

Oct. 24, 1944.

E. DICKEY

2,361,090

REFRIGERATING APPARATUS

Filed Jan. 30, 1942

2 Sheets-Sheet 1

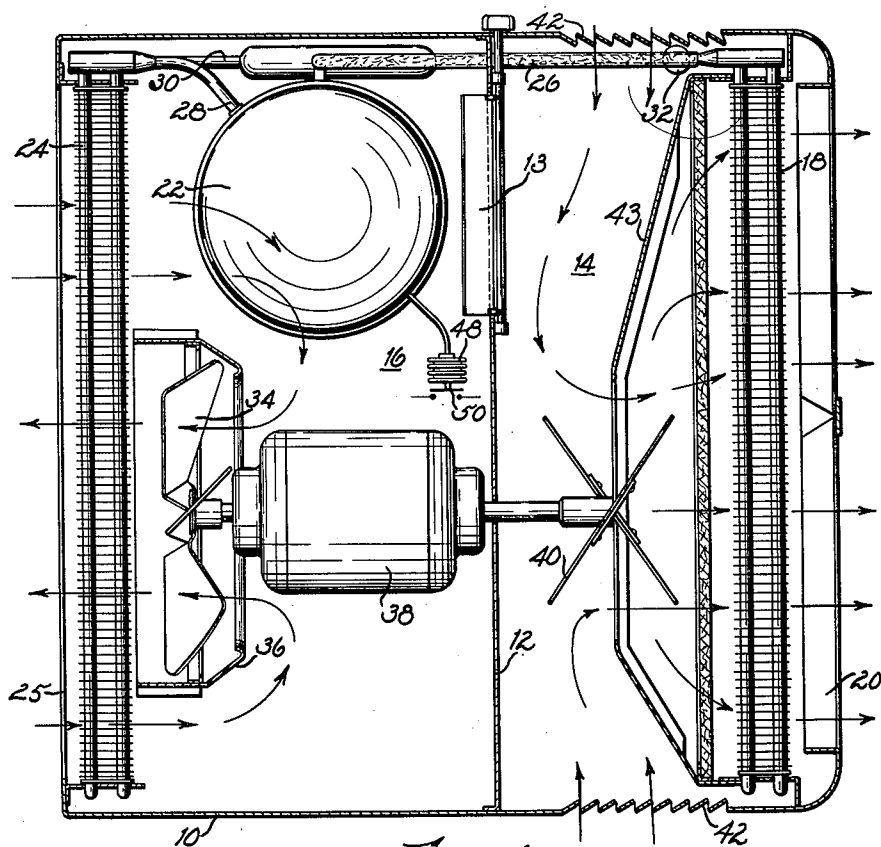
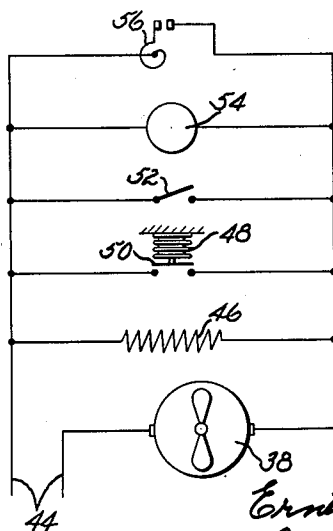


Fig. 1

Fig. 2



Ernest Dickey, INVENTOR.
BY Spencer, Hardman & Fehr,
Attorneys.

Oct. 24, 1944.

E. DICKEY

2,361,090

REFRIGERATING APPARATUS

Filed Jan. 30, 1942

2 Sheets-Sheet 2

Fig. 3

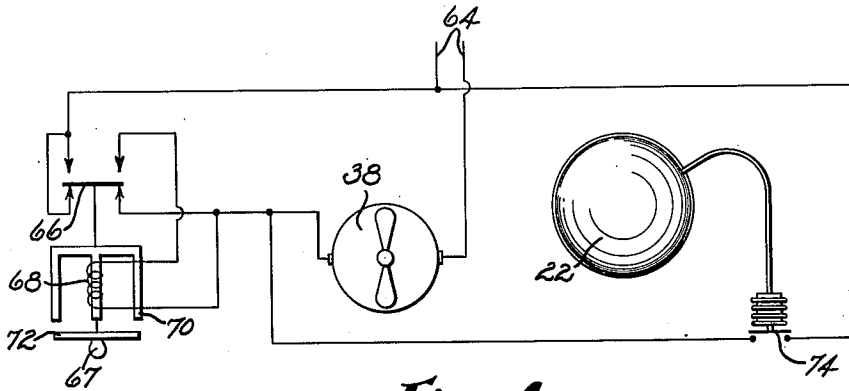
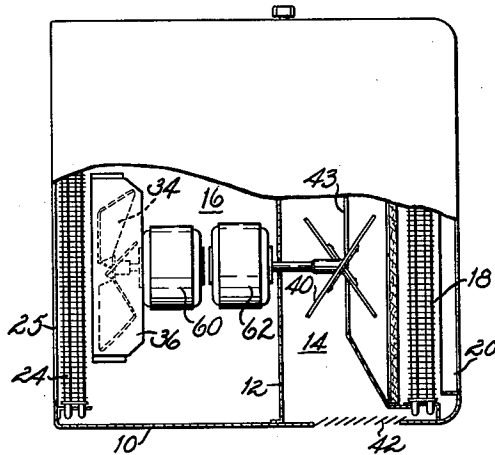
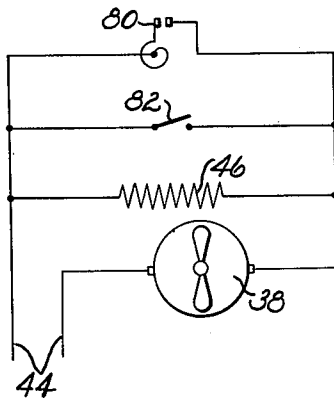


Fig. 4

Fig. 5



Ernest Dickey. INVENTOR.

BY *Spencer, Hardman & Fehr.*
Attorneys.

UNITED STATES PATENT OFFICE

2,361,090

REFRIGERATING APPARATUS

Ernest Dickey, Dayton, Ohio, assignor to General Motors Corporation, Dayton, Ohio, a corporation of Delaware

Application January 30, 1942, Serial No. 428,895

7 Claims. (Cl. 62—6)

This invention relates to refrigerating apparatus and more particularly to an improved type of refrigerating apparatus for use in conditioning air for bedrooms and the like.

One object of this invention is to reduce the operating noise level of an air cooled air conditioning unit.

Frequent cycling of a refrigerating system mounted within a bedroom is disturbing to one wanting to sleep, not only because of the changes in the noise level within the enclosure but also because of noticeable fluctuations in the psychrometric condition of the air resulting from the cycling operation.

It is another object of this invention to provide means for reducing the need for frequent cycling of the refrigerating apparatus and at the same time reducing the noise level of the apparatus during night operation.

Since air conditioning units of the general type disclosed herein are of necessity designed to handle the air conditioning load during the hottest part of the day, it is apparent that the capacity of the apparatus is considerably in excess of that required during the evening and night when the sun is not shining. A further object of this invention, therefore, is to provide means for balancing the capacity of the unit with the air conditioning load during the evening and night hours.

A still further object of this invention is to provide means for reducing the capacity of the apparatus for lowering the dry bulb temperature of the air without materially reducing its moisture removing capacity. This is an important feature since the dry bulb temperature normally drops an appreciable amount toward evening, but the humidity is often oppressive after the dry bulb temperature has dropped.

It is also an object of this invention to provide means for reducing the velocity of the conditioned air at night when one is more sensitive to drafts.

A further object of this invention is to provide a simple control arrangement for varying the volume of air circulated over each heat exchange coil.

Still another object of this invention is to provide means for automatically increasing the condenser fan speed in the event that the refrigeration load increases to the point where increased condenser capacity is required.

Another object of this invention is to provide a simple and inexpensive control which may be

added to existing air conditioning units to accomplish all of the above objects.

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 horizontal sectional view somewhat diagrammatic of a window sill type air conditioning unit;

Fig. 2 is a circuit diagram showing the electrical controls used with the apparatus shown in Fig. 1;

Fig. 3 is a view similar to Fig. 1, showing a modified arrangement in which a separate motor is provided for each fan;

Fig. 4 shows a modified circuit diagram which may be used in controlling the apparatus shown in Figs. 1 and 3; and

Fig. 5 shows a still further modification of the electrical circuit which may be used in controlling the apparatus shown in Figs. 1 and 3.

In Fig. 1 I have shown a window sill type of air conditioning unit comprising a main cabinet 10 which is adapted to be supported directly on the window sill in accordance with practice which is now well known. The cabinet 10 is provided with a partition 12 which separates the cabinet into an evaporator compartment 14 and the refrigerant liquefying compartment 16. The evaporator compartment 14 is adapted to project into the room, whereas the compartment 16 is adapted to project outside of the room. A damper 13 is provided in the member 12. An evaporator 18 is disposed within the evaporator compartment 14 adjacent the conditioned air outlet opening 20 which, for purposes of illustration, has been shown in the front wall of the cabinet 10. A conventional rotary motor compressor unit 22 is provided within the compartment 16. A condenser 24 is provided adjacent the opening 25 provided in the rear wall of the cabinet 10. The motor-compressor unit 22 is adapted to withdraw vaporized refrigerant from the evaporator 18 through the suction line 26 and is adapted to discharge compressed refrigerant vapor into the condenser 24 through the line 28. The refrigerant condensed by the condenser 24 is applied to the evaporator 18 through the liquid line 30 in which is mounted a conventional refrigerant flow control means 32 which may be either of the fixed restrictor type having a relatively long narrow capillary passage or of the expansion valve type. A condenser fan 34 is provided for circulating

outside air in thermal exchange with the condenser 24.

A shroud 36 surrounds the condenser fan and serves to direct the flow of air over the condenser, as indicated by the arrows. The fan 34 is driven by means of a variable speed motor 38 which also drives the evaporator fan 40 which is arranged in the evaporator compartment 14. An air directing baffle 43 directs the air through the evaporator compartment, as indicated by the arrows. Air entering the evaporator compartment 14 through side openings 42 flows over the evaporator 18 and is thereafter discharged into the conditioned space through the outlet 20. A damper 13 is provided in the wall 12 which when open allows some of the room air to discharge to the outside.

Referring now to Fig. 2 in which I have shown a control circuit suitable for controlling the speed of the fan motor 38, reference numeral 44 designates the main power lines through which power is supplied to the fan motor 38. Reference numeral 46 designates a resistance element through which the current supplied to the motor is required to flow when the motor 38 is operated at a reduced speed. Reference numeral 48 designates a bellows responsive to the condenser pressure. The bellows 48 controls a switch 50 which when closed serves to shunt out the resistance element 46 in a manner to be explained more fully hereinafter. Reference numeral 52 designates a manually operated switch which may be used for manually shunting out the resistance 46 whenever desired. Reference numeral 54 designates a conventional time switch or clock operated switch which may be used for shunting out the resistance 46 at predetermined times. Under normal operating conditions, the time operated switch 54 alone may control the speed of the fan motor 38. The pressure operated switch 50 may be adjusted so as to close only at high condenser pressures when the air conditioning load is excessive and demands maximum condenser capacity.

Reference numeral 56 designates a by-metallic thermostat which may also be provided for shunting out the resistance 46. This thermostat may be arranged to respond to the outside air temperature, or to the temperature of a portion of the refrigerant system such as the motor compressor unit 22 or the compressed gas discharge line 28. The thermostat 56 may be set so as to shunt the resistance 46 only when the temperature measured thereby becomes excessive, indicating that full fan speed is necessary for protecting the apparatus from overheating. If desired, the thermostat 56 may be set so as to operate at temperatures whereby it will cut in and out the resistance element 46 at more frequent intervals so as to more closely modulate the capacity of the system in accordance with temperature changes. It will be noted that the circuit arrangement is such that the automatic and manual controls are arranged in parallel whereby any one is capable of increasing the fan speed irrespective of the setting of the others. While I have shown a plurality of automatic controls in addition to a manual control for varying the fan speed, it is apparent that any one or more of the controls may be used alone with very satisfactory results.

By virtue of the above described arrangement, it is obvious that by placing a resistance in the circuit with the fan motor in the manner indicated in Fig. 2, and by providing some means

for shunting the resistance when desired, the speed of the fan may be varied so as to not only reduce the amount of noise produced by the fan but also to reduce the capacity of the refrigerating system for cooling the air without substantially altering the capacity of the system for removing moisture from the air.

While I have disclosed a single motor for driving both the evaporator and the condenser fan in the modification shown in Fig. 1, it is apparent that the invention is equally applicable to a system in which separate motors are provided for driving the evaporator fan and the condenser fan. In Fig. 3 I have shown a slightly modified arrangement in which two fans are thus provided. In all other respects, the apparatus shown in Fig. 3 is similar to the apparatus shown in Fig. 1 and the same reference numerals have been used for designating like parts in both modifications.

In the modification shown in Fig. 3, the condenser fan motor 60 and the evaporator fan motor 62 may be connected in parallel to a source of current and controlled by means of a single resistance element which would simultaneously reduce the speed of both fans. If desired, each fan may have its own circuit in which case the speed of each fan may be independently controlled.

In Fig. 4, I have shown a modified circuit for controlling the speed of the fan motor 38 of Fig. 1 or for controlling one or both of the fan motors shown in Fig. 3. Since there are some types of motors that do not start very readily when a reduced voltage is applied thereto, such as when a resistance is placed in series with the motor, it is desirable to provide some means for automatically eliminating the resistance element from the circuit during the starting of a motor of that type. In the modification shown in Fig. 4, current is supplied through the main power lines 64. A double throw switch 66 having a manual operating means 67 is provided for varying the speed of the fan motor 38. With the switch 66 in the position in which it is shown in Fig. 4, the motor 38 operates at full speed since no resistance is provided in the circuit leading to the motor. By manually elevating the switch 66 into its upper position, the current flowing to the motor 38 is required to flow through the solenoid 68 which is designed so as to have sufficient resistance to reduce the speed of the fan motor. Energization of the solenoid 68 serves to magnetize the holding magnet 70 which serves to hold the armature 72, carried by the switch operating means 67, in the elevated position so long as the solenoid 68 is energized.

Upon de-energization of the solenoid 68, either by current failure in the main power lines or by the closing of the pressure operated switch 74, the armature 72 drops by gravity and pulls the switch element 66 into its lowermost position. The switch 74 is preferably designed to close only at such times when the head pressure within the motor-compressor unit 22 becomes excessive so as to require full speed operation of the condenser cooling fan. By virtue of the above described arrangement, it is apparent that after every period of shut-down it is necessary to manually reset the speed reducing switch 66, and it is also apparent that the switch 66 will not remain in its uppermost position unless current flows through the solenoid 68.

In Fig. 5, I have shown a circuit arrangement which is somewhat similar to the circuit arrange-

ment shown in Fig. 2 but which omits the pressure operated means and the clock operated means for shunting the resistance element 46. In the circuit arrangement shown in Fig. 5, a thermostat 80 has been provided which is adapted to respond to the motor-compressor temperature and which is intended primarily as a safety device for shunting the resistance element 46 when there is danger of the motor compressor element overheating. The thermostat 80 may be mounted directly in contact with the outer surface of the motor-compressor element 22 or it may be disposed within the casing of the motor-compressor unit 22. A manual switch 82 is provided which is intended to be used for manually shunting the resistance element 46 when it is desired to operate the fan motor or motors at full speed.

In order to simplify this disclosure, the resistance element 46 has been shown in each instance as a fixed resistance whereas it is within the purview of this invention to provide a variable resistance which may be manually or automatically controlled. In the average portable air conditioning unit, a fixed resistance is sufficient but there may be special installations in which a closer control of the fan speed may be desirable.

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 a refrigerating system, a compressor, a condenser, an evaporator, fan means for flowing air in thermal exchange with said condenser, manual means for reducing the speed of said fan means, and safety means responsive to a need for increased condenser cooling for rendering said manual means ineffective for reducing the speed of said fan means in response to a need for increased condenser cooling.

2. A self-contained room cooler adapted to be disposed in and to cool a room having a window in a wall thereof, said room cooler comprising a portion adapted to be disposed in said room adjacent said wall and a second portion adapted to project horizontally through the window, an evaporator in said first portion, a condenser and a compressor disposed in said second portion adjacent the outer side thereof, means including a fan disposed inwardly of said condenser for effecting flow of air in thermal exchange with said condenser, fan means for circulating air in thermal exchange with said evaporator and for discharging the air into said room, a motor for operating both of said fans, means for reducing the speed of said motor for night time operation, and safety means responsive to refrigerant pressure for rendering said last named means ineffective at high condenser pressures.

3. In a refrigerating system, a compressor, a condenser, an evaporator, electric fan means for

flowing air in thermal exchange with said condenser, means for supplying electrical current to said fan means, control means for reducing the speed of said fan means, safety means responsive to a need for increased condenser cooling for rendering said control means ineffective for reducing the speed of said fan means, and means responsive to the failure of electrical current for said fan for setting said control means so as to restart said fan at full speed upon resumption of current flow.

4. In a refrigerating system, a compressor, a condenser, an evaporator, fan means for flowing air in thermal exchange with said condenser, control means for reducing the speed of said fan means, and safety means responsive to a need for increased condenser cooling for rendering said control ineffective for reducing the speed of said fan means in response to a need for increased condenser cooling.

5. A self contained room cooler adapted to be disposed in and to cool a room having a window in a wall thereof; said room cooler comprising a portion adapted to be disposed in said room adjacent said wall and a second portion adapted to project horizontally through the window; an evaporator in said first portion; a condenser disposed in said second portion; a compressor; fluid flow connections between said evaporator, compressor, and condenser; fan means for flowing air in thermal exchange with said condenser; control means for reducing the speed of said fan means; and safety means responsive to a need for increased condenser cooling for rendering said control means ineffective for reducing the speed of said fan means.

6. A self contained room cooler adapted to be disposed in and to cool a room having a window in a wall thereof, said room cooler comprising a portion adapted to be disposed in said room adjacent said wall and a second portion adapted to project horizontally through the window, an evaporator in said first portion, a condenser and a compressor disposed in said second portion adjacent the outer side thereof, fan means for effecting flow of air in thermal exchange with said condenser, fan means for circulating air in thermal exchange with said evaporator and for discharging the air into said room, a motor for operating one of said fan means, means for reducing the speed of said motor for night time operation, and separate means for rendering said last named means ineffective.

7. In a refrigerating system, a compressor, a condenser, an evaporator, electric fan means for flowing air in thermal exchange with said condenser, means for supplying electrical current to said fan means, control means for reducing the speed of said fan means, and means responsive to the failure of electrical current for said fan for setting said control means so as to restart said fan at full speed upon resumption of current flow.

ERNEST DICKEY.