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THERMAL RESPONDING INDICATOR

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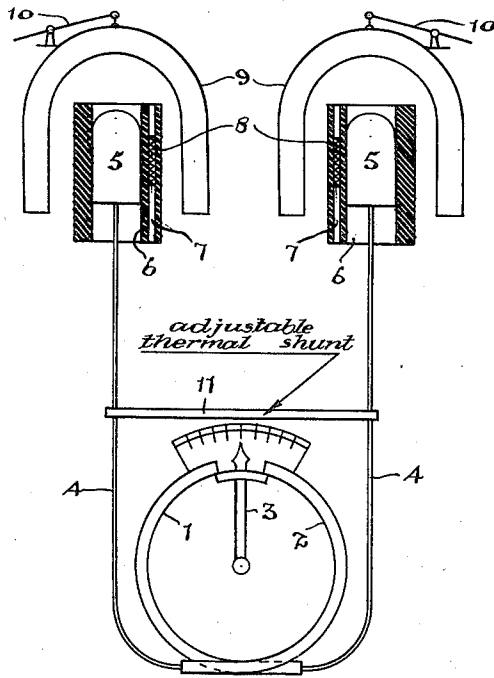


Fig. 1.

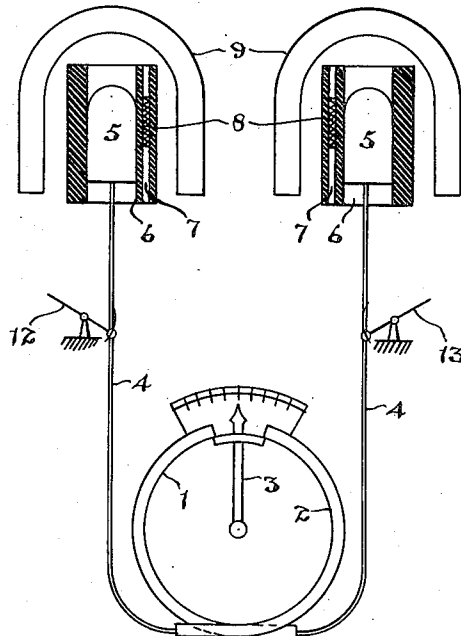


Fig. 2.

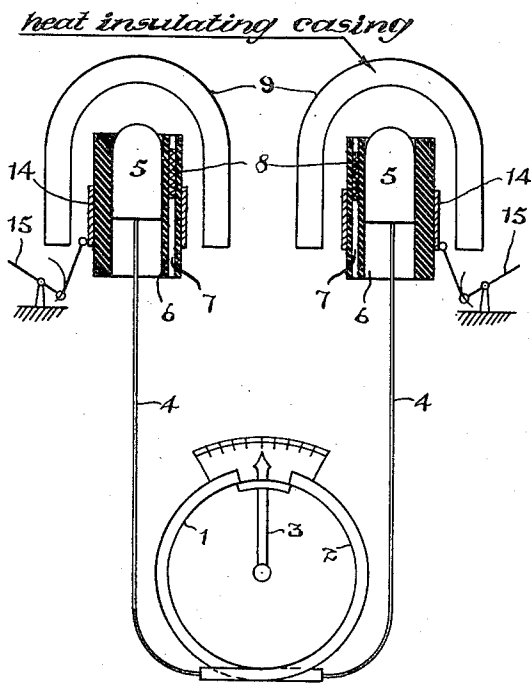
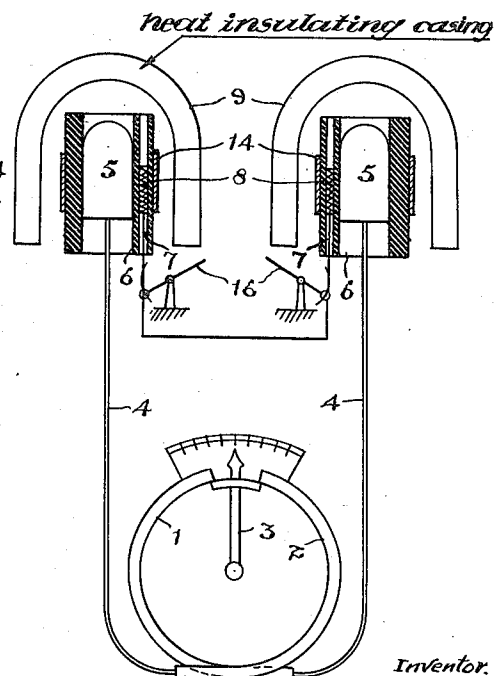


Fig. 3.



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THERMAL RESPONDING INDICATOR

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11 Claims. (Cl. 171—95)

The principal objects of this invention are to overcome the difficulties met with in the commercial manufacture of thermal responding indicators, such as are found in thermal demand watt meters and watt hour meters wherein heat translating devices, such as "Bourdon" tubes, bi-metallic strips, siphon tubes, etc., are arranged in mechanical opposition and effect the operation of the indicating mechanism, and to devise simple and effective means of adjustment to produce a balanced effect in such heat translating devices thereby reducing the error of unbalance that might otherwise exist.

The principal feature of the invention consists in the novel principle in adjusting parts of the heat-translating element whereby variations in heat conductivity between the thermal generator and the elements affected thereby, may be varied to effect the balancing of the elements which operate the indicator under an equalized application of the initial energy applied, thereby eliminating unbalance due to variations in quality and dimensions of materials used, or due to structural or other faults, and dispensing with the difficult and expensive method of attempting to pair these various elements to be used. In other words, the principal feature of the invention consists in offsetting or correcting an unbalance in one element by creating a compensating unbalance in another element.

In the accompanying drawing, Figure 1 is a diagrammatic illustration of a pair of thermal responsive units operatively connected with an indicator device showing two different means of thermal adjustment.

Figure 2 is a similar diagrammatic view showing a further form of adjustment.

Figure 3 is a similar diagrammatic view showing another and alternative form of adjustment and Figure 4 a still further form.

These different forms of the invention herein shown may be used separately or in combination in order to obtain the desired results.

In the device herein illustrated the thermal responsive element constitutes a pair of Bourdon tubes 1 and 2 which are arranged in opposition and connected to an arm 3 which is co-operatively associated with a suitable scale.

Each of the Bourdon tubes is connected by a capillary tube 4 to a sealed fluid reservoir 5. Surrounding each reservoir 5 is an electric insulating sleeve 6 having a longitudinally extending pocket or cavity 7 within which is arranged a suitable thermal generator 8, the heat from which is transmitted into the reservoir 5 by conduction

and has the effect of expanding the fluid medium therein, resulting in a pressure which is transmitted to the Bourdon tubes.

The insulating sleeves may each comprise concentric portions between which the generators are arranged or each may comprise a unitary insulating body of any suitable form preferably recessed to receive the generator element.

The generated heat is closely confined by the heat insulator casings 9 which may be in the form of vacuum tubes or otherwise and substantially the only heat escape from the composite unit is through the capillary tubes 4, or other direct heat conductors.

It will be readily appreciated that there may be considerable variance in the mechanical structure of the paired Bourdon tubes through inequalities in thickness of material, dimensions of structure or the actual physical properties of the tube lengths. There may be also physical differences in the conductor value of the capillary tubes 4 or whatever other heat conductors may be used. Again, there may be physical differences affecting the thermal absorption qualities of the reservoirs 5 and in the thermal transferring value of the insulator sleeves 6 and the insulating value of the outer casing 9 may vary, while of course it will be readily appreciated that the actual generating values of the generator elements may vary.

The variance between these different elements may individually be very slight, but they can also be very widely divergent and the present invention proposes to effect an alteration of relationship between these various elements which will bring them into balance.

In Figure 1 there is diagrammatically shown attached to each of the outer insulating casings 9, a lever 10 which represents any form of longitudinal adjustment of the said casings in respect to the parts enclosed thereby and the movement of these casings may be effected to overcome the unbalance which may be found.

Another and extremely simple form of adjustment is shown in Figure 1 in a thermal bridge or shunt 11 extending between the capillary tubes 4, or between the other heat conductors which may be used. By shifting the position of this bar, moving either end upwardly or downwardly, there will be created a considerable variation in the conductivity of the thermal paths through which the heat escape is arranged and since the torque exerted by the Bourdon tubes 1 and 2 is dependent upon the temperature of the reservoirs 5, varying the position of the thermal shunt

11, may be used as a means to control the torque exerted by said Bourdon tubes. Under some circumstances it may be found possible or desirable to shift the position of the reservoirs 5 and this means is diagrammatically illustrated in Figure 2 by the levers 12, 13, arranged to shift the reservoirs in relation to the generators 8.

In the form illustrated in Figure 3 a thermal shunt is provided in the form of a sleeve 14 which is preferably of copper and encircles the outer sleeve 7 enclosing the generators 8. Such a sleeve arranged outside of the heater or generator element has a very distinct function in the absorption of outwardly conducted heat which it conducts to other portions of the apparatus. Consequently if this sleeve is shifted in its longitudinal relation to the generators it will have a modifying effect ultimately upon the torque produced in the Bourdon tubes and a shifting lever 15 for operating this sleeve is diagrammatically shown.

A still further form of adjustment is shown in Figure 4 where the levers 16 are connected with the generators 8 to move them axially and change their relative transverse position in respect to the reservoirs 5, the sleeve 14 and the outer casing 9.

It will be understood of course that it would hardly be necessary or desirable to incorporate all of these methods of adjustment in one apparatus, but it might be found extremely desirable to couple any two or more together so that a desired adjustment of temperature values might be reached to bring about or effect a uniform relationship in the reaction of the Bourdon tubes 1 and 2 to applied electrical forces throughout the range of their operation.

The adaptation of any single or any combined use of the adjustment means disclosed or any other form of adjustment which might be suggested as being incorporated in the principle involved, will undoubtedly greatly simplify the manufacture of meters of the thermal type, as the ordinary run of stock required for the manufacture of the different elements may be used and by the means herein disclosed an accurate adjustment may be obtained, so that the allowance required for errors in present meter constructions will be reduced to the minimum.

It will be apparent that, in each of the forms of the invention defined the desired adjustment is achieved without interfering with the actual value of the thermal output of the generator, but rather by controlling the escape or distribution of the thermal output so that it may be caused to influence its respective "Bourdon" tube reservoir to a greater or less extent relative to and independent of the extent to which the thermal output of the other generator may influence the other "Bourdon" tube reservoir.

There may thus be applied equal electrical energy to each of the respective generators and adjustment of the indication to zero or neutral may be achieved by permitting more or less of the thermal energy of one generator to escape relative to the other.

Moreover, while I have shown the elements associated with each "Bourdon" tube reservoir as adjustable in relation thereto, in certain cases I may find it desirable to provide this relative adjustability in connection with only one of the "Bourdon" tube reservoirs while the other "Bourdon" tube reservoir may have its associated elements disposed in a desired permanent relation thereto.

Any unbalance that is encountered in the

mechanical or thermal parts may be compensated for by the adjustments provided which bring about an unbalance in the thermal conductivity.

What I claim as my invention is:—

1. In a thermal electric meter, the combination with an indicator, oppositional means controlled by thermal influence for operating said indicator, and means for translating electrical to thermal energy, of means for controlling the relative effectiveness of the produced thermal energy on the oppositional means to bring said indicator to a neutral position under an equalized application of electrical energy to said translating means.

2. In a thermal electric meter, the combination with an indicator, means controlled by thermal influence for operating said indicator, and means for translating electrical to thermal energy, of means for adjusting the physical relation of the aforesaid means to bring said indicator to a neutral position under an equalized application of electrical energy.

3. In a thermal meter, the combination with electric heaters arranged in pairs and oppositionally paired elements responsive to said heaters for operating an indicator, of means for varying the heat conductivity between one of said heaters and its respective heat responsive member relative to the heat conductivity between the other heater and its respective heat-responsive member to effect a thermal balance and the accurate operation of the indicator.

4. In an electric meter, the combination with an indicator, opposed means tending to operate said indicator, thermal means for effecting the operation of said opposed means and means for governing the flow of heat between said thermal means and their co-operative elements, of adjustable means for controlling the relative heat transference between said elements to effect a thermal balance.

5. In an electric meter, the combination with an indicator, opposed means tending to operate said indicator, and thermal means for effecting the operation of said opposed means, of means for mechanically shifting the relative positions of said thermal means and said opposed means to effect a change in thermal conduction.

6. In an electric meter, the combination with an indicator, opposed "Bourdon" tubes for operating said indicator, fluid reservoirs connected with said "Bourdon" tubes, and electric heaters arranged adjacent to said "Bourdon" tubes and adapted to be uniformly energized, of means for relatively regulating the transference of heat from said heaters to their respective "Bourdon" tubes while said electric heaters are uniformly energized to ensure a true neutral or zero indication.

7. A device as claimed in claim 6 in which means is provided for mechanically shifting the relative positions of the fluid reservoirs and said heaters.

8. A device as claimed in claim 6 in which a movable heat conductor is arranged to effect a change in the transference of heat from the heaters to the fluid reservoirs.

9. A device as claimed in claim 6 in which heat enclosing casings are arranged to be moved in relation to the heaters and fluid reservoirs to affect the relative heat transfer values.

10. In a thermal electric meter having an indicator, and means for actuating said indicator including in part a thermally responsive element cooperating with said indicator, and an electric

heater influentially associated with said element, of means for controlling the effect of the thermal energy of said heater on said thermally responsive element independent of the effect of the remaining part of said actuating means on said indicator for the purpose of adjusting said indicator to a neutral or zero position.

11. In a thermal meter, the combination with electric heaters arranged in pairs and paired ele-

ments responsive to said heaters for operating an indicator, of means for effecting an unbalance in the thermal conductivity between one of said heaters and its respective responsive element relative to the thermal conductivity between the other of said heaters and its respective responsive element to compensate for unbalance or error in the operation of said responsive members.

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