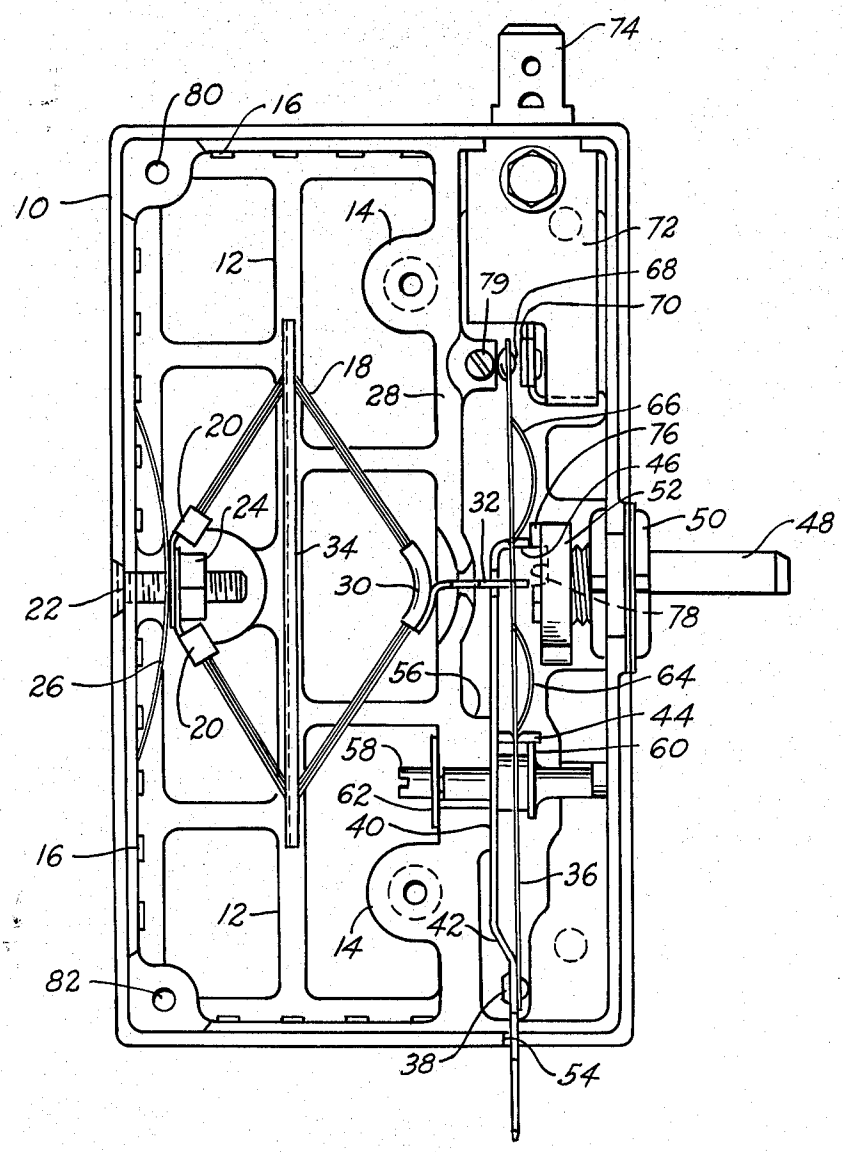
March 29, 1966 W. A. HANSEN 3,243,536

HUMIDISTAT HAVING NOVEL HYGROSCOPIC MATERIAL CONFIGURATION

Filed May 27, 1963



INVENTOR.
WILHELM A. HANSEN.
BY
Killman, Smith & Lamb
ATTORNEYS.

United States Patent Office 3,243,536 Patented Mar. 29, 1966

3,243,536

HUMIDISTAT HAVING NOVEL HYGROSCOPIC MATERIAL CONFIGURATION

Wilhelm A. Hansen, Baltimore, Md., assignor to The Bendix Corporation, Baltimore, Md., a corporation of Delaware

Filed May 27, 1963, Ser. No. 283,344
9 Claims. (Cl. 200—61.06)

This invention relates to humidity responsive electrical switching devices often referred to as humidistats.

There have been continuing developing programs in existence directed toward making relative humidity responsive switching devices or humidistats smaller and less expensive, yet more reliable and more accurate. Certain complicating factors enter into the miniaturization of humidistats because of the need to provide adequate travel of the sensing elements to accomplish a switching operation and because of the size and travel of the switch components themselves if they are to carry any significant amount of power.

In the copending application Serial No. 115,401, filed June 7, 1961 by Thomas K. Kjellman and Frank O. Watson (common assignee), a miniaturized humidistat is shown and described with particular reference to certain novel features of the switch structure which has made it possible for a relatively short length of humidity responsive material having small changes in length with humidity changes, to actuate a switch having a substantial current carrying capacity. The humidistat shown in said application Serial No. 115,401 is quite operative but it has been found that, where the ends of the strip of humidity responsive material are supported in the housing at widely spaced mounting points, the material for the housing must be carefully selected to insure that dimensional changes do not occur which upset the calibration of the instrument. With some types of plastic substances it has been found that aging effects can cause a shrinkage of the housing between the mounting points for the humidity element causing apparent changes substantially greater than that which occurs as a result of the hair element reacting to a full scale change in relative humidity. While these problems can always be met by changing materials or by other means, it is preferable that the configuration of the mounting arrangement for the humidity responsive means be such that minor dimensional changes in the housing do not significantly or seriously affect the calibration of the humidistat. It is, therefore, an object of the present invention to provide a mounting configuration for a humidity responsive element used in a humidistat which will make operation of the humidistat largely independent of minor dimensional changes in the housing.

It is another object of the present invention to provide a mounting configuration for a humidity responsive element which accomplishes the above object and which is simple to assemble and inexpensive to produce.

It is another object of the present invention to provide a mounting configuration for a huimidity responsive element which accomplishes the above objects and which makes possible a reduction in the over-all physical size of the humidistat.

Other objects and advantages will become apparent from the following specification taken in connection with the accompanying drawing in which:

The single figure is a plan view with the cover removed of a humidistat embodying my invention.

In the drawing, a shallow, rectangular housing **10** is molded from an electrically insulating plastic material. Reinforcing webs **12** and bosses **14** for receiving mounting screws are formed integrally with the housing. Vent slots

16, located on the edge of the housing admit air to the portion of the housing containing the humidity sensing element **18**. The element as shown herein is a small rope of human hair, but other hygroscopic material might be used as well. The ends of this small rope of human hair are secured by means of a pair of closed end lugs **20**. The end lugs **20** are each fastened to a screw **22**, which is fastened to the side of housing **10** are secured in position by means of a nut **24** threadedly engaged with the screw **22**. A resilient member **26** interposed between the end lugs **20** and the inside edge of the housing **10** continually urges said lugs against the nut **24**.

A rib **28** partitions housing **10** into an upper vented compartment containing the sensing element **18** and a lower closed compartment containing the switch elements. A saddle **30** having an integrally formed connecting link **32** is placed astride the sensing element **18**. Link **32** passes through a slot in rib **28** to communicate changes in length of the sensing element to the switch. A thin metallic spreader member **34** is positioned approximately midway between the saddle member **30** and the nut **24** and provides a means for placing the humidity element **18** under tension while forcing it into a generally diamond-shaped configuration. Spreader member **34** will typically be either slotted or punched near its ends to receive the humidity element **18**.

A thin flexible switch blade **36** is secured by rivets **38** to a semi-flexible spring leaf **40**. A bend **42** is made in leaf **40** to provide clearance for the movement of blade **36**. A slot punched in leaf **40** provides a tongue **44**, the free end of which is bent downward to form an abutment. The free end of leaf **40** is bent downward to form a second abutment **46**.

An adjusting shaft **48** projects form the housing **10** to permit manual selection of the operating point of the control. One end of shaft **48** is threaded into a bushing **50** and terminates in a disk head **52**. The lower end of abutment **46** bears against the upper surface of the disk head **52**. Leaf **40** carrying its attached blade **36** is pressed into a closely fitting slot **54** in housing **10** where it is held in position by the pressure of the upper surface of the leaf acting against a projecting portion **56** of rib **28**. An adjusting pin **58** shaped wtih an eccentric flange **60** passes through leaf **40** where it is retained by a spring clip **62**. The eccentricity of flange **60** permits factory adjustment of the compression of a resilient spring tongue **64** cut from the switch blade **36** by displacing abutment **44** horizontally a selected amount with only a negligible amount of vertical displacement. A second resilient tongue member **66** is also cut from switch blade **36** and bears against abutment **46** to provide a toggle mechanism for propelling the switch blade between circuit make and break positions. Rotation of the disk head **52** moves a varying cam surface into contact with abutment **46**, moving said abutment vertically and thereby varying the over-center pivot point around which the switch blade **36** is actuated.

The free end of blade **36** carries an electrical contact **68** arranged to move into circuit-make position with a fixed contact **70**. Contact **70** is mounted on a bimetallic cantilever **72** which provides a weld breaking action by responding to the heat resulting from current flow therethrough to move transversely to the direction of the switch blade **36**. A tab **74** on cantilever **72** projects from housing **10** for connecting to an external circuit.

When shaft **48** is rotated to a limit in one direction, a vertical projection **76** on the surface of head **52** is brought beneath the tip of abutment **46**. This elevates the center about which tongue **66** rotates well above the elevation produced at any other position by one full revolution of the shaft **48**. The sensing element **18** cannot contract sufficiently to raise the switch blade **36** above the elevated

center and consequently contacts 68 and 70 will move into and remain in positive engagement irrespective of the humidity to which the sensing element may be subjected. This provides a positive "on" position for the control.

The cam surface on the face of disk head 52 also contains a depression 78. When the shaft 48 is rotated such that the abutment 46 drops into depression 78 this lowers the toggle center of tongue 66 below the level which switch blade 36 assumes when relieved of all external force and consequently, contact 68 moves against an adjustable stop 79. Stop 79 is eccentric to provide a means for adjustment of the clearance between contacts 68 and 70. Since no variation in the length of element 18, either extension or contraction, can cause contact 68 to move off stop 79, a positive "off" position is provided. Between the positive "off" and "on" positions, shaft 48 positions the abutment 46 at a level corresponding to a selected relative humidity operating point. If the relative humidity is in excess of that selected, element 18 lengthens and permits the switch contact 68 to move to a closed position against contact 70. If the relative humidity is less than the selected percentage, the sensing element 18 shortens to the extent that the switch contact 68 is moved and held against stop 79. Both the positive "on" and positive "off" positions are provided without utilizing the sensing element as a connecting link. Hence, the switch can be used as a manual control even if element 18 should break.

It will be apparent that, as compared with the prior art arrangement wherein the humidity sensing element was supported in the case 10 at mounting points such as those shown at 80, 82, the present arrangement offers a considerable advantage in insuring that calibration will remain substantially free of dimensional instability of the case. With the ends of sensing element 18 attached at a common point to screw 22, another significant factor in calibration which could cause serious calibration errors would be dimensional changes in the spreader 34. This member is typically of light metal and is rolled or grooved such that it is sufficiently stiff to avoid any buckling from the compressive forces exerted upon it. Consequently, there remains only the very slight change in length caused by thermal change to consider, and this is so inconsequential that it may safely be ignored. A factor to be recognized is the possibility of a dimensional change between the edge of the case 10 where the screw 22 is attached and the rib 28 which controls the effective positions of members 36 and 40. In the control with which the applicant has been concerned, this change has been found to be well within acceptable limits and has not produced any calibration problems.

While only one embodiment has been shown and described herein, it is recognized that numerous modifications may be made without departing from the scope of the present invention as defined in the following appended claims.

The invention claimed is:

1. A humidistat comprising a housing;
- a flexible contact arm supported at one end in said housing and having a pair of longitudinally spaced apertures therein defining a pair of resilient tongues;
- a second arm spaced from said contact arm and extending generally parallel therewith;
- a pair of abutments extending from said second arm through said apertures of said contact arm, the free ends of said tongues bearing against said abutments;
- an adjusting screw threaded in said housing and bearing against one of said abutments;
- a length of hygroscopic material in said housing and supporting means for said material including an adjusting device mounted in the wall of said housing to which both ends of said hydroscopic material are attached, a link connecting the center of said hydroscopic material to said arm, and a spreader positioned substantially midway between said adjusting member and said link effective to keep said hydroscopic material under tension and to force it into a generally diamond-shaped configuration;
- a bimetallic cantilever supported in said housing adjacent the free end of said contact arm;
- a contact on said cantilever engageable by said contact arm;
- and an adjustable stop for limiting the travel of said arm away from said contact.

2. A humidistat as set forth in claim 1 wherein said adjusting device includes a screw, to which the ends of said length of hygroscopic material are attached, a mating nut for holding said ends on said screw, and a resilient member positioned between said housing and said ends for urging said ends tightly against said nut.

3. A humidistat comprising a housing, a flexible contact arm in said housing having a pair of longitudinally spaced resilient tongues;
- a pair of abutments against which the free ends of said tongues bear;
- means for adjusting one of said abutments in a direction perpendicular to said arm;
- means for adjusting the other of said abutments in a direction parallel to said arm;
- a length of hygroscopic material in said housing and supporting means for said material including an adjusting device mounted in a wall of said housing to which both ends of said hygroscopic material are attached, a link connecting the center of said hygroscopic material to said arm, and a spreader positioned substantially midway between said adjusting member and said link effective to keep said hygroscopic matetrial under tension and to force it into a generally diamond-shaped configuration;
- and a thermally responsive contact engageable by said arm and movable transversely to said arm in response to current flow therethrough.

4. In a humidistat including a housing,
- a flexible contact arm in said housing including a pair of longitudinally spaced resilient tongues,
- a pair of abutments against which the free ends of said tongues bear,
- means for adjusting at least one of said abutments relative to said arm,
- a thermally responsive contact engageable by said arm and movable transversely to said arm in response to current flow therethrough,
- and a length of humidity responsive material in said housing connected to said arm:
- means for supporting said material in said housing including an adjusting device mounted in a wall of said housing to which both ends of said humidity responsive material are attached,
- a link connecting the center of said length of humidity responsive material to said arm,
- and a spreader positioned substantially midway between said adjusting member and said link effective to keep said humidity responsive material under tension and to force it into a generally diamond-shaped configuration.

5. A humidistat as set forth in claim 4 wherein said adjusting device includes a screw, to which the ends of said length of hygroscopic material are attached, a mating nut for holding said ends on said screw, and a resilient member positioned between said housing and said ends for urging said ends tightly against said nut.

6. In a humidistat including a housing,
- a flexible contact arm in said housing including toggle acting spring means for propelling said arm between circuit make and break positions,
- an abutment against which said spring means acts and means for adjusting said abutment relative to said arm,
- a substantially stationary contact in said housing coacting with said contact arm,

and a length of hygroscopic material in said housing connected to said arm:

means for supporting said hygroscopic material in said housing including an adjusting device mounted in a wall of said housing to which both ends of said hygroscopic material are attached,

a link connecting the center of said length of hygroscopic material to said arm,

and a spreader positioned substantially midway between said adjusting member and said link effective to keep said hygroscopic material under tension and to force it into a generally diamond-shaped configuration.

7. In a humidistat including a housing,

a flexible contact arm in said housing including toggle acting spring means for propelling said arm between circuit make and break positions,

an abutment against which said spring means acts and means for adjusting said abutment relative to said arm,

a substantially stationary contact in said housing coacting with said contact arm,

and a length of hygroscopic material in said housing connected to said arm:

means for supporting said hygroscopic material in said housing including an adjustable device extending through a wall of said housing to which the ends of said hygroscopic material are attached,

and a link connecting the center of said length of hygroscopic material to said arm, the forces on said link being effective to keep said hygroscopic material under tension.

8. In a humidistat including a housing,

a flexible contact arm in said housing including a pair of longitudinally spaced resilient tongues,

a pair of abutments against with the free ends of said tongues bear,

means for adjusting at least one of said abutments relative to said arm,

a thermally responsive contact engageable by said arm and movable transversely to said arm in response to current flow therethrough,

and a length of humidity responsive material in said housing connected to said arm:

means for supporting said humidity responsive hygroscopic material in said housing including an adjustable threaded member extending through the wall of said housing,

a supporting member cooperating with said threaded member for supporting the ends of said length of humidity responsive hygroscopic material,

and a link connecting the center of said length of humidity responsive hygroscopic material to said arm, the forces on said link being effective to keep said humidity responsive hygroscopic material under tension.

9. In a humidistat including a housing,

a flexible contact arm in said housing including toggle acting spring means for propelling said arm between circuit make and break positions,

an abutment against which said spring means acts and means for adjusting said abutment relative to said arm,

a substantially stationary contact in said housing coacting with said contact arm,

and a length of hygroscopic material in said housing connected to said arm:

means for supporting said hygroscopic material in said housing including an adjustable threaded member extending through the wall of said housing,

a supporting member cooperating with said threaded member for supporting the ends of said length of hygroscopic material,

and a link connecting the center of said length of hygroscopic material to said arm, the forces on said link being effective to keep said humidity responsive hygroscopic material under tension.

References Cited by the Examiner

FOREIGN PATENTS

179,706 12/1906 Germany.
444,831 3/1936 Great Britain.

BERNARD A. GILHEANY, *Primary Examiner.*

ROBERT K. SCHAEFER, *Examiner.*

R. N. ENVALL, JR., *Assistant Examiner.*