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CONTROL FOR A ROOM AIR CONDITIONER

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Fig. 1

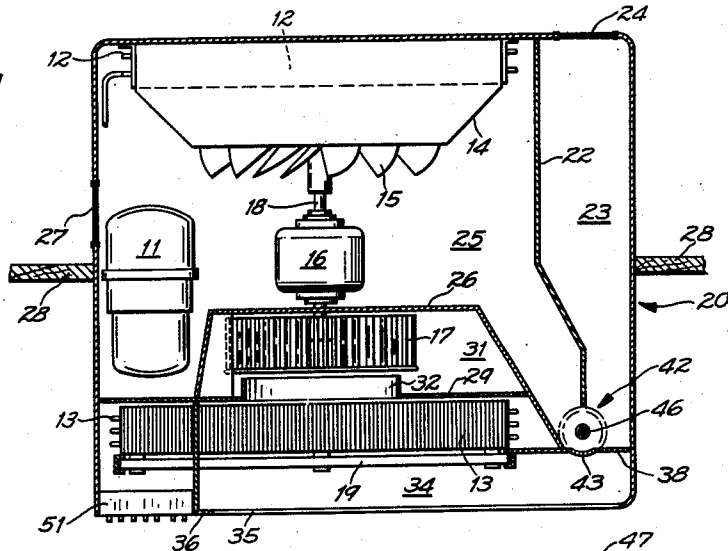


Fig. 2

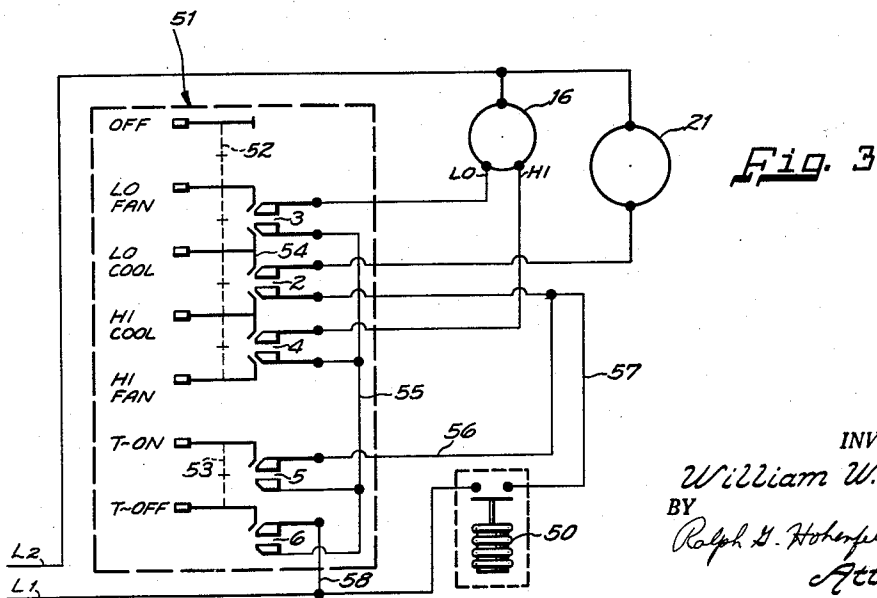
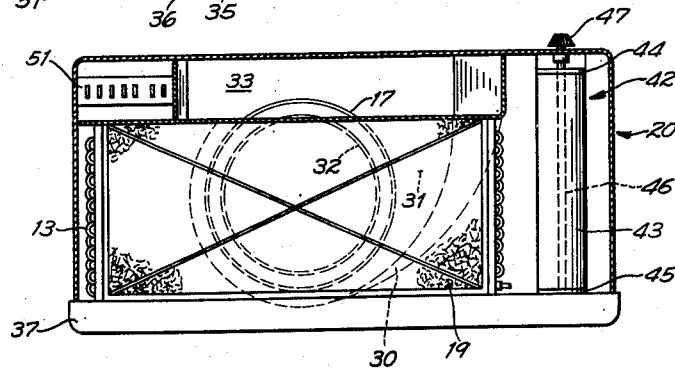


Fig. 3

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CONTROL FOR A ROOM AIR CONDITIONER

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This invention relates to air conditioning units of the type usually mounted in the outside window of a room for the purpose of introducing cooled outside air and cooled recirculated air to the room or merely recirculating the room air without cooling it. More particularly, the invention pertains to electrical means for fully controlling any of the above functions manually or automatically.

In conventional room air conditioners including a motor driven refrigerating compressor and a motor driven room air circulating fan it is customary to arrange the electrical controls for obligating the circulating fan to run continually when the controls are set on "cool" whether or not the compressor is undergoing a cooling cycle in response to a signal from the room thermostat. Although this scheme is advantageous when the room is occupied, since it enhances comfort of the occupants by assuring constant agitation of the room air, it also results in unnecessary expenditure of power by the fan motor when the unit is set on cool and the room is unoccupied. Thus, it is desirable that a control means be provided which enables a choice of whether the circulating fan shall stop when the compressor stops or whether the circulating fan shall run continually when the compressor is not effectively cooling. With this choice available, a room may be kept cool without wasting power while the room is unoccupied, and when re-entered, the feeling of comfort incident to circulating the room air can be almost instantly attained by starting the circulating fan and allowing it to run continually during ensuing cooling cycles.

It is therefore a primary object of this invention to provide an air conditioner control scheme and apparatus that enables a choice of whether the fan motor and compressor motor are to both cease operation when the room thermostat no longer calls for cooling or whether the fan is to run continually under this condition.

A further object is the provision of a room air conditioner control that permits selection of a cooling cycle, subject to the control of a thermal responsive means in the form of a room thermostat, or in the alternative, selection of an air recirculating cycle without cooling but with an additional choice of running the circulating fan either under control of the thermostat or under manual control.

A more general object is to provide a room air conditioner with a control means allowing optimum versatility in selection of the cycle to be performed but which is electrically and mechanically simplified and which is economical to make and install.

Other specific objects will be perceptible throughout the course of this specification.

A more explicit description of the invention will now be set forth in conjunction with the drawing in which:

Fig. 1 is a horizontal, sectional, plan view of an exemplary room air conditioner embodying the novel control means;

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Fig. 2 is a front elevational view of the apparatus illustrated in Fig. 1, partly in section; and,

Fig. 3 is a diagram of the electrical control circuit constituting the invention.

Before entering into a detailed discussion of the novel arrangement for controlling the operational sequence of an air conditioner, features of a typical unit to which the invention may be applied will be briefly outlined primarily in reference to Figs. 1 and 2 of the drawing.

The illustrative air conditioner may be of conventional design in the respect that it includes a motor driven refrigeration compressor 11, a condenser coil 12 and an evaporator or cooling coil 13. Condenser coil 12 has a sheet metal conical shroud 14 for directing air that is delivered by a heat rejecting condenser fan 15 to the outside atmosphere. Refrigerating compressor 11 includes an electrical prime mover in the form of a motor 21, see Fig. 3.

A two speed motor 16 is provided for driving the condenser fan 15 as well as an evaporator or room air circulating fan 17 of the centrifugal type. Both fans are keyed for joint rotation to a double ended motor shaft 18. Air passing through cooling coil 13 under the influence of circulating fan 17 is compelled to pass through a purifying filter 19 under all circumstances.

The components thus far recited are all located within a sheet metal housing designated by the reference numeral 20. Ordinarily there is an additional decorative casing over housing 20 but the casing has here been omitted for the sake of brevity.

Housing 20 is subdivided into a number of compartments for the purpose of separating the components of the unit and enabling control over the flow of air in various directions through the housing. The first compartment, defined by a longitudinally disposed wall or bulkhead 22, is a fresh air inlet chamber 23 communicating with the atmosphere through a screened opening 24. A second compartment 25, containing compressor 11, condenser 12 and fan motor 16, is defined by housing 20, longitudinal wall 22 and a transverse wall 26. Wall 26 is imperforate except where motor shaft 18 penetrates it for supporting centrifugal fan 17. A constant supply of outside air is assured through compartment 25 by provision of additional screened openings 27 located outside the symbolized wall 28 of the room being conditioned.

A third principal cooling section is subdivided into a number of additional compartments primarily by a transverse wall 29 located behind evaporator coil 13. Wall 29 ties in by means of its curved bottom 30 with wall 26 back of it to define a scroll chamber 31 in which centrifugal fan 17 is housed. Wall 29 has an inlet hole 32 for admitting to fan 17 air that has passed through filter 19 and cooling coil 13. Air is discharged from fan 17 to the room being cooled through a duct 33 lying in a horizontal plane, see Fig. 2.

Ahead of filter 19, extending vertically from the base 37 of the unit to a height substantially equal to cooling coil 13, there is a transverse compartment 34 that is defined by a front wall 36 having a large opening 35 therethrough. Compartment 34 is further provided with a short vertically apertured wall 38 that separates compartment 34 from fresh air compartment 23 and condenser compartment 25.

Note that the three last named compartments junction in the vicinity of a rotary damper 42 that permits placing any two of the compartments in communication at one time. Damper 42 comprises a segment 43 molded or formed with a pair of disks 44 and 45 at its upper and lower ends, respectively. A shaft 46, journaled at its bottom end in base 37 for example and having a manual

positioning knob 47 at its upper end, extends through the damper for selecting positions of the latter.

The position of damper segment 43 in the illustrative example corresponds with a condition where air is drawn from the room under the influence of fan 17, filtered, and discharged again to the room without admixture of fresh air. If refrigerating compressor 11 is running under this condition, coil 13 will be cold and cooled air will be discharged to the room. If the compressor is not running, fan 17 will merely recirculate room air. Note, however, that when segment 43 is in its illustrated position that fresh air compartment 23 and condenser compartment 25 are interconnected. Thus, condenser fan 25 may draw fresh air in addition to that obtainable through opening 27 for augmenting rejection of heat through condenser coil 12.

If segment 43 is manually rotated approximately one hundred and twenty angular degrees clockwise it blocks off compartment 25 and interconnects compartments 23 and 34 for mixing fresh air with the room air being circulated by fan 17.

If segment 43 is rotated counterclockwise through the same angle it will block off fresh air inlet 23 and interconnect compartments 25 and 34. Under this circumstance, part of the room air will be circulated by fan 17, as described above, and part will be exhausted to the outside atmosphere under the influence of condenser fan 14.

The methods of directing air flow just described are functionally well established in the art and constitute no part of the instant invention except insofar as they bear a relation to the novel means for controlling operation of the fan motor 16 and the refrigerating unit 11 together with its prime mover 21.

Before proceeding with a description of the structural and functional intricacies of the novel air conditioner control scheme, the general purposes sought to be achieved and the terminology to be employed will be considered. It has been already indicated that the occupants of the room may desire that room air be merely recirculated by circulating fan 17, with or without addition of fresh air through damper 42, and with compressor 11 deactivated so that no cooling takes place. This is to be known as an air "circulating cycle." It will appear hereinafter that in accordance with the invention the operator may choose to place the circulating fan under control of a room thermostat or under manual on-off control by means of depressing appropriate push buttons. It will appear below that the circulating cycle may be selected by depressing push buttons marked "Hi Fan" or "Lo Fan" together with a button marked either "T On" or "T Off."

Another operating condition governable from a selector or push button station is that called a "cooling cycle" where the refrigerating compressor motor runs periodically subject to a signal received from a room thermostat and where under the prior art arrangements the continual operation of the circulating fan is obligatory regardless of whether the thermostat has attained its off temperature. In contrast, the invention allows the operator to elect whether the circulating fan and compressor motor are to stop simultaneously when a room temperature condition has been satisfied or whether the fan is to continue operating during a cooling cycle. To make this choice according to the invention, the operator merely needs to depress a button marked "Hi Cool" or "Lo Cool," to establish a cooling cycle, and one or the other of two buttons for cutting the thermostat in or out of the fan circuit, marked "T On" and "T Off."

Attention is now invited to Fig. 3 where there is schematically represented compressor motor 21, high and low speed circulating fan motor 16, a bellows type room thermostat 50, a push button station indicated generally by the numeral 51, and a source of electric power identified as line wires L₁ and L₂. Push button station 51 may be located at any convenient place such as suggested

in Figs. 1 and 2. Thermostat 50 may be placed anywhere in the room being cooled but is preferably closely associated with the apparatus depicted in the same figures, the whole apparatus thereby being self-contained.

Those versed in the art will appreciate that the push button station 51 may take the form of a rotary type multi-position switch or a combination of a rotary switch and push buttons, the term multi-position switch perhaps being the most accurate generic designation for any combination suggested.

Inviting attention to Fig. 3, the multiple control station 51 includes seven push buttons, in this example, the five top ones of which are interlocked as symbolized by the dashed line 52 and the lower two of which are interlocked as symbolized by numeral 53. The lower two buttons are independent of the others and are marked "T On" and "T Off"; if one is depressed the other will automatically retract. Likewise, among the other group of five, if one is depressed the others retract and if the "Off" button is depressed others in that group clear any electrical connections they may have been accomplishing.

Contacts of the selector station 51 are indicated by the reference numerals 2-6. The contacts may be considered to be of the self-opening spring leaf type adapted to be held closed when any push button is depressed by means of a cross arm such as 54, for example. The contacts are in circuit with other components so that if a cooling cycle is selected, either "Hi Cool" or "Lo Cool" buttons may be depressed for closing contact 2 and energizing the compressor motor 21 from line 2. If "Hi Cool" is depressed, for example, both contacts 2 and 4 close to energize the compressor motor 21 and the high speed winding of fan motor 16. If the "Lo Cool" button is depressed both contacts 2 and 3 close to energize the compressor motor 21 and the low speed winding of fan motor 16. Whether, during a cooling cycle, the fan motor 16 is to stop along with compressor motor 21 when room thermostat 50 opens depends upon which one of the thermostat control circuit contacts 5 or 6 has been closed by depressing either button "T On" or "T Off." This will be more fully explained shortly hereinafter.

If an air recirculating cycle is to be selected, that is, with no cooling, either "Lo Fan" or "Hi Fan" buttons may be depressed for only closing contacts 3 or 4, one at a time, and thereby energizing fan motor 16 at low or high speed without accompanying refrigeration due to inactivity of refrigerator compressor motor 21.

Note that one side of each fan contact 3 and 4 is connected to a common wire 55 which in turn connects to one side of each thermostat contact 5 and 6. When contact 5 is closed, during a circulating cycle, in conjunction with either closing of contacts 3 or 4, the fan motor circuit is completed to line 1 by interposing thermostat 50 in series with the fan through jumper wires 56, 57. This places the fan under automatic control of thermostat 50 during the circulating cycle. However, if contact 6 is closed during a circulating cycle, interlocked contact 5 opens, and the fan circuit is completed directly to line 1 through 6 so that thermostat 50 is by-passed. In this event, fan motor 16 is under manual control because the fan motor may be stopped by pressing the "Off" button and started at will by pressing "T Off" button and "Hi Fan" or "Lo Fan."

During a cooling cycle, thermostat 50 is always in circuit at least with the compressor motor 21 in order to prevent its constant operation when room temperature requirements are met. This can be realized by depressing the "Lo Cool" button, for example, and tracing a circuit from L₂ through compressor motor 21, contact 2, thermostat lead wire 57 and thermostat 50, to L₁. Thus, only opening of room temperature responsive thermostat 50 will stop the compressor motor 21 during a cooling cycle.

According to the invention, however, and for reasons stated very early in this specification, it is also possible to exercise an option of having fan motor 16 stop along with compressor motor 21 or to require the fan motor to run continually though the compressor has stopped. If, during a cooling cycle, it is desired to run the fan motor 16 continually while the compressor has cut out, the operator must depress one "Cool" button and close contact 6 by depressing "T Off". This connects fan motor 16 to L₁ by means of lead 58 directly.

If, during a cooling cycle, it is desired to have the fan motor 16 stop when compressor 21 stops, the operator must depress one "Cool" button and close contact 5 by depressing "T On." This completes the fan motor circuit from common wire 55, through contact 5, jumpers 56, 57, and through thermostat 50 to line 1. Thus, the thermostat interrupts the fan and compressor circuits simultaneously.

Although represented as the bellows type, thermostat 50 may take any form such as the well known bimetal type. Further, conventional elements impressing the thermostat with snap acting properties have been omitted for the sake of brevity.

The invention may be summarized by pointing out that the novel self-contained air conditioner control scheme allows selection of any function that an air conditioner could heretofore accomplish. In addition, the novel control permits the compressor and fan to operate jointly in response to the room thermostat or permits the fan only to be stopped by the thermostat during a cooling cycle. Moreover, during an air circulating cycle, the novel control scheme permits placing the circulating fan under independent manual or thermostatic control.

Although a preferred embodiment of the invention has been described, the disclosure is to be considered illustrative rather than limiting, for the invention may be variously embodied and is to be interpreted in scope according to the claims which follow.

It is claimed:

1. For conditioning the air of a room having a room air conditioner of the window mounted type having an evaporator, condensing unit and prime mover therefor and a room air circulating fan and a motor therefor, thermal responsive electric circuit opening and closing means in heat exchange relation with the air of the room being air conditioned, a first circuit comprising a first manually operable multi-position electric switch adapted to selectively energize said prime mover from a source of electric energy for effecting a room cooling cycle and alternately to energize said fan for effecting a room air circulating cycle while said prime mover is de-energized, and a second circuit comprising a second manually operable multi-position electric switch adapted to energize said prime mover and said fan motor under concurrent control of said thermal responsive means and alternately to energize only said prime mover under control of said thermal responsive means during a cooling cycle, said second circuit and second multi-position switch also being adapted to selectively energize said fan under control of said thermal responsive means during a room air circulating cycle.

2. For conditioning the air of a room having a room air conditioner of the window mounted type having an evaporator, condensing unit and prime mover therefor and a room air circulating fan and a motor therefor, thermal responsive electric circuit opening and closing means in heat exchange relation with the air of the room being air conditioned, a first circuit comprising a first manually operable multi-position electric switch connected to selectively energize said prime mover from a source of electric energy for effecting a room cooling cycle, and a second circuit comprising a second manually operable multi-position switch connected to selectively energize said circulating fan motor under independent control of said thermal responsive means when said prime mover is de-energized and alternately energize said circulating fan motor under dependent control of said second switch when said prime mover is de-energized.

3. For conditioning the air of a room having a room air conditioner of the window mounted type having an evaporator, condensing unit and an electrical prime mover therefor and a fan for circulating cooled air into the room and a motor therefor, thermal responsive electric circuit opening and closing means exposed to room air temperature, a first circuit comprising a first manually operable multi-position switch adapted to connect said prime mover and said fan motor to a source of electric energy to effect a room cooling cycle when in one switch position and adapted to alternately connect independent of said prime mover said fan motor to said source of energy when in another switch position to effect an air circulating cycle, a second circuit comprising a second manually operable multi-position switch mechanically independent of said first switch adapted for connecting said source of electric energy with said thermal responsive means in series circuit with said fan motor and said prime mover when said first switch is positioned for effecting a cooling cycle whereby both said fan and said prime mover are de-energized when said thermal responsive means attains a predetermined temperature during said cooling cycle, said second circuit and said second switch being adapted for connecting said thermal responsive means in series relation with said prime mover and said source of electric energy when said second switch is in an alternate position during a cooling cycle, and said second circuit and second switch being adapted to connect said thermal responsive means in series relation with said fan motor and said source of electric energy during an air circulating cycle whereby said fan motor may be controlled independently of said prime mover.

References Cited in the file of this patent

UNITED STATES PATENTS

969,781	Geissinger	Sept. 13, 1910
2,140,305	Ashley	Dec. 13, 1938
2,516,093	Ruff	July 18, 1950
2,778,197	Legeza	Jan. 22, 1957
2,840,667	Atchison	June 24, 1958