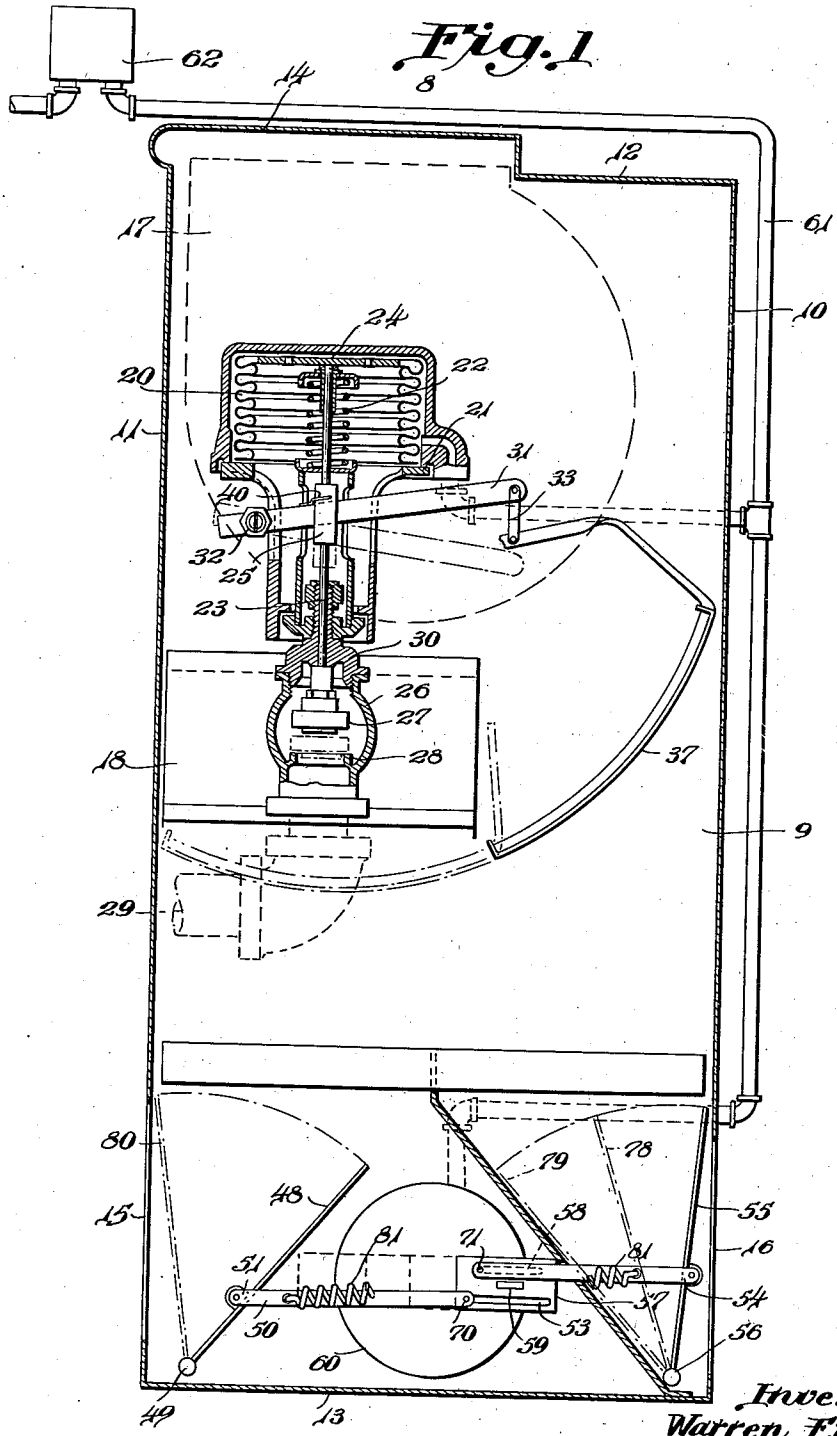
Oct. 1, 1940. W. EWALD 2,216,551

AIR CONDITIONING APPARATUS

Filed July 23, 1938 2 Sheets-Sheet 1

Fig. 1



Inventor
Warren Ewald
by Arthur D. Holmes
Atty

Oct. 1, 1940. W. EWALD 2,216,551

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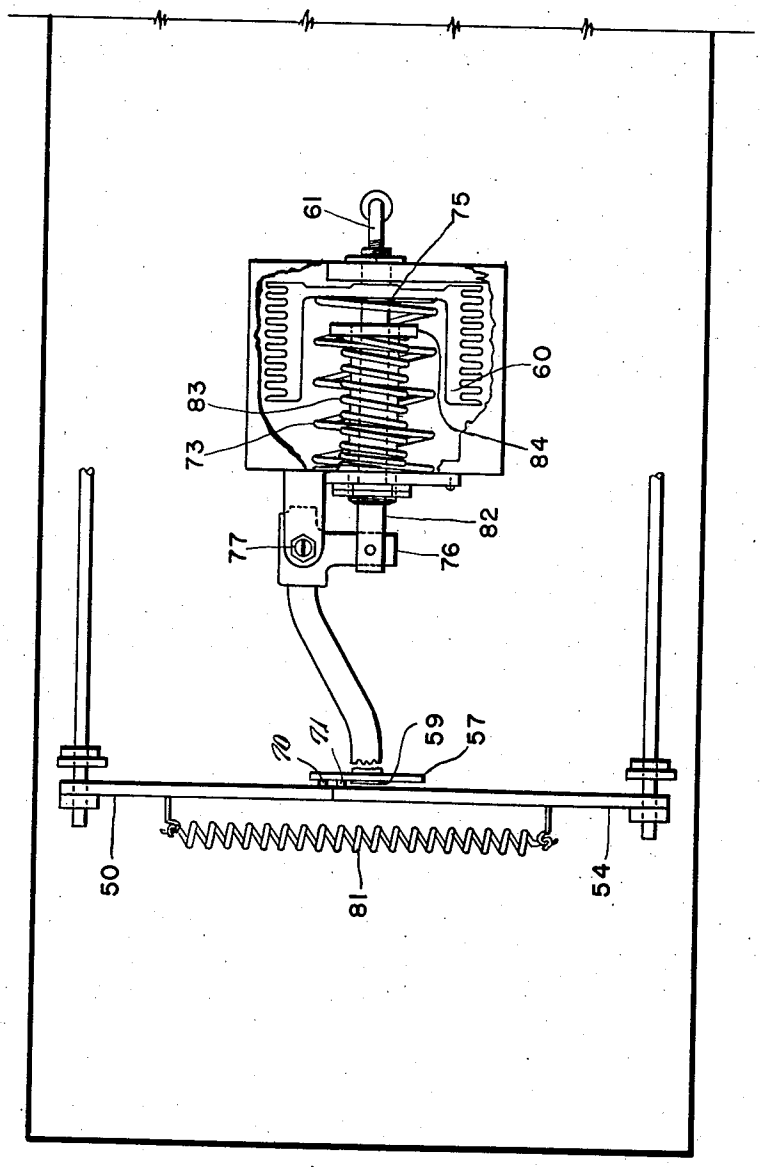


Fig. 2

INVENTOR
Warren Ewald
BY
Arthur Kobelius
ATTORNEY

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UNITED STATES PATENT OFFICE

2,216,551

AIR CONDITIONING APPARATUS

Warren Ewald, La Crosse, Wis.

Application July 23, 1938, Serial No. 220,926

3 Claims. (Cl. 236—38)

One of the objects of my invention is to provide a unit ventilator which will produce a method of heating an enclosure whereby at a pre-determined temperature a pre-determined amount of cold air will be admitted, whereby at a predetermined higher temperature the damper controlling the flow of air through the radiator will close and the damper controlling the flow of air through the bypass will open, and whereby when the damper controlling the flow of air through the radiator is closed that the steam valve will then close, and whereby at a higher pre-determined temperature an additional definite amount of outside air will be introduced and the recirculated air cut off.

Another object of my invention is an apparatus which will accomplish the above sequence with a minimum of working parts.

Another object of my invention is to provide a mechanism which will operate according to the above sequence.

The foregoing and many other specific features of my invention are set forth in the following specification, where I describe what I consider the preferred embodiments of my invention. These are illustrated in the accompanying drawings where—

Figure 1 represents a cross-sectional view of the unit ventilator.

Figure 2 shows a cross-sectional view of the bellows 60 and associated mechanism.

Referring to Figures 1 and 2, the unit ventilator has side walls 10 and 11, top wall 12, bottom wall 13, and an outlet 14 with a fresh air inlet 16 and a recirculated air inlet 15. Air is drawn through the radiator 18 and the bypass 9 by means of the fan 17. A metal bellows 20 is actuated by air pressure in the pipe 61, responsive to the temperature of the room 8. The upper portion of the bellows is free to move and is fixedly fastened at 21. 22 represents a spring tending to resist the movement of the bellows. A valve stem 23 is secured to the top wall 24 of the bellows 20. A yoke 25 in the stem 23 is of sufficient length so that the movement of the valve stem 23 will actuate the lever 31 but have no effect upon the steam passing through the valve until after the lever 31 has completed its full movement. A valve 26 controls the flow of steam to the radiator 18 by means of a valve throttle 27 and a valve seat 28.

Figure 29 represents a steam inlet to the valve 26 and figure 30 represents a valve bonnet through which the stem 23 moves. The lever 31 passes through the yoke 25 and is actuated upwards by the bottom of the yoke 25 so that the movement upward of the stem 23 will raise the damper and open the radiator passage. With a downward movement of the stem 23 the damper will lower due to gravity and completely close the radiator passage before the valve throttle 27 closes sufficiently to shut off the steam, at which time the upper portion of the yoke 25 will be in contact with the lever 31. To insure closure of the radiator passage, a spring 40 may be affixed to the top of the lever 31 so that the top of the yoke 25 will press upon the spring, complete the movement of the damper and then close the valve.

The lever 31 is pivotally secured at 32 and is connected by the link 33 with the arcuate damper 37, the black lines showing the damper closing the bypass and opening the passage through the radiator, while the dotted lines show the position of the damper when the lever 31 is depressed, opening the bypass and closing the radiator passage. While the bypass opening is of smaller width than the radiator passage, the damper because of its arcuate form is able during its entire movement to fully close either of said passage-ways and also to partially close either of said passage-ways. Thus, with a downward movement of the lever 31, the radiator passage is closed, the bypass is open, and with an upward movement of the lever 31 the movement of the damper 37 is reversed. The movement of the lever 31 occurs only when the throttle 27 is completely off its seat so that the steam supply is not throttled or closed during the movement of the damper 37. The steam supply is not affected until the damper 37 is entirely closed. Upon this happening, the movement of the valve stem 23 will operate to close the valve and entirely shut off the steam.

Thus, by action of the single motor bellows the air going through the radiator is regulated and the air going through the bypass is regulated, and when this has been accomplished the steam is shut off. It is also obvious that on the reverse cycle the steam valve will be entirely open before the damper 37 will start to operate. The regulation of the ingress of indoor and outdoor air is regulated by a mechanism contained in the bottom of the unit. The recirculated air inlet 15 is controlled by a damper 48 pivotally secured at 49 and actuated by the rod 50, pivotally secured to the damper at 51. The free end of the lever 50 slides in a slot 53 of the movable plate 57. A fresh air inlet 16 is controlled by damper 55 actuated by the rod 54, pivotally secured thereto at

56. The free end of rod 50 terminates in a pin 70 riding in slot 53 of movable plate 57, affixed to the operating arm 59 of the pneumatic bellows operator 60. Likewise, the free end of rod 54 terminates in a pin 71 riding in slot 58 of the same movable plate 57. Tension spring 81 connects rod 50 and rod 54 tending to pull both dampers toward one another, which tendency is limited by the pins 70 and 71 at certain times in contact with the ends of the slots 53 and 58, and at other times by the dampers contacting immovable stops at their extreme open positions.

The plate 57 moves horizontally and when at the extreme end of its stroke toward fresh air opening 16, the end of the slot 58 forces pin 71 in this same direction and through rod 54 moves damper 55 to a position fully closing fresh air inlet 16. Upon movement of plate 57 away from inlet 16, the pin 71 is held in contact with this same end of slot 58 by tension of spring 81, and the damper is thereby caused to assume a partly open position (position 78), and upon further movement of plate 57 a fully open position (position 79). During the aforesaid movement of plate 57, spring 81 tends to hold damper 48 immovably at its extreme open position, and slot 53 permits plate 57 to move by pin 70 without causing movement of said pin 70. Upon further movement of plate 57 away from inlet 16, damper 55 remains stationary at position 79 with pin 71 sliding in slot 58, while the end of slot 53 contacts pin 70 and forces rod 50 and, thereby damper 48, to progressively close recirculation inlet 15. Upon a reversal of direction of plate 57, the cycle of damper movement will likewise be reversed. It is to be understood from the above that these dampers are caused to move in sequence and never simultaneously.

Bellows 60, which operates by the same method as the bellows 20, is actuated by the air supply in the common supply pipe 61, which is responsive to the room thermostat 62. The spring 73 in the bellows 60 is of pre-determined strength so that the bellows will operate at a different air pressure than the bellows 20. The movement of the bellows 60 will actuate the stem 82 secured to the bellows at 75 and will move the arm 76, which rocks on the pivot 77, thus causing the movement of the plate 57. For example, when the temperature of the room is 68° or below, there will be 0# of pressure in the line 61 and all of the controls will be in the position as shown in black on Figure 1. From 68 to 69° the thermostat will build up a pressure in the line 61 from 0 to 3#, which will be sufficient to move the bellows 60 and open the fresh air damper a predetermined minimum, as shown by the dotted line 78. From 69 to 70½° the thermostat will build up a pressure in the line 61 of 3 to 8#, during which the damper 37 completely closes the radiator passage and will completely open the bypass 9. At 8# pressure the valve throttle 27 will completely seat. When the temperature around the thermostat rises from 70½° to 71°, the pressure will increase in the pipe 61 from 8 to 10#, which will cause the bellows 60 to further operate and by moving the plate 57 cause the damper 55 to further open to fresh air to the position shown by the dotted line 79. When the temperature surrounding the thermostat increases from 71 to 71½°, the pressure will be built up in the pipe 61 from 10 to 13#, which will cause the bellows 60 to move further and by moving the plate 57 close the recirculated damper 48 to the position shown by the dotted line 80.

Referring to Figure 2, this represents a means of operating the fresh air intake damper and the recirculating air intake damper in accordance with the cycle previously described. Rod 50 operates the recirculating air damper through attached shaft. Rod 54 operates the fresh air damper. Plate or arm 59, which is attached to plate 57, is immovably secured to the arm 76, pivoted at 77, operated by piston 82. The piston 82 is secured to the inner movable surface of bellows 60. When the interior of bellows 60 is subjected to varying amounts of air pressure through tube 61 from the room thermostat, bellows 60 will expand moving piston 82 against the resistance, first, of compression spring 73 and finally against the combined resistance of spring 73 plus spring 83. Spring 73 is a comparatively light spring having an initial compression, such that the bellows and piston will start to move at approximately 1# air pressure within the bellows. During 1# and 3# air pressure, the bellows and piston will move to a position where contact with sleeve 84 interrupts this motion.

During this movement the fresh air damper will open to the pre-determined position to admit the minimum desired quantity of fresh air. During this movement also, due to the slot in plate 57, the recirculated air damper does not move.

Compression spring 83 has an initial compression, such that it will hold the bellows and piston immovably between air pressures 3# to 9#. After the air pressure within the bellows 60 has attained 9#, the bellows and piston again start to move against the combined resistance of spring 73 and 83 and will move to their extreme position at approximately 13# air pressure. During this movement the fresh air damper will be progressively opened to its extreme position, and in subsequent order the recirculation air damper will be progressively closed. It is to be understood that the air pressure in 60 varies in accordance with the temperature of the room surrounding the thermostat which supplies and controls the air pressure to the bellows 60. Normally this temperature and, therefore, the air pressure will find some intermediate value for any given set of conditions and the dampers will consequently be forced to assume a resulting intermediate stationary position.

To further explain the manner in which the two intake dampers function mechanically with slotted plate 57, it should be understood that initially during the heating up period in the morning that the fresh air damper will be in the completely closed position and the recirculating damper in a completely open position. At this initial stage of the cycle, plate 57 is at an extreme position in the direction toward the fresh air damper. The terminal pin of link 54 is at the extreme position in its guiding slot of plate 57 away from the fresh air damper and is held in this position by the pull of tension spring 81. At this same stage, the terminal pin or link 70 is in the extreme position in its guiding slot of plate 57, also away from the fresh air damper. The tension spring 81 would tend to move pin 70 within the slot of plate 57 but such movement is prevented by a mechanical stop at the extreme position which the recirculating intake damper can assume.

When the plate 57 moves in a direction away from the fresh air damper to the aforementioned minimum fresh air position, link 54 and the fresh air intake damper likewise will move pulled by tension spring 81 and with the terminal pin of

link 54 at the original position relative to plate 57. During this movement the recirculating air damper and pin 70 will remain stationary with the terminal pin 70 moving in the slot of plate 57.

When the plate 57 again resumes movement in accordance with the higher air pressure in the bellows, then the fresh air damper and link 54 move in accordance therewith until the damper contacts a mechanical stop at its extreme open position. When this occurs and upon further movement of plate 57, the terminal pin of link 54 commences to move within the slot of plate 57 against the tension of spring 81. At this position where the fresh air damper has attained its extreme open position, the terminal pin 70 reaches the end of its slot in plate 57. Pin 70 is then forced to move toward the recirculating air damper, moving this recirculated air damper thereafter in direct accord with the movement of plate 57 against the tension of spring 81. At the extreme position of plate 57 the recirculating air damper will be entirely closed.

While I have described the foregoing preferred embodiments of my invention, I contemplate that many changes may be made without departing from the scope or spirit of my invention.

I claim:

1. In an apparatus for conditioning the air in a room, the combination of a casing with a fresh air inlet, a recirculated air inlet, an air outlet, a radiator, a fan moving air from said inlets to the outlet through said radiator, dampers for controlling said fresh air and recirculated air inlets, means interconnecting said dampers for their sequential operation, an air actuated motor operating through said damper operating means at a pre-determined room temperature to open the fresh air inlet a pre-determined amount and at a pre-determined higher temperature to open the fresh air inlet a further pre-determined amount, and at a further pre-determined higher temperature to close the recirculated air inlet.

2. In an apparatus for conditioning the air in a room, a casing having fresh air and recirculated air inlets and an air outlet, a radiator so mounted within the casing as to provide a by-pass passage communicating with the outlet, a room thermostat, an air motor responsive to said thermostat, a damper connected to said air motor to control the flow of air through said radiator and by-pass, a valve to control said radiator, and actuating means for closing said valve when said damper is in position to cut off the flow of air through said radiator and opening it when said damper closes the by-pass, a second air motor under influence of said thermostat, a pair of dampers controlling said fresh air and recirculated air inlets, respectively, linkage interconnecting said pair of dampers and second air motor to permit of their sequential operation in opening the air passages, said air motors being also adjusted for sequential operation under the influence of said thermostat, whereby as the temperature rises above a predetermined point the radiator heat output is progressively decreased until entirely cut off by closing of said valve and opening of the by-pass, following which the fresh air inlet is progressively opened and, in sequence, the recirculated air inlet is closed.

3. In an apparatus for conditioning the air in a room, a casing having a radiator so mounted within it as to provide a by-pass passage thereabout, a damper movable to control the flow of air through said radiator and by-pass, a valve through which heat exchange medium is supplied to said radiator, a thermostatically responsive motor connected to said damper and valve, acting under the influence of room temperature to close said valve when said damper is in position to cut off flow of air through said radiator, a pair of dampers for controlling fresh air and recirculated air inlets, respectively, in said casing, linkage connecting said dampers for sequential operation, a second thermostatically responsive motor also under the influence of room temperature operating said pair of dampers through said linkage, whereupon as the temperature rises from a predetermined minimum the flow of air through the radiator is reduced and the by-pass opens, the valve supplying heat to the radiator is then shut off, more outside air is next admitted by operation of the damper controlling the fresh air inlet, and finally the damper controlling the recirculated air inlet is closed, and upon a drop in room temperature the sequence of operations is reversed.

WARREN EWALD.