said last-mentioned means.

23. In a temperature regulating system, in combination, means forming a space whose temperature is to be regulated, a refrigeration unit for said space, heating means for said space, fluid-operated means for controlling the operation of said refrigeration unit and said heating means, a source of fluid under pressure for said fluid-operated means, a second source of fluid under pressure, means for controlling the flow of fluid under pressure from said second source to said first source, and temperature-responsive means for controlling the flow of fluid to said fluid-operated controlling means.

24. In a temperature regulating system, in combination, means forming a space whose temperature is to be regulated, a refrigeration unit for said space, heating means for said space, fluid-operated means for controlling the operation of said refrigeration unit and said heating means, a source of fluid under pressure for said fluid-operated means, a second source of fluid under pressure, means for controlling the flow of fluid under pressure from said second source to said first source to maintain said first source at a fixed maximum pressure and operative only when the pressure of said second source is above certain values, and means responsive to the difference in the temperature within said space and outside said space for controlling the flow of said fluid from said first source to said controlling means.

25. In a temperature regulating system, in combination, a vehicle having a chamber whose temperature is to be regulated, and having a source of compressed air for operating the vehicle brakes, the pressure of which source is not to be reduced below a certain operating value, refrigerating means for said chamber, heating means for said chamber, fluid-operated means for controlling the operation of said refrigerating means and said heating means, a source of compressed air for said fluid-operated controlling means, means controlling the flow of air from said first-mentioned source to said second-mentioned source operative when the pressure of said second-mentioned source falls below a certain value and only when the pressure of said first-mentioned source is above said certain operating value, and temperature-responsive means controlling flow of air from said second source to said fluid-operated controlling means.

26. In a refrigeration system for a railway car, in combination, a space in said car whose temperature is to be regulated, means for cooling said space, controlling means for said last-mentioned means responsive to the application of air under pressure, a compressed air line on said car, and means connected with said air line for furnishing compressed air to said controlling means in accordance with the temperature outside said space.

27. In a refrigeration system for a railway car, in combination, a space in said car whose temperature is to be regulated, means for cooling said space, controlling means for said last-mentioned means responsive to the application of air under pressure, a compressed air line on said car, and means connected with said air line for furnishing compressed air to said controlling means in accordance with the difference between the temperatures inside said space and outside said space.

28. In a refrigeration system for a railway car, in combination, a space in said car whose temperature is to be regulated, a refrigeration unit for said space, a heating unit for said space, a compressed air line on said car, means responsive to the temperature within said space for selectively controlling the actuation of said

heating unit and said refrigeration unit, said last-mentioned means being dependent for operation upon the application of a source of compressed air, and means for connecting said last-mentioned means to said air line in accordance with the temperature outside said space.

29. In a refrigeration system for a railway car, in combination, a space in said car whose temperature is to be regulated, a refrigeration unit for said space, motive means for driving an element of said refrigeration unit, means for transferring a portion of the heat generated by said motive means to said space, means for controlling the connection between said motive means and said element in response to the application of pressure, means for controlling the operation of said heat transferring means in response to the application of pressure, a compressed air line on said car, and means for connecting said compressed air line to either one of said last two mentioned means in accordance with the temperature of said space.

30. In a refrigeration system for a railway car, in combination, a space in said car whose temperature is to be regulated, a refrigeration unit for said space, motive means for driving an element of said refrigeration unit, means for transferring a portion of the heat generated by said motive means to said space, means for controlling the connection between said motive means and said element in response to the application of pressure, means for controlling the operation of said heat transferring means in response to the application of pressure, a compressed air line on said car, and means for connecting said compressed air line to either one of said last two mentioned means in accordance with the temperatures inside said space and outside said space.

31. In a refrigeration system for a railway car, in combination, a space in said car whose temperature is to be regulated, a refrigeration unit for said space, an internal combustion engine adapted to run continuously for substantial periods of time, means for connecting and disconnecting said engine to an element of said refrigeration unit responsive to the application of pressure, means for conducting the cooling water from said engine to said space and circulating it thereabout, means for controlling said circulation in response to the application of pressure, a compressed air line on said car, and means for connecting said air line to either of said last two mentioned means according to the temperature of said space.

32. In a refrigeration system for a railway car, in combination, a space in said car whose temperature is to be regulated, a refrigeration unit for said space, an internal combustion engine adapted to run continuously for substantial periods of time, means for connecting and disconnecting said engine to an element of said refrigeration unit responsive to the application of pressure, means for conducting the cooling water from said engine to said space and circulating it thereabout, means for controlling said circulation in response to the application of pressure, a compressed air line on said car, means for connecting said air line to either of said last two mentioned means according to the temperature of said space, and means for modifying the action of said last-mentioned means in accordance with the temperature outside said space.

33. In a temperature regulating system, in combination, means forming a space whose temperature is to be regulated, a refrigeration unit for said space, motive means for an element of said unit, means for passing a heat-abstracting fluid into thermal relation to said motive means to prevent abnormal rises in temperature therein, means responsive to pressure for passing said fluid from said motive means into thermal contact with said space to impart heat thereto, means responsive to the application of pressure for placing said motive means in operative relation with said element, and means responsive to the difference in temperature within said space and outside said space for selectively applying pressure to said fourth mentioned means or said last-mentioned means according to the value of said temperature difference.

GEORGE E. HULSE.