Oct. 26, 1965 M. E. ANDERSON ETAL 3,213,928

AIR CONDITIONER DAMPER CONTROL

Filed May 29, 1962

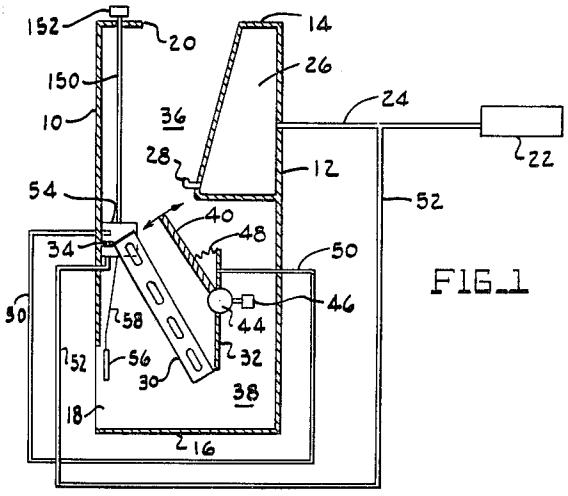


FIG_1

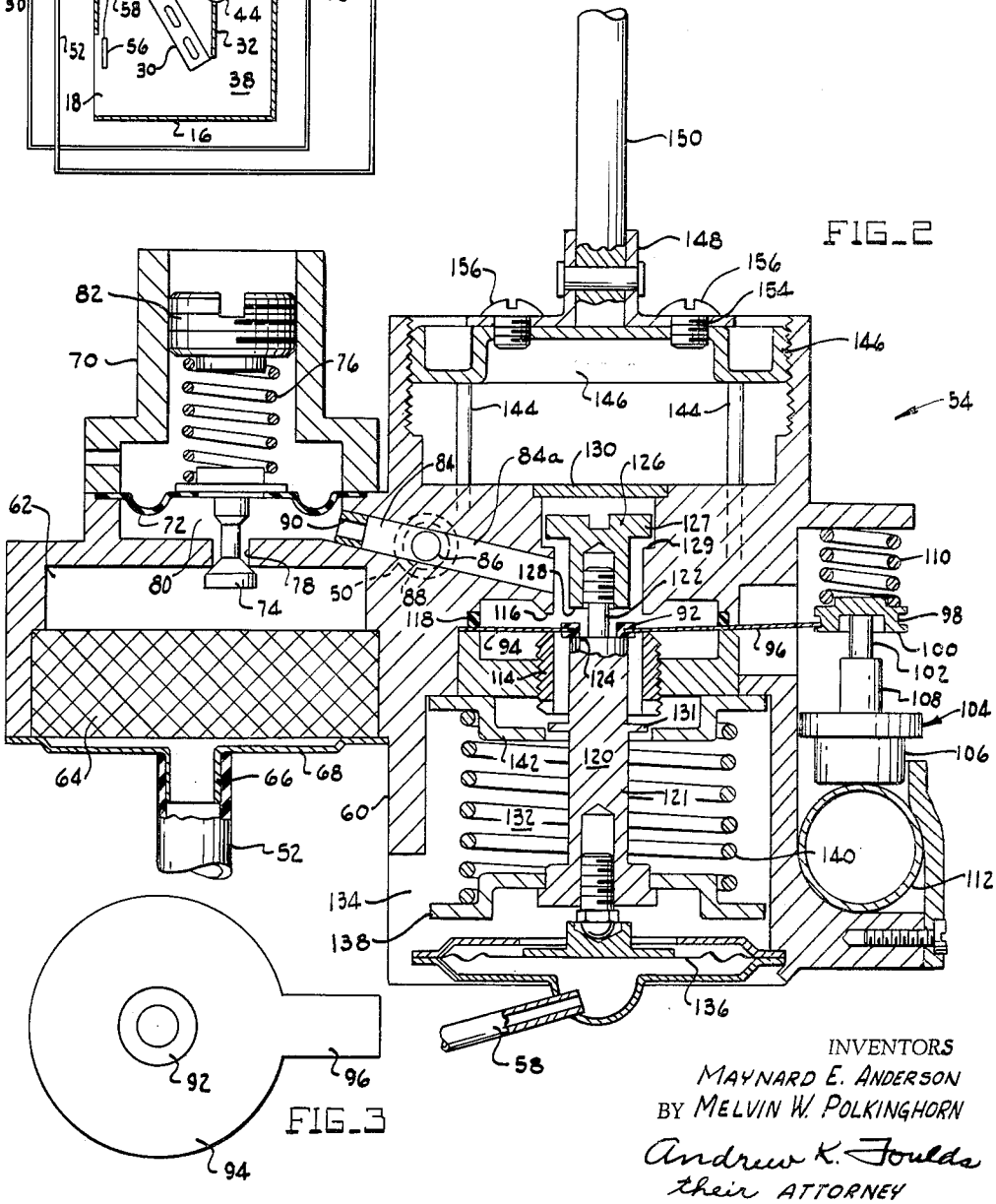


FIG_2

FIG_3

INVENTORS
MAYNARD E. ANDERSON
BY MELVIN W. POLKINGHORN
Andrew K. Foulds
their ATTORNEY

United States Patent Office

3,213,928

Patented Oct. 26, 1965

3,213,928

AIR CONDITIONER DAMPER CONTROL

Maynard E. Anderson, Birmingham, and Melvin W. Polkinghorn, Livonia, Mich., assignors to American Radiator & Standard Sanitary Corporation, New York, N.Y., a corporation of Delaware

Filed May 29, 1962, Ser. No. 198,578
4 Claims. (Cl. 165—26)

This invention relates to an air control device, particularly to a device for delivering a controlled flow of high pressure air through a bleedable air line to an operator for an air conditioner damper. The invention has particular applicability in the type of air conditoner which has a heat exchange coil, a bypass around the coil, and a damper for apportioning flow through the coil and bypass. In such air conditioners the heat exchange coil may be connected to a source of hot water during the heating season and to a source of cold water in the cooling season; the air temperature at the air conditioner discharge is regulated by movement of the aforementioned damper by some suitable control device. The present invention seeks to provide improvements in such control devices.

It is a primary object of the present invention to provide a unitary control device for air conditioner dampers, which device is characterized by features of simplicity, effective control during both the heating and cooling seasons, relatively low cost, ability to use standard control components, and incorporation of a multiplicity of control functions in a single structure.

Other objects of this invention will appear from the following description and appended claims, reference being had to the accompanying drawings forming a part of this specification wherein like reference characters designate corresponding parts in the several views.

In the drawings:

FIGURE 1 is a semi-schematic view showing an air conditioner having a control device of the present invention incorporated therein;

FIG. 2 is a sectional view taken through the control device utilized in the FIG. 1 air conditioner; and

FIG. 3 is a plan view of an adjustable valve seat element utilized in the FIG. 2 device.

Before explaining the present invention in detail, it is to be understood that the invention is not limited in its application to the details of construction and arrangement of parts illustrated in the accompanying drawings, since the invention is capable of other embodiments and of being practiced or carried out in various ways. Also, it is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation.

Referring particularly to FIG. 1, there is shown a conventional induction type air conditioner having first and second elongated parallel walls **10** and **12**, and third and fourth connecting short walls **14** and **16**. A room air entrance opening **18** is formed in wall **10**, and an air discharge opening **20** is formed in wall **14**. Primary high pressure air from source **22** is directed through high pressure air line **24** into the plenum chamber **26** which is equipped with conventional discharge nozzles **28** for directing the high pressure air toward discharge opening **20**. As is conventional, a relatively small flow of primary air through nozzles **28** induces a larger flow of secondary air from entrance opening **18**.

Arranged within the air conditioner casing is a conventional finned heat exchange coil **30**, one end of which is located adjacent a fixed partition **32**, and the other end of which is located adjacent a fixed partition **34**. It can be seen that the air from inlet **18** can be conducted to chamber **36** either by passing through the heat exchange coil **30** or by passing around the heat exchange coil through

the defined bypass **38**. To apportion the air flow across the heat exchange coil and bypass there is provided a damper **40** having a pivotal mounting at **44**, and having a weight **46** causing it to normally close bypass **38**. To operate the damper toward a position opening bypass **38** there is provided a bellows operator **48** which receives high pressure operating air from a control line **50**. This control air is initially taken from source **22**, conducted through high pressure line **52** to our improved control device **54**, and thence into the aforementioned control line **50**. It will be understood that the term "high pressure" is utilized in a relative sense, since in an absolute sense the control air pressure may be low, as for example less than one p.s.i.

Control device **54** is provided with a thermostatic valve section which regulates flow through an atmospheric bleed port (not shown in FIG. 1) in accordance with room temperature change at sensing bulb **56**. When the bleed port is open weight **46** moves damper **40** toward a position closing bypass **38**, and when the bleed port is closed the operating pressure is applied to operator **48** to move the damper toward a position opening the bypass. As will be later apparent, the thermostatic valve section of device **54** is constructed to includes a second temperature sensing element which responds to the temperature of the liquid in coil **30** for causing bulb **56** to properly control the conditioner during both the heating and cooling seasons.

Referring now more particularly to FIG. 2, control device **54** comprises a main housing **60** defining an air inlet chamber **62** in which is mounted a conventional air filter **64**; supply air is delivered to filter **64** through conduit **52**. Disposed in series flow relation with inlet chamber **62** is a pressure regulator which includes a cover-like housing **70**, a diaphragm **72**, and a flow-throttling element **74** normally urged to the open position by a compression spring **76**. In operation of the pressure regulator, at zero pressure in chamber **62** spring **76** is effective to move element **74** to a position opening port **78**. As the air flows through port **78** it develops a pressure on the underside of diaphragm **72** which moves the diaphragm toward a position in which element **74** closes port **78**. After start-up the diaphragm fluctuates back-and-forth so as to maintain a substantially constant pressure in chamber **80**. The value of this pressure is determined by the loading of spring **76**, as by adjustment of set screw **82**. The above described pressure regulator is by itself not new, and it enters into the invention only to the extent that it is incorporated with the other control components to be described hereinafer.

In the illustrated control device chamber **80** communicates with a duct **84** which leads to a transverse duct **86** formed in a tubular air outlet element **88**. Element **88** receives the end portion of conduit **50**, which directs the high pressure control air from chamber **80** to the bellows operator **48** as previously described. It is desirable that the flow through conduit **50** be relatively constant; to insure a constant flow there is provided in duct **84** an annular insert **90** having a desired size restriction orifice for constricting the air flow from chamber **80**. The use of a constant flow regulating or restricting orifice is not new, but it is believed novel to incorporate such a constant flow orifice into a unitary control device as illustrated.

The application of air pressure to bellows operator **48** is controlled by the bleed off of air through a bleed passageway defined by duct section **84***a*, the central opening through rubber grommet **92**, the annular passage within element **114**, and atmospheric chamber **132**. The opposite faces of grommet **92** constitute valve seat surfaces for alternate cooperation with the two valve element surfaces defined by shoulders **128** and **124** on thermostatic stem **120**. Grommet **92** is carried on or forms

part of an oil can disc 94 which is provided with an arm-like extension 96 extending into a groove 98 formed in a spring retainer element 100.

Extending within retainer 100 is the piston 102 of a thermostatic power element 104. Element 104 may take various different constructions, one example of which is shown in U.S. Patent 2,636,776. The illustrated power element comprises a cup-like casing 106 containing a charge of wax or similar thermally expansible material, and a piston-guiding sleeve 108 arranged so that increasing temperatures are effective to move the piston 102 upwardly, and decreasing temperatures are effective to allow the compression spring 110 to move piston 102 downwardly. Power element cup 106 is in thermal engagement with convolution 112 of the heat exchange coil 30 so that when cold water is being circulated through the heat exchange coil (as during the cooling season) piston 102 will be moved downwardly from its illustrated position, and when hot water is being circulated through coil 30 (as during the heating season) piston 102 will be urged upwardly to its illustrated position in which retainer 100 acts on arm 96 for holding disc 94 against the stop formed by annular adjustable element 114. When piston 102 is moved downwardly by spring 110 (cooling season) member 100 acts on arm 96 to urge disc 94 upwardly against stop 116. During movement of disc 94 between the two stops its peripheral edge acts as a fulcrum; to permit the fulcrum action without allowing air flow around the disc peripheral edge there is preferably provided a soft annular givable sealing element 118. It will be understood that disc 94 moves only during summer-winter changeover. During normal operation the disc remains in one position engaged with one of the two stops.

Extending through the central space defined by grommet 92 is a two piece elongated stem 120 comprised of a rod 121 and an internally threaded sleeve 126. A cap 130 is positioned above sleeve 126 so that air from duct passageway 84*a* is directed downwardly along stem 120 into atmospheric chamber 132 when shoulders 124 and 128 are spaced from grommet 92.

In order to operate stem 120 there is provided the aforementioned thermal bulb 56 (FIG. 1) and capillary 58. Bulb 56 is charged with a thermally expansible fluid such that temperature increase in the air entering through conditioner opening 18 is effective to move the metallic diaphragm 136 (FIG. 2) upwardly for thereby effecting a corresponding movement of stem 120. Stem 120 carries a spring retainer 138 which engages one end of compression spring 140. The other end of spring 140 engages a spring retainer 142 which abuts against three push rods 144 extending through suitable bored holes in the casing 60. The upper ends of push rods 144 abut against a threaded disc or screw 146 which carries a flanged sleeve-like connector element 148. Extending from sleeve 148 and fixedly secured thereto is an elongated operating rod 150, the upper end of which may be provided with a temperature adjustment knob 152 for manual rotation purposes. For factory temperature calibration purposes member 148 is preferably arranged to have an adjustable connection with disc 146, as by forming arcuate slots 154 in member 148 and extending clamping screws 156 therethrough into threaded openings in disc 146.

It will be seen that manual rotation of rod 150 to move disc 146 downwardly causes the push rods 144 to advance spring retainer 142 downwardly for thereby increasing the loading on spring 140 . The spring loading opposes the expansion of the charge in bulb 56, so that a lowered position of push rods 144 is effective to raise the air temperature necessary to move stem 120 to a predetermined position. Thus, it will be seen that rod 150 and the associated mechanisms constitute means for varying the entrance air temperature which is effective to close shoulder 124 against grommet 92 during the heating season. Mechanism 150 also functions as a temperature adjustment for varying the entrance 18 temperature at which grommet 92 closes against upper shoulder 128 during the cooling season.

During winter operations disc 94 is in its illustrated position. As the components are pictured in FIG. 2 sensing element 56 is satisfied. On a drop in entrance air temperature element 56 cools so that spring 140 is able to move stem 120 downwardly, with a consequent movement of shoulder 124 away from grommet 92; as a result air from passageway 84*a* is permitted to bleed through grommet 92 to atmosphere, and the pressure in line 50 thereby drops to permit weight 46 to move damper 40 toward a position opening the air path through heat exchange coil 30.

If stem 120 were allowed unlimited downward movement shoulder 128 would engage grommet 92 and send damper 40 to a position closing coil 30 while sensing element 56 was still calling for conditioning; element 56 could never be satisfied, and the damper would be permanently locked in a position closing the coil. To prevent such a condition stem member 126 is provided with a flange 127 which strikes the subjacent surface 129 before shoulder 128 can seat on grommet 92. Flange 127 acts merely as a stop, not as a valve element.

During summer operations coil 30 is connected to a source of cold water so that power element piston 102 moves down to allow member 100 to snap disc 94 to a position engaged with stop 116. While sensing element 56 is satisfied shoulder 128 remains seated on grommet 92, and the pressure in line 50 is sufficient to hold damper 40 at or adjacent a position closed across coil 30. Element 56 calls for cooling by moving stem 120 upwardly such that shoulder 128 leaves grommet 92 to open the bleed passageway 84*a*; the pressure in line 50 thereby drops to permit weight 46 to open the damper. Flange 131 on stem 120 may engage the lower end of member 114 to limit excessive upward movement of the stem such as would cause damper 40 to become permanently locked in a position closing coil 30 during the cooling season.

It will be understood that in actual operations damper 40 may fluctuate between its limiting positions, or remain substantially motionless in an intermediate position, or fluctuate without reaching its limiting positions. In the illustrated air conditioner the flow of primary air through nozzles 28 and the flow of heat exchange liquid through coil 30 may be continuous, with the room temperature being regulated by the damper position as determined by bulb 56 and the temperature adjustment knob 152. In some cases a small continuously open bleed or relief valve may profitably be provided for bellows operator 48; such a bleed or relief valve can be located at various points in the system and during operation tends to prevent the bellows from accumulating a body of high pressure air such as would retard the action of weight 46 at the moments when bulb 56 becomes satisfied.

As shown in FIG. 1 the damper is moved to a bypass-closed position by weight 46 and to the bypass-open position by operator 48. If desired the weight could be arranged to move the damper to the bypass-open position, in which case operator 48 would move the damper to the bypass-closed position. The present invention is not concerned broadly with the weight-operator 48 concept but is rather concerned with the simplified control device of FIG. 2, and its relationship with the air conditioner mechanisms. The air conditioner is shown in an upright position for use as a wall unit; however it could be disposed horizontally for use as a ceiling unit.

Within the broader aspects of the invention the FIG. 2 control device is subject to some modification as regards the construction of the temperature responsive power means defined by elements 104 and 94. For example, disc 94 could be formed as a bimetal snap disc arranged to receive heat from conduit 112 by conduction through hous-

ing 60; in that event element 104 and disc extension 96 would be eliminated.

In reading the claims on the accompanying drawings it is intended that the term "temperature responsive power means" shall comprehend element 104 and its equivalent. It is intended that the term "temperature responsive power mechanism" shall comprehend elements 56, 136, and their equivalents. The term "main passageway" as used in the claims is intended to refer to the passageway defined between inlet chamber 62 and outlet 88, and the terms "bleed passageway" or "bleed line" are intended to refer to the passageway from passage section 84*a* to the atmospheric chamber 132. The essential features of the invention are set forth in the claims.

We claim:

1. In a heating-cooling air conditioner having a heat exchange coil, a bypass around said coil, and a damper operated by pressure developed within a bleedable air line for apportioning flow through the heat exchange coil and bypass, the improvement comprising a single unitary control device for delivering a controlled flow of high pressure air through the bleedable air line to operate the damper; said unitary control device comprising a valve element and connected temperature responsive power mechanism operated by room temperature change to open and close the bleed in the air line, and an adjustable valve seat and temperature responsive power means responding to the temperature of the fluid in the heat exchange coil for modifying the action of the temperature responsive power mechanism so that during one season an increasing room temperature is effective to move the damper toward a position opening the bypass and during the other season an increasing room temperature is effective to move the damper toward a position closing the bypass; said valve element comprising a movable stem having two facing shoulders constituting valve element surfaces, and said valve seat comprising an annular disc located between the two facing shoulders and movable by temperature change in the coil fluid so that one face of the disc cooperates with one valve element surface to open and close the air line during the heating season, and the other face of the disc cooperates with the other valve element surface to open and close the air line during the cooling season.

2. In an air conditioner having first and second elongated parallel casing walls and third and fourth interconnecting short casing walls, a room air entrance opening in the first wall adjacent its juncture with the fourth wall, a mixed air discharge opening in the third wall, a high pressure nozzle-equipped plenum chamber located in the casing adjacent the corner formed by the second and third walls for inducing a flow of air from the entrance opening through the discharge opening, a heat exchange coil disposed within the casing in the path of air flowing through the entrance opening, said coil being spaced from the fourth wall to define a bypass so that air from the entrance opening can either flow through the coil or the bypass, and an operator-equipped damper movably disposed within the casing for apportioning air flow through the heat exchange coil and bypass in accordance with the application of air pressure to the operator; the improvement comprising a unitary control device for the damper operator disposed within the air conditioner casing adjacent the heat exchange coil; said unitary control device comprising a housing structure having an air inlet for high pressure source air, an air outlet for connection with the damper operator, and an air bleed port leading to atmosphere; said control device being divided into an air pressure regulator section and a thermostatic valve section arranged so that high pressure control air flows from the inlet through the pressure regulator section and thence either into the air outlet or bleed port depending on the condition of the thermostatic valve section; said thermostatic valve section including a temperature sensing element positioned in the conditioner air entrance opening to sense room temperature change, and a temperature responsive power element responding to the temperature of fluid in the heat exchange coil for modifying the action of the temperature sensing element so that during one season an increasing entrance air temperature is effective to cause the sensing element to close the bleed port and during the other season an increasing air entrance temperature is effective to cause the sensing element to open the bleed port; and a manually-operable device for varying the temperature at which the sensing element closes the bleed port; said thermostatic valve section comprising a valve stem, a diaphragm connected with the sensing element and stem, and spring means acting on the stem in opposition to the diaphragm; said manually operable device comprising an adjustment screw and push rod means arranged to apply a variable load on the spring means.

3. The combination of claim 2 wherein the diaphragm and adjustment screw are located adjacent opposite faces of the housing structure, with the valve stem therebetween.

4. In a heating-cooling conditioner having a heat exchange coil, a bypass around said coil, and a damper operated by pressure developed within a bleedable air line for apportioning flow through the heat exchange coil and bypass, the improvement comprising a control device for delivering a controlled flow of high pressure air through the bleedable air line to operate the damper; said unitary control device comprising a valve element and connected temperature-responsive power mechanism operated by room temperature change to open and close the bleed in the air line, and an adjustable valve seat element and temperature responsive power means responding to the temperature of the fluid in the heat exchange coil for modifying the action of the temperature responsive power mechanism so that during the heating season an increasing room temperature is effective to move the damper toward a position opening the bypass and during the cooling season an increasing room temperature is effective to move the damper toward a position closing the bypass; said movable valve element having two alternately operable valve element surfaces thereon; said adjustable valve seat element having two alternately operable valve seat surfaces; and two spaced stop elements operatively registering with the seat element whereby flow of hot fluid through the heat exchange coil causes the seat element to take a first position determined by one of the stop elements, and flow of cold fluid through the heat exchange coil causes the seat element to take a second position determined by the other stop element; said movable valve element having one of its valve element surfaces cooperable with one of the seat surfaces to control flow through the air line when the seat element is in its first position; said movable valve element having its other valve element surface cooperable with the other seat surface to control flow through the air line when the seat element is in its second position.

References Cited by the Examiner

UNITED STATES PATENTS

1,988,345	1/35	Vaughn.	
2,231,163	2/41	Johnson	236—92 X
2,495,227	1/50	Lum	236—1
2,532,896	12/50	Dillman	236—99
2,539,194	1/51	Knaus	236—1
2,567,758	9/51	Ashley	165—3
2,660,946	12/53	Peple	98—41
2,776,796	1/57	Mosely	236—1
2,936,121	5/60	Buchel et al.	236—1
2,961,163	11/60	Jensen	236—13
2,998,194	8/61	Curran	236—13
3,100,078	8/63	Dreibelbis	236—47

CHARLES SUKALO, *Primary Examiner.*

ALDEN D. STEWART, *Examiner.*