July 30, 1940. M. C. TERRY 2,209,800

AIR CONDITIONING APPARATUS

Filed Oct. 21, 1937 3 Sheets-Sheet 1

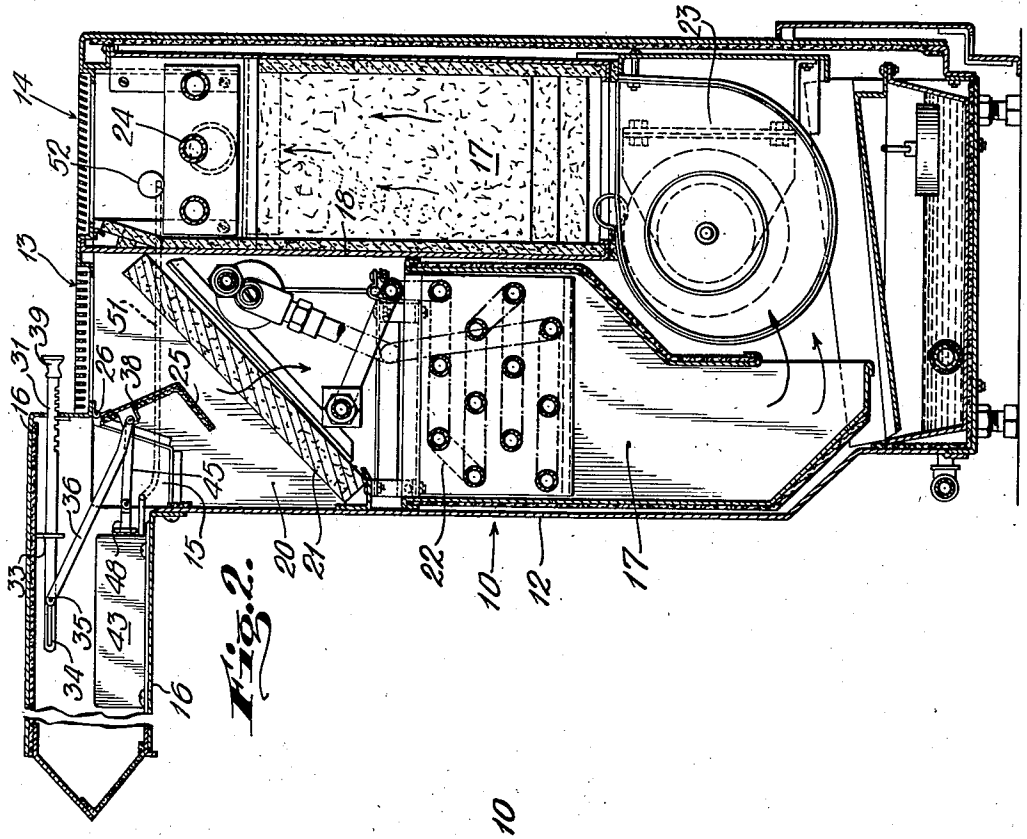


Fig. 2.

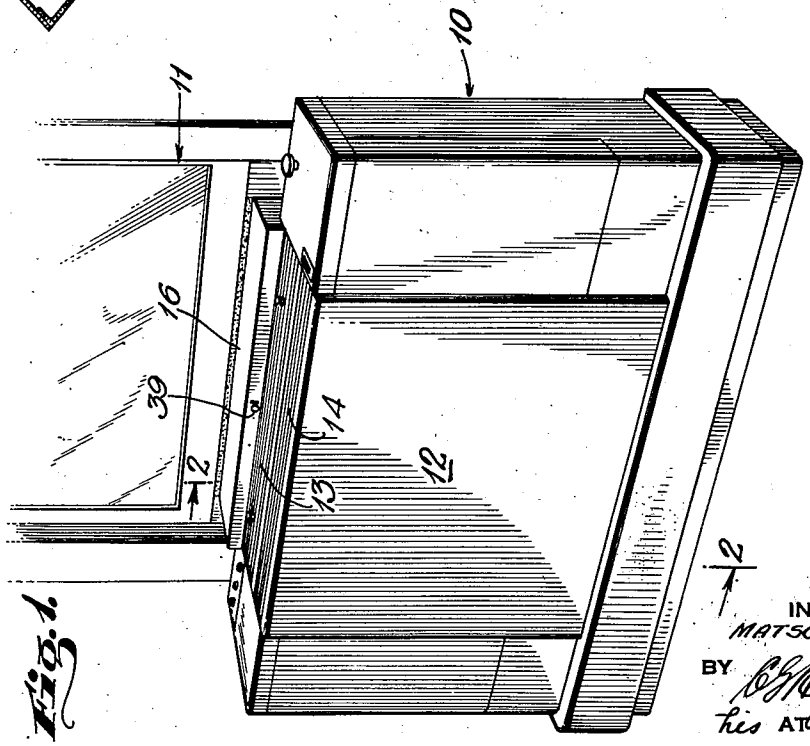


Fig. 1.

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Fig. 3.

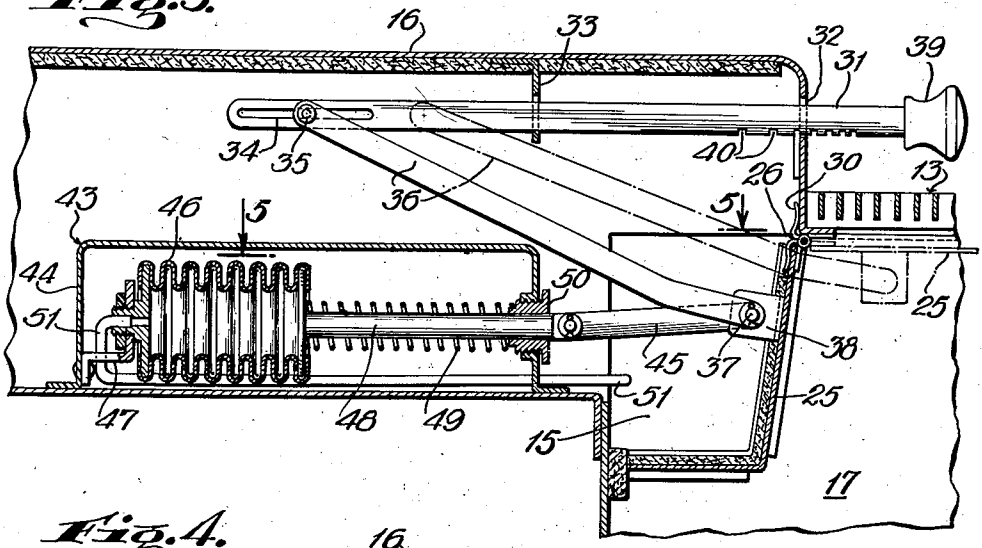


Fig. 4.

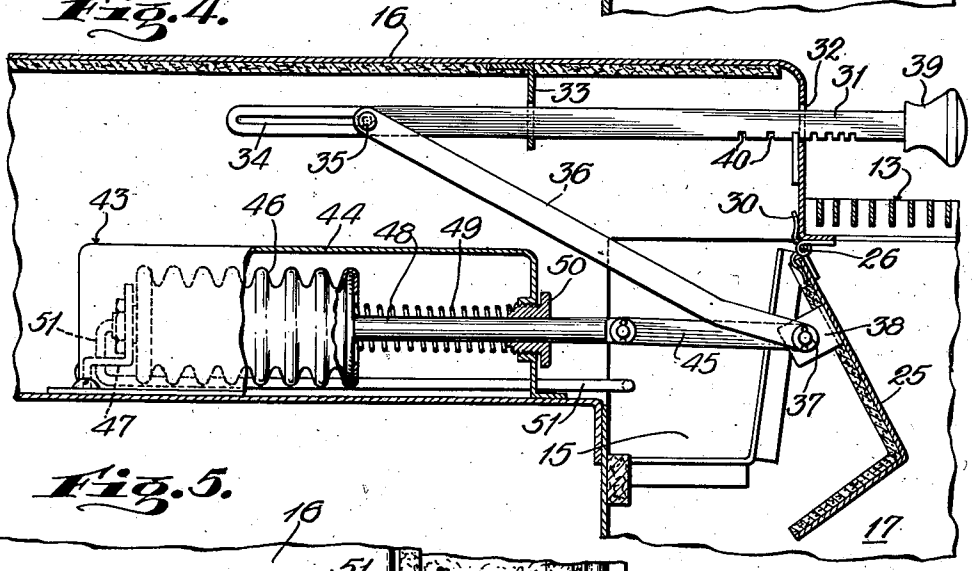
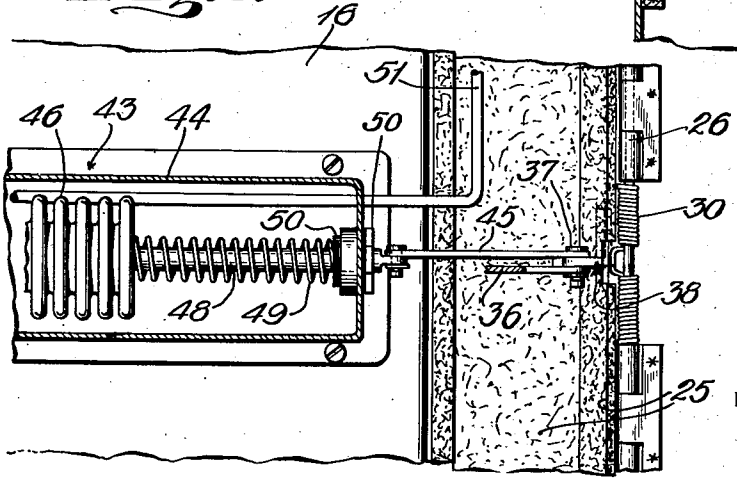


Fig. 5.



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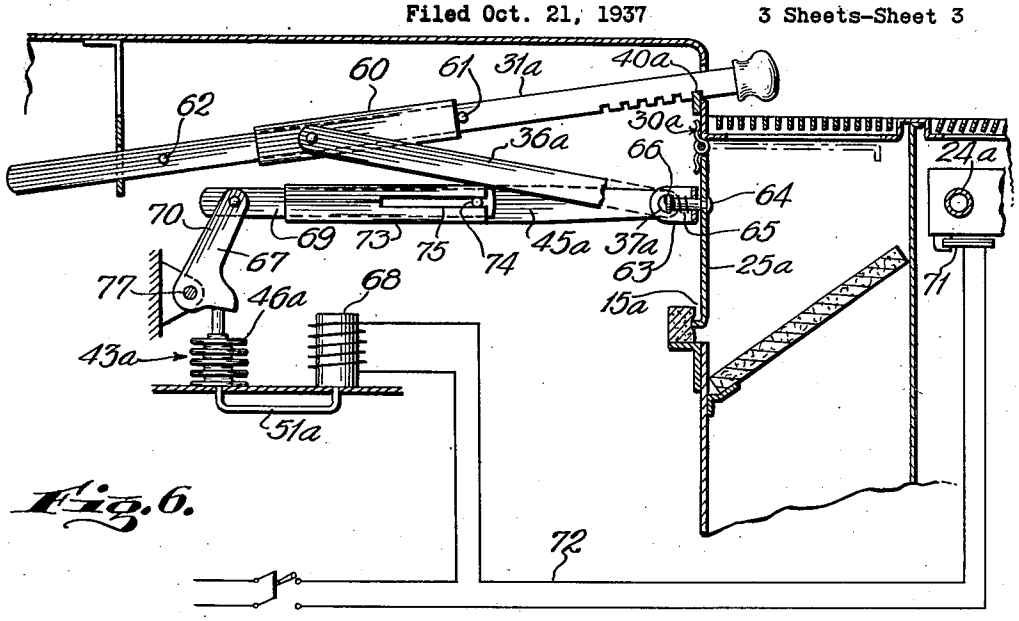


Fig. 6.

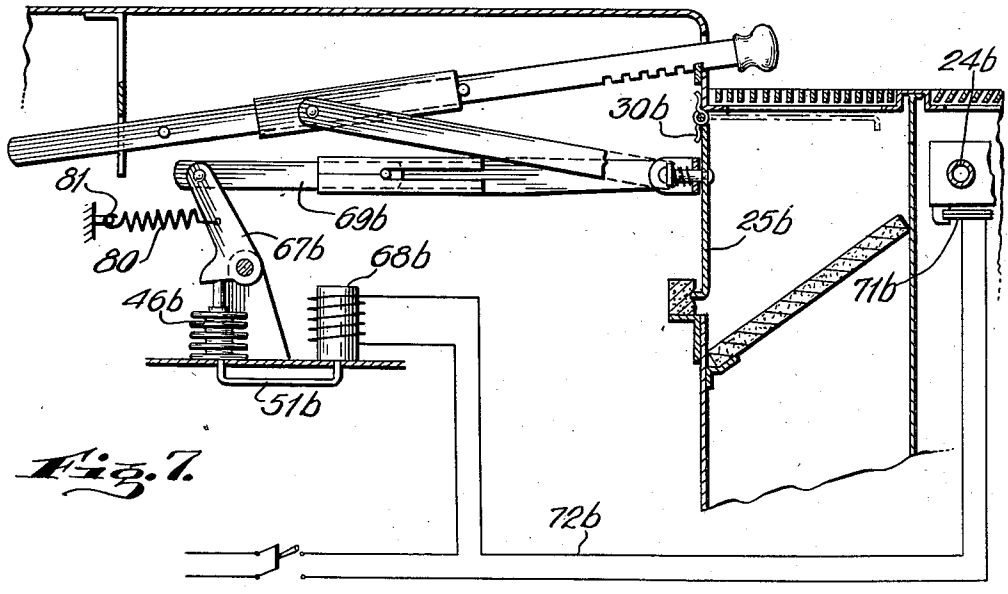


Fig. 7.

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UNITED STATES PATENT OFFICE

2,209,800

AIR CONDITIONING APPARATUS

Matson C. Terry, New Rochelle, N. Y., assignor, by mesne assignments, to American Radiator & Standard Sanitary Corporation, New York, N. Y., a corporation of Delaware

Application October 21, 1937, Serial No. 170,159

9 Claims. (Cl. 98—38)

My invention relates to air conditioning apparatus, and more particularly to mechanism for regulating the amount of outside air flowing into a room space in accordance with the requirements of the room space and in accordance with the operation of a conditioning means.

An object of this invention is to provide apparatus of this type which may be readily adjusted by hand to regulate accurately the desired amount of outside air introduced into the room space; and which, when the conditioning means is inoperative from any cause, will operate to prevent further introduction of outside air into the room.

A further object is to provide apparatus of the above type which is of improved construction and arrangement of parts.

The invention consists in the novel construction and combination of parts, to be more fully described hereinafter, and the novelty of which will be particularly pointed out and distinctly claimed.

In the accompanying drawings, to be taken as a part of this specification, I have fully and clearly illustrated a preferred embodiment of my invention, in which drawings—

Fig. 1 is a perspective view of air conditioning apparatus of the room-unit type, in which my improvement is embodied, and showing the unit as installed adjacent a window and having an outside duct connection extending between the sill and the lower sash rail of the window;

Fig. 2 is a vertical transverse sectional view taken on the line 2—2 of Fig. 1, and showing the construction on an enlarged scale;

Fig. 3 is a fragmentary sectional view taken on the same plane as Fig. 2 and showing a further enlargement of details of my improvement;

Fig. 4 is a view similar to Fig. 3 and showing the outside air damper as being open to a position preselected by the hand adjustment;

Fig. 5 is a fragmentary plan section taken on the line 5—5 of Fig. 3;

Fig. 6 is a view somewhat similar to Fig. 3 and showing a modified form of apparatus, certain elements of the apparatus being shown more or less diagrammatically; and

Fig. 7 is a view similar to Fig. 6 and illustrating a further modified form of my improvement.

Referring now in detail to the construction illustrated, and more particularly to the modification shown in Figs. 1 to 5 inclusive, the reference numeral 10 indicates an air conditioning unit which is adapted to be arranged adjacent a window 11 in a room. The unit 10 is of the same general type as is disclosed and claimed in the copending application of Lambert et al., Serial No. 118,462, filed December 31, 1936.

The unit 10 comprises a casing 12 having a room air inlet 13 in the top wall and at the rear thereof, and a room air outlet 14 in the top wall and at the front thereof. The casing 12 is also provided with an inlet opening 15 which communicates with one open end of a window duct 16, the latter extending rearwardly and through the opening defined by the partially opened window 11.

The interior of the casing 12 is provided with a U-shaped passage 17 communicating at one end with the inlet openings 13 and 15 and at the other end with the room air outlet opening 14. The passage 17 is defined by the outer walls of the casing and by a substantially vertical partition means 18 depending from the top wall of the casing 12 between the inlet and outlet openings 13 and 14. The U-shaped passage 17 may be considered as a part of a main air passage 20 connecting the outside atmosphere with the room space, the duct 16 being the other part of said passage 20.

Arranged within the U-shaped passage 17 and at the upper inlet end thereof, is a suitable filter 21 which functions to separate solid particles, such as dust and pollen, from the entering air. Arranged below the filter is a suitable cooling element, here shown to be in the form of a conventional type of coil 22, through which a suitable refrigerant fluid is adapted to be circulated in the summer season, and which operates to lower the temperature and remove moisture from the air as it flows over the exterior surfaces thereof and through the passage 17.

At the lower end of the U-shaped passage 17 is arranged a motor-driven blower 23 which provides for the positive flow of air through the passage 17 and into the room through the outlet opening 14. Arranged in the upper and outlet end of the U-shaped passage 17 is a heating element, shown as a conventional type of heating coil 24, through which a heating fluid, such, for example, as steam or hot water, may be circulated for the purpose of increasing the temperature of the air flowing through the passage during the winter or colder months of the year.

At the upper inlet end of the U-shaped passage 17 and between the inlet opening 13 and inlet opening 15, is arranged a damper 25 which in the unit shown functions to regulate the amounts of outdoor air flowing into the passage 17 through the inlet opening 15 and room air flowing

through the inlet opening 13. The damper 25 is pivotally supported along its upper edge as indicated at 26, and is movable about its support between two extreme positions, one of which is the position shown in full lines in Fig. 3, and the other of which is the position shown in dot-and-dash lines in Fig. 3. In the full-line position, the outdoor inlet 15 is closed and the room air inlet 13 is full open, and all of the air entering the passage 17 will be air from the room through the inlet 13. In the position shown in dot-and-dash lines, the outdoor air inlet 15 is fully open and the room air inlet 13 is closed, and practically all of the air entering the passage 17 will be outdoor air through the duct 16 and inlet 15. The damper 25 may also be placed at any desired mid position, for example the full-line position in Figs. 2 and 4, for the purpose of proportioning the amounts of room and fresh air entering the passage 17.

In accordance with the present invention, I provide a manually operated means which functions to position the damper 25 at either of its extreme positions or at any selected mid position, so that the damper will admit to the passage 17 any desired amount of outdoor air or room air or any desired proportions of outdoor and room air. To this end, a means is provided which constantly urges the damper toward the extreme position to admit all outdoor air into the passage 17; and a hand-adjustable stop device is provided which limits movement of the damper by the urging means to any desired point.

This urging means is here shown as being in the form of a conventional coil spring 30 surrounding the hinge pin forming a part of the pivotal support 26 of the damper. The stop or limiting device is here shown as being a longitudinally movable pull-rod 31 which extends through an elongated opening 32 in the upper front part of the duct 16 and is slidably supported at its rear by a suitable bracket 33. The extreme rear part of the rod 31 is provided with a slot 34 which receives a pin 35 carried by one end of a link 36. The other end of the link 36 is connected to the damper 25 by means of a pin 37 extending through a bracket 38, the latter being suitably secured, as by spot welding, to the damper 25. The forward end of the longitudinally adjustable rod 31 is provided with a knob 39 which may be grasped by the hand for moving the rod, and the lower surface of the forward end of the rod 31 is provided with a plurality of spaced notches 40, each of which is adapted to receive the lower defining wall of the opening 32 and hold the rod 31 at any desired adjusted position.

From the above, it will be apparent that as the spring 30 at all times urges the damper 25 in a position to open the inlet 15, the pin 35 will engage the right-hand end of the slot 34, and any longitudinal movement of the rod 31 inward or outward will result in the damper 25 being moved to any position preselected by the operator.

In accordance with the present invention, I also provide a mechanism, indicated in general by the reference character 43, which is responsive to an operating characteristic of an air conditioning element of the unit 10 and operates to close the outdoor air inlet 15 upon a failure in operation of the conditioning element, and to permit the opening of the damper 25 to a position preselected by the operator when such conditioning element is in operation. In the construction shown, I have elected to show the mechanism 43 as acting in response to temperature changes in the heating coil 24.

The mechanism 43 is here shown to be enclosed within a housing 44 which is suitably secured to the bottom wall of the duct 16, and the mechanism 43 is connected to the damper 25 by a suitable link 45 connected at one end to the pin 37. The mechanism 43 comprises an expansible-contractible metallic bellows element 46 anchored at one end to the housing 44 by a suitable bracket 47, and having a rod 48 connecting the other and movable end of the bellows with the link 45. Opposing the bellows 46 is a coil compression spring 49 which encircles the rod 48 and abuts at one end the movable end of the bellows 46 and at the other end an adjustable stop 50 carried by an end wall of the housing 44. The interior space of the bellows 46 is connected by means of a tube 51 with a thermostatic bulb element 52 suitably disposed above the heating coil 24 and in the passage 17 and subject to the temperature of the air flowing from said coil (see Fig. 2). The element 52, tube 51, and bellows 43, are adapted to be charged with any suitable volatile fluid, such, for example, as acetone, alcohol, or the like.

The operation of the mechanism 43 is as follows: When a heating fluid is supplied to the coil 24, the heat transmitted to the bulb element 52 increases the vapor pressure within the bulb, and this increased pressure is transmitted through the tube 51 to the bellows 43, the free end of which moves to the right as viewed in Figs. 3, 4 and 5. This movement is assisted by the spring 30. Such movement will result in the spring 49 being compressed and the damper 25 being moved to the position preselected by the position of the rod 31. If the rod 31 is in the position to close inlet 15, the damper 25 will remain in such position. Should the supply of heating fluid be shut off from the heating coil 24 for any reason, the vapor in the element 52 will condense, and as a result the coil spring 49 will move the bellows to the left as viewed in Figs. 2, 3 and 4, and thereby close the damper 25 against the force of the spring 30. The closed position of the damper is shown in Fig. 3.

The damper control apparatus heretofore described is particularly advantageous in air conditioning units of the type disclosed. For example, should the heating element fail during the colder season of the year, the damper 25 will always automatically close the inlet 15 and prevent the flow of cold outside air into the unit. Under such conditions, the cold air flowing into the unit would create cold drafts in the room. Furthermore, uncontrolled introduction of cold air might also damage the unit, due to the freezing of water in the heating coil 24, or similar damage to any other elements of the unit containing water. This feature is particularly useful, because of the fact that the supply of heating fluid to a building is usually shut off during the night time when the occupant is either asleep or out of the building.

One of the particular advantages of the construction thus far described, is that the mechanism 43 only prevents positive movement of the damper by means of the rod 31 when there is no heating fluid in the coil 24 and the spring 49 is holding the damper in the extreme position where it closes the inlet 15. However, even in this position of the damper, the adjustment of

the rod 31 may be readily changed due to the slot 34 and pin 35; and, when heat is again supplied to the coil 24, the damper 25 will open to the new position selected by the operator. With heating fluid in the coil 24, the position of the damper may be readily changed to any desired point by simply lifting the rod 31 so that the particular notch 40 which is in engagement with the bottom of the slot 32 is disengaged, and then moving the rod 31 in or out to any position desired by the operator. When there is heat in the coil, inward movement of the rod will be against the force exerted by the vapor pressure in the bellows 46 and the force of the spring 30, and outward movement of the rod will be in the same direction as the force exerted by the vapor pressure and the spring 30. As the force of the spring 49 partially balances the force exerted by the vapor pressure in the bellows 46 and the force of the spring 30, the inward manual movement of the rod will produce no difficulty. As the fluid in the bellows 46 when expanding and the spring 30 exert a stronger force than the spring 49, the damper will readily follow any outward movement of the rod 31.

The modified construction shown in Fig. 6 performs the same useful functions as the apparatus previously described. In Fig. 6 the connection between the rod 31*a* and the damper 25*a* is slightly different, and the construction and operation of the mechanism 43*a* are also different.

The damper 25*a* is connected to the rod 31*a* by a link 36*a*, one end of which is connected to a sleeve 60 encircling the rod 31*a* and slidable between pins 61 and 62 fixed to the rod 31*a*. The link 36*a* is connected at its other end to a pin 37*a* carried by a U-shaped member 63, and the latter is connected to the damper 25*a* by a pin 64 and compression spring 65. The pin 64 is fixed at one end to the damper 25*a* and extends loosely through an opening in the member 63. The compression spring 65 encircles the pin 64 and abuts at one end a washer 66 on the outer end of the pin 64 and at the other end the member 63. The member 63, pin 64 and spring 65 provide a lost-motion connection between the link 36*a* and the damper 25*a* with the spring tending to take up the lost motion. This connection permits the rod 31*a* to be moved inwardly against the force of the spring 65 after the damper is closed. On account of this, extreme accuracy in the design of the parts is not necessary, as the forward notch 40*a* can be placed at any place within the length of travel of the spring 65 and the damper can be closed and held closed by the spring 65.

The mechanism 43*a* comprises a bell crank lever 67, an expansible bellows 46*a*, an electric heating element 68, links 69 and 45*a* connecting the outer end of one arm 70 of the lever 67 with the pin 37*a* of the member 63, a contact thermostat 71 and an electrical circuit indicated at 72. The link 69 slidably fits within a sleeve portion 73 formed on the adjacent end of the link 45*a*, and a pin 74 carried by the end of the link 69 slides within a slot 75 formed in the portion 73. When the supply of heating fluid to the coil 24*a* is shut off, the thermostat 71 acts to close the electrical circuit 72 and energize the heating element 68 and thereby expand the fluid in the element 68, the connecting tube 51*a* and bellows 46*a*. Expansion of the bellows results in movement of the lever 67 counterclockwise about a fixed pivotal support indicated at 77, and the movement of the pin 74 to the left-hand end of the slot 75. With the rod 31*a* and damper 25*a* in the position to close the inlet 15*a*, shown in Fig. 6, the damper 25*a* will merely be held closed by the mechanism 43*a*. Were the rod 31*a* adjusted so that the damper 25*a* would be in a preselected open position, the expanding of the bellows in the manner just described would result in the pin 74 engaging the end of the slot 75 and pulling the link 45*a* and damper 25*a* to the left and thereby closing the inlet 15*a*. With the parts in the latter position, when heating fluid is again supplied to the coil 24*a*, the thermostat 71 will open the circuit 72 and thereby allow the vapor in the element 68 to condense, and the spring 30*a* on the damper hinge pin will move the damper to the position preselected by the rod 31*a*.

From the above, it will be apparent that the operation of the construction shown in Fig. 6 is substantially the same as that of the previously described construction. It will be observed, however, that due to the pin and slot connection between the links 69 and 45*a*, the damper 25*a* may be closed at any time by the rod 31*a* without compressing the bellows 46. The latter might be considered as being an advantage over the construction previously described.

The construction shown in Fig. 7 of the drawings is somewhat the same as that shown in Fig. 6, with the exception that in Fig. 7 the position of the lever 67*b* is reversed, and the damper 25*b* is closed due to the action of a tension spring 80 instead of the bellows 46*b*. The spring 80 is anchored at one end, as indicated at 81, and is connected at its other end to the lever 67*b*. The spring 80 is stronger than the spring 30*b*, and hence the damper 25*b* will be closed when the fluid in the bellows 46*b* is contracted. In the latter respect, the operation of Fig. 7 is similar to that of Figs. 1 to 5 inclusive. In Fig. 7, when a heating fluid is supplied to the coil 24*b*, the circuit 72*b* is closed by the thermostat 71*b* and the fluid in the element 68*b*, tube 51*b* and bellows 46*b* is expanded, with the result that the lever 67*b* will be moved clockwise and the link 69*b* to the right, thereby permitting the spring 30*b* to open the damper 25*b* to the position preselected by the rod 31*b*. When the supply of heating fluid is cut off from the coil 24*b*, the circuit 72*b* is broken, and the fluid in the element 68*b* will condense and thereby permit the spring 80 to move the lever 69*b* to the position shown in the drawings, which is the closed position of the damper 25*b*. The construction shown in Fig. 7 has the advantage over the construction shown in Fig. 6, in that it is not necessary to depend on the continuous flow of electricity in the circuit 72*b* to keep the damper closed; and, therefore, in case of failure of the current supply, the damper will automatically close. Also, in Fig. 7, the damper 25*b* may be adjusted when heat is supplied to the coil 24*b* without having to compress the bellows 46*b*.

In each of the modifications described above, there is shown a mechanism which will close the damper when the conditioning element fails to operate, and which will permit the damper to be opened when the conditioning element is operating. Also, there is shown a manually adjustable means for positioning the damper at any preselected point so as to admit any desired amount of outdoor air or proportions of outdoor air and room air into the passage 17.

What I claim and desire to secure by Letters Patent of the United States is:

1. Air conditioning apparatus for room spaces

comprising means defining an air passage adapted to communicate at one end with the outdoor atmosphere and at its other end with the room spaces; blower means providing for the positive flow of outdoor air through said passage and into the room spaces; means for changing the temperature of the outdoor air as it flows through said passage so as to maintain the room temperature at a comfortable value; a damper in said passage and movable between open and closed positions to control the flow of outdoor air over the temperature-changing means; manually operated means for positioning said damper at any selected one of a number of open positions so as to predetermine the amount of outdoor air flowing over the temperature-changing means; and means directly responsive to the operation of said temperature-changing means and operable to move said damper from any preselected open position to its closed position upon a failure in operation of said temperature-changing means.

2. Apparatus according to claim 1 wherein means is provided for returning said damper to a preselected open position upon a resumption in operation of said temperature-changing means.

3. Air conditioning apparatus for room spaces comprising means defining an air passage adapted to be communicatively connected at one end with the outdoor atmosphere and at its other end with the room spaces; blower means providing for the positive flow of outdoor air through said passage and into the room spaces; means for changing the temperature of the outdoor air as it flows through said passage so as to maintain the room temperature at a comfortable value; a damper in said passage and movable between open and closed positions to control the flow of outdoor air over the temperature-changing means; means for constantly urging said damper towards its full open position where the maximum amount of outdoor air flows over said temperature-changing means; a manually adjustable stop device for limiting opening movement of said damper by said urging means to any one of a number of preselected open positions so as to predetermine the amount of outdoor air flowing over the temperature-changing means; and means directly responsive to the operation of said temperature-changing means and operable upon a failure in operation of said temperature-changing means to move said damper against the force of said urging means and from its preselected open position to its fully closed position.

4. An air conditioning unit comprising a casing adapted to be arranged within a room space and having a first inlet opening for receiving room air, a second inlet opening for receiving outdoor air, and an outlet opening for discharging air into the room space; means defining an air passage in said casing connecting said first and second inlet openings with said outlet opening; blower means providing for the positive flow of air through said passage; means for changing the temperature of the air as it flows through said passage so as to maintain the temperature of the room spaces at a comfortable value; a damper movable between open and closed positions to control the amount of outdoor air flowing into said passage through said second inlet opening; manually operated means for positioning said damper at any one of a number of selected open positions so as to predetermine the amount of outdoor air flowing over said temperature-changing means and into said room spaces; and means directly responsive to the operation of said temperature-changing means for closing said damper from its preselected open position upon a failure in operation of said temperature-changing means.

5. Air conditioning apparatus comprising a casing adapted to be arranged within a room and adjacent a window opening communicating with the outdoor atmosphere; said casing having a first inlet opening for receiving room air, a second inlet opening for receiving outdoor air, and an outlet opening for discharging air into the room space; a duct connecting said second inlet opening with the outdoor atmosphere through said window opening; means in said casing defining an air passage connecting said first and second inlet openings with said outlet opening; blower means providing for the positive flow of air through said first and second inlet openings, said passage, and into the room through said outlet opening; means arranged within said passage for changing the temperature of the air flowing therethrough so as to maintain the room temperature at a comfortable value; a damper movable between open and closed positions for controlling the amount of outdoor air flowing through said passage and over the temperature-changing means; means for constantly urging said damper toward its full open position; hand-operated mechanism for limiting movement of the damper in an opening direction to any one of a number of selected open positions so as to predetermine the amount of outdoor air flowing over said temperature-changing means and into the room space; and means directly responsive to the operation of said temperature-changing means for closing said damper against the force of said urging means when said temperature-changing means is inoperative and permitting said urging means to move said damper to a position preselected by said hand-operated mechanism when said temperature-changing means is operating.

6. Air conditioning apparatus comprising a casing structure adapted to be arranged within a room space and having a first inlet opening for receiving room air, a second inlet opening for receiving outdoor air, and an outlet opening for discharging air into the room space; means in said casing structure defining an air passage connecting both of said inlet openings with said outlet opening; blower means providing for the positive flow of air through said passage and into the room space; means in said passage for changing the temperature of the air flowing therethrough so as to maintain the room temperature at a comfortable value; a damper for proportioning the amounts of room and outdoor air entering said passage and being movable between two extreme positions, one of which provides for the entrance of only room air into said passage through said first inlet opening and the other of which provides for the entrance of only outdoor air into said passage through said second inlet opening; manually operated means for placing said damper at either of its two extreme positions and at any one of a number of preselected mid positions; and means directly responsive to the operation of said temperature-changing means and operable to move said damper from its preselected mid position to that extreme position which prevents the entrance of

outdoor air upon a failure in operation of said temperature-changing means.

7. Air conditioning apparatus comprising a casing adapted to be arranged in a room space and having a first inlet opening for receiving room air, a second inlet opening for receiving outdoor air, and an outlet opening for discharging air into the room space; means in said casing defining an air passage connecting both of said inlet openings with said outlet opening; blower means providing for the positive flow of air through said passage; means in said passage for changing the temperature of the air flowing therethrough so as to maintain the room temperature at a comfortable value; a damper for proportioning the amounts of room and fresh air entering said passage and being movable between two extreme positions, one of which provides for the entrance of only room air into said passage through said first inlet opening, and the other of which provides for the entrance of only outdoor air into said passage through said second inlet opening; means for constantly urging said damper toward that extreme position which admits only outdoor air; hand-operated mechanism for limiting the movement of said damper by said urging means to any one of a number of preselected mid positions; and means acting in opposition to the force of said urging means and providing for movement of said damper to that extreme position which admits only room air when said temperature-changing means becomes inoperative, and permitting said urging means to move the damper to a preselected mid position when said temperature-changing means is operating.

8. Air conditioning apparatus for room spaces comprising means defining an air passage adapted to communicate at one end with the outdoor atmosphere and at its other end with the room spaces; blower means providing for the positive flow of outdoor air through said passage and into the room space; means for changing the temperature of the outdoor air as it flows through said passage so as to maintain the room temperature at a comfortable value; a damper in said passage and movable between open and closed positions to control the flow of outdoor air over the temperature-changing means; means for constantly urging said damper toward its full open position; hand-operated mechanism for limiting movement of said damper by said urging means to any one of a number of selected open positions; a spring device for closing said damper against the force exerted by said urging means from a preselected open position; and means for rendering said spring device inoperative when said temperature-changing means is operating, and permitting said spring device to close said damper from a preselected open position when said temperature-changing means becomes inoperative.

9. Air conditioning apparatus for room spaces comprising means defining an air passage adapted to communicate at one end with the outdoor atmosphere and at its other end with the room spaces; blower means providing for the positive flow of outdoor air through said passage and into the room spaces; a damper in said passage and movable between open and closed positions for controlling the amount of outdoor air flowing through said passage; means in said passage for changing the temperature of the outdoor air flowing therethrough so as to maintain the room temperature at a comfortable value; means for constantly urging said damper toward its fully open position; hand-operated mechanism for limiting opening movement of said damper to any one of a number of selected open positions so as to predetermine the amount of outdoor air flowing over said temperature-changing means; a spring device for closing said damper against the force exerted by said urging means; and an expansible fluid device responsive to the temperature of the temperature-changing means and opposing said spring device and operable to render the latter inoperative when said temperature-changing means is operating, and permitting said spring device to close said damper from a preselected open position and against the force of said urging means when said temperature-changing means becomes inoperative.

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