

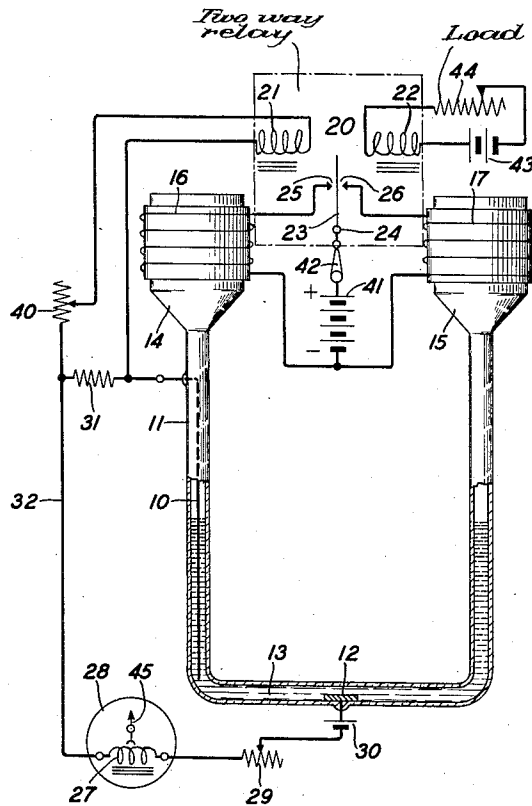
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ELECTRICAL POWER INDICATING APPARATUS

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ELECTRICAL POWER INDICATING
APPARATUS

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61,882. Patent No. 2,097,146, dated October 26,
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4 Claims. (Cl. 171—95)

This is a division of my application, Serial No.
61,882, filed February 1, 1936, now Patent No.
2,097,146 issued October 26, 1937, and relates to
an apparatus for expeditiously indicating varia-
tions in electrical power.

In a preferred embodiment of the invention,
a closed receptacle is provided with a resistance
element immersed partially in a liquid contact,
both of which are embodied in a circuit including
an indicating meter and a battery. Heating ele-
ments controlled by a relay in response to varia-
tions in a load effect displacements of the liquid
contact whereby relatively large changes in the
resistance in the metering circuit are produced.
These resistance changes vary in correspondingly
large amounts the current which actuates the
meter to indicate the load variations relative to a
predetermined magnitude.

It is an object of the invention to produce
relatively large readings of relatively small vari-
ations in the power supplied to an electrical cir-
cuit.

The drawing is a diagrammatic circuit illus-
trating power indicating apparatus constructed
in accordance with the invention.

In the preferred form of the invention illus-
trated in the drawing, a resistance element 10 is
disposed internally of the left vertical leg of a
U-tube 11. An electrical contact member 12 is
secured internally of the horizontal leg at a point
substantially equidistant from both vertical legs
of the U-tube. A mercury contact 13 connects
the resistance element 10 and the contact mem-
ber 12. Formed on the end of the left vertical
leg of the U-tube is a bulbous portion 14 and on
the right vertical leg is a bulbous portion 15.
Heating elements 16 and 17 encircle the bulbous
portions 14 and 15, respectively. A suitable in-
ert gas or fluid is provided in each bulbous por-
tion to engage the mercury contact.

A two-way relay 20 comprises windings 21 and
22 having positioned therebetween an armature
23 pivoted at 24 and spaced equidistant from
contacts 25 and 26 associated with the heating
elements 16 and 17, respectively. The windings
21 and 22 are so arranged that current flows
therein in opposite directions. It is to be under-
stood that when these currents are of equal value
the armature 23 remains in a neutral position
which is indicated in the drawing; and further
that when the current flowing in winding 21 is
the larger the armature 23 is actuated to engage
contact 25, and when the current flowing in
winding 22 is the larger the armature 23 is driven
to engage contact 26.

Winding 27 of an indicating meter 28 is con-
nected in a series circuit comprising a variable
rheostat 29, battery 30, contact 12, mercury con-
tact 13, resistance element 10, fixed resistance
31, and lead 32. Winding 21 of the two-way
relay 20 is shunted across the fixed resistance
31 through a variable rheostat 40. One terminal
of battery 41 is connected through a single pole
switch 42 to the armature 23 while its opposite
terminal is connected through heating element
16 to contact 25 and, in addition, through heat-
ing element 17 to contact 26.

A source of electrical power 43 supplies current
to a series circuit including the source 43, wind-
ing 22, and a load 44. Variations in the magni-
tude of the current flowing in this circuit are re-
corded on the meter 28 in a manner that will
now be explained.

As a preliminary step to the operation of the
circuit, a pointer 45 is brought to a predeter-
mined or normal position on the chart associated
with the meter 28. This is accomplished by ad-
justing rheostat 29, and represents a desired or
normal magnitude of current in the load circuit.
Variations in load current are thereafter indi-
cated as increases and decreases with respect to
the normal magnitude. A portion of the current
flowing in the winding 27 will also flow in wind-
ing 21 of the relay 20. Adjustments of rheostats
29 and 40 will therefore enable sufficient current
to flow in winding 21 to balance a normal cur-
rent in winding 22 so as to allow the pointer 45
to remain in the predetermined position. Dur-
ing this step the switch 42 is opened to preclude
the possibility of battery 41 energizing the heat-
ing elements.

In operation, the switch 42 is closed to connect
battery 41 to one terminal of each of the heat-
ing elements. In the event of an increase in the
current flowing in the winding 22, armature 23
will be caused to engage contact 26 to complete
through battery 41 an energization circuit for
heating element 17. This expands the gas in the
bulbous portion 15 to increase the pressure on
the mercury contact in the right leg of the U-
tube causing the mercury contact to rise in the
left leg. This immerses the resistance element
10 to a greater extent than under a normal con-
dition. Consequently, the resistance of the in-
dicating meter circuit is reduced to permit an
increased current to flow in the winding 27 and
also in the winding 21.

The pointer 45 is actuated until the current
in winding 21 has increased a sufficient amount
to balance the current in winding 22 whereupon

armature 23 is returned to its neutral position and the actuation of pointer 45 is terminated. It is obvious that the increased current in winding 21 is due to the increased current occasioned by the decrease in the resistance of the circuit including the indicating meter 28.

The return of armature 23 to its neutral position interrupts the previously formed energization circuit for heating element 17, hence there will be no further expansion of the gas in the bulbous portion 15. Accordingly, the resistance determined by the extent of the immersion of the resistance element 10 in the mercury contact will remain substantially constant until the gas in the bulbous portion 15 cools to equalize the pressure exerted by the gas in the bulbous portion 14. Obviously, further increases in the current in the load 44 are indicated as described above.

In the event of a decrease in the current flowing in winding 22, armature 23 will engage contact 25 to complete through battery 41 an energization circuit for heating element 16. This causes an expansion of the gas in the bulbous portion 14 to increase the pressure on the mercury contact in the left leg of the U-tube. The mercury contact recedes thereby lessening the immersion of the resistance element 10 therein. This increases the resistance in the indicating meter circuit.

The increased resistance reduces the current flowing in the actuating winding 27 and also in the winding 21, hence the pointer 45 is actuated in a direction opposite to that mentioned above for an increased load current. This actuation continues until the current in the winding 21 has decreased an amount adequate to balance the current in winding 22. Under this balance, actuation of the pointer 45 is arrested and the armature 23 returns to its neutral position to interrupt the previously formed energization circuit for heating element 16. The expansion of the gas in bulbous portion 14 is terminated, hence the resistance determined by the extent of the immersion of the resistance element 10 in the mercury contact will remain substantially constant until the gas in the bulbous portion 14 cools to equalize the pressure exerted by the gas in the bulbous portion 15. Obviously, further decreases in the current flowing in the load are indicated as described above.

It is to be understood that movements of the pointer 45 on the chart associated with the meter 28 will be in such directions as to indicate increases and decreases with respect to the normal load current.

It is seen therefore that by properly proportioning the elements of the apparatus, relatively slight variations in current flowing in the load 44 can be reflected as relatively large changes in the current flowing in the winding 27 of the meter 28. Thus, the apparatus may be utilized to indicate relatively smaller variations in current than could be indicated by the meter 27 functioning by itself. At the same time, the apparatus obviates devices employing delicate and intricate mechanical movements.

While the embodiment is illustrated to record variations in current, it is not necessarily limited thereto and can be readily adapted to record variations in potential. To accomplish this, the several circuit elements are selected to respond to potential rather than to current changes.

It is understood that the invention is capable of modifications other than the one disclosed herein and the scope thereof together with such

modifications is defined in the appended claims.

What is claimed is:

1. In an electrical indicating apparatus, the combination comprising a load, an indicating circuit including in series an indicator, a source of energy, a resistance element and a liquid contact immersing the resistance element; a tube containing the resistance element and liquid contact and terminating in a sealed bulbous portion on each of two opposite ends, an expansible fluid in each bulbous portion to vary the immersion of the resistance element in the liquid contact, a heater disposed on each bulbous portion to vary the volume of the expansible fluid, a source of energy for the heaters, and means connected to the load and indicating circuit and responsive to variations in the load to connect one of the heaters to the source of energy associated therewith to vary the resistance in the indicating circuit and thereby the readings of the indicator.

2. In an electrical indicating apparatus, the combination comprising a load, an indicating circuit comprising in series an indicator, a source of energy, a resistance element and a liquid contact immersing the resistance element; a tube containing the resistance element and liquid contact and terminating in a sealed bulbous portion on each of two opposite ends, an expansible fluid in each bulbous portion to vary the immersion of the resistance element in the liquid contact, a heater disposed on each bulbous portion to vary the volume of the expansible fluid, a source of energy for the heaters, and electromagnetic means connected to the indicating circuit and the load and responsive to variations in the load to connect one of the heaters to the source of energy associated therewith in a manner such that increases in the load cause proportional decreases of resistance in the indicating circuit and decreases in the load cause proportional increases in the resistance of the indicating circuit to respectively produce increased and decreased readings on the indicator.

3. In an electrical indicating apparatus, the combination comprising a load, an indicating circuit comprising in series an indicator, a source of energy, a resistance element and a liquid contact immersing the resistance element; a tube containing the resistance element and liquid contact and terminating in a sealed bulbous portion on each of two opposite ends, an expansible fluid in each bulbous portion to vary the immersion of the resistance element in the liquid contact, a heater disposed on each bulbous portion to vary the volume of the expansible fluid, a source of energy for the heaters, and a two-contact electromagnetic relay having an armature connected to the heater source of energy and associated with each of the two contacts and including two windings one of which is connected in series with the load and associated with one contact and the second winding is connected in shunt of the indicating circuit and associated with the second contact, the power in said second winding and indicating circuit being initially adjusted so that a predetermined load causes between the two windings an effect that balances the armature substantially midway between the two contacts and produces a predetermined reading on the indicator so that variations in the load cause between the two windings effects that upset the balance to actuate the armature to engage one of the two contacts to energize the heater associated therewith to expand the fluid

to vary the resistance in the indicating circuit to produce on the indicator readings corresponding to the variations in the load.

5 4. The combination in the electrical indicating apparatus according to claim 3 in which an increase in the load causes between the windings an effect that actuates the armature into engagement with the one contact to decrease the resistance in the indicating circuit thereby pro-

ducing on the indicator a reading above the predetermined reading and a decrease in the load causes between the windings an effect that actuates the armature into engagement with the second contact to increase the resistance in the indicating circuit thereby producing on the indicator a reading below the predetermined reading. 5

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