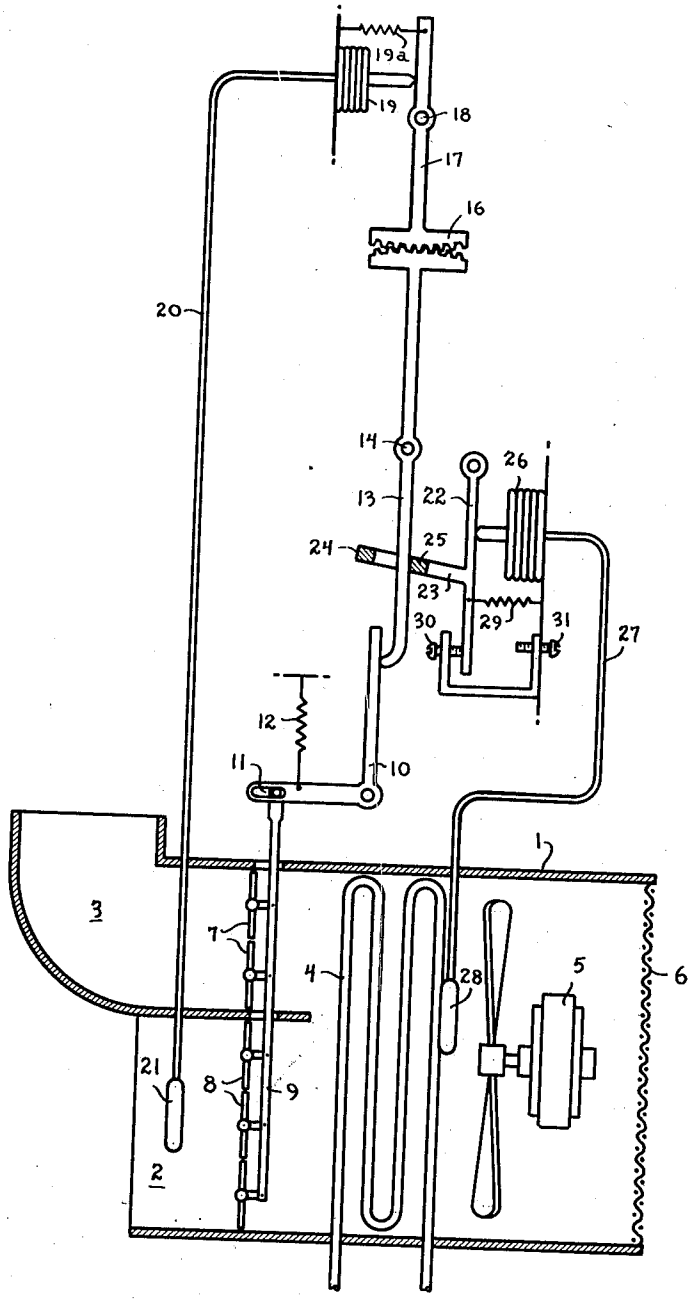
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THERMOSTAT CONTROL SYSTEM

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THERMOSTAT CONTROL SYSTEM

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This invention relates in general to automatic controls and more particularly to thermostatic controls for controlling air conditioning apparatus in both summer and winter.

The object of this invention is to provide a simple thermostatic or condition responsive control arrangement which operates to increase the heating effect of air conditioning apparatus in winter upon fall in temperature and to increase the cooling effect of such apparatus in summer upon rise in temperature.

Another object of this invention is to provide an automatic control arrangement which is adapted to control in one manner at one time and in the reverse manner at another time and to further provide an arrangement of this type for positively reversing the control from one manner to the other.

Other objects of this invention will appear from the following description and the appended claims.

For a full disclosure of this invention reference is made to the following description and to the accompanying drawing, the single figure of which illustrates diagrammatically a small summer-winter air conditioner and the thermostatic controls therefor.

Referring to the drawing reference character 1 indicates an air conditioning unit which is adapted to be located in a space being conditioned. This unit may be located in any room or enclosure which it is desired to condition and is illustrated as one which is especially adapted for conditioning compartments in a railway car. This unit is provided with a return air inlet 2 through which air from the space is drawn. Also the unit is provided with a fresh air inlet 3 which may be connected to a suitable fresh air duct. The conditioning unit 1 also includes a heat exchange coil 4 which is connected to a suitable source of supply of heating or cooling medium. During the heating season this coil is supplied with heating medium such as hot water and during the cooling season this coil is supplied with cooling medium such as cold water. A fan 5 is located within the conditioning unit for drawing air through the inlets 2 and 3 over the coil 4 and discharging it into the space through a suitable grill 6.

The flow of air through the inlets 2 and 3 is controlled by means of damper blades 7 and 8, the blades 7 controlling the flow of fresh air through the inlet 3 and the blades 8 controlling the flow of return air through the inlet 2. These blades 7 and 8 are connected to an operating member 9 so that the blades rotate in unison and in the same direction. It will be noted that the damper blades do not overlap which permits rotation of these blades in either direction from the closed position shown in the drawing. Thus when the operating member 9 is in the intermediate position shown, the damper blades 7 and 8 are in their closed positions wherein flow of air across the coil 4 is substantially prevented. Upon upward movement of the operating member 9 the blades 7 and 8 will rotate counterclockwise thereby permitting flow of air across coil 4. Similarly upon downward movement of the operating member 9 the blades 7 and 8 will rotate clockwise which also permits flow of air across coil 4.

The operating member 9 is shown as being actuated by means of a bell crank member 10, the member 9 being secured to the bell crank 10 by a pin and slot connection 11. This bell crank 10 is biased in the clockwise direction by means of a spring 12, this spring serving to urge the bell crank 10 against a lever 13 which is pivoted at 14. The upper end of lever 13 is formed as a gear segment 15 engaging a similar segment 16 formed on lever 17 which is pivoted at 18. This lever is rotated about its pivot by means of a thermostatic bellows 19, this bellows being connected by a capillary tube 20 to a bulb 21 located in the return air inlet 2 of the conditioner. The bellows, tube and bulb are charged with a suitable volatile fill which causes the bellows 19 to expand and contract upon change in return air temperature. The lever 17 is urged against the bellows 19 by means of a spring 19a. This spring may be adjusted so that when the temperature in the space is at a desired value such as 74° F. the lever 17 will assume the position shown wherein the lever 13 and bell crank 10 are in their intermediate positions for causing the damper blades 7 and 8 to be closed. At this time no or a minimum quantity of air will flow across the coil 4. If the space temperature falls below the desired value, the bellows 19 will contract due to the action of spring 19a (which is stronger than spring 12) which will cause counter-clockwise rotation of the bell crank 10 for lowering the actuating member 9 which in turn causes rotation of the damper blades 7 and 8 clockwise for permitting air flow across coil 4. It will be apparent that the degree of opening of blades 7 and 8 will be dependent upon the departure of the space temperature from the desired value. If the space temperature rises above the desired value the bellows 19 will expand against the action of spring 12 thereby forcing lever 17 clockwise from

the intermediate position illustrated. This will cause counter-clockwise rotation of the lever 13 for causing upward movement of the actuating member 9 which will rotate the damper blades 7 and 8 counter-clockwise from the closed position. From the description thus far it will be apparent that whenever the space temperature is at the desired value the damper blades 7 and 8 will assume the closed positions shown, and that upon either rise in temperature above or fall in temperature below the desired value the damper blades will be opened in proportion to the departure in room temperature from a desired value.

During the heating season when heating medium is supplied to the coil 4, it is necessary to prevent the dampers from being opened upon rise in temperature above the desired value. Also during the cooling season when coooling medium is supplied to the cooling coil it is necessary to prevent the dampers from opening upon fall in room temperature below the desired value. In order to prevent opening of the damper upon rise in temperature during the heating season or upon fall in temperature during the cooling season a lever 22 is provided having a slotted arm 23 through which the lever 13 passes, this slotted arm providing stops 24 and 25. The lever 22 is actuated by means of a bellows 26 which is connected by a capillary tube 27 to a control bulb 28 mounted upon the heat exchange coil 4. The lever 22 is biased against the bellows 26 by means of a spring 29. This lever is also arranged to abut adjustable stop screws 30 and 31.

During the heating season, heating medium is supplied to the coil 4 at a temperature of 100° F. or higher. Due to the bulb 28 responding to the temperature of coil 4, the vapor pressure of the volatile fill will be relatively high which causes the bellows 26 to expand for forcing the lever 22 into engagement with the stop screw 30. This causes the stop 25 to be brought into position for preventing counterclockwise rotation of the lever 13 from the intermediate position. Upon decrease in space temperature from the desired value the bellows 19 will contract which will cause counter-clockwise rotation of the lever 17 about pivot 18. This will cause clockwise rotation of lever 13 about pivot 14, the lever 13 being free to move in this direction between stops 23 and 24. This clockwise rotation of lever 13 will cause counter-clockwise rotation of the bell crank 10 which lowers the actuating member 9 for rotating the blades 7 and 8 in clockwise direction from closed position. Thus upon fall in space temperature the dampers 7 and 8 will open for permitting air to flow across the coil 4. It will be noted that if the space temperature rises above the setting of the actuating thermostat, the lever 13 will engage the stop 25 which prevents it from moving beyond intermediate position and therefore a rise in temperature when heating medium is supplied to the coil cannot cause opening of the dampers 7 and 8.

When cooling medium is supplied to the coil 4 such medium will be at or below 50° F. which will cause the vapor pressure in bellows 26 to be relatively low, this permitting the spring 29 to hold lever 22 against the stop screw 31. This position of the lever 22 will cause the stop 24 to be brought into engagement with the lever 13 when it is in its intermediate position. At this time upon rise in space temperature from the desired value, the bellows 19 will expand thereby rotating the lever 17 clockwise which in turn rotates lever 13 counter-clockwise. The stop 25 will now be removed which permits the lever 13 to rotate freely in this direction thus permitting air to flow across the coil 4. However, if the space temperature falls below the setting of the thermostat, the thermostat will attempt to rotate the lever 13 clockwise. Such motion of lever 13 will be prevented due to its engagement with the stop 24. Thus a fall in temperature below the setting of the thermostat when the system is acting to cool will not result in opening of the dampers.

It will be noted that the changes in room temperature affecting the pressure in bellows 19 are quite small as compared to the difference in temperature of the heating and cooling medium supplied to the heat exchanger 4. In other words the room or return air thermostat operates through a differential of only several degrees F. while the change-over thermostat responding to the heat exchanger temperature is subjected to changes in temperature of 50° F. or more. The change in pressure in the bellows 26 between the heating and cooling seasons is therefore very large as compared to changes in pressure in the bellows 19 which renders the bellows 19 incapable of forcing the stops 24 or 25 away from the proper positions. While for convenience the invention has been described as applied to a system in which the temperature of the heat exchange fluid is shifted suddenly from hot to cold, the invention will operate equally well when applied to a system in which the temperature of the heat exchange fluid is graduatingly varied from hot to cold as the load changes from heating to cooling. This is due to the fact that the thermostat which adjusts the stops assumes mid position at the same temperature as the damper thermostat places the dampers in mid position. For example, when the room temperature is at 74°, the dampers 7 and 8 are closed and when the heating medium temperature is at 74°, the lever 22 which carries stops 24 and 25 will be in mid position thus rendering both stops substantially ineffective. However, at this time, no stops are necessary as the room temperature and heat exchanger temperature are equal which causes the damper position to have no affect upon room temperature. Now as the heat exchanger temperature varies from 74°, the effect of the damper position upon room temperature increases, but at this same time, the force available for holding the lever 22 against stop screw 30 or 31 increases, so that the effectiveness of the stop increases in proportion to the necessity for such effectiveness.

From the foregoing description it will be apparent that this invention provides a simple arrangement for automatically controlling an air conditioner in both summer and winter and which will not operate reversely at any time. While it is preferred to utilize the automatic changeover or stop mechanism illustrated, the invention is not limited to the automatic changeover mechanism as the stops may be adjusted manually if so desired. While the invention is particularly adaptable to direct control of small units as illustrated the invention is not limited to the self contained type control system illustrated and may be incorporated into thermostats or other year around controls which in turn control air conditioning motor devices. As many modifications may be made without departing from the scope of the invention it is desired to be

limited only by the scope of the appended claims.

I claim as my invention:

1. In an air conditioning system, in combination, conditioning means for heating and cooling said space, a controller for controlling said conditioning means, said controller having a mid position wherein both heating and cooling are prevented and operative to graduatingly increase the effect of said conditioning means upon movement in either direction from said mid position, a thermostatic element responsive to the temperature of said space for moving said controller in a first direction from mid position upon rise in temperature and for moving said controller in the opposite direction from mid position upon fall in temperature, first movable stop means for resisting movement of said controller in said first direction from mid position, second movable stop means for resisting movement of said controller in the opposite direction from mid position, and means for rendering one or the other of said stop means ineffective.

2. In an air conditioning system, in combination, conditioning means for heating and cooling said space, a controller for controlling said conditioning means, said controller having a mid position wherein both heating and cooling are prevented and operative to graduatingly increase the effect of said conditioning means upon movement in either direction from said mid position, a thermostatic element responsive to the temperature of said space for moving said controller in a first direction from mid position upon rise in temperature and for moving said controller in the opposite direction from mid position upon fall in temperature, first movable stop means for resisting movement of said controller in said first direction from mid position, second movable stop means for resisting movement of said controller in the opposite direction from mid position, a single actuator for actuating both of said movable stop means, said actuator having a first position rendering said first stop means ineffective and said second stop means effective and a second position rendering said first stop means effective and said second stop means ineffective.

3. In an air conditioning system, in combination, conditioning means for heating and cooling said space, a controller for controlling said conditioning means, said controller having a mid position wherein both heating and cooling are prevented and operative to graduatingly increase the effect of said conditioning means upon movement in either direction from said mid position. a thermostatic element responsive to the temperature of said space for moving said controller in a first direction from mid position upon rise in temperature and for moving said controller in the opposite direction from mid position upon fall in temperature, first movable stop means for resisting movement of said controller in said first direction from mid position, second movable stop means for resisting movement of said controller in the opposite direction from mid position, a single actuator for actuating both of said movable stop means, said actuator having a first position rendering said first stop means ineffective and said second stop means effective and a second position rendering said first stop means effective and said second stop means ineffective, and thermostatic means responsive to a temperature varying with the demand for heating or cooling for controlling said actuator.

4. In an air conditioning system, in combination, conditioning means for heating and cooling said space, a controller for controlling said conditioning means, said controller having a mid position wherein both heating and cooling are prevented and operative to graduatingly increase the effect of said conditioning means upon movement in either direction from said mid position, a thermostatic element responsive to the temperature of said space for moving said controller in a first direction from mid position upon rise in temperature and for moving said controller in the opposite direction from mid position upon fall in temperature, first movable stop means for resisting movement of said controller in said first direction from mid position, second movable stop means for resisting movement of said controller in the opposite direction from mid position, a single actuator for actuating both of said movable stop means, said actuator having a first position rendering said first stop means ineffective and said second stop means effective and a second position rendering said first stop means effective and said second stop means ineffective, a pair of stops associated with said actuator for determining the first and second positions of said actuator and a pressure motor for shifting said actuator between said pair of stops.

5. In an air conditioning system, in combination, heat exchange means for heating or cooling a stream of air passing to a space, means for selectively supplying heating or cooling medium to said heat exchange means, damper means for controlling the flow of air over said heat exchange means, said damper means having an intermediate position in which the air flow is reduced to a minimum and acting to increase the flow of air over said heat exchange means upon movement in either direction from said intermediate position, means including a thermostatic element responsive to the temperature in the space for causing said damper means to assume said intermediate position when the space temperature is at a desired value, while causing said damper means to move in one direction upon rise in temperature and to move in the opposite direction upon fall in temperature, a first stop for preventing movement of said damper means in one direction from said intermediate position, a second stop for preventing movement of said damper means in the opposite direction from said intermediate position, and means for selectively rendering one or the other of said stops ineffective.

6. In an air conditioning system, in combination, heat exchange means for heating or cooling a stream of air passing to a space, means for selectively supplying heating or cooling medium to said heat exchange means, damper means for controlling the flow of air over said heat exchange means, said damper means having an intermediate position in which the air flow is reduced to a minimum and acting to increase the flow of air over said heat exchange means upon movement in either direction from said intermediate position, means including a thermostatic element responsive to the temperature in the space for causing said damper means to assume said intermediate position when the space temperature is at a desired value, while causing said damper means to move in one direction upon rise in temperature and to move in the opposite direction upon fall in temperature, a first stop for preventing movement of said damper means in one direction from said intermediate position, a second stop for preventing movement of said

damper means in the opposite direction from said intermediate position, and thermostatic means responsive to a temperature varying with demand for heating or cooling for rendering one of said stops ineffective upon demand for heating and for rendering the other of said stops ineffective upon demand for cooling.

7. In an air conditioning system, in combination, heat exchange means for heating or cooling a stream of air passing to a space, means for selectively supplying heating or cooling medium to said heat exchange means, damper means for controlling the flow of air over said heat exchange means, said damper means having an intermediate position in which the air flow is reduced to a minimum and acting to increase the flow of air over said heat exchange means upon movement in either direction from said intermediate position, means including a thermostatic element responsive to the temperature in the space for causing said damper means to assume said intermediate position when the space temperature is at a desired value, while causing said damper means to move in one direction upon rise in temperature and to move in the opposite direction upon fall in temperature, a first stop for preventing movement of said damper means in one direction from said intermediate position, a second stop for preventing movement of said damper means in the opposite direction from said intermediate position, and thermostatic means responsive to the temperature of the medium supplied to said heat exchange means for rendering one of said stops ineffective when heating medium is supplied to said heat exchange means and for rendering the other of said stops ineffective when cooling medium is supplied to said heat exchange means.

8. In an air conditioning system, in combination, heat exchange means for heating or cooling a stream of air passing to a space, means for selectively supplying a stream of cooling medium or heating medium to said heat exchange means, a flow controller for controlling one of said streams, said flow controller having an intermediate position wherein the effect of said heat exchange means is reduced to a minimum and acting to increase the effect of said heat exchange means upon movement in either direction from said intermediate position, a thermostatic element responsive to the temperature in said space, a mechanical linkage between said thermostatic element and said flow controller whereby said flow controller is positioned by said thermostatic element, a first stop means for preventing movement of said flow controller by said thermostatic element in one direction from said intermediate position, a second stop means for preventing movement of said flow controller by said thermostatic element in the opposite direction from said intermediate position, and selective means for rendering one or the other of said stop means ineffective.

9. In an air conditioning system, in combination, heat exchange means for heating or cooling a stream of air passing to a space, means for selectively supplying a stream of cooling medium or heating medium to said heat exchange means, a flow controller for controlling one of said streams, an actuating member for actuating said flow controller, said actuating member and flow controller being arranged in a manner to cause the effect of the heat exchange means to be reduced to a minimum when the actuating member is in an intermediate position while acting to increase the effect of said heat exchange means upon movement of said actuating member in either direction from said intermediate position, a thermostatic element responsive to the temperature of said space, connecting means for transmitting movements of said thermostatic element to said actuating member, a first stop means for preventing movement of said actuating member by said thermostatic element in one direction from said intermediate position, a second stop means for preventing movement of said actuating member by the thermostatic element in the opposite direction from said intermediate position, and selective means for rendering one or the other of said stop means ineffective.

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