

Aug. 8, 1933.

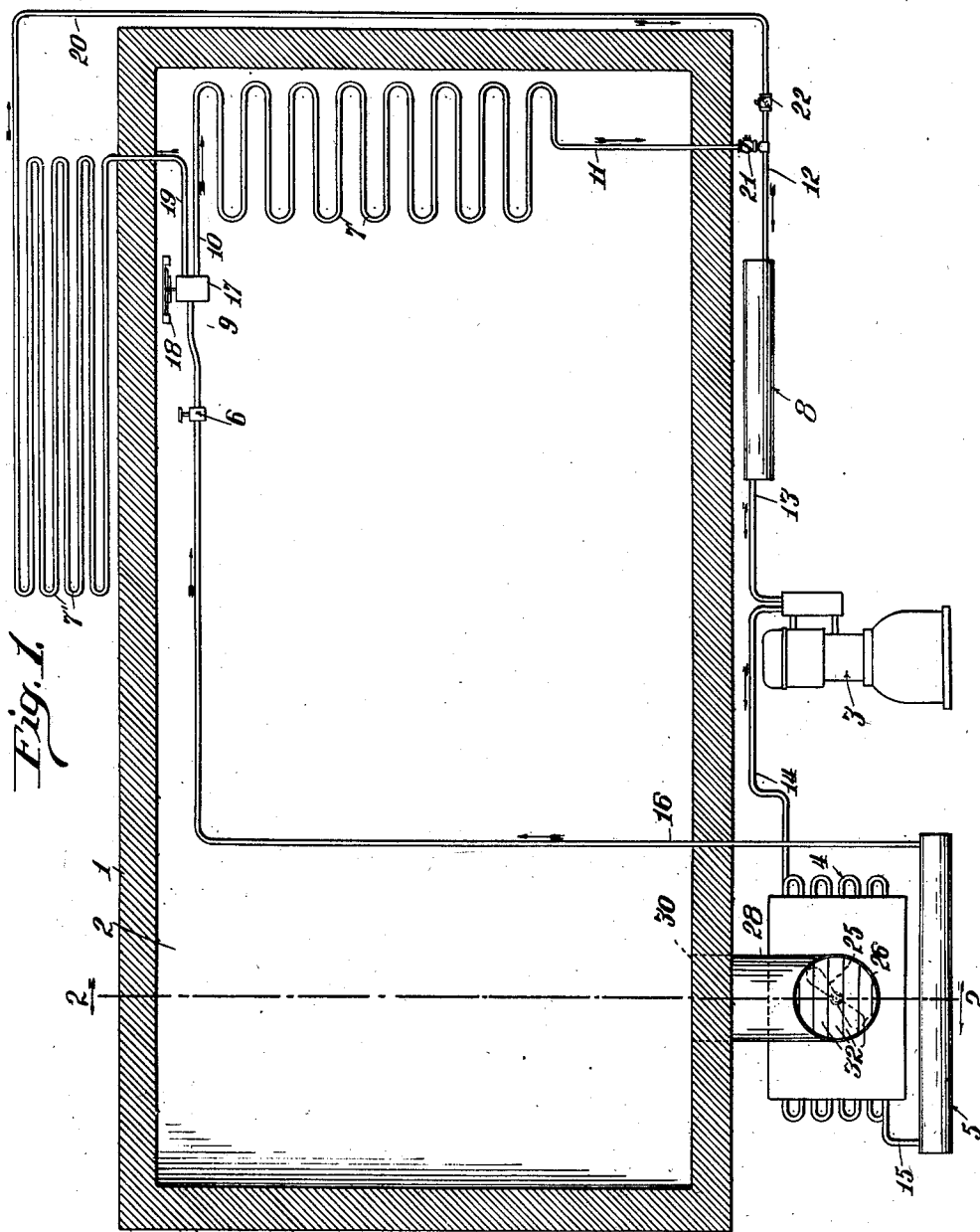
E. C. WOOD

1,921,178

TEMPERATURE CONTROL APPARATUS

Filed June 4, 1932

2 Sheets-Sheet 1



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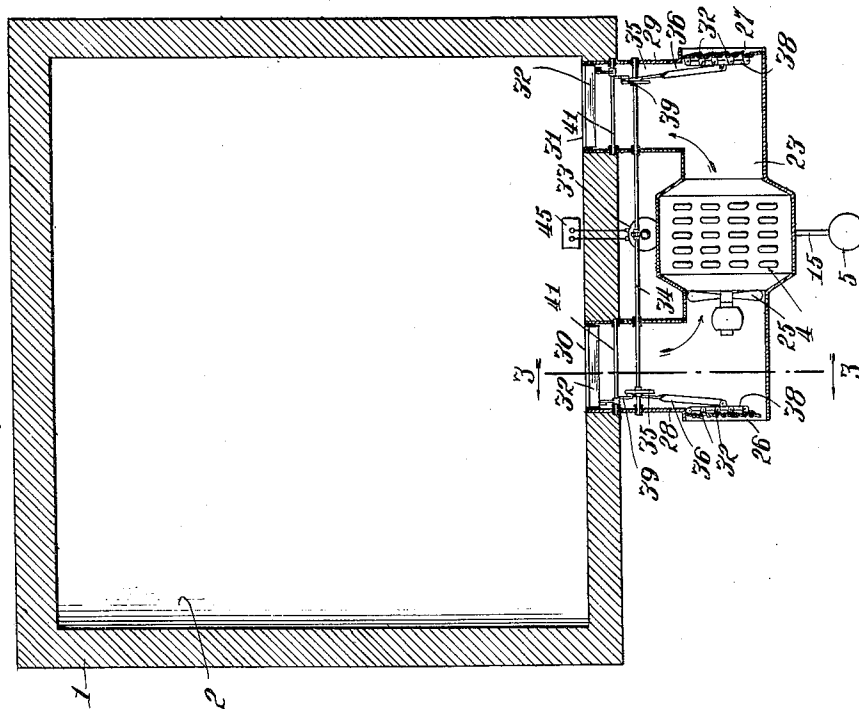
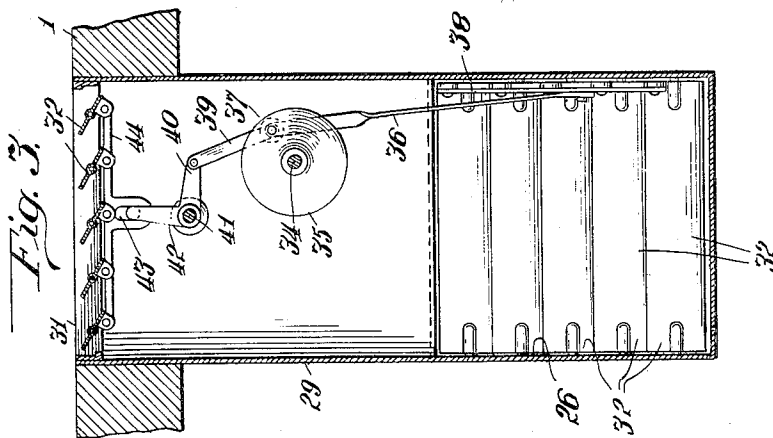
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2 Sheets-Sheet 2

Fig. 2.



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UNITED STATES PATENT OFFICE

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TEMPERATURE CONTROL APPARATUS

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Application June 4, 1932. Serial No. 615,412

12 Claims. (Cl. 62—117)

This invention relates to a new and improved temperature control apparatus, and more particularly to a temperature control apparatus of the refrigerating type adapted to maintain a predetermined low temperature within a closed chamber no matter whether the outside temperature is above or below this predetermined temperature.

The invention is desired more particularly for use in refrigerator cars, although in principle it can be used for regulating the temperature within any type of closed chamber whether stationary or adapted to be moved from place to place. In refrigerator cars adapted to transport certain perishable commodities, it is necessary that a certain predetermined low temperature be maintained, but it is essential that the temperature within the car shall not fall too low or the goods may be frozen or otherwise damaged. It is therefore necessary to provide a heating system which is available for use under certain circumstances, such as sudden periods of extremely cold weather. Such conditions are encountered when a car moves, while in transit, to extremely high altitudes. Since it will only be necessary to supply heat to the chamber for relatively short periods of time, it is undesirable to have to provide a separate heating system for this purpose, and since in the case of a refrigerator car the refrigerating system is usually in continuous operation as long as the car is in motion it is desirable to utilize, if possible, this same refrigerating system for transferring heat from outside the car to the interior thereof instead of functioning as usual to remove heat from the car.

According to the present invention a refrigerating system of the compression type is so arranged that it can transfer heat from the air within a closed chamber to the outside air, or can transfer heat from the outside air to the air within the chamber as conditions may require.

The principal object of this invention is to provide a temperature control apparatus of the type briefly referred to hereinabove and disclosed more in detail in the specifications which follow.

Another object is to provide a heat transfer apparatus of the compression refrigeration type adapted to transfer heat in either direction between two separate spaces.

Another object is to provide a refrigerating system of the compression type comprising two separate evaporators positioned in separate spaces together with thermostatic means for alternatively directing the refrigerant through either of the

evaporators, together with a condenser and means for causing air from either of the two spaces to circulate in contact with the condenser.

Other objects and advantages of this invention will be more apparent from the following detailed description of one approved example of apparatus constructed and operating according to the principles of this invention.

In the accompanying drawings:

Fig. 1 is a diagrammatic vertical section illustrating the application of the invention to a closed chamber such as a refrigerator car.

Fig. 2 is a transverse vertical section taken substantially on the line 2—2 of Fig. 1.

Fig. 3 is a transverse vertical section, on a larger scale, taken substantially on the line 3—3 of Fig. 2.

At 1 is indicated the walls or shell which enclose a chamber 2 in which goods are to be maintained at a predetermined low temperature. This chamber may be the interior of a refrigerator car, or any other refrigerating device. For the purpose of cooling the interior of the refrigerator, means is provided for transferring heat from the air within the car to the outer air. This may be a compression refrigerating system of usual type comprising a compressor 3, a condenser 4, a receiver 5 for the compressed liquid refrigerant, an expansion valve 6, an evaporating coil 7, and an accumulator 8 for preventing the return of unvaporized refrigerant to the compressor. The refrigerant flows through this closed system in the order in which the parts were described, and in the direction of the arrows shown in Fig. 1, and the system normally operates in the usual manner. The compressed liquefied refrigerant confined in the high pressure side of the system is released through expansion valve 6 and flows through pipes 9 and 10 into the evaporator 7 wherein it expands and vaporizes thus absorbing heat from the air within chamber 2. The vaporized refrigerant passes through pipes 11 and 12, accumulator 8, and pipe 13 into the compressor 3, the compressed refrigerant being forced through pipe 14 into the condenser 4 wherein it is condensed, the liquefied refrigerant flowing through pipe 15 into the receiving tank 5. The heat absorbed from the air within chamber 2 is transferred to the cooling air which is circulated in contact with the condenser 4. The condensed liquefied refrigerant is then forced through pipe 16 to the expansion valve 6 thus completing the cycle.

A second evaporator 7', of suitable form and size, is located at some suitable position in the

space outside of chamber 2. The refrigerant flows from expansion valve 6 through pipe 9 to a distributing valve 17 which is controlled by a suitable thermostat 18. From the valve 17 lead two similar branch distributing pipes 10 and 19, the pipe 10 leading to the evaporator 7 as already described and the pipe 19 leading to the alternative evaporator 7'. The valve 17 may be of any suitable and well known type comprising a movable valve member actuated by the thermostat 18 in such manner that when the temperature within chamber 2 is above a predetermined temperature the refrigerant will be directed from pipe 9 into pipe 10 and thence through the evaporator 7. When the temperature within chamber 2 falls below a predetermined temperature, the distributing valve 17 will be actuated so as to direct the refrigerant from pipe 9 into branch pipe 19 and thence into the outside evaporator 7'. The vaporized refrigerant flows from evaporator 7' through pipes 20 and 12 into the accumulator 8 and thence as before through the condenser and compressor. The return pipes 11 and 20 are provided with the one-way valves 21 and 22 so that refrigerant is only permitted to flow in one direction through these pipes.

The condenser 4 is positioned partially or wholly within a suitable conduit indicated generally at 23 through which cooling air is circulated by means of a fan or blower indicated at 25 and driven in any suitable manner. The conduit 23 is provided with inlet and outlet openings 26 and 27 respectively so that outside air can normally be circulated continuously through the conduit by means of fan 25 so as to dissipate from the condenser the heat withdrawn from chamber 2. The conduit 23 is provided with separate inlet and outlet passages 28 and 29 communicating respectively with inlet and outlet ports 30 and 31 leading from and back to the chamber 2. Suitable shutters or closures 32 are provided for each of the inlet and outlet ports 26, 27, 30 and 31. These shutters are so interconnected that when the ports 26 and 27 are open the ports 30 and 31 will be closed, and vice versa. In the example here shown, a motor 33 operates, through suitable reducing gearing, a rock-shaft 34 carrying a pair of crank discs 35. A link 36 connects a crank pin 37 on the disc 35 with a slide rod 38 which opens and closes the shutters 32 for outlet opening 27. A second link 39 extending from crank pin 37 connects with one arm 40 of a bellcrank pivoted at 41, the other arm 42 of this bellcrank having a pin and slot connection 43 with a slide 44 which operates the shutters 32 for the outlet opening 31. A similar set of link and lever connections operates the shutters for the two inlet openings 26 and 30.

The motor 33 may be controlled by a thermostat indicated diagrammatically at 45, the motor being adapted to rotate the crank discs 35 far enough to open the shutters controlling the inlet opening 26 and outlet opening 27 and at the same time to close inlet and outlet openings 30 and 31, or conversely to open the shutters for inlet and outlet openings 30 and 31 and close the openings 26 and 27.

In the normal operation of the device as a refrigerating unit, the refrigerant will be directed by valve 17 through the inside coil or evaporator 7 so as to absorb heat from the air within chamber 2, and the conduit openings 30 and 31 communicating with chamber 2 will be closed so that outside air will be circulated by fan 25 through inlet opening 26, conduit 23 and outlet 27 thereby

dissipating the heat withdrawn from the chamber 2 and delivered from condenser 4. In case the temperature within chamber 2 falls below a predetermined temperature, the thermostat 18 will act to cut off the flow of refrigerant through pipe 10 into evaporator 7 and direct the refrigerant through pipe 19 into the outside evaporating coil 7'. Even though the outside temperature may be quite low, the expanding refrigerant in coil 7' will absorb heat from this air. When this refrigerant is again compressed and delivered into the condenser 4, this heat will be transferred into the air stream which flows through conduit 23 in contact with the condenser. At this time the thermostat 45 will function to open the shutters controlling inlet and outlet openings 30 and 31 and to close the shutters covering openings 26 and 27. Air from within chamber 2 will now be circulated through the conduit 23 passing from chamber 2 through inlet opening 30, branch passage 28, fan 25, condenser 4, conduit 23, branch passage 29, and outlet port 31 back into the chamber 2. In this way the heat absorbed from the outside air in evaporator 7' will be transferred to the air within chamber 2 so that the apparatus functions as a heating means to raise the temperature within the refrigerating chamber.

In order to obtain the best results, it is desirable to have a lag between the operation of the thermostats 18 and 45 so that the operation of the refrigerating system (as such) will be discontinued some time before the system commences to function as a heating system for delivering heat into the chamber 2.

As already noted, a system of this type is particularly useful on refrigerator cars of the type where the compressor is continuously in operation and the refrigerant is circulating as long as the car is in motion. This operating system may thus be put to a useful purpose when it is necessary to supply heat within the car instead of running idly when the desired low temperature within the car has been established. The improvement could be used, however, in systems wherein the operation of the compressor is stopped when certain temperatures have been established, as in the usual household refrigerator.

It will be understood that the showing in the drawings is largely diagrammatic, and the form, proportioning and positioning of the various elements of the system can be varied considerably as conditions require without departing from the principles of the invention. The compressor 3 and the fan 25 can be driven from any suitable source of power. In the case of a refrigerator car, the power may be obtained in well known manner from the car axles. The shutters or closures for the air conduit opening may be operated in any desired manner, the apparatus here disclosed being shown merely by way of example.

I claim:

1. A temperature controlling mechanism comprising a single heat transferring apparatus of the type in which a heat transfer medium moves in a closed circuit comprising a pair of evaporators one positioned in each of two separated spaces, and a single condenser, means for circulating the heat transfer medium alternatively through either one or the other of the evaporators, and means for circulating air in contact with the condenser from the space in which the evaporator not functioning is located and back to said space.

2. A temperature controlling mechanism com-

prising a single heat transferring apparatus of the type in which a heat transfer medium moves in a closed circuit, said apparatus being positioned partially in each of two separated spaces and comprising means for providing alternative paths of flow for the medium and for the air within the respective spaces so that heat can be transferred from the air in one space to the air in the other in either direction, and means for directing the flow of the medium and air.

3. A temperature controlling mechanism comprising a single heat transferring apparatus of the type in which a heat transfer medium moves in a closed circuit, said apparatus being positioned partially in each of two separated spaces and comprising means for providing alternative paths of flow for the medium and for the air within the respective spaces so that heat can be transferred from the air in one space to the air in the other in either direction, and thermostatically controlled means responsive to changes in temperature in one of the spaces for directing the flow of the medium and air.

4. An apparatus for regulating the temperature within a closed chamber comprising a heat transfer apparatus through which a medium is circulated, said apparatus comprising two heat absorbing means one positioned within and the other outside the chamber, a heat delivering means, means for alternatively directing the medium through either one of the heat absorbing means and thence through the heat delivery means, and means for alternatively circulating outside air or air from within the chamber in contact with the heat delivery means.

5. An apparatus for regulating the temperature within a closed chamber comprising a heat transfer apparatus through which a medium is circulated, said apparatus comprising two heat absorbing means one positioned within and the other outside the chamber, a heat delivering means, means responsive to changes in temperature within the chamber for alternatively directing the medium through either one of the heat absorbing means and thence through the heat delivery means and means for alternatively circulating outside air or air from within the chamber in contact with the heat delivery means.

6. An apparatus for regulating the temperature within a closed chamber comprising a heat transfer apparatus through which a medium is circulated, said apparatus comprising two heat absorbing means one positioned within and the other outside the chamber, a heat delivering means, thermostatic means for alternatively directing the medium through either one of the heat absorbing means and thence through the heat delivery means and means thermostatically controlled for alternatively circulating outside air or air from within the chamber in contact with the heat delivery means.

7. An apparatus for regulating the temperature within a closed chamber comprising a heat transfer apparatus through which a medium is circulated, said apparatus comprising two heat absorbing means one positioned within and the other outside the chamber, a heat delivering means, a thermostatically controlled valve for alternatively directing the medium through either one of the heat absorbing means and thence through the heat delivery means, an air conduit in which the heat delivery means is positioned, means for enforcing a flow of air through the conduit, said conduit having alternative sets of

inlet and outlet openings, one set leading from and back to the chamber, the other set communicating with the outer air, shutters for controlling the openings, and thermostatically controlled means for alternatively opening and closing each set of shutters.

8. In an apparatus for regulating the temperature within a closed chamber, a refrigerating system of the compression type comprising a compressor, a pair of evaporators arranged in parallel, one being positioned within the chamber and the other outside of the chamber, a condenser, an air conduit in which the condenser is positioned, means for alternatively directing the refrigerant from the condenser through one or the other of the evaporators and thence through the compressor and condenser, and means for alternatively circulating air from the chamber or outside air through the conduit.

9. In an apparatus for regulating the temperature within a closed chamber, a refrigerating system of the compression type comprising a compressor, a pair of evaporators arranged in parallel, one being positioned within the chamber and the other outside of the chamber, a condenser, an air conduit in which the condenser is positioned, thermostatically controlled means responsive to changes in the temperature within the chamber for alternatively directing the refrigerant from the condenser through one or the other of the evaporators and thence through the compressor and condenser, and thermostatically controlled means for alternatively circulating outside air or air from the chamber through the conduit.

10. In an apparatus for regulating the temperature within a closed chamber, a refrigerating system of the compression type comprising a compressor, a pair of evaporators arranged in parallel, one being positioned within the chamber and the other outside of the chamber, a condenser, an air conduit in which the condenser is positioned, means for propelling air through the conduit, means for alternatively directing the refrigerant from the condenser through one or the other of the evaporators and thence through the compressor and condenser, inlet and outlet ports leading to the conduit from within the chamber and alternate inlet and outlet ports leading to the conduit from the outer air, shutters for controlling the ports, and means for closing the first mentioned set of ports when the second set is open and vice versa.

11. In an apparatus for regulating the temperature within a closed chamber, a refrigerating system of the compression type comprising a compressor, a pair of evaporators arranged in parallel, one being positioned within the chamber and the other outside of the chamber, a condenser, an air conduit in which the condenser is positioned, means for propelling air through the conduit, thermostatically controlled means responsive to changes in the temperature within the chamber for alternatively directing the refrigerant from the condenser through one or the other of the evaporators and thence through the compressor and condenser, inlet and outlet ports leading to the conduit from within the chamber, and alternate inlet and outlet ports leading to the conduit from the outer air, shutters for controlling the ports, and thermostatically controlled means for closing the first mentioned set of ports when the second set is open and vice versa.

12. In an apparatus for regulating the tem-

perature within a closed chamber, a refrigerating system of the compression type comprising a compressor, a pair of evaporators arranged in parallel, one being positioned within the chamber and the other outside of the chamber, a condenser, an air conduit in which the condenser is positioned, thermostatically controlled means responsive to changes in the temperature within the chamber for directing the refrigerant through the inside evaporator and thence through the compressor and condenser when the chamber temperature is above a predetermined temperature, and for alternatively directing the refrigerant through the outside evaporator and thence through the compressor and condenser when the chamber temperature is below a predetermined temperature, and thermostatically controlled means for circulating outside air through the conduit when the inside evaporator is in operation, and for alternatively circulating air from the chamber through the conduit and back into the chamber when the outside evaporator is in operation.

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15	90
20	95
25	100
30	105
35	110
40	115
45	120
50	125
55	130
60	135
65	140
70	145
75	150