

[54] **MOVEMENT FOR INSTRUMENTS**
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[51] **Int. Cl.**.....**G01r 5/26, G05f 5/00**
[58] **Field of Search**.....**324/106, 28; 323/68**

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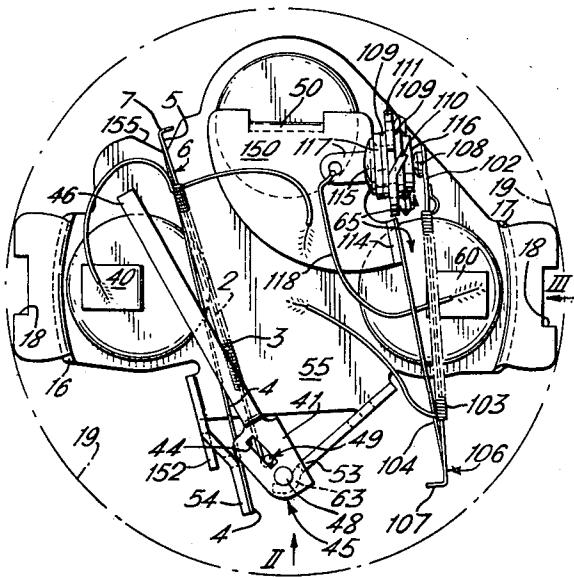
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[57] **ABSTRACT**
Bimetal instrument movements of the V-pivot type and the pin-pivot type in which the integral upstanding portions of a one-piece frame member support the fulcrum for the movements' pointer means and U-shaped bimetallic structure. Calibration and/or adjustment is effected by forcibly bending the upstanding portions. The instrument movement of the pin-pivot type described is provided with removable pointer means.

4 Claims, 8 Drawing Figures



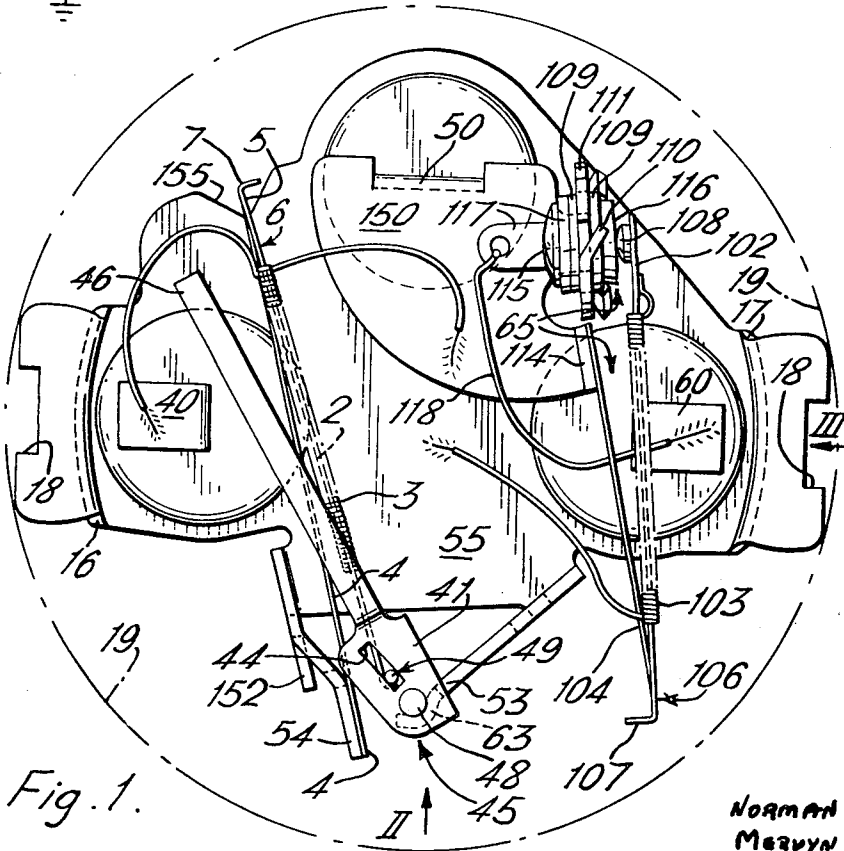
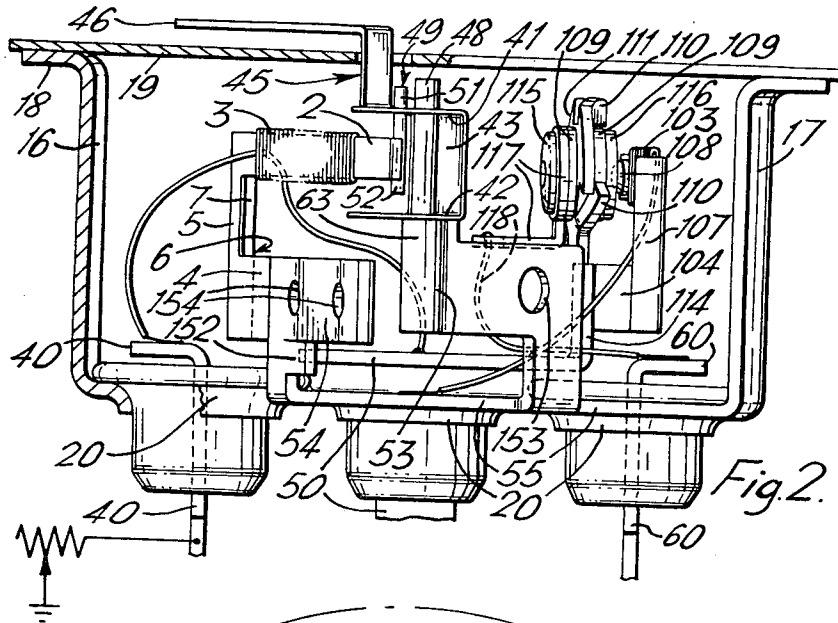
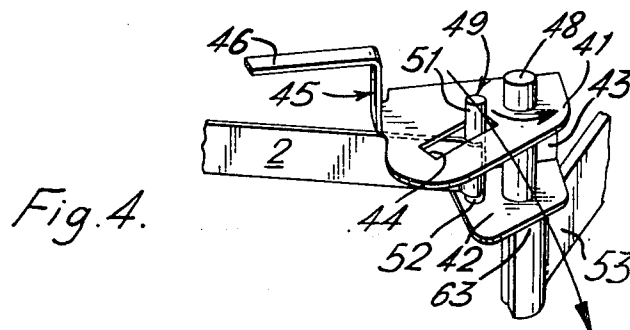
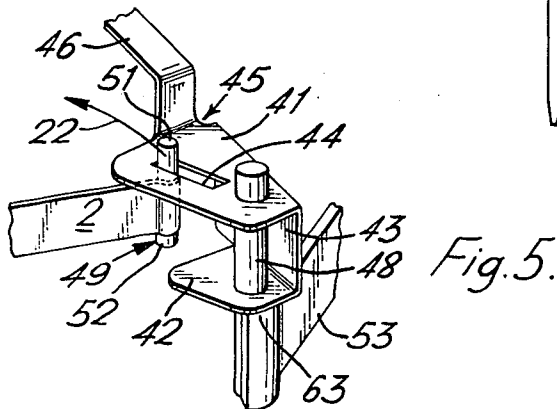
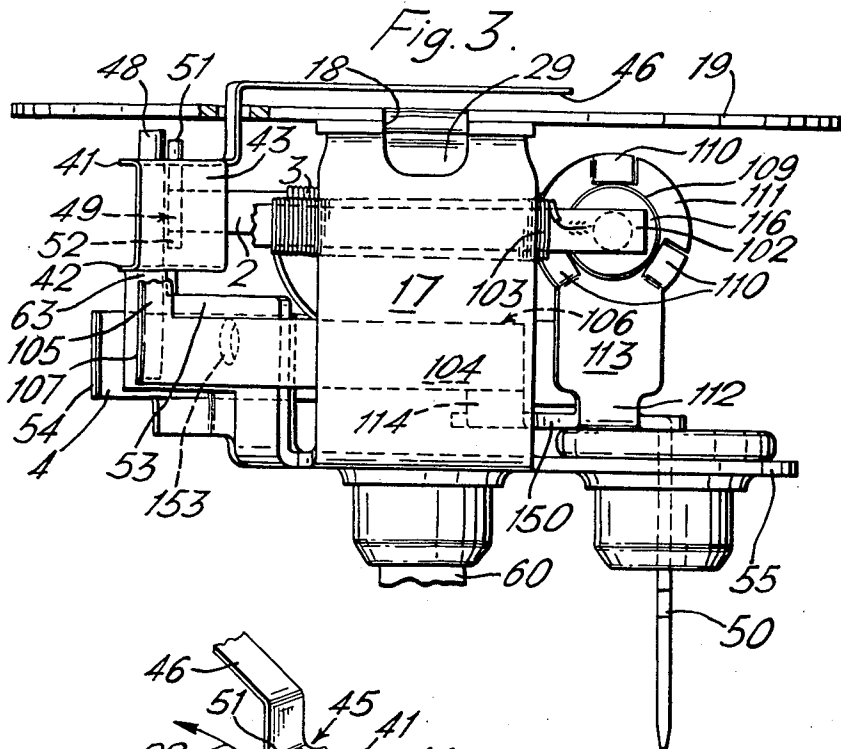


Fig. 1.

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Fig. 6.

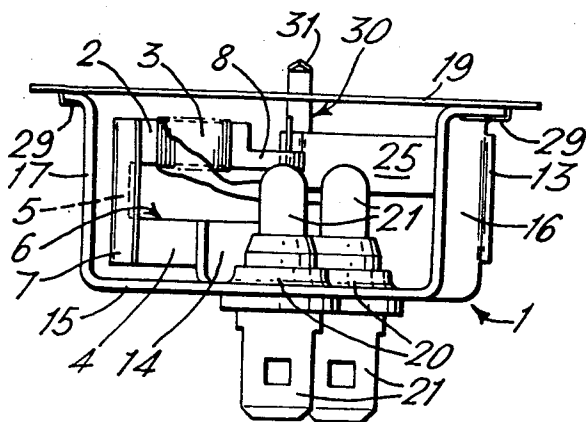


Fig. 7.

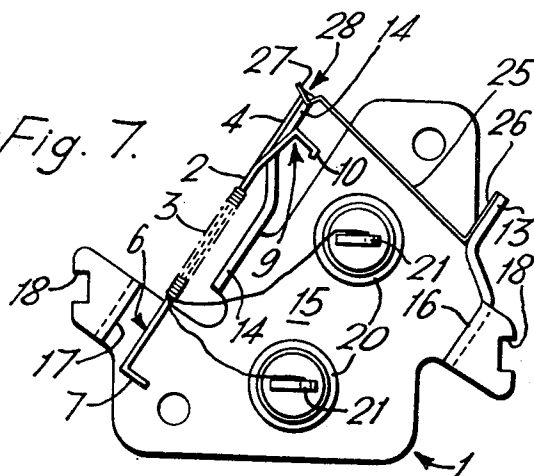
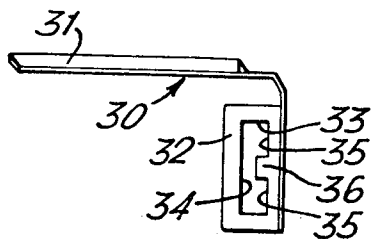


Fig. 8.



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MOVEMENT FOR INSTRUMENTS

BACKGROUND OF THE INVENTION

This invention relates to movements for instruments and in particular to bimetal movements wherein pointer means is coupled to a plate-like bimetallic arm that is encompassed by an electric resistive wire heater. Such bimetal movements operate in response to variations in the electrical potential difference applied across the heater to vary its heat output the consequential temperature changes of the bimetallic arm causing it to move, and the motion of the bimetallic arm being magnified by the pointer means.

Of such bimetal movements, those hereinafter referred to as "of the kind described" comprise an additional plate-like bimetallic arm connected to the first-mentioned bimetallic arm by a bridge to form a somewhat U-shaped unitary structure that is secured to a support for the structure by the end of the said additional bimetallic arm remote from the bridge; and also comprise a fulcrum for and possibly part of the pointer means, which fulcrum is secured to a support therefor. The additional bimetallic arm serves as a compensator for ambient temperature fluctuations.

The expression "a somewhat U-shaped unitary structure" is intended to imply that the structure comprises a bridge part or portion connected to two spaced apart arms extending away from the bridge in generally the same or almost the same direction, which arms need not necessarily be of equal length.

Known bimetal movements of the kind described additionally comprise a one-piece base plate to which the said two individual supports are pivotally attached (usually by means of rivets) so that the bimetal movement may be calibrated and/or adjusted by angularly displacing said individual supports relative to the base plate.

Bi-metal movements of the kind described may be of two types - hereinafter referred to as the V-pivot type and the pin-pivot type.

In the V-pivot type of movement the fulcrum is constituted by the apex of a V-shaped portion of a leaf spring disposed adjacent a free end of the leaf spring while the other end of the leaf spring is secured to its support. The bimetallic arm that is encompassed by the heater is generally V-shaped adjacent its free end (i.e. remote from the bridge), and the pointer means comprises a flat plate-like portion having an aperture, two edge walls of which aperture are substantially parallel. These two edge walls are engaged respectively by the V-shaped end of the bimetallic arm and by the V-shaped portion of the leaf spring, the resiliency of the leaf spring serving to maintain the fulcrum and the free end of the bimetallic arm at a fixed maximum separation dependent on the distance apart of the two edge walls of the aperture. The pointer means is usually supported by the leaf spring, although it may be supported by the said bimetallic arm.

In the pin-pivot type of movement, the fulcrum is constituted by a pin secured to its support. The bimetallic arm that is encompassed by the heater has rigidly secured to it, at or adjacent to its free end, a second pin substantially parallel to the pin constituting the fulcrum. The pointer means is pivotally mounted on the fulcrum pin and comprises a flat plate-like portion having an elongate, parallel-sided, guide slot through which the said second pin projects and within which the second pin is free to move. The pointer means is usually supported by the support for the fulcrum pin, but it may be supported by the said bimetallic arm.

This invention is applicable to either type of bimetal movement.

SUMMARY OF THE INVENTION

According to one aspect of this invention there is provided a bimetal movement of the kind described, wherein there is provided a one-piece frame member having portions that are integral therewith and that are non-resiliently displaceable relative to the remainder of said frame member upon the application of an appropriate force, wherein the said fulcrum is

secured to one of said portions (so that said one portion constitutes the support for the fulcrum), and wherein the said free end of the additional bimetallic arm that forms part of the bimetallic unitary structure is secured to another of said portions (so that said other portion constitutes the support for the structure).

The fulcrum and/or the free end of the additional bimetallic arm may be secured to their associated portions by welding or soldering or brazing or rivetting. Preferably the fulcrum and/or said free end are secured by projection spot welding - that is to say one of the two contacting parts of the weld is formed with at least one projecting dimple that deforms during the spot welding operation.

Preferably the frame member is a one-piece metal base plate, the said portions being constituted by upstanding tags integral with said base plate.

Preferably, the frame member is provided with further integral portions to which a marked scale for the instrument may be attached.

According to another aspect of this invention there is provided an instrument having a movement according to said first-mentioned aspect of this invention and a marked scale.

Calibration and/or adjustment of the instrument may be effected by bending those portions of the frame member to which the fulcrum and the unitary structure are each secured.

BRIEF DESCRIPTION OF THE DRAWINGS

Particular embodiments of this invention will now be described by way of example with reference to the accompanying drawings of which:

FIG. 1 is a schematic plan view of an instrument incorporating a bimetal movement according to this invention and of the pin-pivot type, and also incorporating a voltage regulator;

FIGS. 2 & 3 are elevations of the instrument of FIG. 1 as viewed respectively in the direction of arrows II and III;

FIGS. 4 & 5 are scrap perspective views of parts of the bimetal movement shown in FIGS. 1 to 3 in respectively normal and extreme positions of those parts;

FIG. 6 is an end elevation of an instrument incorporating a bimetal movement according to this invention and of the V-pivot type;

FIG. 7 is a plan view of the instrument of FIG. 6 with a marked scale 19 and pointer means 30 both removed; and

FIG. 8 shows the pointer means of FIG. 6.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The bimetal movement shown in FIGS. 1 to 5 comprises a bimetallic arm 2 that is encompassed by an electric resistive wire heater 3 coiled about the arm 2. An additional bimetallic arm 4 is joined to the arm 2 by a bridge 5 to form a somewhat U-shaped unitary structure 6. As shown the unitary structure 6 is a one-piece integral unit formed from a layered sheet of bimetallic material so that the arms 2, 4 and the bridge 5 are integral with one another. Alternatively the bridge and arms of the unitary structure 6 may be connected by rivets. The marginal edge of the bridge 5 remote from the arms 2, 4 is bent to form a stiffening rib 7. An unheaded metal pin 49 is welded to the free end of arm 2 so that upper and lower portions 51 and 52 of the pin 49 project vertically from the upper and lower side edges of the arm 2 respectively. The free end of arm 4 is formed with one or more small laterally projecting dimples (not shown) by means of which it is projection spot welded to a portion 54 of a one-piece metal frame member 55 so that the structure 6 is thereby supported.

The one-piece metal frame member 55 is a base plate for the bimetal movement and is provided with two forcibly displaceable portions 53, 54 constituted by upstanding tags integral with the base plate. The forcibly displaceable portions 53, 54 are non-resiliently displaceable relative to the remainder of the frame member 55 upon the application of an appropriate force, but in normal usage are rigid and fixed in relation to the remainder of the frame member 55. Two

further portions 16, 17 also formed as tags upstanding from and integral with the base plate 55, project further upwards from the base plate 55 than the tags 53, 54 and have their free ends bent outwardly and notched as at 18 so that a marked scale 19 may be attached to the free ends of tags 16, 17. Tags 16, 17 are rigid and fixed in relation to the remainder of the base plate 55. The base plate 55 is formed with three downwardly plunged holes 20 through each of which extends an electrically insulated terminal 40, 50, 60 such as that described in U.K. Patent Specification 1120464. The bared ends of the heater 3 are welded to the upper ends of terminals 40, 50 (leaving sufficient wire for adjustment and flexure of the structure 6) and the connection is coated with an electrically insulating lacquer.

An unheaded cylindrical metal pin 48 is welded to the upstanding tag 53 so that it lies substantially parallel to pin 49 and so that it projects vertically from the tag 53 but not as far as the outwardly bent free ends of tags 16, 17. The tag 53 is curved at its free end to receive the unheaded pin 48 which serves as a fulcrum. The pin 48 is of somewhat larger cross-sectional area than pin 49.

The pointer means 45 is integrally formed of thin gauge metal and comprises an indicating finger 46 integral with and vertically higher than upper and lower horizontal plate-like portions 41 and 42 that are substantially parallel with one another and are interconnected by a vertical portion 43. The unheaded pin 48 passes through two aligned holes in portions 41 and 42, and the upper portion 41 is provided with an elongate, parallel-sided, closed guide slot 44 through which extends the upper portion 51 of the unheaded pin 49 that is secured to the bimetallic arm 2.

In assembly, the pointer means 45 is coupled to the bimetallic arm 2 by manually deflecting the bimetallic arm 2 in the direction of arrow 22 to an extreme position (as shown in FIG. 5) and downwardly pushing the pointer means on to the unheaded pin 48 until the upper portion 51 of unheaded pin 49 projects through the guide slot 44 in the upper plate-like portion 41. With the bimetallic arm 2 and the pointer means 45 maintained in the extreme positions shown in FIG. 5, there is no impedance of this assembly operation since the end of guide slot 44 remote from the pin 48 does not vertically overlie the lower plate-like portion 42 of the pointer means 45. That is to say an imaginary plane containing the longitudinal axis of the closed guide slot 44 and extending the length of closed guide slot 44 normally to the plate-like portion 41, is intersected by an edge of the plate-like portion 42. Upon release of the bimetallic arm 2 and/or the pointer means 45, these parts deflect to their normal position (as shown in FIG. 4 by the arrows) under the inherent resilience of the bimetallic arm 2. When the parts are in this position of FIG. 4 the lower portion 52 of unheaded pin 49 overlies the lower plate-like portion 42 of the pointer means 45 so that removal of the pointer means is normally prevented by abutment of the lower plate-like portion 42 with the bottom of the pin lower portion 52 and is only permitted when the parts 2 and 45 are in their extreme positions so that the plate-like portion 42 clears the pin 49.

As shown in FIGS. 1 to 3, the pointer means 45 is pivotally mounted on fulcrum pin 48 and is supported by the uppermost edge of a vertical extension 63 of tag 53 at the free end of tag 53. Alternatively, the pointer means 45 may be supported by the uppermost edge of the bimetallic arm 2 or by a shoulder formed on the upper portion 51 of pin 49.

It will be readily apparent that the bimetal movement just described does not require an additional base plate on to which the supports must be mounted since the support for the fulcrum pin 48 and the support for the unitary structure 6 are constituted by the forcibly displaceable portions 53, 54 respectively of the one-piece frame member 55.

The voltage regulator 65 shown in FIGS. 1 to 3 comprises a bimetallic arm 102 that is encompassed by an electric resistive wire heater 103 coiled about the arm 102. An additional bimetallic arm 104 is joined to the arm 102 by a bridge 105 to

form a somewhat U-shaped unitary structure 106. As shown the unitary structure 106 is a one-piece integral unit formed from a layered sheet of bimetallic material so that the arms 102, 104 and the bridge 105 are integral with one another. Alternatively the bridge and arms of the unitary structure 106 may be connected by rivets. The marginal edge of the bridge 105 remote from the arms 102, 104 is bent to form a stiffening rib 107 and a metal contact 108 is riveted to the free end of arm 102. The free end of arm 104 is formed with one or more small laterally projecting dimples (not shown) by means of which it is projection spot welded to a tag 114 integral with and upstanding from a shaped horizontal portion 150 of terminal 50.

This shaped horizontal portion 150 of terminal 50 is also provided with a forcibly displaceable upstanding tag 113 integral therewith (see FIG. 3). Tag 113 is of reduced cross-section as at 112 adjacent its root to permit of such forcible displacement in this region, and is formed adjacent its free end with a substantially annular portion 111. The annular portion 111 is formed with three equispaced ears 110 projecting laterally towards the contact 108. Two annular electrically insulating washers 109 of internal diameter less than the internal diameter of annular portion 111 are placed one each side of the annular portion 111 and a metal rivet 115 is threaded through the washers 109 and the annular portion 111, the head 116 of rivet 115 serving as a fixed contact to be engaged by the contact 108. A generally L-shaped tag 117 having an eye adjacent each end is threaded over the end of rivet 115 remote from the contact head 116. The rivetting operation on the rivet 115 rigidly fixes the contact 116 in position by clamping it, the washers 109 and the tag 117 to the free end of the tag 113. By virtue of the difference in internal diameters of the annular portion 111 and the washers 109 (which latter closely fit the rivet 115), and of the positioning of the right-hand washer 109 (as viewed in FIG. 1) by the ears 110, the contact 116 is electrically connected to the tag 117 and is electrically insulated from the tag 113.

An insulated length of electrical wire 118 connects the tag 117 to the terminal 60. The bared ends of the heater wire 103 are welded to the bimetallic arm 102 and the base plate 55.

When installed in a motor vehicle say, the base plate 55 is connected to ground; the terminal 60 is connected to the live terminal of the vehicle battery; the terminal 40 is connected to a condition-responsive electrical transmitter (for example a fuel tank unit); and the terminal 50 is connected to other vehicle instruments or devices requiring a regulated voltage supply.

In operation the current supplied to the heater 103 from the battery passes from the terminal 60 to the grounded base plate 55 via wire 118, tag 117, rivet 115, contacts 116 and 108, and heater 103; and passes from terminal 60 to the terminal 50 via wire 118, tag 117, rivet 115, contacts 116 and 108, unitary structure 106, and tag 114 integral with terminal 50. The heat output of heater 103 causes the bimetallic arm 102 to move thereby breaking the contacts 108, 116 and cutting off the current supply. Upon cooling of the bimetallic arm 102, the contacts 108, 116 re-engage and current is again allowed to pass from the terminal 50. This current oscillates as the contacts 108, 116 engage and disengage upon cooling and heating of the bimetallic arm 102. The voltage regulator 65 is calibrated so that the effective potential difference between terminal 50 and grounded base plate 55 is equivalent to a mean value of say 5 volts. Calibration of the voltage regulator 65 is effected by forcibly bending tag 113 in the region of the neck 112 so as to displace the fixed contact 116 and thereby alter the time ratio of contacts closed to contacts open (i.e. the mark/space ratio).

The regulated voltage of 5 volts is applied across the heater 3 of the bimetal movement and the variable resistance of the condition-responsive transmitter to ground. As the condition being measured changes, the resistance changes and thus the effective potential difference across the heater 3 changes. Thus the heat output of heater 3 is a measure of the condition

(for example the level of fuel in the vehicle fuel tank) and is transformed into a displacement of the bimetallic arm 2, which displacement is magnified by the pointer means 45. Indication of this magnified displacement is achieved by the indicating finger 46 of the pointer means co-operating with a marked scale 19 forming part of the completed instrument (incorporating both the bimetal movement and the voltage regulator), the marked scale 19 being disposed between the indicating finger 46 and the upper plate-like portion 41 and being secured to the outwardly bent free ends of the tags 16, 17 by downwardly and inwardly bending tabs 29 that are integral with the scale 19 so that the tabs enter the notches 18.

Calibration and/or adjustment of the bimetal movement of the instrument is achieved by bending the forcibly displaceable tags 53 and 54, apertures 153 and 154 being provided through the tags to facilitate such bending. The root of tag 54 is provided with an additional tag 152 at an angle thereto, the free end of tag 152 serving as a stop for the adjusting tool to prevent excessive bending of the tag 54 which might damage the unitary structure 6. This additional tag 152 may be omitted if a corresponding abutment is formed on the adjusting tool.

To assist calibration and/or adjustment of the bimetal movement, the base plate 55 is formed with a V-shaped cut 155 (FIG. 1) and the unitary structure 6 is so arranged that the marginal edge of the bridge 5 adjacent the arms 2, 4 is in substantially vertical alignment with the apex of the V.

It will be appreciated that in the event of damage the pointer means of the above described instrument can be removed without removing the marked scale 19; that the one-piece frame member 55 may be mounted in a casing that forms a housing for just that instrument alone or for that instrument plus one or more other instruments, switches or devices; and that by virtue of the incorporation of terminals 40, 50 and 60 such as those shown, the instrument may be connected in the vehicle circuits by being plugged into a pre-wired socket so as to reduce vehicle assembly time.

If it is desired that the pointer means 45 should be only removable from the instrument after removal of scale 19, the scale may be formed with two depending tags (not shown) that are engaged by the indicating finger 46 in the limits of the permissible movement range of the pointer means, the extreme position of FIG. 5 being outside this range.

The above-described embodiment of this invention may be modified by either or both of the following:

- i. The free end of tag 53 is not curved as shown in FIG. 1, but is contiguously in line with the remainder of tag 53. The unheaded cylindrical pin 48 is secured to the straight free end of tag 53.
- ii. The V-shaped cut 155 in the periphery of base plate 55 is replaced by a circular hole or mark within the periphery, and to assist calibration and/or adjustment of the bimetal movement the unitary structure 6 is arranged so that its arm 4 is in substantially vertical alignment with a diameter of the circular hole or mark.

As shown in FIGS. 6 to 8, the bimetal movement 1 comprises a bimetallic arm 2 that is encompassed by an electric resistive wire heater 3 coiled about the arm 2. An additional bimetallic arm 4 is joined to the arm 2 by a bridge 5 to form a somewhat U-shaped unitary structure 6. As shown the unitary structure 6 is a one-piece integral unit formed from a layered sheet of bimetallic material so that the arms 2, 4 and bridge 5 are integral with one another. Alternatively the bridge and arms of the unitary structure 6 may be connected by rivets. The marginal edge of the bridge 5 remote from the arms 2, 4 is bent to form a stiffening rib 7. The free end portion 8 of arm 2 is of reduced width and is bent to a generally V-shape having an apex at 9, the actual end of arm 2 being bent to form an end stop 10. The free end of arm 4 is formed with one or more small laterally projecting dimples (not shown) by means of which the structure 6 is projection spot welded to a portion 14 of a one-piece metal frame member 15 so as to be supported thereby.

The one-piece metal frame member 15 is a base plate for the bimetal movement 1 and is provided with two forcibly displaceable portions 13, 14 constituted by upstanding tags formed integrally therewith. Two further portions 16, 17 also formed as integral upstanding tags, project further upwards from the base plate 15 than the tags 13, 14 and have their free ends bent outwardly and notched as at 18 so that a marked scale 19 may be attached to the free ends of tags 16, 17. The base plate 15 is formed with two upwardly plunged holes 20 through each of which extends an electrically insulated terminal 21 such as that described in U.K. Patent Specification No. 1120464. The bared ends of the heater 3 are electrically connected by welding to the upper ends of the terminal 21 (leaving sufficient wire for adjustment and flexure of the structure 6) and the connection is coated with an electrically insulating lacquer.

A resilient metal leaf spring 25 is formed with a bent end 26 that is formed with one or more small projecting dimples (not shown) by means of which the bent end 26 is projection spot welded to the upstanding tag 13. The other end of leaf spring 25 is formed with a V-shaped portion 27 so that the apex 28 of the V constitutes a fulcrum. A circular hole (not shown) is formed in portion 27, the apex 28 diametrically intersecting the hole.

The pointer means 30 of FIG. 8 is integrally formed of thin gauge metal and comprises a horizontally disposed indicating finger 31 and a vertically disposed plate-like portion 32 beneath the finger 31 and vertically spaced therefrom. Portion 31 has an aperture 33 therein, two vertical edge walls of the aperture (namely 34 and 35) being substantially parallel. Aperture edge wall 35 is divided into two lengths by a tab 36 directed towards the aperture edge wall 34. During assembly, the pointer means 30 is coupled to the bimetallic arm 2 and the leaf spring 25 by first threading the plate-like portion 32 over the free end of the leaf spring 25 with the finger 31 uppermost and overlying the base plate 15 until the aperture edge wall 35 engages the apex 28 and the tab 36 enters the circular hole in the region of the apex; and then threading the plate-like portion 32 over the end stop 10 until the aperture edge wall 34 engages the apex 9 in the free end portion 8 of arm 2.

It will be readily apparent that the bimetal movement does not require an additional base plate on to which the supports must be mounted since the support for the fulcrum 28 and the support for the unitary structure 6 are constituted by the forcibly displaceable portions 13, 14 respectively of the one-piece frame member 15.

Assembly of the instrument is completed by inserting the marked scale 19 between the indicating finger 31 and the plate-like portion 32, and securing the scale 19 to the outwardly bent free ends of the tags 16, 17 by downwardly and inwardly bending tabs 29 that are integral with the scale 19 so that they enter the notches 18. Calibration and/or adjustment of the assembled instrument is achieved by bending the forcibly displaceable tags 13 and 14, tag 13 being provided with a vertical closed-ended slot (not shown) in the vicinity of the curved portion of the tag nearest leaf spring 25 to facilitate such bending.

It will be appreciated that the one-piece frame member 15 may be mounted in a casing that forms a housing for just the instrument of FIGS. 6 to 8 or for that instrument plus one or more other instruments, switches or devices. Furthermore, by virtue of the incorporation of terminals 20 such as those shown, the instrument may be connected in the vehicle circuits by being plugged into a pre-wired socket so as to reduce vehicle assembly time.

What is claimed is:

1. A readily calibratable instrument of the bimetal movement type comprising
 - i. a one-piece metal base plate having first, second and third integral portions upstanding therefrom, the first and second portions being rigid and each being normally fixed in position relative to the remainder of said base plate and

being non-resiliently displaceable relative to said base plate only upon the application of an appropriate bending force;

- ii. a somewhat U-shaped unitary structure formed by
 - a. a first plate-like bimetallic arm,
 - b. an electric resistive wire heater encompassing said first arm,
 - c. a second plate-like metallic arm secured to said non-resiliently displaceable first portion, and
 - d. a bridge connecting one end of said first arm to one end of said second arm;
- iii. a marked scale secured to said third portion;
- iv. pointer means coupled to said first arm and cooperating with said marked scale; and
- v. a fulcrum for said pointer means secured to said non-resiliently displaceable second portion, whereby application of an appropriate bending force to at least one of said first and second integral portions achieves a non-resilient positional displacement of at least one of said first and second portions relative to said third integral portion and a consequent non-resilient positional displacement of said pointer means relative to said scale thereby to effect calibration of said instrument.

2. An instrument of the pin-pivot type and according to

claim 1, comprising a first pin constituting said fulcrum, and a second pin rigidly secured to said first plate-like bimetallic arm at least adjacent to its free end remote from the bridge and substantially parallel to said first pin; and wherein said pointer means is pivotally and removably mounted on said first pin, and comprises a flat plate-like portion having an elongate parallel-sided guide slot through which said second pin projects and within which said second pin is free to move.

3. An instrument of the pin-pivot type and according to claim 2, wherein said first pin is constituted by an unheaded pin.

4. An instrument of the pin-pivot type and according to claim 3, wherein said pointer means is in use movable within a normal operating range and can attain a position outside said range; and wherein said second pin projects from each edge of said first plate-like bimetallic arm, and said pointer means comprises a further flat plate-like portion spaced in substantially parallel relation to the first-mentioned flat plate-like portion, the further flat plate-like portion being shaped so that at least a portion of the second pin is engageable by said further flat plate-like portion when the pointer means is within said range and is clear of said further flat plate-like portion when the pointer means is in said position outside said range.

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