AIR CONDITIONING SYSTEM

Filed Jan. 16, 1937

2 Sheets-Sheet 1

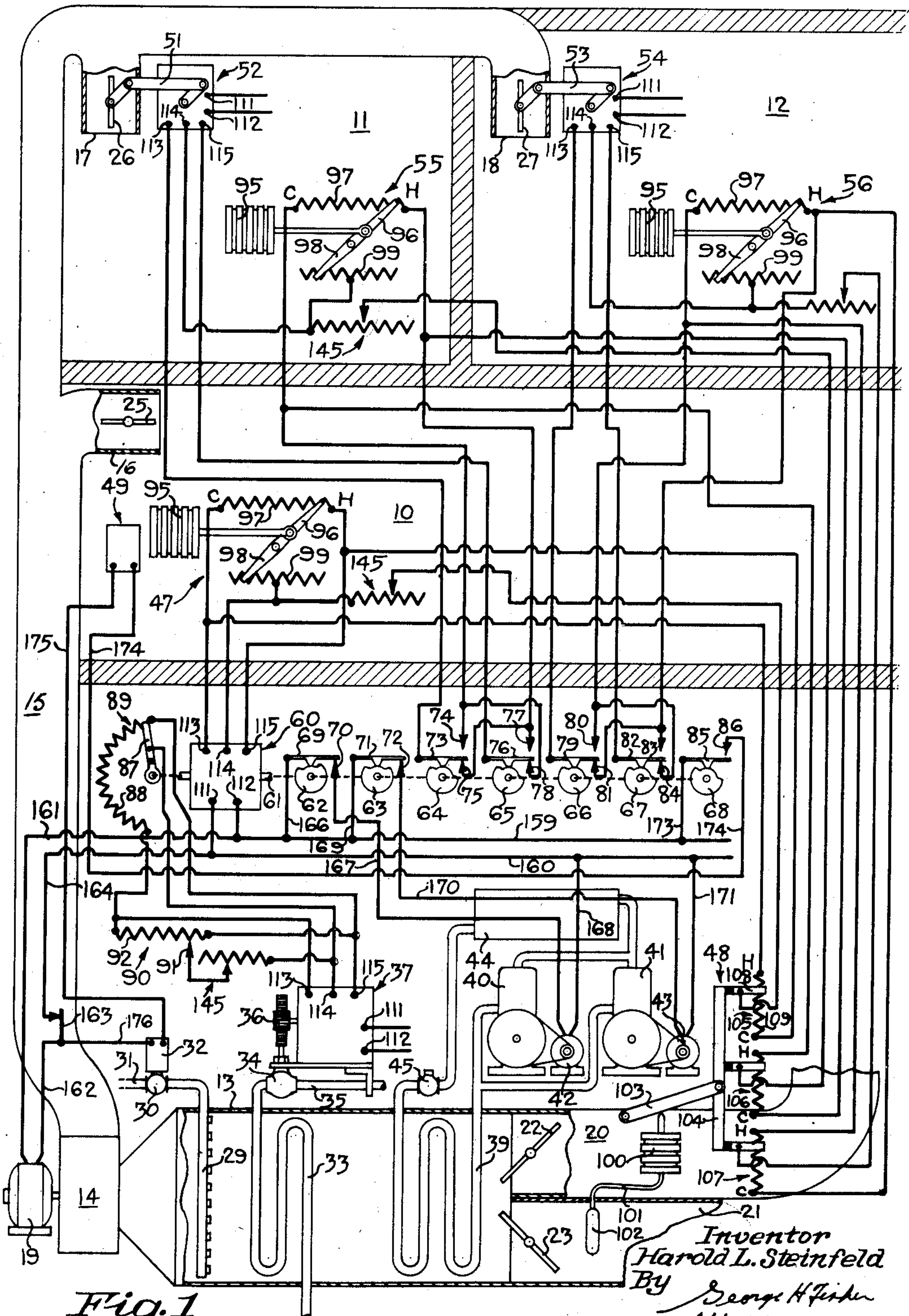

Fig. 1

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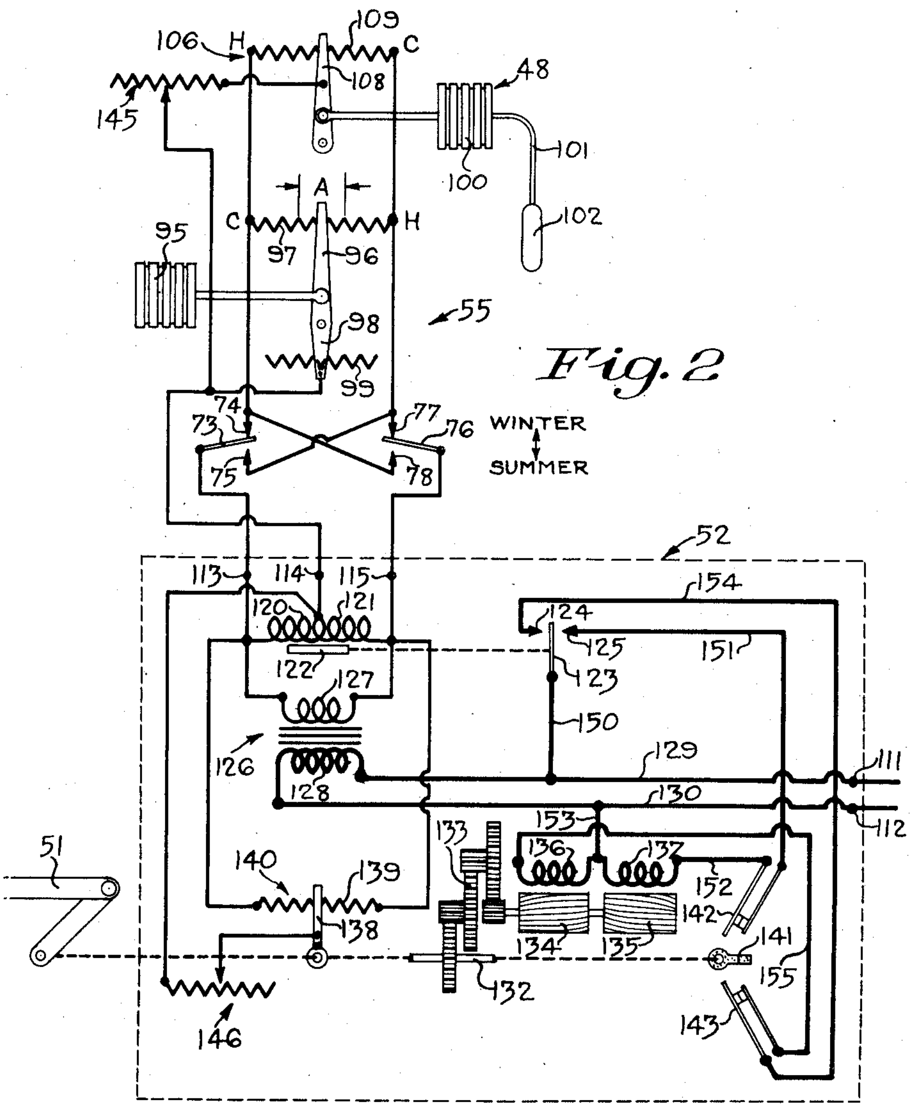

Fig. 2

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Patented Apr. 9, 1940 **2,196,687**

UNITED STATES PATENT OFFICE

2,196,687

AIR CONDITIONING SYSTEM

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Application January 16, 1937, Serial No. 120,946

12 Claims. (Cl. 257—3)

It is an object of this invention to provide an air conditioning system for a building having a plurality of spaces wherein air conditioning means are provided for conditioning air and delivering conditioned air to all of the spaces, wherein means responsive to the condition of the air in certain of the spaces controls the condition of the conditioned air delivered to all of the spaces and wherein means responsive to the condition of the air in other of the spaces controls the volume of conditioned air delivered to these other of said spaces.

Another object of this invention is to provide an air conditioning system of the type outlined above along with the means for adjusting the condition responsive means in accordance with variations in the condition of the air outside of the building.

Another object of this invention is to provide an automatic summer-winter changeover for the condition responsive means which controls the volume of conditioned air delivered to the other of the spaces whereby the air conditioning system is adapted for year around operation.

Still another object of this invention is to provide an air conditioning system for a space having an air conditioning unit provided with heating means and cooling means for conditioning air delivered to the space along with means responsive to the space temperature for operating the heating means when the space temperature decreases and for operating the cooling means when the space temperature increases.

The specific structure and manner of operation for accomplishing the objects of this invention also form objects of this invention.

Other objects and advantages will become apparent to those skilled in the art upon reference to the accompanying specification, claims and drawings.

For a more thorough understanding of this invention reference is made to the accompanying drawings in which:

Figure 1 diagrammatically discloses the preferred form of this invention as applied to a building having a plurality of spaces,

Figure 2 is a diagrammatic illustration of a portion of the control system utilized in Figure 1 to illustrate more clearly the mode of operation thereof.

Referring now to Figure 1, there is disclosed a building having a plurality of spaces 10, 11 and 12 to be conditioned. The space 10 is hereinafter termed the main space and may be an auditorium, an assembly room or the like. The spaces 11 and 12 may be termed auxiliary spaces which may be office spaces or the like. Air for the spaces 10, 11 and 12 is conditioned in an air conditioning unit 13 and the conditioned air is drawn from the unit 13 by means of a fan 14 and delivered through ducts 15 to the various spaces 10, 11 and 12. Specifically, the air is delivered to the space 10 by an air inlet 16, to the space 11 by an air inlet 17 and to the space 12 by an air inlet 18. The fan 14 is suitably operated by an electric motor 19.

Return air is admitted to the air conditioning unit 13 through a duct 20 and fresh air is admitted to the unit 13 through a duct 21. The amount of return air and fresh air so admitted to the unit 13 may be controlled by return air and fresh air dampers 22 and 23 respectively. The volume of air delivered to the space 10 may be controlled by a manually operated damper 25 and the volume of air delivered to the spaces 11 and 12 is controlled by automatically operated dampers 26 and 27 respectively.

The air conditioning unit 13 comprises an air moistening means in the form of a spray 29. The delivery of water to the spray 29 from a suitable water supply pipe 31 is controlled by a valve 30 which in turn is operated by a solenoid motor 32. The air conditioning unit 13 is also provided with a heating coil 33. The supply of heating medium, such as steam, to the coil 33 from a steam supply pipe 35 is controlled by a valve 34. The valve 34 is operated through a rack and pinion 36 by a modulating motor 37. The air conditioning unit 13 is also provided with a cooling coil which, for purposes of illustration is shown to be an evaporator 39. Refrigerant is drawn from the evaporator 39 by two compressors 40 and 41. The compressors 40 and 41 are arranged in parallel with respect to each other and are operated by electric motors 42 and 43 respectively. Refrigerant is discharged by the compressors 40 and 41 into a condenser 44. The refrigerant flows from the condenser 44 through an expansion valve 45 into the evaporator 39. Such a mechanical refrigerating apparatus is well known in the art and therefore a further description thereof is not considered necessary.

The valve 34 which controls the supply of heating fluid to the coil 33 and the compressors 40 and 41 which control the cooling effect of the cooling coil 39 are controlled by a thermostat generally designated at 47 responsive to the temperature of the space 10. The temperature setting of the thermostat 47 is adjusted by an outdoor compensator generally designated at 48. The arrangement is such that upon a decrease in space temperature the steam valve 34 is modulated to increase the supply of heating fluid to the heating coil **33** and upon an increase in space temperature the compressors **40** and **44** are sequentially brought into operation. A humidity responsive device generally designated at **49** controls the water valve **30** to supply moisture to the air in the air conditioning unit **13** when the relative humidity of the space **10** decreases below a predetermined value.

The volume damper **26** for the space **11** is operated through a link **51** by a modulating or proportioning motor **52** and in a like manner the volume damper of the space **12** is operated through a link **53** by a modulating or proportioning motor **54**. The modulating motor **52** is controlled by a thermostat **55** responsive to the variations in the temperature of the air within the space **11**. The temperature setting of the thermostat **55** is also adjusted by the outdoor compensator **48**. In a like manner the modulating motor **54** is controlled by a thermostat **56** responsive to the variations of the temperature of the air in space **12** and this thermostat **56** is also adjusted by the compensator **48**. The thermostats **55** and **56** and the motors **52** and **54** are so arranged that when the heating coil **33** is in operation the dampers **26** and **27** are moved toward an open position upon a decrease in the temperature of the air in the spaces **11** and **12**, and the dampers **26** and **27** are moved toward an open position when the cooling coil **39** is in operation upon an increase in temperature. The manner in which this reverse operation for summer cooling and winter heating is accomplished will be pointed out more fully hereafter.

The thermostat **47** responsive to the temperature of the space **10** controls the heating effect of the heating coil **33**, the cooling effect of the cooling coil **39**, the operation of the water valve **30** of the air moistening means and the reversal of the dampers **26** and **27** of the spaces **11** and **12** through a step-controller generally designated at **60**. The step-controller **60** includes a proportioning motor for operating a shaft **61**. The shaft **61** operates cams **62** to **68** inclusive. The cams **62** and **63** operate a switch arm **69** and **71** with respect to contacts **70** and **72**. The cams **64**, **65**, **66** and **67** operate switch arms **73**, **76**, **79** and **82** with respect to contacts **74**, **75**, contacts **77**, **78**, contacts **80**, **81** and contacts **83**, **84** respectively. The cam **68** operates switch arm **85** with respect to a contact **86**. The shaft **61** also operates a slider **87** with respect to a potentiometer resistance element **88**. The slider **87** and the resistance element **88** form a control potentiometer **89** for the proportioning motor **37** which controls the steam valve **34**. As shown in Figure 1 the proportioning motor of the step-controller **61** is in one extreme position. The cams **62** to **68** are in their extreme counter-clockwise positions and the slider is in its extreme clockwise position. Assume now that the motor is operated from the extreme position shown in the drawings to the other extreme position. If this be the case the slider **87** is moved from the position shown in a counter-clockwise direction until it reaches the other end of the resistance element **88**. In other words, the slider **87** is moved co-extensively with the movement of the motor of the step-controller **60**. Movement of the motor **60** away from the position shown first causes switch arm **69** to disengage contact **70**. Upon further rotation the switch arm **71** is caused to disengage contact **72**. When the motor has moved half way through its complete travel, the switch arms **73**, **76**, **79** and **82** are moved out of engagement with their respective contacts **75**, **78**, **81** and **84** and into engagement with their respective contacts **74**, **77**, **80** and **83**. At the same time the switch arm **85** is moved into engagement with the contact **86**.

As stated above the control potentiometer **89** controls the operation of the proportioning motor **37** which controls the supply of steam to the heating coil **33**. In order that the proportioning motor **37** will not open the valve **34** during the first half of rotation of the step-controller **60** or until the slider **87** has rotated downwardly beyond the mid point of the resistance element **88**, a compensator generally designated at **90** is utilized. This compensator comprises a slider **91** which may be manually moved with respect to a potentiometer resistance element **92**.

Each of the control thermostats **47**, **55** and **56** comprise a thermostatic element **95** which may be of bellows type containing a volatile fluid. The thermostatic element **95** operates a slider **96** with respect to a resistance element **97** and a slider **98** with respect to a center tapped resistance element **99**. The slider **96** and the resistance element **97** form a control potentiometer and the slider **98** and the resistance element **99** form what may be termed a differential equalizer. Since all of the thermostats **47**, **55** and **56** are exactly the same, like reference characters have been utilized. Upon an increase in space temperature the slider **96** is moved to the right with respect to the resistance element **97** in the direction indicated by the character H as shown in Figure 1. Upon a decrease in temperature the slider **96** is moved to the left in the direction indicated by the character C. Hereafter the right end of the control potentiometer will be designated H and the left end of the control potentiometer will be designated C.

The outdoor compensator, generally designated at **48** and which adjusts the temperature setting of the room thermostats, may comprise a bellows **100** connected by a capillary tube **101** to a bulb **102** located in the fresh air duct **21**. Bulb **102** contains a volatile fluid and upon an increase in fresh air temperature the bellows **100** is expanded and upon a decrease in fresh air temperature the bellows **100** contracts. The bellows **100** operates a pivoted lever **103** which is connected to a carriage **104**. The carriage **104** operates three compensating potentiometers generally designated at **105**, **106** and **107** respectively. Each of these compensators comprise a slider **108** carried by the carriage **104** and a stationary resistance element **109**. The upper ends of the resistance elements **109** are designated by the character H and the lower ends of the resistance elements **109** are designated by the character C. It is therefore seen that upon an increase in fresh air temperature sliders **108** are moved upwardly toward the character H and upon a decrease in fresh air temperature the sliders **108** are moved downwardly toward the character C.

The proportioning motors **37**, **52**, **54** and **60** may all be of the same construction and therefore like reference characters relating to the parts of each of these motors have been utilized. Therefore, each motor is provided with terminals **111** and **112** which are connected to a source of power. In other words the terminals **111** and **112** provide power for the operation of the proportioning motors and also provide power for the control circuits of the proportioning motors. Each proportioning motor is also provided with terminals **113**, **114**, **115**, these terminals being suitably connected to the various control potentiometers and compensating potentiometers.

For a more thorough understanding of the construction of the proportioning motors and the manner in which they are operated by the controlling and compensating potentiometers reference is made to Figure 2. In describing the operation of the proportioning motors the proportioning motor 52 which operates the volume damper 26 of the space 11 is utilized and this proportioning motor is controlled by the thermostat 55, the compensator 48 and the reversing switches of the step-controller 60. In Figure 2 the proportioning motor 52 includes a relay having relay coils 120 and 121 for operating an armature 122 which is suitably connected to a switch arm 123. The switch arm 123 is adapted to engage contacts 124 and 125. When the relay coil 121 is energized more than the relay coil coil 120 the switch arm 123 is moved into engagement with the contact 125. When the relay coil 120 is energized more than the relay coil 121 the switch arm 123 is moved into engagement with the contact 124. When the relay coils 120 and 121 are equally energized the switch arm 123 is maintained spaced midway between the contacts 124 and 125 as shown in Figure 2. Power is supplied to the relay by means of a step-down transformer 126 having a secondary 127 and a primary 128 which is connected by wires 129 and 130 to the power terminals 111 and 112. The relay coils 120 and 121 are connected in series and across the secondary 127.

The proportioning motor 52 includes a shaft 132 which operates the link 51 which in turn operates the damper 26. The shaft 132 is rotated through a reduction gear train 133 by motor rotors 134 and 135. The rotors 134 and 135 are controlled by field windings 136 and 137 respectively. The arrangement is such that when the field winding 137 is energized the link 51 is moved to the right to move the damper 26 of Figure 1 toward an open position and when the field winding 136 is energized the link 51 is moved to the left to move the damper 26 of Figure 1 toward a closed position. The shaft 132 also operates a slider 138 with respect to a potentiometer resistance element 139. The slider 138 and the resistance element 139 form a balancing potentiometer generally designated at 140. When the link 51 is moved toward the left, the slider 138 is moved toward the left and vice versa when the link 51 is moved toward the right the slider 138 is also moved toward the right. The shaft 132 operates an abutment member 141 for opening limit switches 142 and 143 when the link 51 is moved to an extreme right-hand position and to an extreme left-hand position, respectively.

The H end of the resistance element 109 of the compensator 48 and the C end of the resistance element 97 of the controller 55 are connected together and to the contact 74 of the step-controller. In a like manner the C end of the resistance element 109 of the compensator 48 and the H end of the resistance element 97 of the controller 55 are connected together and to the contact 77 of the step-controller. The switch arms 73 and 76 of the step-controller are connected to the terminals 113 and 115 respectively. These terminals are connected to the left end and right end of the relay coils 120 and 121 respectively. The contact 74 of the step-controller is connected to the contact 78 and in a like manner the contact 75 is connected to the contact 77. Switch arms 73 and 76 are adapted to engage the contacts 74 and 77 or contacts 75 and 78. As shown, during the winter time when heating is required the contacts 74 and 77 are engaged by the switch arms 73 and 76 and in the summer when cooling is required the contacts 75 and 78 are engaged by the switch arms 73 and 76. The left and right ends of the resistance element 139 of the balancing potentiometer are connected to the left and right ends respectively of the relay coils 120 and 121. The slider 108 of the compensator 48, the center tap of the resistance element 99 of the controller 55 and the slider 138 of the balancing potentiometer are all connected together and through the terminal 114 to the junction of the relay coils 120 and 121. In series with the slider 108 is a rheostat 145 and in series with the slider 138 is a rheostat 146. The purpose of these rheostats will be pointed out more fully hereafter.

With the parts in the position shown in Figure 2 and more particularly with the switch arms 73 and 76 engaging the contacts 74 and 77 it is seen that the left end of the relay coil 120 is connected to the left end of all of the potentiometer resistance elements, that the right end of the relay coil 121 is connected to the right ends of all of the potentiometer resistance elements and that the sliders are all connected to the junction of the relay coils 120 and 121. By reason of these connections the compensating potentiometer, the controller potentiometer, the balancing potentiometer, and the relay coils 120 and 121 are all connected in parallel and across the secondary 127.

Omitting for the time being the operation of the rheostats 145 and 146 and the compensator 106, upon a decrease in space temperature slider 96 is moved to the left in the direction indicated by the character C. By reason of the above referred to parallel relationship this causes partial short circuiting of the relay coil 120 to decrease the energization thereof and increases the energization of the relay coil 121. As a result the switch arm 123 is moved into engagement with the contact 125 to complete a circuit from the power terminal 111 through wires 129 and 150, switch arm 123, contact 125, wire 151, limit switch 142, wire 152, field winding 137, and wires 153 and 130 back to the other power terminal 112. Completion of this circuit energizes the field winding 137 to move the link 151 towards the right, to move the damper 26 of Figure 1 toward an open position. Operation of the motor to move the damper 26 toward an open position causes right-hand movement of the slider 138 of the balancing potentiometer. This right-hand movement of the slider 138 decreases the energization of the relay coil 121 and increases the energization of the coil 120. When the slider 138 has moved sufficiently far to the right to rebalance the energization of the relay coils 120 and 121 the switch arm 123 is moved out of engagement with the contact 125 to break the circuit through the field winding 137. In this manner upon a decrease in space temperature the damper 26 is modulated toward an open position in direct accordance with the amount of decrease in space temperature.

Upon an increase in space temperature the slider 96 of the control potentiometer is moved to the right in the direction indicated by the character H and this right-hand movement decreases the energization of the relay coil 121 and increases the energization of the relay coil 120 whereupon the switch arm 123 is moved into engagement with the contact 124. This completes a circuit from the power terminal 111 through wires 129 and 150, switch arm 123, contact 124, wire 154, limit switch 143, wire 155, field winding 136 and wires 153 and 130 back to the other power terminal 112. Completion of this circuit energizes the field winding 136 to move the link 51 toward the left to move the damper 26 toward a closed position. Operation of the motor to move the damper 26 towards a closed position causes left-hand movement of the slider 138 of the balancing potentiometer. This left-hand movement decreases the energization of the relay coil 120 and increases the energization of the relay coil 121 and when the slider 138 has moved sufficiently far to the left to rebalance the energizations of the relay coils 120 and 121 the switch arm 123 is moved out of engagement with the contact 124 to break the circuit through the field winding 136. In this manner the damper 26 is modulated toward the closed position in accordance with the amount of increase in space temperature.

In a like manner movement of the slider 108 of the compensator 106 toward the right in the direction indicated by the character C causes closing movement of the damper 26 and movement of the slider 108 to the left in the direction indicated by the character H causes opening movement of the damper 26. Therefore the motor 52 and consequently the damper 26 is controlled by the combined action of the control potentiometer 55 and the compensating potentiometer 106.

The rheostat 146 is placed in series with the slider 138 of the balancing potentiometer to decrease the sensitivity thereof so that movement of the slider 96 of the control potentiometer through the range designated A requires complete movement of the proportioning motor 52 and therefore complete movement of the balancing potentiometer slider 138 to rebalance the relay coils 120 and 121. In other words, as the slider 96 of the control potentiometer is moved from the left end of the range A to the right end of the range A the damper 26 is moved from an extreme open position to an extreme closed position. By placing the rheostat 145 in series with the slider 108 of the compensating potentiometer 106 the sensitivity of the compensating potentiometer 106 is decreased and therefore the compensating potentiometer operates to shift the range or operating differential designated A from the left to right along the control potentiometer resistance element 97. As the outdoor temperature increases the slider 108 moves toward the left and as a result the range A or operating differential of the control potentiometer is shifted towards the right so that higher temperatures are maintained in the space. Conversely as the outside temperature decreases the slider 108 of the compensating potentiometer is moved toward the right to shift the control range A or differential of the control potentiometer toward the left to decrease the space temperature. In this manner the temperature setting of the space thermostat is adjusted in accordance with outside temperatures to raise the setting of the space thermostat as the outdoor temperature increases and to lower the setting of the space thermostat as the outdoor temperature decreases. The center tap resistance 99 engaged by the slider 98 of the controller 55 is to maintain the range A or the operating differential constant regardless of its position along the control potentiometer resistance element 97.

The above mode of operation is applicable for winter heating since the damper is moved toward an open position as the space temperature decreases and is moved toward a closed position as the space temperature increases. For summer cooling just the reverse action is desired and to accomplish this the switch arms 73 and 76 are moved into engagement with the contacts 75 and 78. This reverses the connections of the control potentiometer and compensating potentiometer with respect to the relay coils 120 and 121 so that upon a decrease in space temperature the damper 26 is moved toward a closed position and upon an increase in space temperature the damper 26 is moved toward an open position.

Referring now again to Figure 1 it is seen that the control potentiometer 56, the compensating potentiometer 107, and the proportioning motor 54 for the damper 27 of the space 12 are connected together in exactly the same manner through the step-controller 60 so that the damper 27 of the space 12 is operated in exactly the same manner as the damper 26 of space 11. It is also seen that the control thermostat 47 and the compensator 105 are connected to the proportioning motor of the step-controller 60 in exactly the same manner as in Figure 2 with the exception that the summer-winter change over switches are omitted. Therefore the motor of the step-controller 60 is positioned in accordance with variations in the temperature of space 10 and the temperature setting is adjusted in accordance with outdoor temperature in exactly the same manner as the winter operation of Figure 2.

The control potentiometer 89 operated by the step-controller and the motor 37 which controls the steam valve 34 are connected in the same manner as in Figure 2 and also the manually operated compensator 90 is connected in the same manner as the compensator of Figure 2. Since the slider 91 of the compensator is located in the right-hand portion of the resistance element 92 the valve 34 will be held in a closed position until such time as the slider 87 of the control potentiometer 89 is moved to a position below the mid point of the resistance element 88. In other words the valve 34 will be maintained in a closed position until such time as the slider 87 moves below the mid point of the resistance element 88 and upon further downward movement of the slider 87 beyond this position the valve 34 will be modulated toward an open position.

Assume now the parts in the position shown in Figure 1, the outdoor temperature is relatively high and therefore sliders 108 of the compensating potentiometers are in their upper or H positions. The space temperatures are relatively high since the sliders 96 are in the right-hand or H positions and as a result the dampers 26 and 27 are wide open and the motor of the step-controller 60 is in an extreme position. Line wires leading from some source of power (not shown) are designated at 159 and 160. The motor 19 which operates the fan 14 is placed in operation when the fan switch 163 is closed, this being accomplished by a circuit leading from the line wire 159 through wire 161, fan motor 19, wire 162, fan switch 163, and wire 164 back to the other line wire 160. The fan 14 thereupon delivers conditioned air to all of the spaces 10, 11 and 12. The switch arm 69 of the step-controller 60 engages the contact 70 to complete a circuit from the line wire 159 through wire 166, switch arm 69, contact 70, wire 167, electric motor 42 and wire 168 back to the other line wire 160. Completion of this circuit causes operation of the compressor 40. The switch arm 71 of the step-controller is also in engagement with the contact 72 which completes a circuit from the line wire 159 through wire 169, switch arm 71, contact 72, wire 170, electric motor 43 and wire 171 back to the other line wire 160. Therefore both of the compressors 40 and 41 are operated to supply the maximum amount of cooling. The switch arms 73, 76, 79 and 82 are in their lower or summer cooling positions and therefore the dampers 26 and 27 for the spaces 11 and 12 are operated by the space thermostats 55 and 56 for summer cooling.

As the temperature of the space 10 decreases the motor 60 is operated to move the cams 62 to 68 in a counter-clockwise direction and the slider 87 in a counter-clockwise direction. After the motor has moved them through a given angle, the switch arm 69 is moved out of engagement with the contact 70 to break the circuit through the motor 42 which stops operation of the compressor 40. This decreases the amount of cooling accomplished by the cooling coil 39. Upon a further decrease in space temperature the switch arm 71 is moved out of engagement with the contact 72 to break the circuit through the motor 43 which stops operation of the compressor 41. In this manner refrigeration or cooling is stopped.

Upon a further decrease in space temperature the switch arms 73, 76, 79 and 82 are moved into engagement with the contacts 75, 77, 80 and 83 respectively to reverse the action of the thermostats 55 and 56 of the spaces 11 and 12. At the same time the switch arm 85 is moved into engagement with the contact 86 and if the relative humidity in the space 10 is below a desired value a circuit is completed from the line wire 159 through wire 173, switch arm 85, contact 86, wire 174, humidity responsive device 49, wire 175, solenoid motor 32, wire 176, fan switch 163 and wire 164 back to the other line wire 160. Completion of this circuit energizes the solenoid motor 32 to supply moisture to the air in the air conditioning unit 13. Since the switch arm 85 and the contact 86 of the step-controller are in series with the humidistat 49 the water valve 30 cannot be opened while the refrigerating apparatus is operating. Also since the fan switch 163 is in series with the humidistat 49 the spray 29 may not operate in case the fan is not running.

Upon a further decrease in space temperature the slider 87 of the control potentiometer 89 continues its downward movement and since at this time the slider 87 passes the mid point of the resistance element 88, the valve 34 controlling the supply of steam to the heating coil 33 is operated towards an open position which heats the air in an increasing amount as the space temperature decreases. Upon an increase in space temperature the same cycle of operation occurs except it occurs in reverse order and therefore a further description is not considered necessary.

Since the temperature and condition of the air delivered to all of the spaces is controlled by the thermostat in the space 10, and since heating and cooling load conditions in space 10 may differ from those in spaces 11 and 12, the volume dampers 26 and 27 controlling the supply of air to the spaces 11 and 12 are utilized. In this manner the temperature in the spaces 11 and 12 may be maintained at the desired value regardless of the condition of the air being delivered to these spaces and to the space 10. Such a system is quite advantageous and facilitates the balancing out of the complete air conditioning system. More uniform temperatures may be thus obtained.

Summarizing briefly the operation of the complete control system, upon a demand for cooling by the thermostat in the space 10 the refrigeration apparatus is progressively placed in operation in accordance with the demand for cooling, and upon a demand for heating, the steam valve 34 is progressively opened in accordance with the amount of such demand. The space thermostats in the spaces 11 and 12 control their respective volume dampers to maintain the temperatures in the spaces at the desired value. When the space thermostat 47 in the space 10 changes from a heating cycle to a cooling cycle the controlling action of thermostats 55 and 56 in the spaces 11 and 12 is reversed so that proper operation of the dampers 26 and 27 is automatically obtained. A humidity responsive device in the space 10 controls the supply of moisture added to the conditioned air and this humidity responsive device cannot operate the air moistening means in case the fan 14 is not operating or in case the refrigerating apparatus is in operation. The temperature settings of the thermostat 47 in the space 10 and of the thermostats 55 and 56 in the spaces 11 and 12 are adjusted in accordance with variations in outside temperature in such a manner that as the outdoor temperature increases the thermostat setting is raised. If desired the adjustment of the thermostats in accordance with outdoor temperatures may be eliminated.

Although for purposes of illustration I have shown one form of my invention, other forms thereof may become obvious to those skilled in the art upon reference to this specification and therefore this invention is to be limited only by the scope of the appended claims and prior art.

I claim as my invention:

1. An air conditioning system for a building having a plurality of spaces, comprising in combination, means for conditioning air and delivering the conditioned air to all of said spaces, means responsive to the condition of the air in a main space for controlling the condition of the conditioned air delivered to all of the spaces and to maintain the condition of the air in the main space at desired values, and means responsive to the condition of the air in the other spaces and to the condition of the air outside of the building for controlling the volume of conditioned air delivered to the other spaces to maintain the condition of the air therein at values which are varied in accordance with variations in outside conditions.

2. An air conditioning system for a building having a plurality of spaces, comprising in combination, means for conditioning air and delivering the conditioned air to all of said spaces, means responsive to the condition of the air in a main space and to the condition of the air outside of said building for controlling the condition of the conditioned air delivered to all of said spaces and to maintain the condition of the air in the main space at values which are varied in accordance with variations in outside conditions, and means responsive to the condition of

the air in the other spaces and to the condition of the air outside of the building for controlling the volume of conditioned air delivered to the other spaces to maintain the condition of the air therein at values which are varied in accordance with variations in outside conditions.

3. An air conditioning system for a building having a plurality of spaces, comprising in combination, means for conditioning air by changing its temperature and delivering the conditioned air to all of said spaces, thermostatic means responsive to the temperature of the air in a main space for controlling the temperature of the conditioned air delivered to all of the spaces and to maintain the temperature of the air in the main space at desired values, and thermostatic means responsive to the temperature of the air in the other spaces and to the temperature of the air outside of the building for controlling the volume of conditioned air delivered to the other spaces to maintain the temperature of the air therein at values which are varied in accordance with variations in outside temperatures.

4. An air conditioning system for a building having a plurality of spaces, comprising in combination, means for conditioning air by changing its temperature and moisture content, circulating means for circulating the conditioned air to all of said spaces, thermostatic means responsive to the temperature of the air in a main space and to the temperature of the air outside of the building for controlling the temperature of the air delivered to all of the spaces and to maintain the temperature of the air in the main space at values which are varied in accordance with variations in outside temperatures, means responsive to the moisture content of the air in the main space for controlling the moisture content of the conditioned air delivered to all of the spaces and to maintain desired moisture conditions in the main space, and means responsive to the condition of the air in the other spaces for controlling the volume of conditioned air delivered to the other of said spaces to maintain desired moisture conditions therein.

5. An air conditioning system for a building having a plurality of spaces, comprising in combination, an air conditioning unit having temperature changing means and air moistening means, circulating means for circulating air through the air conditioning unit and delivering conditioned air to all of said spaces, means responsive to the temperature and moisture content of the air in a main space and to the condition of the air outside of the building for controlling the temperature changing means and the air moistening means to control the condition of the air delivered to all of the spaces and to maintain desired temperature and moisture conditions in the main space, means responsive to the condition of the air in the other spaces for controlling the volume of conditioned air delivered to the other spaces to maintain desired conditions therein, and means for preventing operation of the air moistening means in case the circulating means is not operating.

6. An air conditioning system for a plurality of spaces, comprising in combination, an air conditioning unit including heating means, cooling means and means for delivering conditioned air to all of the spaces, control means responsive to the temperature of the air in a main space for progressively operating the heating means and the cooling means to condition the air delivered to all of the spaces and to maintain the temperature of the air in the main space at desired values, means responsive to the temperature of the air in the other spaces for controlling the volume of air delivered to the other spaces to maintain desired temperatures therein, and means for reversing the controlling action of the last mentioned temperature responsive means when the conditioning of the air is changed from heating to cooling and vice versa.

7. An air conditioning system for a plurality of spaces, comprising in combination, an air conditioning unit including heating means, cooling means and means for delivering conditioned air to all of the spaces, control means responsive to the temperature of the air in a main space for progressively operating the heating means and the cooling means to condition the air delivered to all of the spaces and to maintain the temperature of the air in the main space at desired values, means responsive to the temperature of the air in the other spaces for controlling the volume of air delivered to the other spaces to maintain desired temperatures therein, and means controlled by the control means for reversing the controlling action of the last mentioned temperature responsive means when the conditioning of the air is changed from heating to cooling and vice versa.

8. An air conditioning system for a building having a plurality of spaces, comprising in combination, an air conditioning unit including heating means, cooling means and means for delivering conditioned air to all of the spaces, control means responsive to the temperature of the air in a main space for operating the heating means when the temperature decreases and for operating the cooling means when the temperature increases to condition the air delivered to all of the spaces and to maintain desired temperature conditions in the main space, and means responsive to the temperature of the air in the other spaces to increase the volume of conditioned air delivered to the other spaces when the temperature therein decreases and the heating means is in operation to maintain desired temperatures therein.

9. An air conditioning system for a building having a plurality of spaces, comprising in combination, an air conditioning unit including heating means, cooling means and means for delivering conditioned air to all of the spaces, control means responsive to the temperature of the air in a main space for operating the heating means when the temperature decreases and for operating the cooling means when the temperature increases to condition the air delivered to all of the spaces and to maintain desired temperature conditions in the main space, and means responsive to the temperature of the air in the other spaces to increase the volume of conditioned air delivered to the other spaces when the temperature increases and the cooling means is in operation to maintain desired temperatures therein.

10. An air conditioning system for a building having a plurality of spaces, comprising in combination, an air conditioning unit including heating means, cooling means and means for delivering conditioned air to all of the spaces, control means responsive to the temperature of the air in a main space for operating the heating means when the temperature decreases and for operating the cooling means when the temperature increases to condition the air delivered to all of the spaces and to maintain desired tem-

perature conditions in the main space, and means including means controlled by the control means to increase the volume of heated conditioned air delivered to the other spaces when the temperature of the air thereof decreases and to increase the volume of cooled conditioned air to the other spaces when the temperature of the air thereof increases to maintain desired temperatures therein.

11. An air conditioning system for a building having a plurality of spaces, comprising in combination, an air conditioning unit including heating means, cooling means and means for delivering conditioned air to all of the spaces, control means responsive to the temperature of the air in a main space for operating the heating means when the temperature decreases and for operating the cooling means when the temperature increases to condition the air delivered to all of the spaces and to maintain desired temperature conditions in the main space, means for adjusting the temperature setting of the control means in accordance with changes in temperature outside of the building, and means responsive to the temperature of the air in the other spaces to increase the volume of conditioned air delivered to the other spaces when the temperature decreases and the heating means is in operation to maintain desired temperatures therein.

12. An air conditioning system for a building having a plurality of spaces, comprising in combination, an air conditioning unit including heating means, cooling means and means for delivering conditioned air to all of the spaces, control means responsive to the temperature of the air in a main space for operating the heating means when the temperature decreases and for operating the cooling means when the temperature increases to condition the air delivered to all of the spaces and to maintain desired temperature conditions in the main space, means for adjusting the temperature setting of the control means in accordance with changes in temperature outside of the building, and means including means controlled by the control means to increase the volume of heated conditioned air delivered to the other spaces when the temperature of the air thereof decreases and to increase the volume of cooled conditioned air to the other spaces when the temperature of the air thereof increases to maintain desired temperatures therein.

HAROLD L. STEINFELD.

CERTIFICATE OF CORRECTION.

Patent No. 2,196,687. April 9, 1940.

HAROLD L. STEINFELD.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 6, first column, line 45, claim 4, strike out the word "moisture" ; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 25th day of June, A. D. 1940.

Henry Van Arsdale,
Acting Commissioner of Patents.

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