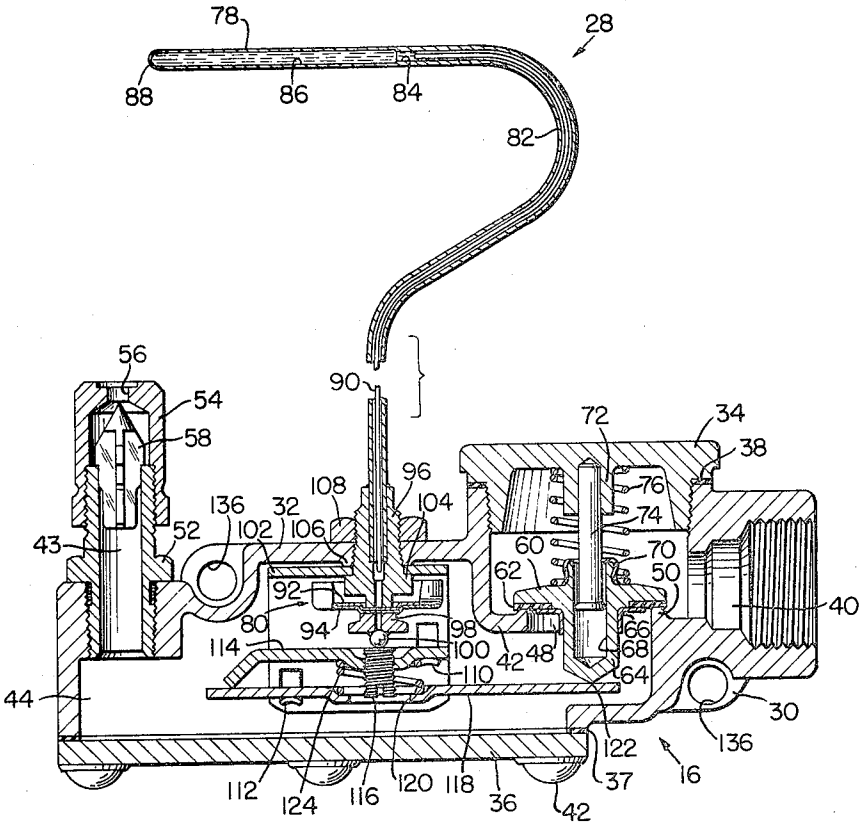
March 1, 1966 V. WEBER 3,237,296

METHOD OF MAKING A THERMOSTATIC CONTROL DEVICE

Original Filed Sept. 29, 1958



United States Patent Office

3,237,296

Patented Mar. 1, 1966

3,237,296

METHOD OF MAKING A THERMOSTATIC CONTROL DEVICE

Victor Weber, Greensburg, Pa., assignor to Robertshaw Controls Company, a corporation of Delaware

Original application Sept. 29, 1958, Ser. No. 763,892. Divided and this application Oct. 8, 1962, Ser. No. 229,778

3 Claims. (Cl. 29—454)

This application is a divisional patent application of the copending parent application, Serial Number 763,892, filed September 29, 1958.

This invention relates to control apparatus for fuel burning appliances and, more particularly, to apparatus of the type adapted to control the flow of gas to a gas burner in such a manner that:

(1) Gas is prevented from flowing to the burner when there is no flame burning which can ignite gas flowing from the burner; and

(2) Gas flow to a burner is interrupted if the flame, which ignited the gas flowing from the burner, goes out.

An object of this invention is to provide an improved method for making such a control appaartus or the like, the method of this invention having one or more of the novel features set forth above or hereinafter shown or described.

In accordance with one feature of this invention, a temperature responsive means is provided with a capillary tube which has a uniform outer diameter, within the limits of manufacturing tolerances, throughout the entire length thereof. One end of the capillary tube is formed with a temperature sensitive portion which comprises an interior chamber having a larger internal diameter than that of the capillary bore of the capillary tube. The length of such a chamber, and the relatively small outer diameter of the tube surrounding the chamber, are especially adapted to be disposed within the path of a small flame which substantially envelopes the temperature sensitive portion and makes the same rapidly responsive to changes in the flame.

In accordance with another feature of this invention, the temperature responsive means is provided with an expanisble power element which is disposed within a flow passage in a valve casing and actuates a lever system to cause a valve means to open and close in response to movement of the temperature responsive power element. The lever system and the power element are supported by a single connecting means within the flow passage.

In accordance with another feature of this invention, the valve is formed with a somewhat elongated casing and has an outlet, extending in a direction transverse to the elongated direction, which is especially adapted to be connected to the mixing chamber of a gas burner so that it is discharged directly through an orifice in the outlet into the mixing chamber. The elongated shape of the valve reduces the vertical depth required and allows such a valve to be installed in installations having a shallow vertical depth between the end of a mixing chamber and an oven wall.

Other objects and advantages of this invention will be apparent from the following description taken in connection with the accompanying drawings wherein:

The drawing is a partial cross-sectional view of the control apparatus of this invention.

As shown in the drawing, valve **16** is provided with a generally elongated casing **30** comprising casing member **32**, cap **34** and plate **36**. Cap **34** is threadably received in casing member **32** and has a gasket **38** disposed therebetween to form a fluid-tight seal. Plate **36** has a gasket **37** disposed between the same and casing member **32** and is connected thereto by a plurality of screws **42**.

Casing **30** is formed with an inlet **40**, an outlet **43**, and an elongated chamber or flow passage **44** extending between inlet **40** and outlet **43**. A partition **46** is formed integral with casing member **32** and extends across chamber **44**. Partition **46** is formed with an aperture or flow passage **48** therein and an annular valve seat **50**.

A double threaded-end connector **52** is threadably received at one end thereof in casing member **32** at outlet **43**. A hood **54**, having a throttling orifice **56** in the end thereof, is threadably received on the other end of connector **52** and cooperates with a needle valve member **58** to restrict the flow of gas through valve **16**. Hood **54** may be rotated to move orifice **56** relative to needle valve **58** to adjust the flow of gas to burner **10**.

A valve member **60** is provided with a ring **62** of flexible material which is engageable with valve seat **50** to prevent gas from flowing from inlet **40** to outlet **43**. An axially extending hub **64** has a retaining ring **66** mounted thereon to hold ring **62** in place. Hub **64** is formed with a bore **68** and has a guide cap **70**, provided with a clip periphery, mounted at the other end thereof.

A projection **72** is formed integral with cap **34** and has a hollow central portion adapted to receive one end of a guide pin **74**. Pin **74** is formed at the other end thereof with an enlarged section which is slightly less in diameter than the bore **68** and acts as a guide, in conjunction with cap **70**, to limit the movement of valve member **60** to a vertical plane, as viewed in the drawing, which movement is generally transverse to chamber **44**. A helical spring **76**, held in compression, extends from casing **30** into contact with valve member **60** and biases the same towards a closed position with valve seat **50**.

Thermally responsive means are provided for moving valve member **60** between positions and generally comprises a temperature sensitive means **28** and an expansible power element **80**. Temperature sensitive means **28** comprises a relatively flexible capillary tube **82** having a capillary bore **84** extending substantially throughout the length threof. A bulb **78** is formed at the outer end of tube **82** by counterboring the end thereof, as for example by drilling, to form an enlarged chamber bounded by a counterbore **86** having a greater internal diameter than that of capillary bore **84**. The outer end of tube **82** is sealed as shown at **88**, as for example by swaging and welding. A wire **90** is disposed within capillary bore **84** and extends substantially throughout the length thereof.

The expansible power element **80** is formed from a pair of shallow, cup-shaped flexible diaphragm members **92** and **94** which are joined together near the outer peripheries thereof to form an expansible chamber therebetween. The power element **80** is connected to the capillary tube **82** by a connector **96** which is adapted to receive the open end of tube **82** and be permanently attached thereto in a fluid-tight seal by welding. Connector **96** has an axial bore formed therethrough which is disposed in alignment with an aperture in diaphragm **92** so that the bore communicates with the space between diaphragm members **92** and **94**. The inner end of connector **96** is permanently attached to diaphragm **92**.

A stud **98** is welded to the lower diaphragm member **94** and is formed with an axial bore which communicates with the space between diaphragm members **92** and **94**. The thermally responsive means is charged, through this axial bore, with a temperature sensitive fluid, after which a ball **100** is welded over the end of the axial bore to form a fluid-tight seal.

It is preferable that the temperature sensitive means **28** be charged with mercury and that the parts in contact with the mercury be formed of a stainless steel which is insoluble in the mercury at the elevated temperatures expected to be encountered during operation. The wire **90** forms a filler for the capillary bore **84** to minimize the

necessary amount of mercury and to act as a compensating means for ambient temperatures existing between the bulb 78 and the expansible power element 80. When the mercury in bulb 78 is heated and it reaches a temperature in excess of its vaporization point, the vaporized mercury causes rapid flow of the liquid mercury through the capillary tube 82 into the space between diaphragm members 92 and 94. Since diaphragm member 92 is held relatively stationary with respect to casing 30, diaphragm 94 moves downwardly, as viewed in the drawing, and causes ball 100 to move therewith. A decrease in the temperature of the mercury within the temperature sensitive means 28 causes mercury vapor therein to contract and return to the liquid state whereupon some of the liquid mercury flows back into bulb 78 from the expansible power element and ball 100 moves upwardly, as viewed in the drawing.

A U-shaped support bracket 102 is disposed within chamber 44 and has an aperture formed in the end wall thereof through which connector 96 extends. A shoulder 104 formed on connector 96 underlies bracket 102 and forces the same into engagement with an annular ridge 106 formed on casing member 32. A nut 108 threadably engages connector 96 and holds bracket 102 and expansible power element 80 within chamber 44.

The legs of bracket 102, only one of which is shown in the drawing, have a pair of fulcrum members 110 and 112. A lever 114 is formed with a shallow, apertured depression intermediate the ends thereof and is adapted to receive a threaded adjusting screw 116 which abuts ball 100. One end of lever 114 is pivoted about fulcrum 110 and the other end engages one end of a lever 118. Lever 118 is pivoted about fulcrum 112 and has an aperture 120 formed therein through which access may be had to adjusting screw 116 when plate 36 is removed from casing 30. Lever 118 contacts valve member 60 at point 122. The legs of bracket 102 prevent lateral displacement of levers 114 and 118.

A helical spring 124 extends between levers 114 and 118 and serves to bias the same apart in such a manner that lever 114 is held in contact with ball 100 and lever 118 is held in contact with fulcrum 112. It should be noted that spring 76 tends to bias the lever 118 in a clockwise direction about fulcrum 112 and lever 114 in a clockwise direction about fulcrum 110. The screw 116 provides an adjusting means by which, one, variations in manufacturing tolerances may be compensated for, two, the maximum opening of valve member 60 can be changed, and three, the temperature at which valve member 60 begins motion upwardly can be varied.

In operation, increases in temperature of sensing means 78 above the vaporization point of the mercury cause power element 80 to expand whereupon ball 100 rapidly moves downwardly, as shown in the drawing, causing levers 114 and 118 to pivot in counterclockwise directions causing valve member 60 to rapidly disengage from valve seat 50. Decreases in temperature of the mercury cause power element 80 to contract whereupon return spring 76 causes valve member 60 to move at the same rate as the levers 118 and 114 move in contact with ball 100 until the valve means, comprising valve member 60 and valve seat 50, is closed.

In operation, when a control valve opens, gas flows concurrently to valve 16 and an igniter pilot. However, since the temperature sensitive means 28 is relatively cool, valve member 60 remains seated against valve seat 50 to prevent a flow of gas through valve 16. The gas flowing to the igniter pilot flows outwardly therefrom and is deflected by a deflector and ignited by the flame at a standby pilot. After ignition, this flame causes temperature sensing means 28 to become heated whereupon, as in the manner previously described, the thermally responsive means causes valve member 60 to open and allow gas to flow through valve 16 to a burner. The gas, flowing from the burner, is ignited by the flame at the igniter pilot. If there is no flame at the standby pilot, the thermally responsive means is not actuated and valve member 60 remains closed.

When the burner is lighted, the flame thereat is ordinarily sufficient to maintain the flame at the igniter pilot which, in turn, maintains the flame at the standby pilot. However, if for some reason, the flame at the igniter pilot goes out and the flame at the standby pilot or the burner is insufficient to re-ignite the same, the temperatur sensitive means 28 cools with the resultant closing of valve member 60 and interruption of the flow of fuel to burner 10. This provides a fail-safe feature. To reset the system, it is necessary to re-ignite the gas flowing from the igniter pilot.

It will be understood that many changes and modifications in the details of construction and arrangement of parts may be made without departing from the scope of this invention as defined in the appended claims.

I claim:

1. The method of producing a temperature sensitive device comprising the steps of nesting one cup-shaped diaphragm within a second cup-shaped diaphragm, sealing together the outer edges of said diaphragms to form an expansible chamber therebetween, each of said diaphragms being centrally apertured, attaching a capillary tube outwardly from the first of said diaphragms centrally thereof and in communication with the aperture therein, sealing the outer end of said capillary tube, attaching a tubular extension outwardly from the second of said diaphragms and in communication with the aperture therein, introducing a temperature sensitive fluid through said tubular extension to fill said capillary tube, said expansible chamber and said tubular extension, and thereafter sealing said tubular extension by welding a steel ball over the open end thereof so that said ball forms a seal at said open end of said tubular extension and an outwardly projecting motion transmitting member for said temperature sensitive device.

2. The method of producing a temperature sensitive device comprising the steps of nesting one cup-shaped diaphragm within a second cup-shaped diaphragm, sealing together the outer edges of said diaphragms to form an expansible chamber therebetween, each of said diaphragms being centrally apertured, attaching a capillary tube outwardly from the first of said diaphragms and in communication with the aperture therein, counterboring the outer end of said capillary tube, sealing said end of said capillary tube, attaching a tubular extension outwardly from the second of said diaphragms and in communication with the aperture thereof, introducing a temperature sensitive fluid through said tubular extension to fill said capillary tube, said expansible chamber, and said tubular extension by welding a steel ball over the open end thereof so that said ball forms a seat at said open end of said tubular extension and an outwardly projecting motion transmitting member for said temperature sensing device.

3. The method of producing a temperature sensitive device by providing a power element with a pair of opposed walls, each of said walls being provided with an aperture therein, hermetically sealing one of said apertures in one of said walls by attaching one end of a capillary tube thereto, said capillary tube being formed with an enlarged bulb portion at the other end thereof, attaching a tubular extension in hermetically sealed relationship over the other of said apertures in the other of said walls, disposing temperature sensitive fluid through said tubular extension, said power element and said capillary tube, and thereafter fastening a ball over the open end of said tubular extension to form a hermetically sealed system throughout the joined interiors of said tubular extension, said diaphragm and said capillary tube so that said ball forms a seal at said open end of said tubular extension and an outwardly projecting motion transmitting member for said temperature sensitive device.

(References on following page)

References Cited by the Examiner

UNITED STATES PATENTS

1,109,705	9/1914	Serrell et al.	92—91 X
1,646,548	10/1927	Maclaren	236—99
1,704,141	3/1929	Muffly	73—368.2
1,751,688	3/1930	Eggleston	236—99
1,884,794	10/1932	McKee	236—99
1,889,792	12/1932	Rosenburgh	73—368.4
1,892,809	1/1933	Robertshaw	158—143
1,956,052	4/1934	Te Pas	158—143
1,958,814	5/1934	Carson	236—99

1,962,063	6/1934	Fickert	73—368.7 X
2,180,018	11/1939	Persons	236—99 X
2,334,603	11/1943	Brumbaugh et al.	236—68
2,387,793	10/1945	Holmes	236—99
2,413,513	12/1946	Morill	73—368.2
2,430,133	11/1947	Muffly	73—368.7 X
2,489,209	11/1949	Watkins	73—368.7 X
2,667,217	1/1954	Caparone	158—125

FREDERICK L. MATTESON, JR., *Primary Examiner.*

FREDERICK KETTERER, JAMES W. WESTHAVER, *Examiners.*