

Dec. 31, 1940.

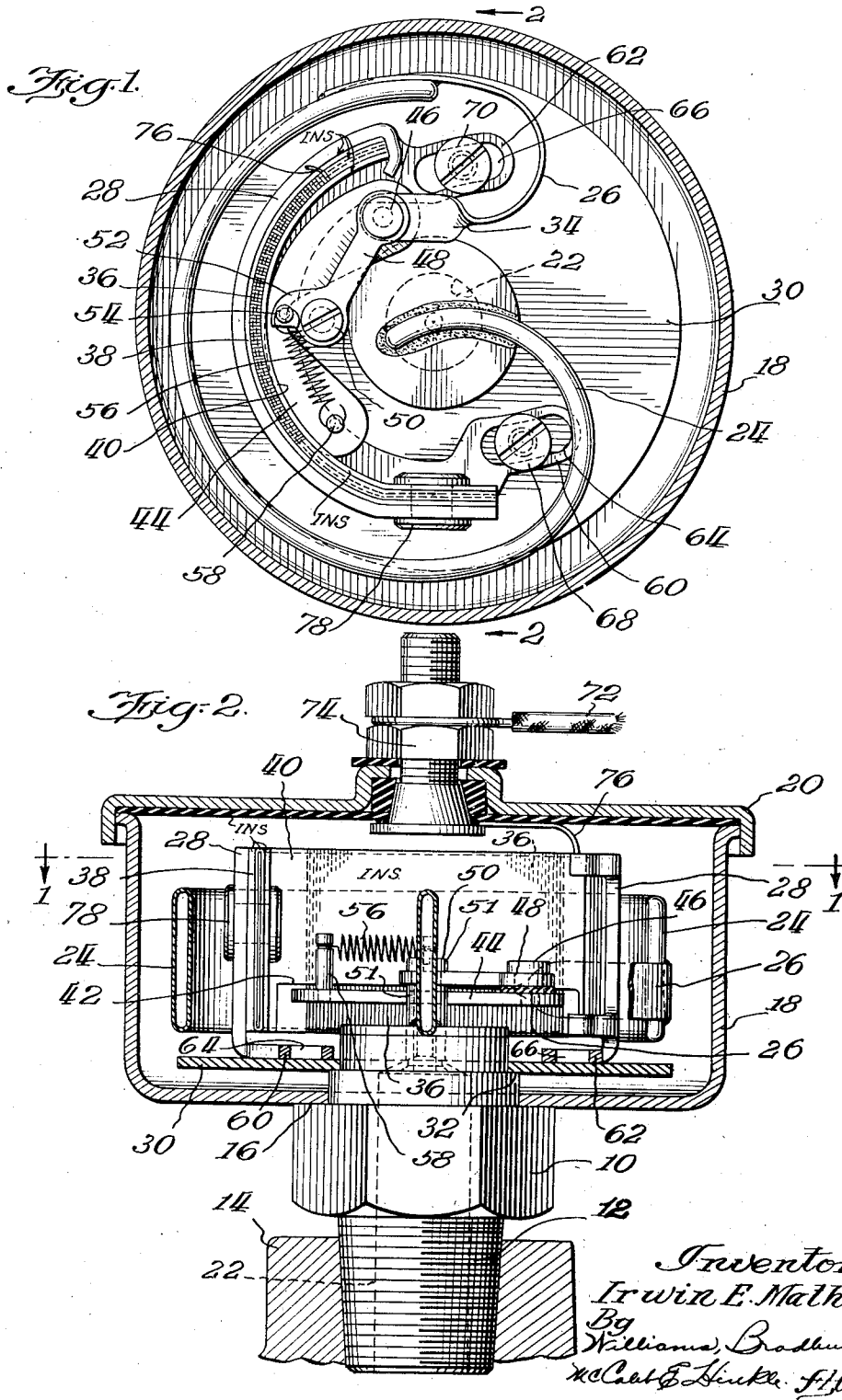
I. E. MATHER

2,226,629

PRESSURE RESPONSIVE RHEOSTAT

Filed Feb. 10, 1936

2 Sheets-Sheet 1



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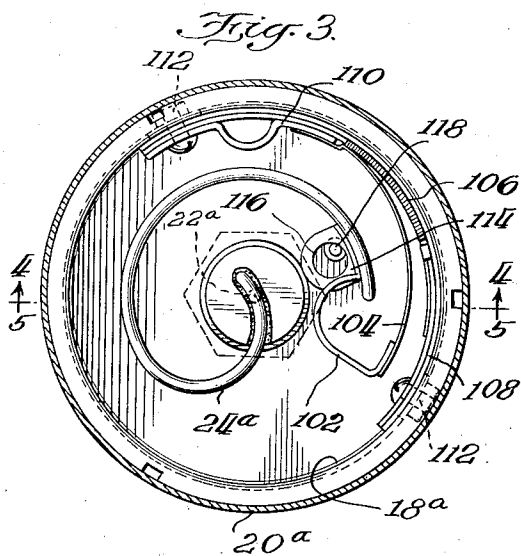
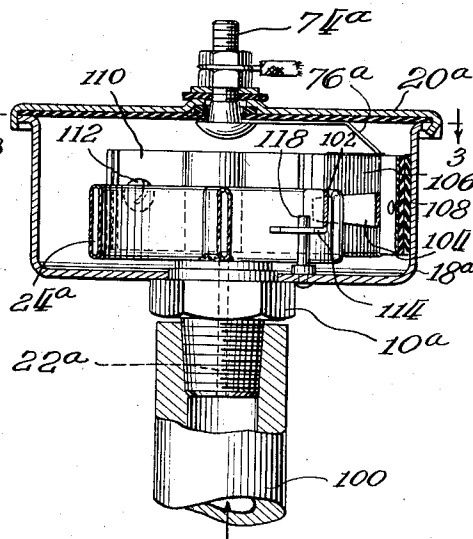
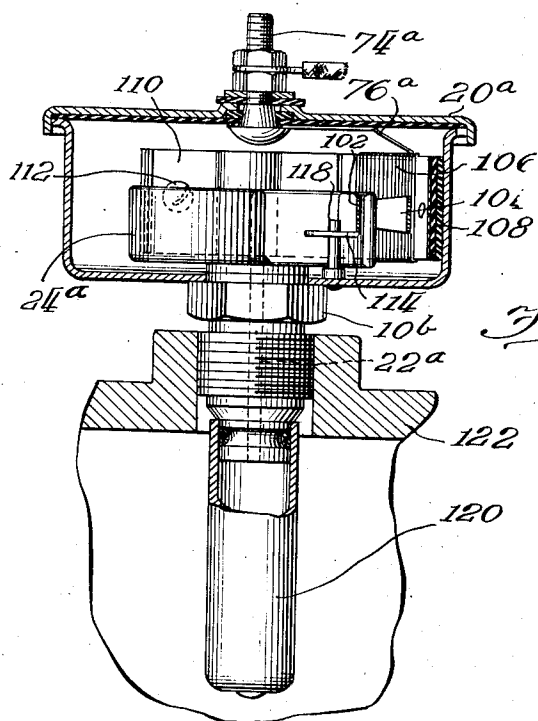
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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

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PRESSURE RESPONSIVE RHEOSTAT

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11 Claims. (Cl. 201—48)

My invention pertains to pressure and temperature responsive rheostats and is particularly concerned with rheostats for regulating electrical indicators of the types commonly used on automobiles and for many other purposes.

An object of my invention is to provide an improved rheostat which is simple and durable and which will be economical to manufacture.

Another object is to provide an improved rheostat which will more accurately respond to the pressure or temperature which it is sought to indicate.

Another object is to provide an improved rheostat which can readily be manufactured to provide any desired current variation.

Another object is to provide an improved rheostat which can readily be adjusted either to modify its own characteristics in accordance with a standard of comparison or to modify its own characteristics to compensate for the irregular characteristics of the indicating means with which it is used.

Other objects and advantages will become apparent as the description proceeds.

In the drawings, Figure 1 is a horizontal section taken on the line 1—1 of Figure 2 and shows a preferred form of my invention;

Figure 2 is a vertical section taken on the line 2—2 of Figure 1;

Figure 3 is a view similar to Figure 1 but showing a modified form of my invention, this view being taken on the line 3—3 of Figure 4;

Figure 4 is a vertical section taken on the line 4—4 of Figure 3; and

Figure 5 is a vertical section also taken on the line 4—4 of Figure 3 but showing the modification thereof adapted to respond to temperature variations.

Referring to Figures 1 and 2 of the drawings, I have shown a preferred form of my invention comprising a base 10 having a portion 12 provided with a pipe thread so that it can be inserted into a part 14 such as a branch of a T connection in a conduit of the oiling system of an automobile engine. The base 10 may be made hexagonal to facilitate the threading of the base into the part 14.

The base 10 is provided with a shoulder 16 supporting a cup 18 having an upper end adapted to be closed by a cover 20. The cup 18 and cover 20 provide convenient means for inclosing and protecting the operating parts against dirt, water and injury.

The base 10 is provided with a bore 22 affording

fluid communication with the interior of the Bourdon tube 24 supported on the upper end of this base. This tube 24 is curved, as indicated in Figure 1, and a sheet metal strap 26 is soldered or otherwise attached to the end of the tube 24 which is remote from the base 10. As clearly shown in the drawings, the main portion of the tube 24 lies between the cup 18 and an arcuate support 28 mounted on a plate 30 carried on a second shoulder 32 of the base 10. The strap 26 is bent into the form of a semicircle so that the end 34 of this strap lies within one end of the arcuate support 28.

This arcuate support 28 carries a resistance element 36, there being an insulating strip 38 between the resistance element and the support. A second insulating strip 40 is located on the inside of the resistance element and serves to prevent any of the wires of the resistance element from projecting inwardly beyond any of the other wires. This insulating strip 40 has a lower edge which terminates at a distance above the lower edge of the resistance element, as indicated at 42, whereby the lower edge of the resistance element is exposed and may be engaged by a contact element such as the shoe 44.

A pin 46 forms a common pivotal connection for the contact shoe 44, lever 48, and end 34 of the strap 26 attached to the Bourdon tube 24. The lever 48 is pivotally attached by a screw 50 to the upper end of a hollow post 51 which is riveted to the plate 30. The lever 48 has a short arm 52 carrying a pin 54 receiving one end of a tension spring 56 having its other end connected to a pin 58 attached to the end of the contact shoe 44 opposite the pin 46.

As the pressure of the fluid admitted to the Bourdon tube 24 increases, this tube tends to unwind and moves the end 34 of strap 26 toward the arcuate support 28 and the resistance element carried thereby. The linkage by means of which the contact shoe is attached to the stationary plate 30 multiplies the movement of the Bourdon tube about sixteen times, thereby permitting the rheostat to respond accurately to very small variations in fluid pressure. As the contact shoe 44 is moved toward the resistance element 36, the lower end of this contact shoe, as viewed in Figure 1, first contacts with the lower end of the resistance element and short-circuits the contacted portion of the resistance element, thereby reducing the resistance in the circuit of which the resistance element forms a part. Increases in pressure result in causing more and more of the contact shoe 44 to engage and short-circuit more

and more of the resistance element until, at the maximum pressure at which the gauge is designed to operate, the entire resistance element may be short-circuited.

It will be appreciated that my rheostat may be so made as to produce any desired relationship between decrease in resistance and fluid pressure by simply making the curved contact edge of the contact shoe 44 of such shape as to give the desired characteristic. Furthermore, for any given shape of the curved contact edge of the contact shoe 44, the operating characteristics of my improved rheostat may be varied by shifting the relationship between the contact shoe 44 and the resistance element 36. This change in relationship may be accomplished by providing the mechanism with any desired adjusting means.

In Figures 1 and 2, such adjusting means takes the form of ears 60 and 62 integral with opposite ends of the arcuate support 28 and provided, respectively, with slots 64 and 66 for receiving screws 68 and 70 by means of which the arcuate support 28 is adjustably attached to the stationary plate 30.

The particular instruments shown in the drawings of this application were designed primarily for use in connection with the indicating instruments of automobiles and were intended to receive current from the battery of an automobile. In automotive practice, the frame and connected mechanism of the automobile constitute the ground and only one wire is used to connect the battery to the various instruments. I accordingly show a single wire 72 leading from a binding post 74 on the cap 20 to the indicating instrument which is not shown. The binding post 74 is insulated from the cap 20, and the inner end of this binding post is connected to one end of the resistance element 36 by an electrical conductor 76. For automotive use, the other end of the resistance element 36 may be grounded as, for example, by way of rivet 78 and arcuate support 28. This rivet serves to clamp the resistance element and its insulating strips to the support 28.

A feature of my invention is the firm support afforded to the operating elements. In this connection attention is directed to the fact that the plate 30 is firmly secured to the base 10 and carries the support 28 for the resistance element and also carries the post 51 on which the lever 48 and attendant mechanism is operatively supported.

It should be noted that the shoe 44 establishes a rolling contact with the resistance element 36 and progressively short-circuits successive turns of the wire of this resistance element as the pressure in the Bourdon tube increases. The contact edge of this shoe 44 may be silver-plated to provide the most efficient electrical connection with the resistance 36.

Another advantage of this form of my invention lies in the particular mounting for the spring 56. This mounting is such that the length of this spring does not vary appreciably for all positions of the shoe 44 whereby the force exerted by this spring is uniform, giving a uniform calibration of the instrument. Furthermore, this spring removes all slack from the operating connections for the shoe 44 and thus eliminates any lag in operation which might otherwise be present.

While I have shown this preferred form of my invention as adapted only for use as a pres-

sure indicator, it is to be understood that this preferred form may be used with equal facility to respond to temperature variations of a medium whose temperature it is desired to indicate. In utilizing this preferred form as a temperature indicator, the base 10 may be modified to carry a gas filled bulb in the manner hereinafter described in connection with Figure 5.

In Figures 3, 4 and 5 of the drawings, I have shown a modified form of instrument which does not use the movement amplifying linkage of Figures 1 and 2. Referring particularly to Figures 3 and 4, the base 10a is shown as threaded into one end of a fluid conduit 100 which may be connected with any source of fluid pressure which it is desired to indicate. The base 10a carries a cup 18a provided with a cover 20a for inclosing and protecting the operating parts of the device.

The bore 22a of the base 10a communicates with one end of a Bourdon tube 24a attached to the upper end of the base. The other end of the Bourdon tube is soldered or otherwise attached to a sheet metal strap 102 carrying one end of a silver-plated spring 104 which constitutes the contact member for engaging the resistance element 106. In this form of my invention the resistance element 106 is mounted on the cup 18a, a suitable insulating strip 108 being interposed therebetween. The other end of the spring 104 is secured to a rigid conductor 110.

It is to be understood that the operating characteristics of this form of my invention can be varied by shifting the resistance element 106 with respect to the contact spring 104. In order to permit this, the parts are provided with suitable slots for receiving the bolts 112 by means of which the parts are adjustably secured to the cup 18a.

As in the previous form of my invention, the cover 20a is provided with a binding post 74a adapted to be connected by wire with the indicating means located on the instrument board of the automobile. This binding post is connected to one end of the resistance element by conductor 76a.

The structure shown in Figure 5 is identical with that shown in Figures 3 and 4 except that in this figure the device is adapted to respond to temperature variations instead of pressure variations. For this purpose the base 10b is provided with a gas filled bulb 120 which is in free communication with the interior of the Bourdon tube 24a. This gas filled bulb is shown as extending into the water jacket 122 of an automobile engine.

As the temperature of the water increases, the temperature of the gas in the metal bulb 120 is correspondingly raised, whereupon the pressure of the gas is increased a definite amount corresponding to each increase in temperature of the water in the water jacket. The increased pressure of the gas in the bulb 120 is communicated to the Bourdon tube 24a and operates the device in the manner previously described. Where the device is to be used for indicating temperatures, the bore in the base 10b which connects the interior of the bulb 120 with the Bourdon tube 24a is made small in order that substantially all of the gas confined in the device will be raised to the full temperature of the water in the water jacket 122.

I find it desirable to limit the movement of the free end of the Bourdon tube 24a of the

modification shown in Figures 3, 4 and 5 of the drawings. I accomplish this by providing the strap 102 with a laterally-projecting flange 114 having an opening 116 receiving a pin 118. This pin may be riveted or otherwise attached to the bottom of the cup 18a.

While I have illustrated and described several forms of my invention, it is to be understood that my invention is not limited to the specific details shown or described, but that my invention may assume numerous forms and that the scope of my invention is to be limited solely by the following claims.

I claim:

1. In a rheostat of the class described, the combination of a base, a plate firmly mounted thereon, a support adjustably carried by said plate, a resistance element mounted on said support, a Bourdon tube having a movable end and another end secured to said base, means for admitting fluid pressure to said tube, a lever pivotally mounted on said plate, a common pivotal mounting for one end of said contact member, said lever and the movable end of said tube, and a connection between the other end of said contact member and said lever normally urging said ends toward each other and the contact member toward the resistance element.

2. In a rheostat of the class described, the combination of a base, a Bourdon tube supported on said base, said base including a threaded nipple and a bore connecting said nipple with said tube, a cup supported on said base, an arcuate electrical resistance supported on said base, means insulating all but one terminal of said resistance from said cup, a contact member connected to said Bourdon tube and rollingly engaging said resistance upon expansion of said tube, said contact member having an arcuate resistance engaging face of a radius not less than half that of said resistance and of a substantial length and being so mounted with respect to said resistance that slight movement of said tube effects movement of the contact face over a considerable portion of said resistance, a cover for said cup, a binding post mounted on said cover, and an electrical connection between said binding post and one end of said resistance.

3. In a rheostat of the class described, the combination of an electrical resistance, a Bourdon tube, means for admitting fluid pressure to said tube, a contact member for engaging said resistance, a movement-multiplying connection between said tube and said contact member, said connection including a pivoted lever, a pivotal connection between said lever and one end of said contact member, and a resilient connection between said lever and the other end of said contact member, said resilient connection having a spring for eliminating slack from said movement-multiplying connection.

4. In a rheostat of the class described, the combination of an electrical resistance, a Bourdon tube, fluid pressure means for effecting movement of one end of said tube, a contact member adapted to engage said resistance, a lever, a common pivotal mounting for said lever, the movable end of said tube and the contact, a fixed pivotal mounting for said lever, and resilient means connecting the lever and contact tending to maintain the contact in engagement with the resistance.

5. In a rheostat of the class described, the combination of an electrical resistance, a Bourdon tube, fluid pressure means for effecting

movement of one end of said tube, a contact member adapted to engage said resistance, a substantially L-shaped lever pivotally mounted intermediate its ends and having each end connected but relatively movable with respect to an end of said contact, means connecting a corresponding end of said contact and lever for simultaneous movement by said tube whereby said contact member is moved over said resistance, and means permitting independent adjustment of the positions of each end of said resistance.

6. In a rheostat of the class described, the combination of an electrical resistance, a support, a pair of slot and pin connections between said resistance and said support, said pins and slots providing sufficient play to permit substantially universal adjustment of said resistance, a contact member for engaging said resistance, a Bourdon tube, means for admitting fluid pressure to said tube, and a movement-multiplying connection between said tube and contact member, said movement-multiplying connection comprising an L-shaped lever pivotally supported intermediate its ends, a pivoted connection between the one end of said lever and one end of said contact member, and a spring connecting the other end of said lever with the other end of said contact member.

7. In a rheostat of the class described, the combination of a base, a plate firmly mounted thereon, a support adjustably carried by said plate, a resistance element mounted on said support, a contact member adapted to engage said resistance, a Bourdon tube having a movable end and another end secured to said base, means for admitting fluid pressure to said tube, a lever pivotally mounted on said plate, a common pivotal mounting for one end of said contact member, said lever and the movable end of said tube, and a connection between the other end of said contact member and said lever permitting relative movement between them when their opposite ends are moved by said tube.

8. In a rheostat of the class described, the combination of a base, a plate firmly mounted thereon, a support adjustably carried by said plate, a resistance element mounted on said support, a Bourdon tube having a movable end and another end secured to said base, means for admitting fluid pressure to said tube, a lever pivotally mounted on said plate, a common pivotal mounting for one end of said contact member, said lever and the movable end of said tube, a spring connecting the other end of said contact member and said lever, and a housing mounted on said base and enclosing said plate, resistance, tube, and lever.

9. In a rheostat of the class described, the combination of a base comprising a threaded nipple having a passageway therethrough, a Bourdon tube in communication with said passageway and supported on said base, a plate firmly mounted upon said base, a support mounted upon said plate, a resistance element mounted on said support, a contact in co-operative relationship to said resistance element and actuated by said tube, means electrically connecting one end of said element to said base, a cup supported on said base, a cover for said cup co-operatively associated therewith to enclose said tube, plate and resistance element, a binding post mounted upon and insulated from said cover, and an electrical connection from said post to the other end of said resistance element.

10. In a rheostat of the class described, the

combination of an electrical resistance, a Bourdon tube, fluid pressure means for effecting movement of one end of said tube, a contact member having an elongated contact face only a portion of which is adapted to engage said resistance at any time, a common pivotal connection for one end of said tube and said contact whereby said tube may move one end of the contact relative to said resistance, and means defining a floating pivotal mounting for said contact whereby different portions of the face of the contact are brought into engagement with said resistance upon movement thereof by said tube.

11. In a rheostat of the class described, the combination of an elongated electrical resistance having an arcuate shape, a Bourdon tube, fluid pressure means for effecting movement of one

end of said tube, an elongated contact member having an arcuate resistance engaging face of a radius less than the radius of the arcuate resistance, a substantially L-shaped lever mounted intermediate its ends for pivotal movement about a fixed point, said point lying between the arcuate resistance, the arcuate contact face, and the centers of the radii of the arcs, a common floating pivotal mounting for the movable end of said tube and corresponding ends of said contact and lever whereby movement of the tube effects movement of said ends of the contact and lever with respect to said resistance, and a resilient connection between the other ends of said contact and lever providing a floating pivotal mounting for said other end of the contact.

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