# United States Patent

[11] **3,621,432**


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[54] **THERMOSTAT**
**5 Claims, 5 Drawing Figs.**


[52] **U.S. Cl.** ..... **337/100,** 337/107, 337/377
[51] **Int. Cl.** ..... **H01h37/34,** H01h 61/013
[50] **Field of Search** ..... 219/511; 337/99, 100, 102, 105, 107, 377, 378



[56] **References Cited**

UNITED STATES PATENTS

| | | | |
|---|---|---|---|
| 3,312,802 | 4/1967 | Ryckman, Jr. | 337/102 |
| 3,211,863 | 10/1965 | Levinn | 337/107 |
| 2,920,165 | 1/1960 | Dittman et al. | 337/107 |
| 2,905,790 | 9/1959 | Markham | 337/107 X |
| 2,231,115 | 2/1941 | Garrey | 337/99 X |
| 3,339,043 | 8/1967 | Baak | 337/100 X |



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**ABSTRACT:** A thermostat including a nichrome wire anticipator. The wire is bent into an arc and has a spring to it. The wire, bare of insulation, is placed in contact with the bare bimetal. The spring character of the wire holds it in pressure contact with the bimetal. The wire is everywhere insulated from the bimetal except over a relatively short length of the wire near the midpoint along its length for maximum heat conduction with the bimetal shorting out a substantial length of the wire.

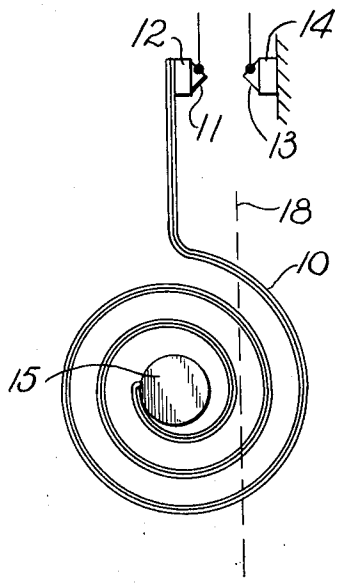



Fig. 1.

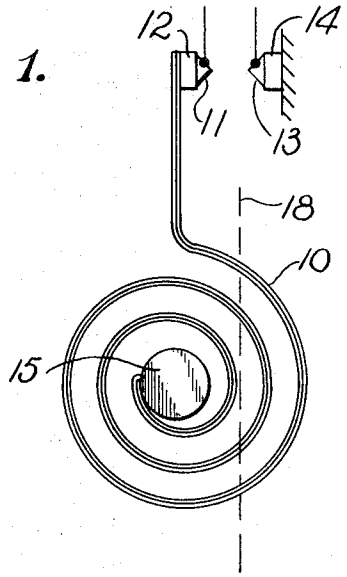



Fig. 2.

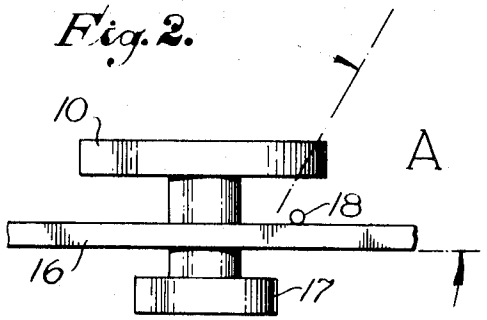
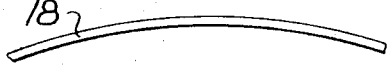



Fig. 4.



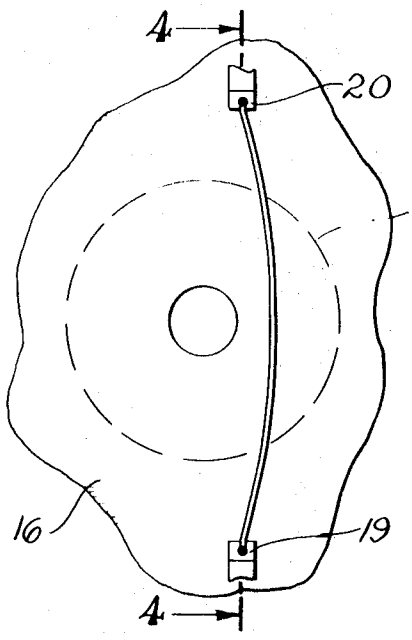
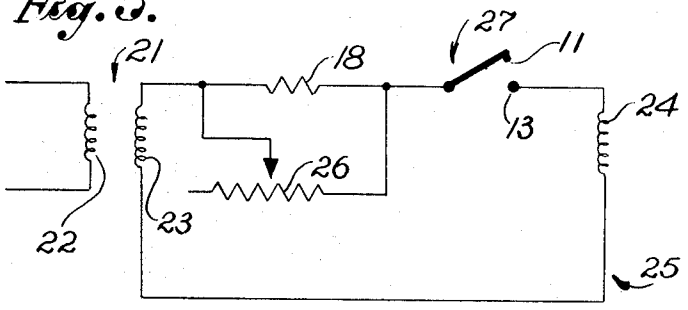




Fig. 3.

Fig. 5.




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# THERMOSTAT

## BACKGROUND OF THE INVENTION

This invention relates to heat-sensitive elements and, more particularly, to a thermostat having a highly efficient heater for use as an anticipator.

A prior art thermostat for use in turning a solenoid gas valve on and off in a conventional gas furnace for use in homes and offices and the like normally includes a bimetal spiral to operate a switch for energizing the valve solenoid. However, when the furnace is turned on by the switch, the furnace will tend to overshoot. That is, the room will get too hot before the thermostat turns the furnace off. For this reason, an anticipator is conventionally used to heat the bimetal so that the thermostat will open the switch in advance of the time it would otherwise shut off the furnace. Such an anticipator is simply a resistive winding which receives electric current as long as the switch is closed. For example, see U.S. Pat. No. 3,339,043.

Notwithstanding the advantage of an anticipator, its use causes another problem. As the heating load increases, the thermostat cycles more often. This causes the anticipator to pump more heat into the thermostat. As a result, the average bimetal temperature is raised further above ambient, and the thermostat fails to switch on the furnace until ambient has fallen below a comfortable temperature. This failure is called droop. Moreover, for a fairly constant ambient temperature, a large cycle rate is desired. However, an increase in cycle rate increases droop.

Prior art thermostats have difficulty maintaining a better cycle rate than 3 cycles per hour if the droop is 40° F. or less. This performance is poor because a cycle rate of 6 cycles per hour is desirable. However, with such a cycle rate, the droop increases to an intolerable 80° F.

## SUMMARY OF THE INVENTION

In accordance with the device of the present invention, the above-described and other disadvantages of the prior art are overcome by providing an anticipator in contact with the heat-sensitive element of a thermostat.

Another feature of the invention resides in electrically insulating most of the element from the anticipator.

According to a special feature of the invention, the anticipator is a single spring wire resistor made of nichrome. The wire is nearly straight. The bimetal of the thermostat is also bare. The spring wire is held, by the spring thereof, into pressure contact with the bimetal over a small area on both. Heat conduction from wire to bimetal is strikingly improved by a metal-to-metal contact and by the spring action. A cycle rate of 6 cycles per hour with a droop of 2° F. is thereby made possible. The present invention thus has a performance much improved over that of the prior art. Note will be taken that the present invention makes possible a high cycling rate with little droop because the little wire efficiently heats the bimetal. Less power input to the wire is required because it is an efficient heater. Since less heat is put into the thermostat, droop is less.

The above-described and other advantages of the invention will be better understood from the following description when considered in connection with the accompanying drawings.

## BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings, which are to be regarded as merely illustrative:

FIG. 1 is a side elevational view of the thermostat of the present invention;

FIG. 2 is an end elevational view thereof;

FIG. 3 is a side elevational view with the bimetal removed;

FIG. 4 is an end elevational view of the anticipator wire; and

FIG. 5 is a schematic diagram of the circuit of the present invention.



## DESCRIPTION OF THE PREFERRED EMBODIMENT

In the drawings in FIG. 1, a thermostat bimetal is indicated at **10** having an electrical switch contact **11**. Contact **11** is fixed to bimetal **10** by an electrical insulator **12**. A fixed contact **13** is mounted on an insulator **14**. Bimetal **10** is fixed to a shaft **15** rotatable through a housing **16** with a knob **17**. Shaft **15** and knob **17** are conventional. Shaft **15** is maintained in a fixed axial but rotatable angular position through housing **16** by conventional means. See FIG. **2** for bimetal **10**, shaft **15**, anticipator **18**, housing **16**, and knob **17**.

In FIG. **1**, the location of the anticipator is indicated generally at the dotted line **18**.

As shown in FIG. **2**, anticipator **18** is a nichrome wire having a circular cross section. The wire **18** lies generally in plane at an angle A relative to housing **16**. In the said plane, wire **18** is bowed as indicated in FIG. **4**.

As shown in FIG. **3**, wire **18** has a location relative to bimetal **10** as indicated by the dotted line. Circuit terminals **19** and **20** are fixed to housing **16**, which is made of an insulator. The ends of wire **18** are electrically and mechanically fixed to terminals **19** and **20**. Wire **18** is resilient and has a spring to it. It therefore is somewhat rigid in the position shown in FIG. **3**. As shown in FIG. **2**, it is bare wire and by its own spring action is forced into pressure contact with the bare metal of bimetal **10**.

The circuit of the invention is shown in FIG. **5**. A transformer **21** has a primary winding **22** and a secondary winding **23**. Secondary **23**, anticipator **18**, contacts **11** and **13**, and winding **24** of the solenoid gas valve for a gas furnace are connected in series circuit **25**. A variable resistor **26** is connected in parallel with anticipator **18**.

Resistor **26** is set at installation to give a fixed current through anticipator **18** when switch **27** is closed. This current would vary with the type of winding **24**. Resistor **26** is adjusted depending upon the amount of current winding **24** takes.

In operation, anticipator **18** is heated each time winding **24** is energized to turn the gas furnace on by the periodic closure of contacts **11** and **13**.

The anticipator **18** has considerably less droop than prior art anticipators because wire **18** has a metal-to-metal contact with the metal of bimetal **10**. Efficient heating of bimetal **10** requires less power and reduces droop. The efficiency is improved by the spring contact of wire **18** with bimetal **10**.

It is also a feature of the invention that bimetal **10** is insulated from contacts **11** and **13** to prevent a substantial length of wire **18** from being shorted out.

Note will be taken that only a short length of wire **18** contacts bimetal **10** near the top of the bow shown in FIG. **4**.

Anticipator **18** may have a resistance of about 0.5 ohm. Resistor **26** may have a resistance of about 2.5 ohms.

Wire **18** may be about 0.007 inch in diameter and about 1.0 inch long.

What is claimed is:

**1**. A thermostat comprising a heat-sensitive element; an electrical conductor positioned in contact with said element, said conductor having at least one surface portion bare of insulation in contact with said element, said element and said conductor being made of metal, said conductor and said element being free of insulation at least at a point of mutual contact to permit efficient heat transfer therebetween by conduction; a power circuit to pass electric current through said conductor to cause it to heat, said conductor being made of spring metal, said conductor being bowed, the spring thereof holding it in pressure contact with said element.

**2**. A thermostat comprising: a heat-sensitive element; an electrical conductor positioned in contact with said element, said conductor having at least one surface portion bare of insulation in contact with said element, said element and said conductor being made of metal, said conductor and said element being free of insulation at least at a point of mutual contact to permit efficient heat transfer therebetween by conduction; a power circuit to pass electric current through said con-

ductor to cause it to heat, said conductor being positioned in contact with said element over a relatively small length thereof as compared to its total length so that the metal of said element will not short out a considerable portion of the length of said conductor, said element being everywhere insulated from said power circuit except by contact with the conductor over said relatively small length thereof.

3. A thermostat comprising: a heat-sensitive element; an electrical conductor positioned in contact with said element, said conductor having at least one surface portion bare of insulation in contact with said element, said element and said conductor being made of metal, said conductor and said element being free of insulation at least at a point of mutual contact to permit efficient heat transfer therebetween by conduction; a power circuit to pass electric current through said conductor to cause it to heat, said element being a bimetal strip wrapped in a spiral; and means to rotate said bimetal strip about the axis of said spiral, said conductor contacting said spiral at a distance from said axis equal to about one-half the radius of the largest spiral turn.

4. The invention as defined in claim 3, wherein said conductor is resilient, said conductor being shaped to form a spring and positioned in a manner such that the spring action holds the conductor and element in pressure contact with each other.

5. The invention as defined in claim 3, wherein said element is a strip of two dissimilar metals bonded together to cause movement thereof when said strip is heated or cooled, a switch, said movement being adapted to open and to close said switch, an electrical power supply, a fuel valve having a solenoid winding, and a variable resistor connected in parallel with said conductor, a series circuit including said conductor, said switch, said winding and said power supply all connected in series, said conductor having a circular cross section, means to fix the ends of said conductor rigidly to said circuit, said conductor being made of a nichrome wire spring 0.007 inch in diameter, said wire being bowed, said bow lying in compression against said strip, the spring character of said wire forcing it in pressure contact with said strip, said strip being located sufficiently close to said wire to deform the bow thereof slightly to cause a contact pressure to exist between said wire and said strip, said wire being bare of insulation, said strip also being bare of insulation, the bare metal of said wire lying in contact with the bare metal of said strip, said strip being spaced from said circuit except by the said pressure contact of said wire thereagainst, said strip being wound in a spiral, said wire contacting said spiral at the edge of a least one turn thereof at a position approximately halfway between the spiral center and the radius of the outside turn thereof, said resistor having a resistance of about 2½ ohms, said wire having a resistance of about one-half ohm, said wire being about 1 inch long, the outside turn diameter of said spiral being less than 1 inch, said wire extending generally in a diametral direction across said spiral touching the same at about the midpoint of said wire.

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