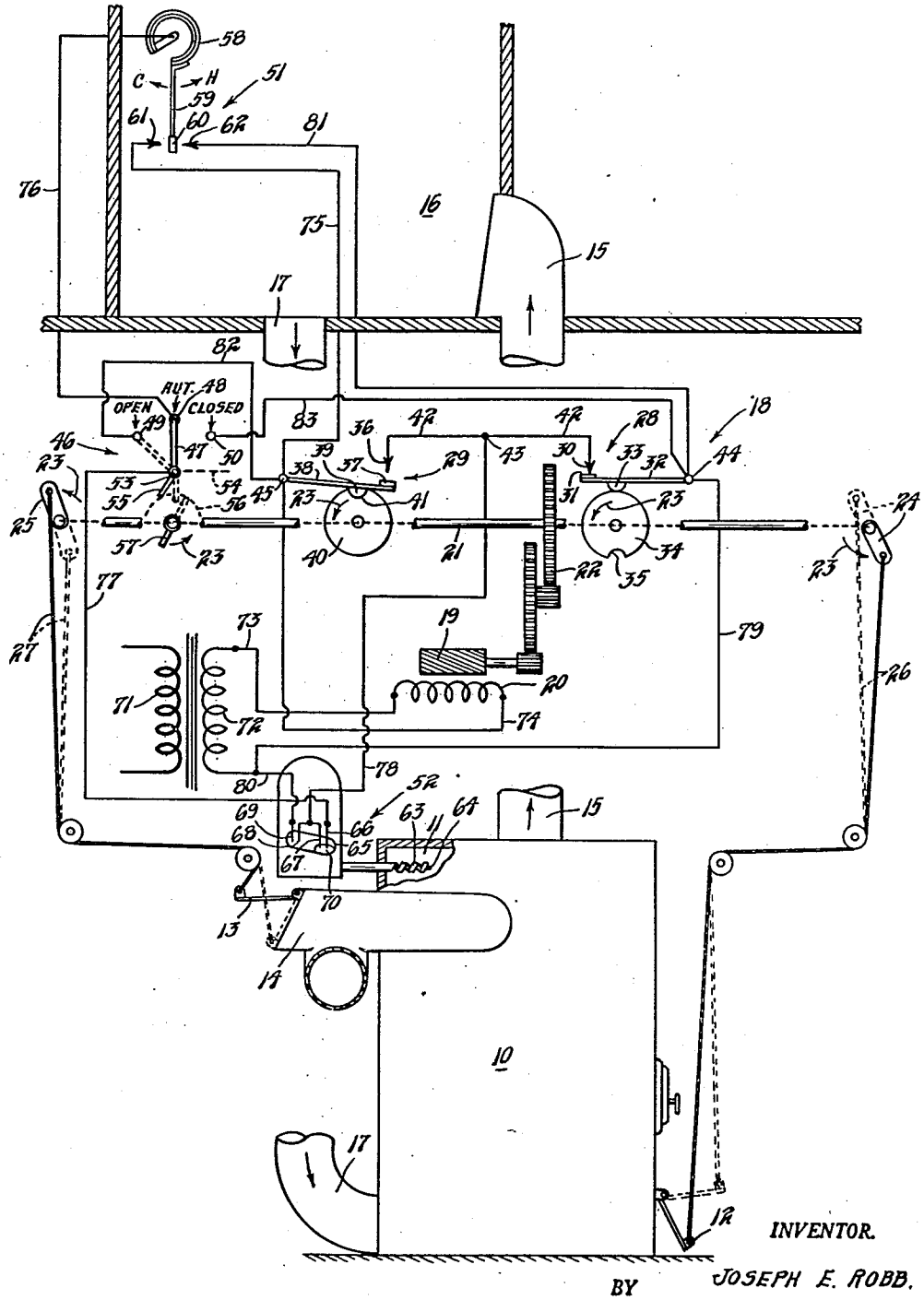
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CONDITION CONTROL APPARATUS

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CONDITION CONTROL APPARATUS

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This invention relates to the condition control art but more particularly to improvements in condition control apparatus specially applicable to great advantage in temperature control systems of the type employing damper regulated furnaces.

It is usually customary in such systems to provide a motor operator for driving the dampers between draft-increasing and draft-retarding positions, and to also provide automatic means responsive to a condition or conditions indicative of a need for regulation of the furnace to initiate operation of the motor operator. It is usually desirable in the use of such furnaces to further provide a manually operable basement switch in control of the motor operator for moving the dampers to a "firing" position during the stoking or firing of the furnace. Since the most ideal "firing" position of the dampers is generally considered to be the draft-increasing position thereof, and since attendants frequently inadvertently leave the basement switch in this position, the furnace is in a condition to develop dangerously high temperatures.

Accordingly, various prior art means have been devised first, to move the dampers to their draft-retarding position independently of the basement switch position, and second, to return the basement switch to its initial position. Some of these prior art devices have comprised auxiliary time switches operable after a time period to return the basement switch to its initial position. Others have provided time delay arrangements inherent in the apparatus employed to attain the above first and second objectives. Others have provided declutching arrangements of the motor operator whereby the dampers are released and may be manually moved to the "firing" posttion, such movement initiating a follow-up motor action. Still other means have combined the basement switch with apparatus other than the motor operator, the switch being actuated by the apparatus which is associated with the furnace in such a manner as to be responsive to the dangerously high temperatures referred to hereinabove.

While these prior art arrangements have met the above objectives to a certain extent, they have been more or less unsatisfactory as being either unreliable, inconvenient, complicated, or expensive.

The present invention contemplates a motor operator for a temperature responsive system of the type described having a manual switch for causing a motor action to drive the dampers to a firing position when the switch is manually moved into a position in which a standard furnace thermostat controls subsequent motor action, and the subsequent motor action is utilized to return the switch to its initial position under power of the motor operator. In accordance with the invention the motor operator and switch are combined in a unitary structure, and simple and inexpensive driving connections are provided between them for producing the function described above. With this arrangement, the motor operator may be used in control systems not employing the furnace thermostat without materially increasing the cost of the motor operators above that of operators not equipped with the switch return feature.

Accordingly, a broad object of the present invention is to generally provide improvements in the construction and arrangement of apparatus employed in temperature control systems of the type described, promoting increased economy of construction and efficiency in operation.

Another object of the invention is to provide an improved motor operator for use with a damper regulated furnace comprising an electric motor and a manually operable switch movable into a position to initiate a motor action moving a damper into a firing position, the switch being operable when in such position to place subsequent motor action under control of a standard furnace thermostat, and a motor operator comprising driving connections between the motor and the switch whereby motor action initiated by the furnace thermostat returns the manual switch to its initial position.

A further object of this invention is the provision of a motor operator having an electric motor, and a shaft driven thereby through a sequence of one-half revolution movements, having also a manual switch for initiating motor action to drive the shaft through one of the movements, and further having driving connections between the shaft and switch whereby subsequent movement of the shaft returns the switch to its initial position.

A still further object of this invention is to provide, in a motor operator having an electric motor, a manual switch for initiating motor operation and simple, reliable, and inexpensive driving connections between the motor and switch whereby the switch is returned to its initial position under power of the motor upon subsequent motor action.

Other objects and advantages of the invention

will become apparent from the following specification and claims, reference being had to the accompanying drawing in which the single figure schematically discloses the improved motor operator as used in a temperature control system employing a damper regulated furnace.

Referring to the drawing, the numeral 10 generally designates a conventional furnace of the hot air type having a bonnet 11 and the usual draft and check dampers 12 and 13, respectively. The draft damper 12 is associated with the combustion chamber of the furnace in the usual manner, and the check damper 13 is mounted on the stack 14 which communicates with the combustion chamber, also in the usual manner. Leading from the bonnet 11 is a duct 15 through which heat generated in the bonnet is transferred to a space 16. A return duct 17 is provided through which the cold air in the space is returned to the bonnet.

A motor operator generally designated by the numeral 18 is provided for driving the dampers 12 and 13 between draft-increasing and draft-retarding positions. The motor operator 18 comprises a motor which may be of the unidirectional inductive motor type having a squirrel cage rotor 19 and a single winding 20 for actuating the rotor. The rotor 19 drives an operator shaft 21 through a reduction gear train 22, the direction of rotation being indicated by the arrows 23. The operator shaft 21 carries a pair of diametrically opposed operator arms 24 and 25 which are connected to the dampers 12 and 13 by suitable chain and pulley connections 26 and 27, respectively. Thus, when the arms 24 and 25 are in the position shown, the dampers are in their full line positions which provides a draft-retarding condition of the furnace 10. When the arms 24 and 25 are in their dotted line positions, the dampers 12 and 13 are in their dotted line positions which provides a draft-increasing condition of the furnace 10.

In order to limit the movement of the shaft 21 to 180° movement to thereby provide movement of the dampers between the draft-increasing and draft-retarding positions, a pair of limit switches 28 and 29 are provided which are actuatable by the shaft 21. The switch 28 comprises a fixed contact 30 engageable by a movable contact 31 carried by a blade 32. The blade 32 is provided with a follower 33 which rides upon the peripherial surface of a cylindrical cam 34 secured to the shaft 21. The cam 34 is provided with an indentation 35 which when aligned with the follower 32 receives the same to open the switch 28. In like manner, the switch 29 comprises a fixed contact 36 engageable with a movable contact 37 which is carried by a blade 38. The blade 38 carries a follower 39 which rides upon a cylindrical cam 40 secured to the shaft 21. The cam 40 has an indentation 41 which receives the follower 39 when aligned therewith to open the switch 29. Since the indentations 35 and 41 are diametrically opposed, it will readily be seen that but one of the switches 28 and 29 will be opened at any one time. Also, since the indentations are small compared to the peripheral surface of the cams 34 and 40, slight movement of the shaft 21 provides a closed condition of the switches for the greater part of one-half a revolution. Thus, by this arrangement, as will hereinafter appear, the switches 28 and 29 provide a means for maintaining the energization of the motor winding 20 once the energization has been initiated. The fixed contacts 30 and 36 are connected by a suitable conductor 42 which in turn is provided with a terminal 43. The switch blades 32 and 38 are similarly provided with terminals 44 and 45, respectively.

Means hereinafter to be described are provided for short-circuiting the terminals 43, 45 when the switch 29 is open to complete a circuit through the switch 28 for energizing the winding 20 to drive the dampers to their draft-increasing position. The means is also arranged to short-circuit the terminals 43, 44 when the switch 28 is open to establish a circuit for energizing the winding 20 through the switch 29 to drive the dampers to their draft-retarding position.

The motor operator 18 further comprises a manual switch 46 which is manually movable into three positions indicated by the legends "open," "automatic" and "closed." The switch 46 comprises a switch arm 47 which is engageable with a fixed contact 48 when in the automatic position, is engageable with a fixed contact 49 when in the open position, and is engageable with a fixed contact 50 when in the closed position. As will hereinafter appear, when the switch arm 47 is in engagement with the contact 48 a thermostat 51 located in the space 16 is provided for short-circuiting the terminals 43, 45 upon a decrease in temperature below a desired value and for short-circuiting the terminals 43, 44 upon an increase in the space temperature above the desired value to initiate energization of the winding 20. When the switch arm 47 is moved into engagement with the contact 49, the terminals 43 and 45 are short-circuited to complete a circuit to the winding 20 to move the dampers to a draft-increasing position, and when the switch arm 47 is moved into engagement with the contact 50 the terminals 43 and 44 are short-circuited to complete a circuit to the winding 20 to move the dampers to a draft-retarding position. Also, as will hereinafter appear, when the switch arm 47 is placed in the open position, further motor operation is placed in control of a furnace thermostat generally designated by the numeral 52. When the furnace temperature rises to a dangerously high value, the thermostat 52 short-circuits the terminals 43, 44 to drive the dampers to their draft-retarding position.

The switch arm 47 is pivotally mounted at 53, the pivotal axis 54 extending generally parallel to the axis of the shaft 21. The arm 47 is provided with an extension 55 which extends from the switch arm 47 in such a manner that when the arm 47 is in the automatic position the extension 55 just clears the path of movement 56 of an arm 57 secured to the shaft 21 for rotation therewith. As previously stated, when the switch arm 47 is moved to the open position the shaft 21 rotates 180°. Such movement of switch arm 47 brings its extension 55 to the dotted line position. The 180° movement of the dampers brings them into draft-increasing position. With this motor movement, the arm 57 moves to its dotted line position. Further slight movement of arm 57 will cause it to engage extension 55. Accordingly, as the arm 56 moves from its dotted line to full line position, it drives the switch arm 47 back to its full line position, thus providing a return of the manual switch 46 to its automatic position under power of the motor for a purpose hereinafter to appear.

The thermostat 51 is of the three wire type comprising a bimetallic element 58 to which is secured an actuating blade 59. The blade 59 car-

ries a movable contact 60 which is engageable with spaced fixed contacts 61 and 62. Upon a decrease in temperature from a desired value, the blade 59 moves in the direction of the legend C for causing an engagement of the contacts 60 and 61. Upon a rise in temperature above the desired value, the blade moves in the direction of the legend H to cause engagement of the contacts 60 and 62.

The furnace thermostat 52 comprises a helical bimetallic element 63 which is inserted in the bonnet 11. On a rise in furnace temperature the element 63 actuates a rod 64 which in turn rocks a mercury switch in a counter-clockwise direction. The mercury switch comprises a glass envelope 65 provided with two pairs of electrodes 66, 67 and 68, 69 engageable by a globule of mercury 70 carried in the envelope 65. The electrodes 67 and 68 are connected together to provide a common terminal as shown in the drawing.

The motor winding 20 is energized by a step-down transformer comprising a primary winding 71 connected to a suitable A. C. source of power and a secondary winding 72.

In operation, with the parts in the positions as shown, the thermostat 51 is satisfied and the heat supplied by the furnace 10 is just sufficient to offset the loss from the space 16. Upon a drop in temperature from the desired value, the contact 60 engages the contact 61 to provide a circuit for energizing the motor winding 20. This circuit may be traced as follows: from the top side of the secondary 72 through a conductor 73, motor winding 20, conductor 74, a conductor 75, contacts 61, 60, blade 59, element 58, conductor 76, contact 48, switch arm 47, a conductor 77, electrode 66, mercury 70, electrode 67, a conductor 78, conductor 42, contacts 30, 31, switch blade 32, and a conductor 79 back to secondary 72.

Upon energization of winding 20, the shaft 21 rotates sufficiently in the direction of arrow 23 to move the follower 39 out of engagement with the indentation 41, thereby closing the switch 29 to establish a maintaining circuit for the winding 20. This circuit may be traced as follows: from the top side of the secondary 72 through the conductor 73, winding 20, conductor 74, switch arm 38, contacts 37, 36, conductor 42, contacts 30 and 31, switch blade 32, and conductor 79 back to secondary 72. The shaft 21 then continues to rotate until the switch 28 is opened, at which time the dampers have been driven to their draft-increasing position. The furnace 10 then operates to provide additional heat to the space 16. After a time, the thermostat 51 will begin to feel the effect of the additional heat supplied and under ordinary circumstances would move in the direction of legend H to close the contact 60, 62. If, however, the temperature in the bonnet 11 increases until it reaches a dangerously high value before the room thermostat is satisfied, the mercury switch will be rotated counter-clockwise by the element 63 to close a circuit through electrodes 68 and 69. This completes a circuit for energizing the winding 20 as follows: from the top side of the transformer 72, through conductor 73, the winding 20, conductor 74, switch blade 38, contacts 37, 36, conductor 42, conductor 78, electrode 68, mercury 70, electrode 69, and a conductor 80 back to secondary 72. Upon energization of the winding 20, the dampers are returned to their draft-retarding position, where they remain until the temperature in the bonnet drops below the value at which thermostat 52 is set to act. Thereupon the mercury switch returns to the position as shown in the figure, and if the room thermostat is still calling for heat, the circuit previously traced to the winding 20 again causes a motor action to drive the dampers to their draft-increasing position. It will be seen that any circuit completed to the winding 20 through the switch 46 or thermostat 51 for the purpose of opening the draft of the furnace must be completed through the electrodes 66, 67 of the thermostat 52. However, when the dangerously high furnace temperature is reached the electrodes 66, 67 are no longer shorted by the mercury 70. Consequently, the switch 46 and the thermostat 51 are unable to initiate a motor operation to again drive the dampers to a draft-increasing position while the high furnace temperature exists. As will hereinafter appear, the motor operation initiated by the thermostat 52 to return the dampers to a draft-retarding position is utilized to return the manual switch arm 47 to the automatic position when it has inadvertently been left in the open position.

Assuming the room temperature is raised sufficiently before the furnace temperature became excessive. the contact 60 moves out of engagement with the contact 61 and into engagement with the contact 62 to establish a circuit for energizing the winding 20. This circuit may be traced as follows: from the top side of secondary 72 through conductor 73, winding 20, conductor 74, switch blade 38, contacts 37, 36, conductor 42, conductor 78, electrode 67, mercury 70, electrode 66, conductor 77, switch arm 47, contact 48, conductor 76, element 58, blade 59, contacts 60, 62, a conductor 81, and conductor 79 back to the secondary 72. Upon energization of the winding 20 the motor then drives the dampers to their draft-retarding position.

In stoking or firing the furnace, it is desirable to move the dampers to their draft-increasing position. For this purpose, the manual switch 46 is operated, the switch arm 47 being moved into the "open" position. This completes a circuit to the winding 20 as follows: from the top side of the secondary 72 through conductor 73, winding 20 conductor 74, a conductor 82, switch arm 47, conductor 77, electrode 66, mercury 70, electrode 67, conductor 78 conductor 42, contacts 30, 31, switch blade 32, and conductor 79 back to the secondary 72. The motor 20 is then energized to drive the dampers to their draft-increasing position. After the firing of the furnace has been completed the attendant usually moves the switch arm 47 back to the automatic position in which position, as previously pointed out, the thermostat 51 will initiate a motor operation if the temperature of the space 16 is at the desired value or when the temperature rises to the desired value to drive the dampers to their draft-retarding position. If the attendant desires that the dampers be moved to their draft-retarding position immediately, he may move the switch arm 47 to the closed position which establishes a circuit for energizing the winding 20 as follows: from the top side of the secondary 72 through a conductor 73, winding 20, conductor 74, switch blade 38, contacts 37 and 36, conductor 42, conductor 78, electrode 67, mercury 70, electrode 66, conductor 77, switch arm 47 contact 50, a conductor 83, and conductor 79 back to secondary 72. Winding 20 is then energized providing a motor action which drives the dampers to their draft-retarding position.

It frequently happens that the attendant inadvertently leaves the switch arm 47 in the open

position after firing the furnace. As previously stated, this movement of the switch 46 takes the motor operator out of control of the thermostat 51 and places it in control of the thermostat 52. Thus, with the dampers in their draft-increasing position the furnace 10 develops the dangerously high temperature referred to hereinabove which actuates the thermostat 52 to cause a motor action driving the dampers to their draft-retarding position. As previously pointed out, during this motor action the arm 57 on the shaft 21 engages the extension 55 from the switch arm 47 to drive the switch arm 47 back to its automatic position to again place further motor action under the normal control of the room thermostat 51 and limit control 52.

From the foregoing, it is now apparent that I have provided a motor operator well adaptable to fulfill the objects of the invention set forth hereinabove. While I have disclosed but a single embodiment of my invention, I contemplate all such further embodiments and structural modifications thereof as would naturally occur to those skilled in the art without departing from the spirit of the invention as defined by the appended claims.

I claim as my invention:

1. In a temperature control system, a furnace for heating a space, dampers on the furnace movable between draft-increasing and draft-retarding positions, a unidirectional motor operator for driving the dampers between said draft-increasing and draft-retarding positions, a thermostat in the space for initiating operation of the motor operator in accordance with variations of the space temperature from a desired value, a manually operable switch associated with the motor operator movable between a first position in which the thermostat completes a circuit through the switch for the control of said dampers according to the temperature in said space, a second position in which the switch completes a circuit to the motor operator independently of the thermostat, said motor operator operating to drive said dampers to a draft-increasing position when said switch is manually moved to said second position, and a third position in which the switch completes another circuit to the motor operator independently of the thermostat to move said dampers to a draft retarding position, a thermostat associated with the furnace and responsive to a predetermined temperature thereof for initiating operation of the motor operator independently of the space thermostat and manual switch when the same is in said second position to drive the dampers to a draft-retarding position, and operative connections between the motor operator and manual switch operable to positively move the switch to the first position thereof only when the motor operator moves said dampers into said draft-retarding position.

2. In a temperature control system, a furnace for heating a space, dampers on the furnace movable between draft-increasing and draft-retarding positions, a motor operator for driving said dampers between said draft-increasing and draft-retarding positions, said operator comprising switch means for maintaining a circuit thereto for one-half revolution movements and for terminating operation thereof at the end of said movements, a space responsive thermostat, a furnace responsive thermostat, a manually operable switch associated with the motor movable between first, second and third positions, a source of power, and electrical connections between the source of power, manual switch, furnace thermostat, space thermostat, motor switch means, and motor providing a first circuit in which motor operation is initiated by the room thermostat for control of said dampers according to the temperature in said space when the manual switch is in said first position, said connections providing a second circuit in which motor operation is initiated by the manual switch independently of the room thermostat to move said dampers to a draft increasing position when the manual switch is moved to said second position, said connections providing a third circuit in which motor operation is initiated by a manual switch independently of the room thermostat to move said dampers to draft retarding position when the manual switch is moved to said third position and said connections providing a fourth circuit in which motor operation is initiated by the furnace thermostat independently of the space thermostat and manual switch when the manual switch is in said second position, and driving connections between the motor and manual switch operable to move the manual switch from said second to said first position when the motor operation is initiated by said fourth circuit.

3. In a temperature control system, a furnace for heating a space, dampers on the furnace movable between draft-increasing and draft-retarding positions, a motor operator for driving said dampers between said draft-increasing and draft-retarding positions, said operator comprising switch means for maintaining a circuit thereto for one-half revolution movements and for terminating operation thereof at the end of said movements, a space responsive thermostat, a furnace responsive thermostat, a manually operable switch associated with the motor movable between first, second and third positions, a source of power, and electrical connections between the source of power, manual switch, furnace thermostat, space thermostat, motor switch means, and motor providing a first circuit in which motor operation is initiated by the room thermostat when the manual switch is in said first position, said first circuit including the source of power, motor, space thermostat, manual switch, furnace thermostat, and motor switch means, said connections providing a second circuit in which motor operation is initiated by the manual switch independently of the room thermostat to move said dampers to a draft increasing position when the manual switch is moved to said second position, said second circuit including the source of power, manual switch, furnace thermostat, and motor switch means, said connections providing a third circuit in which motor operation is initiated by the manual switch independently of the room thermostat to move said dampers to a draft retarding position when the manual switch is moved to said third position, said third circuit including the source of power, motor, motor switch means, furnace thermostat, and said manual switch and said connections providing a fourth circuit in which motor operation is initiated by the furnace thermostat independently of the space thermostat and manual switch when the manual switch is in said second position, said fourth circuit including the source of power, motor, and motor switch means, and driving connections between the motor and manual switch operable to move the switch from said second to said first

position when the motor operation is initiated by said fourth circuit.

4. In a temperature control system a space to be heated, heat exchange means for heating said space, a member controlling said heat exchange means, said member having first and second positions respectively adapted to increase and decrease the output of said heat exchange means, motor means operating said member, first heat responsive means in said space selectively actuating said motor means to operate said member into said first and said second positions, means manually operable to a first, second and third position for controlling the operation of said member, said member being operable by said first heat responsive means when said manual means is placed in said first position, said member being operable to supersede said first heat responsive means to move said member to its first position when said manual means is placed in said second position, said manual means being operable to supersede said first heat responsive means when said manual means is placed in said third position to actuate said motor means to move said member into its said second position and second heat responsive means in heat transfer relation with said heat exchange means superseding said first heat responsive means and said manually operable means and actuating said motor means to operate said member only into said second position, said manually operable means being positively disengageable from operative relation by operation of said member only from said first position to said second position.

5. In a temperature control system a space to be heated, heat exchange means for heating said space, a member controlling said heat exchange means, said member having first and second positions respectively adapted to increase and decrease the output of said heat exchange means, unidirectional motor means operating said member, first heat responsive means in said space selectively actuating said motor means to operate said member into said first and said second positions, means manually operable to a first, second and third position for controlling the operation of said member, said member being operable by said first heat responsive means when said manual means is placed in said first position, said member being operable to supersede said first heat responsive means to move said member to its first position when said manual means is placed in said second position, said manual means being operable to supersede first heat responsive means when said manual means is placed in said third position to actuate said motor means to move said member into its said second position, and second heat responsive means in heat transfer relation with said heat exchange means superseding said first heat responsive means and said manually operable means and actuating said motor means to operate said member only into said second position, said manually operable means being positively disengageable from operative relation by operation of said member only from said first position to said second position.

6. In combination, a motor operator comprising, motor means and an operator shaft driven thereby through a cycle having distinct successive first and second positions; a manually operable control member having first, second and third positions; said manual member being operably connected to said motor means for the control thereof, and means carried by said shaft and adapted to positively move said control member from said first position to said second position only during said second portion of said cycle of said shaft.

7. In combination, a motor operator comprising, motor means and an operator shaft unidirectionally driven thereby through a cycle having distinct successive first and second positions, a manually operable control member having first, second and third positions; said manual member being operably connected to said motor means for the control thereof, and means carried by said shaft and adapted to positively move said control member from said first position to said second position only during said second portion of said cycle of said shaft.

8. In combination, a motor operator comprising, motor means and an operator shaft driven thereby through a cycle having distinct successive first and second portions, said shaft having first and second positions successively attained by moving through said first and second portions of said cycle, a manually operable control member having first, second and third positions; said manual member being operably connected to said motor means for the control thereof, and means carried by said shaft and adapted to positively move said control member from said first position to said second position only during said second portion of said cycle of said shaft.

9. In combination, a motor operator comprising, motor means and an operator shaft unidirectionally driven thereby through a cycle having distinct successive first and second portions, said shaft having first and second positions successively attained by movement through said first and second portions of said cycle, a manually operable control member having first, second and third positions; said member being operably connected to said motor means for the control thereof, and means carried by said shaft and adapted to positively move said control member from said first position to said second position only during the second portion of said cycle of said shaft.

10. In a temperature control system, a furnace for heating a space, dampers on the furnace movable between draft-increasing and draft-retarding positions, a motor operator for driving the dampers between said draft-increasing and draft-retarding positions, a thermostat in the space for initiating operation of the motor in accordance with variations of the space temperature from a desired value, a manually operable switch associated with the motor movable to a first position in which the thermostat completes a circuit through the switch and to a second position in which the switch completes a circuit to the motor independently of the thermostat, said motor operating to drive said dampers to a draft-increasing position when said switch is manually moved to said second position, a thermostat in heat transfer relation with the furnace and responsive to a predetermined temperature thereof for initiating operation of the motor independently of the space thermostat and manual switch when the same is in said second position to drive the dampers to a draft-retarding position, and operative connections between the motor operator and manual switch operable to return the switch to the first position thereof only when the motor operates to move said dampers into said draft-retarding position.

11. In combination, a motor operator comprising, motor means and an operator shaft driven

thereby through a cycle having distinct successive first and second positions; a manually operable control member having first, second and third positions; said manual member being operatively connected to said motor means, said control member being operable in said third position to only move said shaft from said first to said second position.

12. In a condition control system, a space whose condition is to be affected, a unit for affecting the condition of said space, elements of said unit being movable between two positions, motor means operable to move said elements between a first position and a second position, a manual member operably associated with said motor means for controlling the position of said elements, said member being adapted for movement to one of three positions.

13. In a temperature control system, a furnace for heating a space, dampers on the furnace movable between draft-increasing and draft-retarding positions, a thermostat in the space for initiating operation of the motor in accordance with variations of the space temperature from a desired value, a manually operable switch associated with the motor movable to a first position in which the motor is responsive to the space thermostat for initiating the operation of the motor to move the dampers to draft-increasing or draft-retarding position, a second position in which the motor drives the dampers to a draft-increasing position, and a third position in which the motor drives the dampers to a draft-retarding position, a thermostat in heat transfer relation with the furnace and responsive to a predetermined temperature thereof for initiating operation of the motor independent of the space thermostat and manual switch when the manual switch is in said second position, to drive the dampers to a draft-retarding position, and operative connections between the motor operator and manual switch operable to return said switch from said second to said first position only when the motor operates to move said dampers into draft-retarding position.

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