Aug. 5, 1958 H. I. BAKER 2,846,531

ELECTRICAL INDICATING SYSTEM

Filed Nov. 7, 1956 2 Sheets-Sheet 1

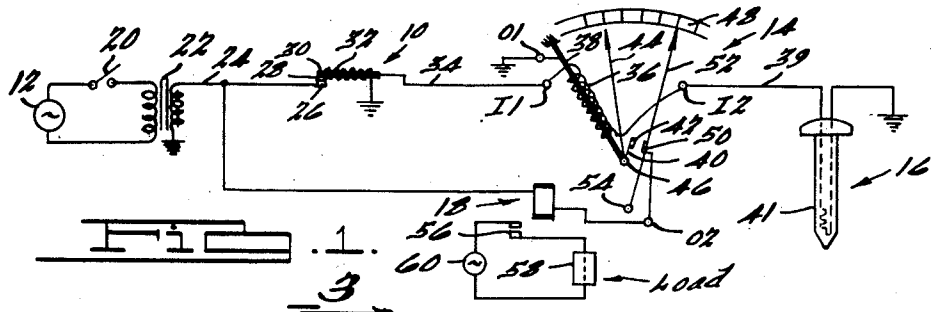



Fig. 1.

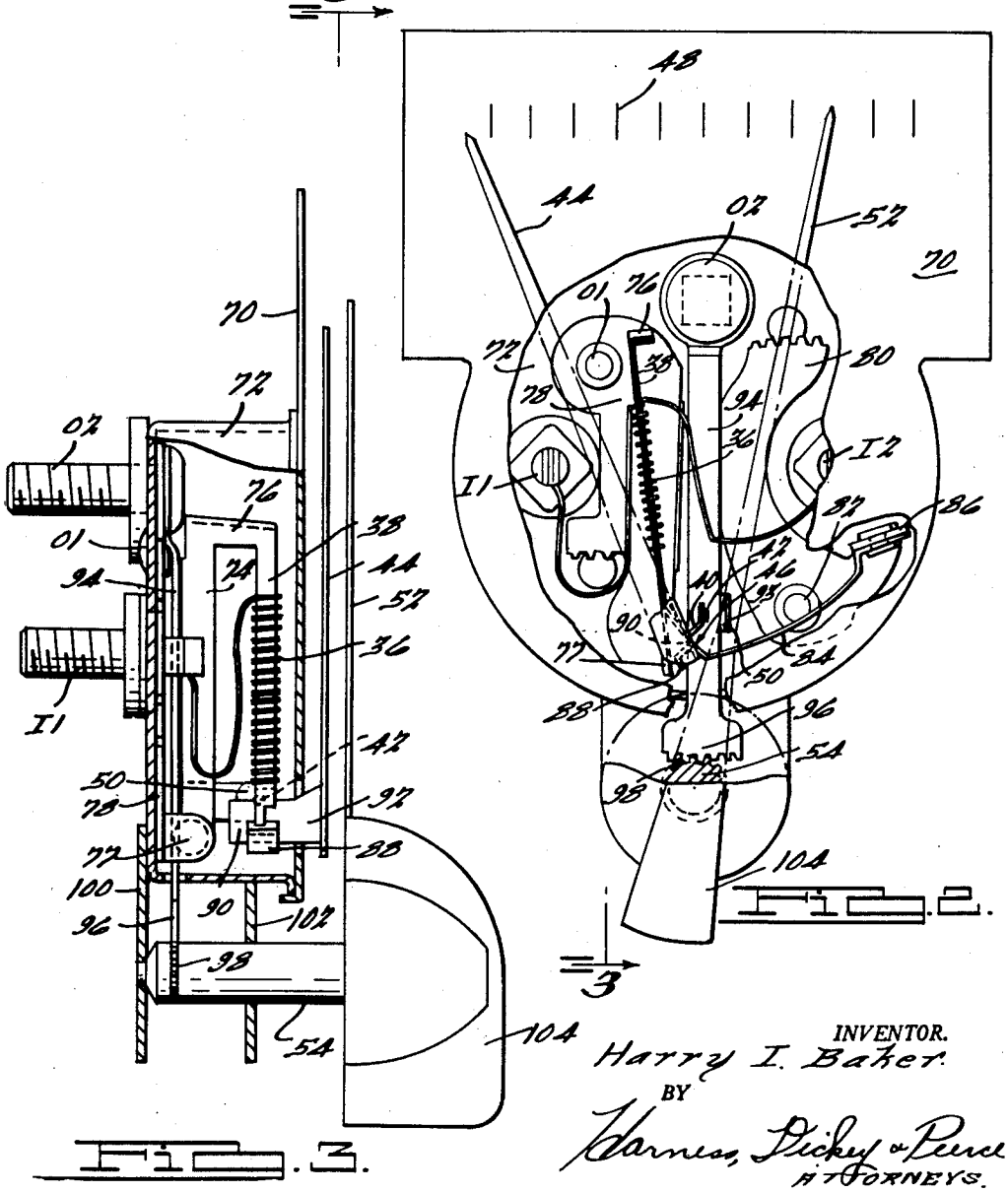


Fig. 2.



Fig. 3.

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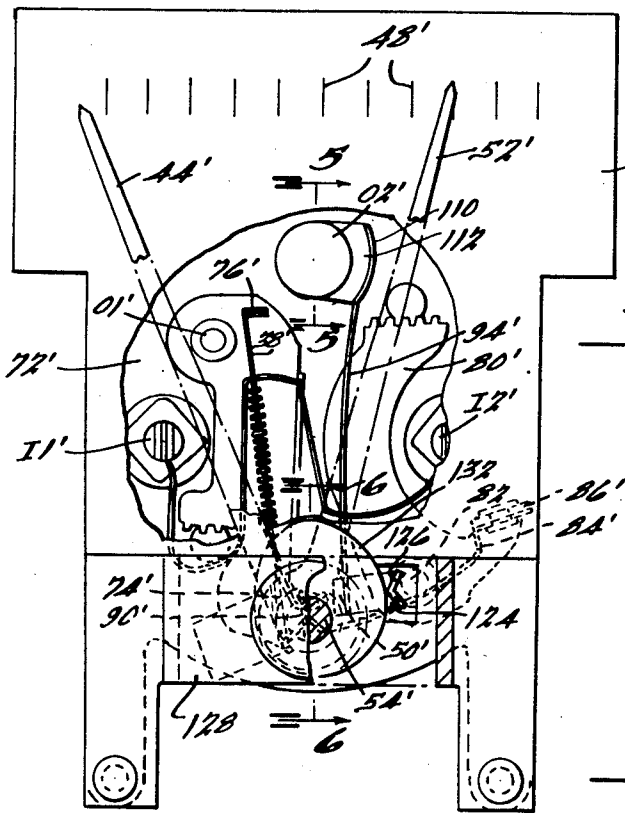



Fig. 4.

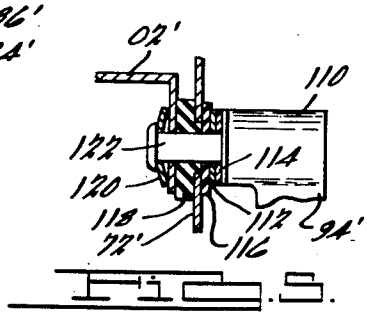



Fig. 5.

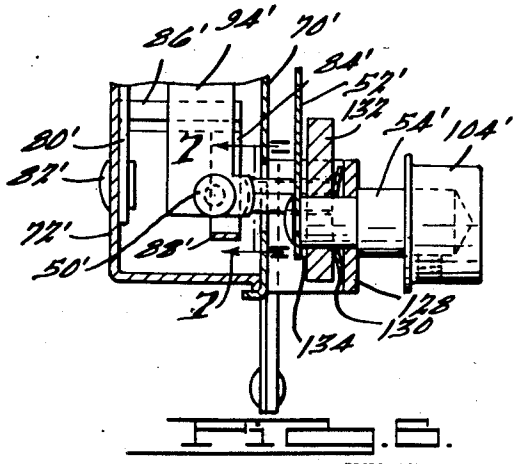



Fig. 3.

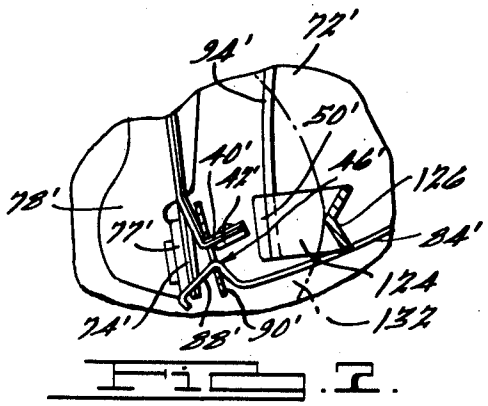



Fig. 2.

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2,846,531

# ELECTRICAL INDICATING SYSTEM

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Application November 7, 1956, Serial No. 620,935

16 Claims. (Cl. 200—56)

This invention relates to telemetering systems and, more particularly, to condition indicating and signaling apparatus.

The principles of the invention are representatively embodied in an apparatus for providing a continuous or an effectively continuous indication of a remote condition, such as the temperature of a body, and for signaling the attainment of a preselected critical value of that condition, such as the attainment of a preselected temperature as the result of heating or cooling of the body.

Objects of the invention are to improve indicating and signaling devices, and to reduce their cost of manufacture and maintenance.

Another object of the invention is to provide improved means for pivotally supporting a manually settable pointer and an indicating pointer upon separate pivots.

Another object of this invention is to provide an improved means for supporting one electrical contact in a manually adjustable position relative to a second electrical contact the position of which is determined by an electroresponsive mechanism

The manner of accomplishing the foregoing objects, and other objects and features of the invention, will become apparent from the following detailed description of embodiments of the invention when read with reference to the accompanying drawings, in which:

Figure 1 is a schematic representation of a control system including an apparatus embodying the principles of the present invention;

Figure 2 is a front elevational view, partially cut away, of one form of apparatus embodying the principles of the present inventional and suitable for inclusion in the system of Figure 1;

Figure 3 is a sectional view taken substantially along the line 3—3 of Figure 2;

Figure 4 is a front elevational view, partially cut away, of another form of apparatus embodying the principles of the present invention and suitable for inclusion in the system of Figure 1;

Figure 5 is a sectional view taken substantially along the line 5—5 of Figure 4;

Figure 6 is a sectional view taken substantially along the line 6—6 of Figure 4; and

Figure 7 is a sectional view taken substantially along the line 7—7 of Figure 6.

In the control system representatively illustrated in Figure 1 of the drawings, a voltage regulating device 10 is employed to apply energy from a source 12 to a controlling circuit including an indicating and signaling instrument 14 and a sensing unit 16. When a preselected critical condition obtains, the instrument 14 completes a circuit for energizing an output relay 18 which is adapted to control a load circuit.

The source 12 is connectable, upon the closure of switch 20, across the primary winding of transformer 22 so as to develop a voltage across the secondary winding of that transformer, that is, between conductor 24 and the system ground. It will be appreciated that a metallic



return circuit may be employed if desired and that other sources of input voltage may be employed, including a battery or other direct current source or an alternating curent source without the interposition of a transformer.

Conductor is connected to a fixed or adjustably fixed electrical contact 26 adapted to mate with a contact 28 carried by a cantilever-mounted polymetallic element 30. A heater winding 32 is disposed in heat transfer relationship with element 30, one end of the winding being electrically connected to the element 30 and the other end of the winding being connected to the system ground. By virtue of these connections, heater winding 32 is energized when contacts 26 and 28 are closed, the resultant elevation of the temperature of polymetallic element 30 producing a deflection of that element in a direction to separate contact 28 from contact 26, interrupting the energization of the heater 32 and permitting the polymetallic strip 30 to cool until the contacts 26 and 28 are again brought into engagement. The device 10 therefore functions as an electro-thermal self-interrupter and will operate, in the manner disclosed in Patent 2,762,997, granted September 11, 1956, to Leonard Boddy, to maintain a pulsating voltage of substantially constant average magnitude across its heater winding 32 and hence between polymetallic element 30 and the system ground.

The pulsating, constant-average-magnitude voltage appearing between conductor 34, connected to polymetallic element 30, and the system ground is applied across a series indicating or gauging circuit which may be traced from conductor 34, input terminal 11, heater winding 36, a constituent element of instrument 14, input terminal 12, conductor 39, through sensing device 16, and to the system ground. Sensing device 16 is representatively illustrated in the form of a probe suitable for insertion, for example, in a piece of meat to sense its internal temperature. Senser 16 is shown to comprise a resistor 41 having a high temperature coefficient of resistance electrically insulated from the probe casing but in good thermal contact with the tip of that casing. In the illustrated arrangement, it is assumed that resistor 41 has a high negative temperature coefficient of resistance.

Heater winding 36 is disposed in heat transfer relationship with a polymetallic leg portion 38 supported essentially as a cantilever, as will be seen. Leg portion 38 has an end projection 40 to which an electrical contact 42 is secured and is connected to grounded output terminal O1 so that contact 42 is maintained at the system ground potential. Polymetallic leg portion 38 is also adapted to drive, in a manner more clearly disclosed in the structural views of Figures 2–7, an indicating pointer 44 rotatable about a pivotal axis 46 and adapted to cooperate with a scale 48.

The orientation of the constituent metallic elements of the polymetallic leg 38 is selected in the light of the direction of the temperature coefficient of resistance of senser resistor 41 so that increasing sensed temperatures will result in the deflection of the indicating pointer 44 in a direction along the scale 48 to produce a correspondingly increased temperature indication. In the representative arrangement, with a negative temperature coefficient of resistance resistor 41, increasing sensed temperatures will result in increased current through winding 36 and increased heating of leg 38 to produce an increasing deflection of that leg. This increasing deflection is in a direction to deflect pointer 44 in a clockwise direction, assuming scale 48 to be calibrated in increasing temperatures from left to right.

This same motion of polymetallic leg 38 serves to move contact 42 to the right in the view of Figure 1 towards its mating contact 50. The position of contact 50 is preferably manually adjustable to permit setting of the critical value at which the output function will be

performed, and means in the form of a setting pointer 52 are preferably provided for providing, in cooperation with scale 48 or another scale, an indication of that setting. While the arrangements illustrated in the structural views are preferred, contact 50 is shown for diagrammatic clarity, mounted upon setting pointer 52, with that shaft being pivotally mounted upon shaft 54. The rotational positioning of shaft 54 both sets the position of pointer 52 and adjusts the position of contact 50 in its spacing from contact 42.

Electrical contact 50 is connected to output terminal O2 which, in turn, is connected to the voltage at conductor 24 through the winding of output relay 18. When the sensed temperature has in the disclosed arrangement risen to the selected value, contact 42 will engage contact 50 to complete a circuit from ground, terminal O1, polymetallic element 38, contacts 42 and 50, terminal O2, winding of relay 18 and to conductor 24, operating relay 18 to close contacts 56 to connect the load 58 across a source of energy 60. Load 58 may be a visible signal such as a lamp, an audible signal such as a bell or buzzer, or a controlling device. It is, of course, possible to employ normally closed contacts rather than normally open contacts 56 as elements of relay 18 and to connect the heater (which is to supply heat to the body the temperature of which is sensed by senser 16) as the load 58, although the device illustrated is intended primarily, and best serves, as an indicating and signaling mechanism.

The indicator mechanism 14 may assume either the form shown in Figures 2 and 3 or the form shown in Figures 4–7.

The unit disclosed in Figures 2 and 3 of the drawings comprises a face plate 70, bearing scale indicia 48 and surmounting and secured to a case 72. The motivating electroresponsive element including active leg portion 38 is a generally U-shaped polymetallic element also including a back or compensating leg 74, one end of which is joined to one end of active leg 38 by a flanged crosspiece 76. The other end of the ambient temperature leg 74 is riveted or otherwise secured to an upstanding flange 77 upon a calibrating arm 78, the other end of which is secured to the case 72 in a manner so that the arm 78 resists rotation but is rotatable to adjust the instrument, upon the application of suitable force. The illustrated affixing means comprises a rivet designated O1 since it is the means by which the polymetallic element is electrically connected to the case, it being assumed that the case is connected to the system ground.

The heater winding 36, disposed in heat transfer relationship with the active polymetallic leg portion 38 is connected to input terminals 11 and 12. The free end of leg portion 38 is bent reversely to define the projection 40 which supports the active electrical contact 42, the angle between the leg portion 38 and the projection 40 defining a knee or notch serving a function to be described.

A second calibrating arm 80 is frictionally rotatably mounted upon the casing 72 by a rivet 82, and a flexible calibrating spring arm 84 is riveted or otherwise secured to an upstanding flange 86 on arm 80. The end 88 of spring arm 84 is bent to define a knee or notch positionable proximate the knee or notch defined by the junction of polymetallic strip 38 and projection 40 and serving, in a manner to be described, as the pivotal axis 46 above discussed with reference to Figure 1.

A generally frame-shaped sheet metal link 90 is supported by elements 38 and 84, the projection 40 of the polymetallic element 38 and the end portion 88 of the calibrating spring arm 84 passing through the central aperture of the frame and the edges of the frame engaging the notches or knees on those elements. Link 90 is provided with an integral extension 92 which supports and is illustratively integral with the indicating pointer 44. Heating of the polymetallic active leg portion 38 by heater 36 will cause the projection 40 to be moved generally to the right in the view of Figure 2 to tilt the link 90 about pivotal axis 46 and thereby to rotate indicating pointer 44 in a clockwise direction.

This movement of the free end of polymetallic element 38 and of projection 40 will cause contact 42 to be moved generally to the right towards contact 50. Contact 50 is supported upon an upstanding leg portion 93 secured intermediate the ends of a supporting arm 94 which is pivotally secured to but electrically insulated from the case 72 by means including terminal screw O2. The remote end of arm 94 is provided with teeth defining a rack or sector 96. Sector 96 is adapted to engage the teeth of a pinion gear 98 carried by or formed on shaft or arbor 54. Shaft 54 is rotatably supported by plates 100 and 102 depending from case 72 and carries a manual adjusting knob 104. The setting pointer 52 is secured to and rotatable with the knob 104 and the shaft 54.

As knob 104 and shaft 54 are rotated, the position of setting pointer 52 with respect to the indicia 48 is changed and arm 94 is rotated about its pivot to shift the position of contact 50 relative to the active contact 42. The more the knob 104 is rotated in a clockwise direction and the higher the setting of pointer 52 (assuming that the indicia 48 reflect increasing temperatures from left to right), the further contact 50 is spaced from the contact 42 under initial temperature conditions and the higher the sensed temperature must become before contact 42 will engage contact 50 to produce the output indication. The ratio of pinion to sector size is selected to provide the same motional relation between the setting pointer 52 and the adjustable contact 50 as that which exists between the indicating pointer 44 and the active contact 42 in order that the contacts will close when the indicating pointer 44 reaches the indicated temperature at which the setting pointer 52 is set.

It will be observed that the pivotal axis 46 and the longitudinal axis of shaft 54 are in approximately vertical alignment so that whatever the range of travel, the fact that the pointers 44 and 52 are not pivoting about the same axis will not be apparent to the observer. The arrangement illustrated in Figures 4–7, however, permits the establishment of substantially coaxial pivots for the two pointers. The structure in this modified, and presently preferred, arrangement is similar to that previously described and corresponding parts are designated with the same reference characters suffixed by a prime.

The differences between the structure of Figures 4–7 and the structure previously described pertain primarily to the location and supporting of the arbor 54′ and the supporting and adjusting of the passive contact 50′, although there are other minor changes including a repositioning of the active contact 42′ upon the projection 40′, as may best be seen in Figure 7 of the drawings.

The passive contact 50′ is mounted upon arm 94′ which, in this case, is flexible, with contact adjustment being accomplished by flexing the arm 94′. The upper end of arm 94′ is rigidly secured to the case 72′ in the manner best shown in Figure 5. Arm 94′ is formed with an integral portion 110 which is bent laterally to define a mounting flange 112. Flange 112 is interposed a washer 114 and an insulating washer 116, the latter of which abuts the inner face of casing 72′. An insulating washer 118 having a projecting shoulder is mounted on the reverse side of casing 72′, with its shoulder seated within an aperture in that casing. Terminal O2′ is disposed between outer face of insulator 118 and a spring washer 120. The stack is maintained in its assembled relationship by a rivet 122.

Near its free end, and representatively adjacent the point of attachment of the passive contact 50′ to the arm 94′, arm 94′ is provided with a projection 124 (Fig. 7) carrying an upstanding V-shaped end portion 126 serving, as will be seen, as a cam follower.

Shaft 54′ is rotatably supported by a bridge 128 (Fig. 6) secured in any suitable fashion to the casing 72′. A spring washer 130, engaging the inner face of bridge

128, a cam 132, a washer 134 and the settable pointer 52' are mounted upon a portion of the shaft 54', the end of the shaft being headed over to maintain these elements in their shown relationship. It will be observed that the position of bridge 128 is selected so that the longitudinal axis of the shaft 54' substantially coincides with the pivotal axis 46' of the indicating pointer 44', that is, so that the pivotal axis of the two pointers 44' and 52' substantially coincide even though those pointers have different pivot elements.

Cam follower 126 engages the edge of cam 132 so that upon rotation of shaft 54' the position of cam follower 126 will be changed, deflecting contact spring arm 94' and changing the position of passive contact 50' relative to active contact 42'. The shape of the cam surface 132 is selected to establish the correct relationship between the position of pointer 52' and the indicia 48' with reference to the temperature at which the contacts 42' and 50' will be closed to produce the output function.

While it will be apparent that the embodiments of the invention herein disclosed are well calculated to fulfill the objects of the invention, it will be appreciated that the invention is susceptible to modification, variation and change without departing from the proper scope or fair meaning of the subjoined claims.

What is claimed is:

1. A manually adjustable indicating device comprising a mounting plate, an indicating pointer movable to indicate the magnitude of a condition, a first electrical contact, electroresponsive means supported upon said mounting plate for moving said pointer and for moving said first electrical contact relative to said mounting plate, an arm, supporting means for supporting said arm at one end on said mounting plate, a second electrical contact secured to a portion of said arm and matable with said first electrical contact, a manually rotatable shaft supported for rotation relative to said mounting plate and about an axis located upon the opposite side of a line through said contacts from said supported one end of said arm, and means including said shaft and said arm for varying the position of said second electrical contact relative to said mounting plate and hence relative to said first electrical contact.

2. A manually adjustable indicating device comprising a mounting plate, first and second matable electrical contacts, electroresponsive means supported upon said mounting plate for moving said first electrical contact relative to said mounting plate, an arm, supporting means for supporting said arm at one end on said mounting plate, means securing said second electrical contact to said arm at a portion thereof remote from said one end, a manually rotatable shaft supported for rotation relative to said mounting plate and about an axis located upon the opposite side of a line through said contacts from said supported one end of said arm, and means responsive to rotation of said shaft for moving said portion of said arm relative to said mounting plate comprising driving means on said shaft and driven means on said arm engageable with said driving means.

3. A manually adjustable indicating device comprising a mounting plate, first and second matable electrical contacts, electroresponsive means supported upon said mounting plate for moving said first electrical contact relative to said mounting plate, an arm supported at one end by said mounting plate, means securing said second electrical contact to said arm at a portion thereof remote from said one end, a manually rotatable shaft supported for rotation relative to said mounting plate, and means responsive to rotation of said shaft for moving said portion of said arm relative to said mounting plate comprising a gear on said shaft and a rack on said arm engageable with said gear.

4. A manually adjustable indicating device comprising a mounting plate, first and second matable electrical contacts, electroresponsive means supported upon said mounting plate for moving said first electrical contact relative to said mounting plate, an arm supported at one end by said mounting plate, means securing said second electrical contact to said arm at a portion thereof remote from said one end, a manually rotatable shaft supported for rotation relative to said mounting plate, and means responsive to rotation of said shaft for moving said portion of said arm relative to said mounting plate comprising a cam on said shaft and a cam follower on said arm engageable with said cam.

5. A manually adjustable indicating device comprising a setting pointer rotatable about an axis, an indicating pointer, first and second matable electrical contacts, an arm supporting said second electrical contact, means for supporting one end of said arm at a point remote from said setting pointer and from said setting-pointer axis, a manually rotatable shaft, means including said shaft for shifting the position of said setting pointer, means including said shaft and said arm for varying the position of said second electrical contact, and electroresponsive means for varying the positions of both said indicating pointer and said first electrical contact.

6. A manually adjustable indicating device comprising a setting pointer, an indicating pointer, first and second matable electrical contacts, an arm supporting said second electrical contact, a manually rotatable shaft, means including said shaft for shifting the position of said setting pointer, means including said shaft and said arm for varying the position of said second electrical contact, an ambient temperature compensated polymetallic element, a heater winding in heat exchange relation with said element for deflecting an end portion of said element, means supporting said first electrical contact on said end portion, a spring element having a hook adjacent one end, and a link engaging said end portion and said hook and pivotal in response to movement of said end portion about said hook, said indicating pointer being supported by said link.

7. A manually adjustable indicating device comprising a setting pointer, an indicating pointer, first and second matable electrical contacts, an arm supporting said second electrical contact, a manually rotatable shaft, means including said shaft for shifting the position of said setting pointer, means including said shaft and said arm for varying the position of said second electrical contact, an ambient temperature compensated polymetallic element, a heater winding in heat exchange relation with said element for deflecting an end portion of said element, means supporting said first electrical contact on said end portion, a spring element having a hook adjacent one end and spaced from said shaft, and a link engaging said end portion and said hook and pivotal in response to movement of said end portion about said hook, said indicating pointer being supported by said link.

8. A manually adjustable indicating device comprising a setting pointer, an indicating pointer, first and second matable electrical contacts, an arm supporting said second electrical contact, a manually rotatable shaft, means including said shaft for shifting the position of said setting pointer, means including said shaft and said arm for varying the position of said second electrical contact, an ambient temperature compensated polymetallic element, a heater winding in heat exchange relation with said element for deflecting an end portion of said element, means supporting said first electrical contact on said end portion, a spring element having a hook adjacent one end, and a link engaging said end portion and said hook and pivotal in response to movement of said end portion about said hook, said indicating pointer being supported by said link, the pivotal axis of said link and of said indicating pointer being spaced from said shaft.

9. A manually adjustable indicating device comprising a setting pointer, an indicating pointer, first and second matable electrical contacts, an arm supporting said second electrical contact, a manually rotatable shaft, means including said shaft for shifting the position of said setting pointer, means including said shaft and said arm for

varying the position of said second electrical contact, an ambient temperature compensated polymetallic element, a heater winding in heat exchange relation with said element for deflecting an end portion of said element, means supporting said first electrical contact on said end portion, a spring element having a hook adjacent one end, and a link engaging said end portion and said hook and pivotal in response to movement of said end portion about said hook, said indicating pointer being supported by said link, the pivotal axis of said link and of said indicating pointer being spaced from said shaft but in substantial alignment with the rotational axis of said shaft.

10. A manually adjustable indicating device comprising a setting pointer, an indicating pointer, first and second matable electrical contacts, an arm supporting said second electrical contact, a manually rotatable shaft, means including said shaft for shifting the position of said setting pointer, means including driving means on said shaft and driven means on said arm engageable with said driving means for varying the position of said second electrical contact, an ambient temperature compensated polymetallic element, a heater winding in heat exchange relation with said element for deflecting an end portion of said element, means supporting said first electrical contact on said end portion, a spring element having a hook adjacent one end, and a link engaging said end portion and said hook and pivotal in response to movement of said end portion about said hook, said indicating pointer being supported by said link, the pivotal axis of said link and of said indicating pointer being spaced from said shaft.

11. A manually adjustable indicating device comprising a setting pointer, an indicating pointer, first and second matable electrical contacts, an arm supporting said second electrical contact, a manually rotatable shaft, means including said shaft for shifting the position of said setting pointer, means including a gear on said shaft and a rack on said arm engageable with said gear for varying the position of said second electrical contact, an ambient temperature compensated polymetallic element, a heater winding in heat exchange relation with said element for deflecting an end portion of said element, means supporting said first electrical contact on said end portion, a spring element having a hook adjacent one end, and a link engaging said end portion and said hook and pivotal in response to movement of said end portion about said hook, said indicating pointer being supported by said link, the pivotal axis of said link and of said indicating pointer being spaced from said shaft.

12. A manually adjustable indicating device comprising a setting pointer, an indicating pointer, first and second matable electrical contacts, an arm supporting said second electrical contact, a manually rotatable shaft, means including said shaft for shifting the position of said setting pointer, means including a cam on said shaft and a cam follower on said arm engageable with said cam for varying the position of said second electrical contact, an ambient temperature compensated polymetallic element, a heater winding in heat exchange relation with said element for deflecting an end portion of said element, means supporting said first electrical contact on said end portion, a spring element having a hook adjacent one end, and a link engaging said end portion and said hook and pivotal in response to movement of said end portion about said hook, said indicating pointer being supported by said link, the pivotal axis of said link and of said indicating pointer being spaced from said shaft.

13. A manually adjustable indicating device comprising a setting pointer, an indicating pointer, first and second matable electrical contacts, an arm supporting said second electrical contact, a manually rotatable shaft, means including said shaft for shifting the position of said setting pointer, means including said shaft and said arm for varying the position of said second electrical contact, an ambient temperature compensated polymetallic element, means for drivingly coupling said element to said indicating pointer, a heater winding in heat exchange relation with said element for deflecting an end portion of said element, and means supporting said first electrical contact on said end portion.

14. A manually adjustable indicating device comprising a mounting plate, a setting pointer, an indicating pointer, first and second matable electrical contacts, an arm supporting said second electrical contact, means for supporting one end of said arm upon said mounting plate, a manually rotatable shaft rotatably supporting said setting pointer and rotatably supported by said mounting plate at a location remote from said one end of said arm, means including said shaft and said arm for varying the position of said second electrical contact, an ambient temperature compensated polymetallic element, means for drivingly coupling said element to said indicating pointer, a heater winding in heat exchange relation with said element for deflecting an end portion of said element, and means supporting said first electrical contact on said end portion.

15. A manually adjustable device comprising a setting pointer, manually rotatable means for adjusting said setting pointer, an indicating pointer, a first electrical contact, a polymetallic element carrying said first electrical contact, a heater winding in heat exchange relation with said element for deflecting a portion of said element, means drivingly connecting said element to said indicating pointer, an arm supported independently of said pointers, and a second electrical contact carried by said arm and matable with said first electrical contact.

16. A manually adjustable device comprising a setting pointer, manually rotatable means for adjusting said setting pointer, an indicating pointer, a first electrical contact, a polymetallic element carrying said first electrical contact, a heater winding in heat exchange relation with said element for deflecting a portion of said element, means drivingly connecting said element to said indicating pointer, an arm supported independently of said pointers, a second electrical contact carried by said arm and matable with said first electrical contact, and means including said manually rotatable means and said arm for moving said second electrical contact relative to said first electrical contact.

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