

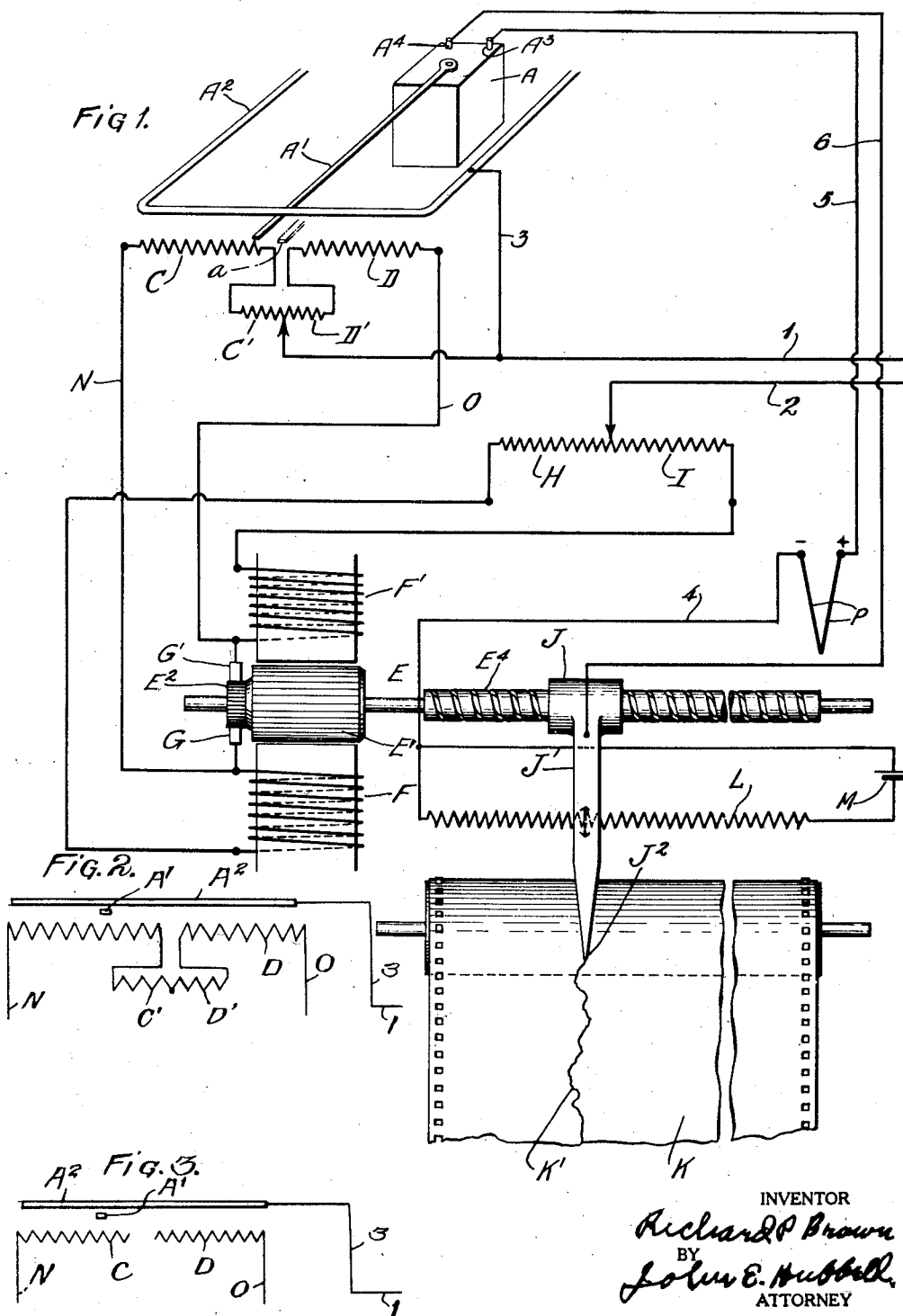
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METER CONTROLLED RELAY MECHANISM

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METER CONTROLLED RELAY MECHANISM

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My present invention relates to mechanism comprising a relay motor controlled by a meter such as is used in so-called potentiometer and other instruments for measuring and recording furnace temperatures, and for regulating the supply of heat to a furnace to maintain regulated temperature conditions therein. The general object of the present invention is to provide apparatus of the character described which is simple and effective and which comprises improved means for making the actuation of the relay motor dependent in direction and extent upon the direction and extent of displacement of the movable element of the meter away from a neutral or intermediate position.

My invention is characterized by the use of a reversible electric motor, which may well be an ordinary commutator motor as the relay motor proper, in conjunction with provisions controlled by the displacement of a meter pointer from its neutral position for supplying an energizing current to the motor, the amount and direction of which depends upon the extent and direction of the needle displacement. In a preferred practical mode of obtaining the advantages of the invention, the relay motor energizing means comprises a constantly energized electric circuit mesh with the motor armature connected between two points in said circuit mesh which are normally at the same potential. With this arrangement, the meter pointer when displaced is employed to vary the amount of resistance in one or the other of two portions of said circuit mesh depending on the direction of pointer displacement, by an amount which depends upon the extent of pointer displacement, to thereby create a corresponding difference in potential between the points in the two circuits to which the motor is connected. The desired variation in motor speed and direction of rotation of the motor in correspondence to the direction and extent of pointer displacement may obviously be obtained in other ways however.

The various features of novelty which characterize my invention are pointed out with particularity in the claims annexed to and forming a part of this application, but for a better understanding of the invention, its advantages and specific objects obtained with it, reference should be had to the accompanying drawing and descriptive matter in which I have illustrated and described preferred embodiments of the invention.

Fig. 1 of the drawing is a diagrammatic representation of one form of the invention; and

Figs. 2 and 3 are diagrammatic representations of different modifications of a portion of the apparatus shown in Fig. 1.

In the drawing A represents a meter, the pointer A' of which is displaced from a neutral position *a* by an amount and in a direction dependent upon the relation between the voltage of a thermo-couple P and the potential drop in the portion of a potentiometer resistance L at the left hand side of an adjustable contact arm J'. The arm J' is adjusted by a relay motor E, which is a reversible electric motor, and is intermittently set into operation in one direction or the other, according to the extent and direction of displacement of the pointer A' from the neutral position *a* at the instants at which the pointer is depressed by an intermittently actuated depressor bar A² into contact with one or the other of two resistances C and D which extend along the path of movement of the free end of the pointer A in opposite directions from the neutral position *a* of the pointer. The meter A may well be a millivolt meter of the kind commonly used in conjunction with a thermocouple to measure temperatures and comprising a depressor A² intermittently turned about a horizontal axis by a clock motor or the like (not shown), to depress the pointer A' into contact with whichever of the two resistances C and D is beneath the pointer when the latter is so depressed.

The electric relay motor E may be an ordinary commutator motor. As shown, the shaft of the motor armature E' has a threaded extension E⁴ working in a sliding nut J carrying the potentiometer contact arm J', and as shown, the contact arm J' is provided with a marker J² for tracing a record K' on a travelling record sheet K. The energizing means

for the motor E illustrated in the drawing, comprises supply conductors 1 and 2, between which a difference of potential is maintained which may be that of an ordinary lighting circuit. The conductors 1 and 2 are connected by two circuits N and O. The circuit N includes in series a resistance C', the above mentioned resistance C, one field winding F of the motor E, and a resistance H. The circuit O includes a resistance D', the above mentioned resistance D, a second field winding F' of the motor E, and the resistance I. One commutator engaging brush G of the motor E is connected to the circuit N between the resistance C and the field winding F and resistance H. The second commutator engaging brush G' of the motor E is connected to the circuit O between the resistance D and the field winding F' and resistance I. One terminal of the thermo-couple P is connected to the left hand end of the potentiometer resistance L by a conductor 4; the second terminal of the thermo-couple is connected to one terminal A² of the meter A by a conductor 5, and the second terminal A' of the meter is connected to the contact arm J' by a conductor 6. The connection between the thermo-couple and the potentiometer resistance L should be such that the E. M. F. of the thermo-couple is opposed in the meter circuit by the potential drop through the portion of the potentiometer resistance L at the left of the contact J'.

With the described circuits, if the ratio of the sum of the resistances C' and C to the sum of the resistance of the field winding F and the resistance H, is the same as the ratio of the sum of the resistances D' and D to the sum of the resistance of the field winding F' and the resistance I, as should be the case, there will be no difference in potential between the brushes G and G' so long as the pointer A' is out of engagement with the resistances C and D. The motor armature will then have no tendency to turn in either direction, although current will flow through each of the motor field windings F and F'. If the depressor A² is actuated to depress the pointer A' when the latter is displaced from its neutral position *a* to the left, the resistance C' and a portion of the resistance C to the right of the pointer A' is short-circuited. The short circuit provisions diagrammatically illustrated consists of a low resistance shunt comprising the end of the pointer A', the depressor A², and a conductor 3 connecting the depressor A² to the supply conductor 1. This varies the ratio of the resistances at the two sides of the brush G in the circuit N, and decreases the resistance in that circuit, and thereby creates a potential difference between the brushes G and G' causing a portion of the current flowing through the resistance C to flow through the windings of the motor armature E' and resistance I.

This causes the motor armature to rotate in one direction.

If the meter pointer A' swings in to the position shown in the drawing as a result of the fact that the E. M. F. of the thermo-couple P exceeds the potential drop in the portion of the potentiometer resistance L at the left of the conductor arm J', the direction of rotation of the motor armature E' resulting from the engagement of the resistance C by the pointer A', should be that required to move the contact arm J' to the right. Such movement, if of the proper extent, will make the potential drop in the portion of the resistance L to the left of the contact J' equal to the E. M. F. of the thermo-couple P and thus return the pointer A' to its neutral position *a*. Conversely, if, with the assumptions made, the potential drop in the potentiometer resistance L to the left of the contact J exceeds the E. M. F. of the thermo-couple, the pointer A' will be deflected to the right of its neutral position *a*, and when depressed will engage the resistance D and thereby short-circuit the resistance D' and the portion of the resistance D between the resistance D' and the pointer A'. This decreases the amount of resistance in the circuit O and changes the ratio of the resistances in the portions of that circuit at opposite sides of the brush G', and, in consequence, current will then flow through the motor armature E' in a direction opposite to that in which it flows when a portion of the resistance C is short-circuited. The resultant rotation of the motor armature tends to move the contact arm J' to the left, so as to decrease the potential drop in the portion of the resistance L at the left of the contact arm J', and thereby tends to restore the balance between the E. M. F. of the thermocouple and said potential drop.

When the meter pointer A' is depressed into engagement with either resistance C or D, the extent to which the resistance in the corresponding circuit N or O is reduced and the potential difference thereby created between the brushes G and G', and consequently the speed and extent of rotation of the motor armature E' produced, will increase with the extent of displacement of the meter pointer. In consequence, the extent of the resultant movement of the contact arm J' is made proportional to the extent of such movement required to restore the desired balance between the E. M. F. of the thermo-couple and the potential drop of the brush of the potentiometer resistance in circuit with the thermo-couple and meter. This desirable mode of operation is obtained, moreover, with an exceedingly simple and mechanically and electrically effective and reliable apparatus which is relatively inexpensive to construct and maintain.

The described variation in the adjusting

effect of the motor E, in accordance with the extent as well as the direction of displacement of the needle pointer A', is a desirable characteristic of a meter controlled relay of the general type described regardless of whether the relay is employed to adjust a potentiometer resistance and recorder, as shown, or in lieu thereof, or in addition thereto is employed for other purposes such as the regulation of furnace heat controlling valves or switches.

It will be apparent to those skilled in the art that many changes may be made in the form of the apparatus disclosed without departing from the spirit of my invention as set forth in the appended claims, and that certain features of the invention may sometimes be used with advantage without a corresponding use of other features. For example, I may omit the resistances C' and D' which in effect form extensions of the resistances C and D, respectively, and when used tend to increase the extent of the corrective movements of the relay motor E produced by small displacements of the pointer A' from its neutral position. It will be apparent to those skilled in the art, moreover, that the motor field windings F and F' need not be included in the circuits N and O, but may be separately excited. I contemplate ordinarily using circuits N and O of the same resistance, but in some cases the resistances of these two circuits may be unequal. When the resistance in the circuit N, for example, is less than the resistance in the circuit O, the resultant effect would be to increase the corrective movement of the motor E in response to a given displacement of the needle A' to the right of its neutral position α , as compared with the motor movement produced by a similar pointer displacement to the left of the neutral position. It will be understood, of course, that sections of equal length of either of the resistances C and D along the path of travel of the free end of the pointer A' may, or may not be of equal resistance.

While the most desirable values of the various resistances employed depend upon conditions, and these resistances may obviously be varied through a wide range, I will state by way of illustration, that in one contemplated embodiment of the invention shown in Fig. 1, C and D are each of 420 ohms resistance, C' and D' are each of 60 ohms resistance, H and I are each of 480 ohms resistance, each of the field windings F and F' is of 20 ohms resistance, and the armature resistance is 110 ohms.

In lieu of continuously energizing the motor current supply mesh as is done with the arrangement shown in Fig. 1, I may dispense with the permanent connection from the supply conductor 1 to the resistances C and D as shown in Fig. 2, and pass the entire

motor energizing current through the conductor 3, depressor A², and pointer A'. The resistances C and D need not be permanently connected either through the resistances C' and D' as shown in Figs. 1 and 2 or directly when the resistances C' and D' are omitted, but may be disconnected from one another as shown in Fig. 3. The arrangements shown in Figs. 2 and 3 while simpler in some respects than the arrangement shown in Fig. 1 are open to the objection that all of the motor energizing current must pass through the instrument pointer A' and the tendency to sparking when the depressor A² lifts and permits the pointer A' to separate from the resistance C or D is consequently more pronounced with the arrangement shown in Figs. 2 and 3, than with the arrangement shown in Fig. 1.

Having now described my invention, what I claim as new and desire to secure by Letters Patent, is:

1. In a meter controlled relay mechanism, the combination with an electric motor, of a source of current, two circuits energized by said source of current and each including a resistance, said motor being connected between said two circuits at points therein normally at the same potential and operating in one direction or the other when the potential of one of said points respectively rises above or falls below the potential of the other point, a meter pointer, and means co-operating therewith for intermittently short-circuiting a portion of the resistance in one or the other of said circuits at regular intervals and in accordance with the direction and extent of the direction of displacement of the pointer from an intermediate position, and the amount of which portion depends on the extent of said displacement.

2. Control apparatus comprising the combination with a selector member, of apparatus responsive to changes in temperature for exerting a force on said selector member for deflecting it, normally balanced paths over which energy may be transmitted, means periodically actuating said selector member for periodically unbalancing one of said paths on each actuation in selective accordance with the position of said selector, control apparatus controlled by the energy transmitted over the selected path and means controlled by said control apparatus influencing said first named apparatus to cause a change in the selection of said selector member.

3. The combination with a meter element movable toward and away from a neutral position in accordance with changes in value of the quantity measured by the meter, of an energizing motor circuit, a motor connected to two points in said circuit normally at equal potential, means controlled by said meter for unbalancing said circuit and thereby supplying to said motor at regulated intervals

an energizing current at each of said intervals increasing and decreasing in intensity in accordance with the extent of displacement of said meter element from its neutral position, and means controlled by said motor for restoring said meter element to its neutral position.

4. The combination with a meter pointer movable in opposite directions from the neutral position in accordance with changes in value of the quantity measured by the meter, of an energizing motor circuit, a motor connected to two points in said circuit normally at equal potential, means controlled by said meter pointer for unbalancing said circuit and thereby supplying to said motor at regulated intervals an energizing current varying in intensity at each such interval in proportion to the extent of displacement of said pointer from its neutral position, and means actuated by the movement of said motor for returning said pointer to its neutral position and for cutting off said supply of energizing current to said motor.

5. The combination with a meter circuit comprising a temperature responsive means and a meter element movable toward and away from a neutral position in accordance with changes in temperature, said meter being normally in a balanced condition with the meter element in its neutral position, of a reversible electric motor, a motor energizing circuit, said motor being connected to two points in said motor circuit normally at equal potential, means for unbalancing said circuit and thereby supplying an energizing current to said motor at regular intervals on an unbalancing of said meter circuit varying at each such interval in accordance with the extent of unbalance in said circuit, and means controlled by said motor for restoring the meter circuit to its balanced condition.

6. The combination with a meter pointer arranged to move in opposite directions from a neutral position in accordance with changes in the quantity measured by the meter, of a normally balanced motor energizing circuit comprising a resistance, and means for short circuiting a portion of said resistance comprising an intermittently operated depressor arm arranged above said meter pointer and arranged to force said pointer when in a deflected position into contact with a portion of said resistance at each operation varying with the deflection of the pointer from a neutral position to thereby correspondingly unbalance said motor energizing circuit.

7. In a control system, the combination with a sensitive meter including an element deflecting toward and away from a neutral position in accordance with changes in value of a quantity measured by the meter, a control device, a reversible electrical relay motor for adjusting said device, and means for periodically supplying and energizing current

to said motor varying in intensity and direction in accordance with the extent and direction of displacement of said element from said neutral position, said means comprising a resistance extending along the path of said deflection and normally out of engagement with said element and means for periodically effecting engagement of said element and said resistance at a point along the length of the latter dependent upon the then position of said element relative to said neutral position.

8. In a meter controlled relay mechanism, the combination with a meter element movable toward and away from a neutral position in accordance with changes in value of the quantity measured by the meter, of a commutating electric motor and its brushes, and energizing means for the motor comprising a source of current, separate connections from one side of said source to said brushes, each of said connections including resistance, and means co-operating with said element and comprising resistances distributed along the path of movement of the element and engaged by the latter for connecting the other side of said current source to said brushes, to thereby create a difference in a potential between said brushes varying in direction and intensity with the direction and extent of displacement of said element from its neutral position.

Signed at Philadelphia, in the county of Philadelphia, and State of Pennsylvania, this 27 day of September, A. D. 1924.

RICHARD P. BROWN.