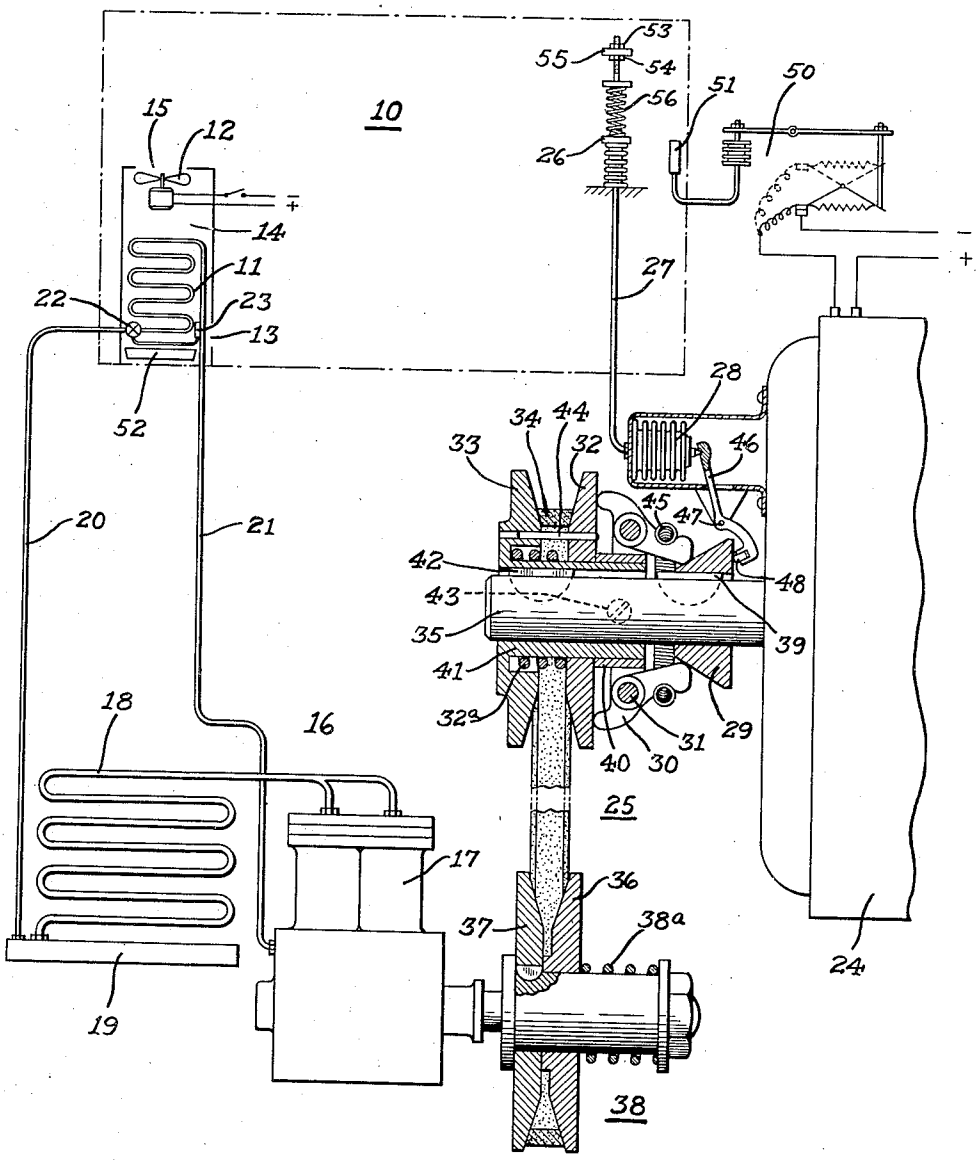
Sept. 20, 1938. C. F. HENNEY 2,130,995

REFRIGERATING APPARATUS

Filed April 20, 1934



Inventor

Charles F. Henney

By Spencer Hardman & Fehr

Attorneys

Patented Sept. 20, 1938 2,130,995

UNITED STATES PATENT OFFICE

2,130,995

REFRIGERATING APPARATUS

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

Application April 20, 1934, Serial No. 721,512

12 Claims. (Cl. 62—6)

This invention relates to refrigeration, and more particularly to the conditioning of air.

It is among the objects of this invention to provide apparatus for conditioning air in which even temperatures are maintained and in which objectionable frequent starting and stopping of the refrigerant liquefying unit is avoided.

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

In the drawing:

The figure is a representation, partly in cross-section and partly diagrammatic, of an air conditioning apparatus embodying features of my invention.

In practicing my invention, air for the compartment 10 is brought in thermal contact with an evaporator 11. The air is caused to flow in the form of an air stream by an electrically driven blower 12 which causes the stream of air to flow from the enclosure 10 (or from the outside, or both) through the inlet 13 into the air conditioning casing or compartment 14 where it is brought in thermal contact with the evaporator 11 and from which it is discharged through the outlet 15 into the compartment 10.

The refrigerant evaporator 11 is in refrigerant flow relationship with a refrigerant liquefying unit 16. Preferably this unit takes the form of a compressor 17, condenser 18, and a liquid refrigerant receiver 19. The refrigerant liquefied by this unit flows through the liquid line 20 to the evaporator 11, and the evaporated refrigerant returns from the evaporator through the line 21 to the compressor 17.

Preferably the evaporator is provided with an automatic expansion valve 22 which tends to feed liquid refrigerant into the evaporator 11 when the refrigerant pressure therein falls below a predetermined limit. However, this valve 22 is also controlled by a thermostatic bulb 23 placed adjacent the outlet of evaporator, and this bulb 23 throttles the valve 22 whenever liquid refrigerant tends to spill over or flow into the line 21 from the evaporator.

The compressor 17 is driven by an electric motor 24 which preferably is of constant speed type. A variable speed transmission 25 is placed between the motor 24 and the compressor 17, so that the compressor 17 may be driven at variable speeds notwithstanding the constant speed of the motor.

The arrangement is such that the speed of the compressor 17 is automatically increased when the temperature created by the evaporator 11 increases, and the speed of the compressor tends to decrease when that temperature decreases. This is accomplished by providing a temperature responsive means 26, responsive either to dry bulb temperatures or wet bulb temperatures, or both, in the compartment 10, which automatically varies the setting of the speed responsive device 25 to accomplish this purpose. Thus the bulb 26 is connected by a pipe 27 with an expansion bellows 28 adjacent the transmission 25. The bellows 28, when expanded, forces the cone 29, against levers 30 which are pivoted in 31. This in turn causes the levers 30 to force the flange 32 toward the flange 33 and thus tends to force the belt 34 radially outward from the shaft 35 of motor 24. This increases the effective diameter of the pulley. When this occurs, the belt 34 forces the flanges 36 and 37 of the pulley 38 on the compressor 17 outwardly against the spring 38a and reduces the effective diameter of the pulley on the compressor shaft. This increases the speed of the compressor as the temperature in the compartment 10 rises. When the temperature in the compartment 10 decreases the converse operation occurs and the speed of the compressor is accordingly decreased.

The variable speed transmission 25 may take any desired form, but as above described, the form shown is now preferred. The cone 29 is slidably keyed at 39 so that the same may slide axially on the shaft 35, but must rotate therewith. The fulcrums 31 are mounted on the sleeve 40 which is fixed on the shaft 35 through the hub 41 of flange 33 which is likewise fixed on shaft 35 through the medium of a key 42 and a set screw 43. The flange 32 is slidably mounted on the hub 41 so that the same may move axially; but is keyed against relative rotation by the pins 44. Also the flange 32 is pressed against the levers 30 by the spring 32a. The levers 30 are provided with a flexible band 45 which tends to contract the right hand ends of the levers against the cone 29. A lever 46 is fulcrumed at 47 with one end in an engagement with the bellows 28 and is provided at the other end with an anti-friction roller 48 in contact with the cone 29.

If desired, the motor 24, and consequently the compressor 17, is caused to start and stop automatically in response to temperature conditions in the compartment 10. This is accomplished by providing a thermostatic switch 50 with its temperature response element 51 placed in compartment 10, where it is responsive to conditions

created by the evaporator 11. This switch may be responsive to dry bulb, or wet bulb temperatures, or both. The switch 50 causes the motor 24 to start when the temperature in the compartment 10 rises above a predetermined limit, and causes the motor to stop when temperature falls below a predetermined limit. Both of these limits, whether they are identical or different, are preferably near the lower range of comfort temperature, so that the compressor starts to operate when the temperature rises sufficiently to require air conditioning and so that the compressor stops when the temperature falls near the lower comfort range when no refrigeration is required.

The various parts of the apparatus are so calibrated that the refrigerant temperatures of the evaporator 11 are maintained sufficiently low to create comfort conditions in the compartment 10, but the refrigerant temperatures are maintained sufficiently high to prevent the freezing of moisture from the stream of air passing through compartment 14 on the evaporator. The temperature may be sufficiently low to condense moisture from the air, but not to freeze it. Any moisture thus condensed may accumulate in being drained from the pan 52 placed below the evaporator 11.

In operation, when the temperature in the compartment rises to the point where refrigeration is required, the switch 50 causes the motor 24 to operate. The temperature responsive means 26 then actuates the lever 46 to the proper position to insure the proper speed of rotation of the compressor shaft. The means 26 may be manually set so that the apparatus tends to maintain higher or lower temperatures. Thus the nuts 53 and 54 may be turned against the fixed stop 55 to vary the tension on the spring 56. This in turn varies the calibration of the device 26.

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. An air conditioning apparatus comprising a compartment to be cooled, an evaporator for cooling air for said compartment, a refrigerant liquefying unit operatively connected to said evaporator, an electric motor, means controlling the operation of said motor in accordance with temperature conditions, a variable speed mechanical connection between said motor and unit and means for controlling said variable speed connection in accordance with air conditions in said compartment.

2. An air conditioning apparatus comprising a compartment to be cooled, an evaporator for cooling air for said compartment, a refrigerant liquefying unit operatively connected to said evaporator, an electric motor, means for starting and stopping said motor automatically in accordance with refrigeration demands, a variable speed mechanical connection between said motor and unit and means for controlling said variable speed connection in accordance with temperature conditions of air in said compartment.

3. An air conditioning apparatus comprising a compartment to be cooled, an evaporator for cooling air for said compartment, a refrigerant liquefying unit including a compressor and condenser operatively connected to said evaporator, an electric motor, a thermostatic switch controlling the operation of said motor, a variable speed mechanical connection between said motor and compressor and means for controlling said variable speed connection in accordance with the cooling effect of said evaporator on air discharged into said compartment.

4. An air conditioning apparatus comprising a compartment to be cooled, an evaporator for cooling air for said compartment, a refrigerant liquefying unit including a compressor and condenser operatively connected to said evaporator, an electric motor, an element responsive to conditions in said compartment controlling the operation of said motor, a variable speed mechanical connection between said motor and unit and means for controlling said variable speed connection in accordance with the cooling effect of said evaporator on air in said compartment.

5. An air conditioning apparatus comprising a compartment to be cooled, an evaporator for cooling air for said compartment, a refrigerant liquefying unit operatively connected to said evaporator, a constant speed electric motor, means for automatically starting said motor in accordance with refrigeration demands, a variable speed mechanical connection between said motor and unit and means for controlling said variable speed connection in accordance with the cooling effect of said evaporator on air in said compartment.

6. An air conditioning apparatus comprising an evaporator, compressor and condenser in refrigerant flow relationship, a constant speed electric motor, a mechanical transmission between said motor and compressor, means controlling the operation of said motor in accordance with refrigeration demands and means automatically responsive to temperature conditions created by said evaporator to increase the speed of said compressor when the temperature increases and to decrease the speed of said compressor when the temperature decreases, said means including a mechanical variable ratio drive and a thermostat actuating said drive to vary the driving ratio, said thermostat being independent of evaporator temperatures.

7. An air conditioning apparatus comprising an evaporator, compressor and condenser in refrigerant flow relationship, a fan for blowing air over said evaporator, a motor driving said fan, a constant speed electric compressor motor, a mechanical transmission between said compressor motor and compressor, and means automatically responsive to air temperature conditions created by said evaporator to adjust said transmission to increase the speed of said compressor when the air temperature increases and to decrease the speed of said compressor when the air temperature decreases.

8. An air conditioning apparatus comprising an evaporator, compressor and condenser in refrigerant flow relationship, a constant speed electric motor, a mechanical transmission between said motor and compressor, means automatically responsive to air temperature conditions created by said evaporator to adjust said transmission to increase the speed of said compressor when the air temperature increases and to decrease the speed of said compressor when the air temperature decreases, and means responsive to temperature conditions created by said evaporator for starting and stopping said motor.

9. An air conditioning apparatus comprising an evaporator, compressor and condenser in re-

frigerant flow relationship, a fan for blowing air over said evaporator, a constant speed electric motor, a mechanical transmission between said motor and compressor, means automatically responsive to air temperature conditions created by said evaporator to adjust said transmission to increase the speed of said compressor when the air temperature increases and to decrease the speed of said compressor when the air temperature decreases and means responsive to temperature conditions created by said evaporator for starting and stopping said motor.

10. An air cooling apparatus comprising a compartment to be cooled, an evaporator cooling air for said compartment, a compressor and condenser connected to said evaporator in refrigerant flow relationship, an electric motor, a variable ratio drive between said motor and compressor, and means for adjusting said drive in accordance with air conditions in said compartment.

11. An air cooling apparatus comprising a compartment to be cooled, an evaporator cooling air for said compartment, a compressor and condenser connected to said evaporator in refrigerant flow relationship, an electric motor, a variable ratio drive between said motor and compressor, and means for adjusting said drive in accordance with air conditions in said compartment, said drive and adjusting means comprising a driven compressor V-pulley, spring means urging the sides of said V-pulley together, a motor driving V-pulley, a belt between said pulleys, and thermostatic means varying the distance between the sides of said driving V-pulley.

12. An air conditioning apparatus comprising a compartment to be cooled, an evaporator for cooling air for said compartment, a refrigerant liquefying unit including a compressor and condenser operatively connected to said evaporator, an electric motor, a thermostatic switch controlling the operation of said motor, a variable speed mechanical connection between said motor and compressor, and means for controlling said variable speed connection in accordance with temperature conditions of air at a point within said compartment remote from said evaporator.

CHARLES F. HENNEY.