

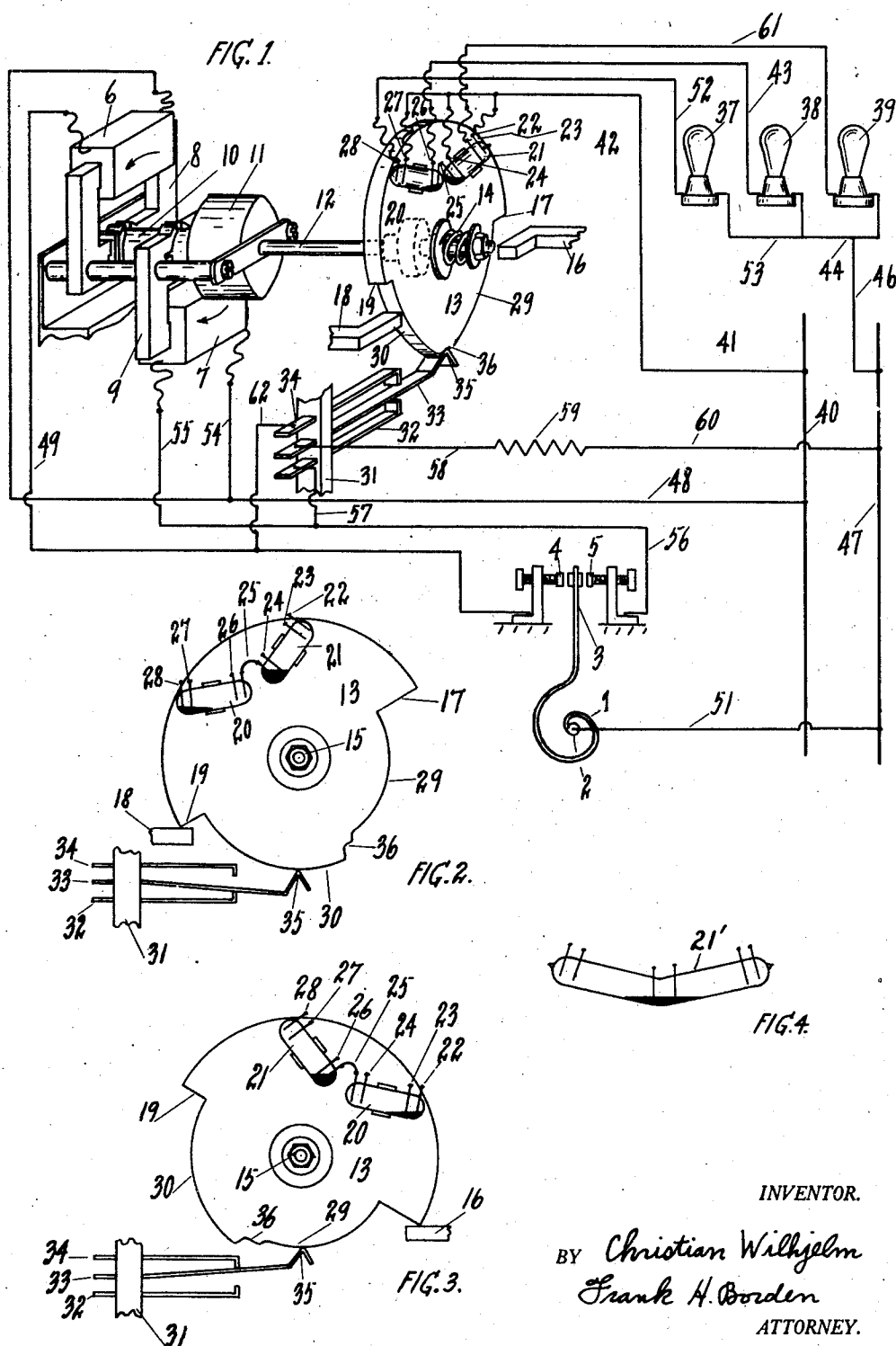
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MOTOR OPERATED RELAY

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MOTOR-OPERATED RELAY

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This invention relates to motor operated relays, and particularly to relays operable automatically to control other circuits in response to deviations of a condition-responsive-circuit maker.

Automatic control of pressure, light, humidity, temperature, etc., characterized as of variable "condition", in most cases depends on a sensitive instrument pointer for setting in motion a number of other more or less powerful devices, which, through mechanical operation in some way or another makes the necessary correction, whatever it may be, to maintain the desired conditions.

The most common method of actuating control devices from sensitive instrument pointers is to arrange one or more contacts in the necessary instrument so that the indicating pointer, or condition responsive device, as it changes position in response to a change of condition, touches these contacts and thereby selects one of two or more different passages for an electric circuit, which in turn must set the controlling machinery in action until the changed conditions have been corrected, as manifested by a return of the conditions to a predetermined normal condition. However the amount of electric current that can usually be passed through such flimsy instrument contacts is very limited, so it nearly always becomes necessary to introduce one or more stages of relays. The one stage being capable of carrying more current through its contacts than the next previous stage in the series. Now, one of the main objects of this invention is to provide such an intermediate relay device between a contact instrument and the correcting control equipment, that although it only uses a very faint current for its operation, it can make and break large amounts of electric current and operate electric motors of several horsepower without any additional step-up relays.

Another object is to provide a relay to operate from these flimsy instrument contacts in such a manner that the flickering which is due to vibration of the instrument when mounted in a factory building does not pass the relay. Any ordinary solenoid operated relay naturally will carry such flickering through the whole control system and cause almost the destruction of moving parts. Relays are now used which prevent this chattering by self locking features, but when used it becomes necessary for the controlling pointer to move far enough back to close another contact in order to make the locked relay fall out, and then close the circuit that in turn

makes corrections for variations in the opposite direction. This method makes the control instrument complicated and at the same time less sensitive for control as the required large distance between the two contacts needed for each operation necessary, must be travelled by the pointer either way before any change in conditions can be effected through the relays. Therefore, a further object of the invention is to provide a control relay that on the faintest closing of the instrument contact will operate the required correcting mechanism and which also, as soon as this contact is severed will react into some other position causing some other correcting mechanism to operate. Due to the fact that the current consumed by the relay operation is very faint, there is practically no sparking when the instrument contact is broken, hence the faintest move of the pointer from the contact will cause a desired change in the operation of the controlling mechanism.

There are many varied means of making the electric contacts in standard measuring or condition responsive instruments. There are also many different mechanical means for controlling the conditions from such gauges or instruments. This invention, therefore, primarily applies to an intermediate device wired in between the sensitive control gauge and the controlling means, therefore, in the description and accompanying drawing, I am describing the invention in order to show how it can apply to the now commonly used contact instruments and control means of the different types. The details here shown, however, should by no means confine my invention, but merely show a few of its many applications.

It might be noted in connection with the past art in circuit controllers, that it has been attempted heretofore to utilize a fully enclosed tube of glass, in which is embedded sets of contacts, arranged for selective circuit closing by contact with a globule of mercury, as the tube is given a change in position, and in which as many as three different circuits are established in the same tube. This construction has never been completely successful, owing among other factors to the danger of a residual trail of mercury lying in the tube in such position as to simultaneously energize two different sets of contacts. It is an object of this invention to secure all of the benefits of such multiple contact tube without the disadvantages of prior constructions.

In the accompanying drawing, forming part of this description,

Fig. 1 represents a diagrammatic perspective of one, purely illustrative form of the invention,

Fig. 2 represents an end elevation of the circuit controlling element actuated by the motor, showing the element in one extreme position,

Fig. 3 represents an end elevation of the circuit controlling element actuated by the motor, showing the element in another extreme position, and

Fig. 4 represents an elevation of a modification of a portion of the circuit controlling device actuated by the motor.

The actuating instrument for simplicity is only shown as a simple bi-metallic thermostat 1, responsive to temperature changes, but it will be understood that this is purely illustrative, and any other condition responsive device or other circuit maker might equally well be used. One end of this thermostat is permanently fixed at 2, the other end forms the moving pointer 3 which will move right or left as the temperature or other condition to which the thermostat or responsive instrument is exposed changes up or down. In the drawing the movement of the pointer 3 to the left means dropping temperature, a raising temperature will move the pointer to the right. Two contacts 4 and 5 are provided to engage the pointer 3 as it deviates, from a certain temperature drop 3 engages 4, if the temperature raises, 3 will engage 5.

The following parts are the essentials in a reversing self-starting alternating current motor which is now a standard generally known article on the market. For illustrative and not limitative purposes reference might be made to U. S. Patent No. 1,283,435 for a disclosure of a type of motor that might be usable herein when suitably modified to comprise a reversing motor. There are numerous reversing motors, made by different manufacturers, that will admirably fill the requirements of this invention, but for further disclosure of a reversing motor of the type preferred with this invention, reference may be made to Bulletin MI-3 of the Warren Telechron Company, Ashland, Massachusetts, published in 1930, and particularly to pages 8 and 11, type BX and CX, respectively. However, for this purpose any electric motor that can conveniently be reversed by sending current to it alternately through one or the other of two wires can be used. The motor has a field winding 6 on an iron core 8 tending to force the motor counter clockwise, and has an oppositely wound coil 7 on an iron core 9, tending to force the motor in a clockwise direction, both direction of force being indicated by arrows appropriately placed on the sides of the windings for purposes of clarity. The motor armatures are housed within a tube 10, which is extended to form the enlarged housing 11, within which latter is mounted a reduction gearing of any desired sort, as preferably a train of spur gears (not shown), sufficient to transform the high speed of the motor into the slow speed of a shaft 12, extending from the gear housing 11. This motor as shown is on the market in this general design with drive shaft speed of 1 R. P. M. more or less as may be required. In this description, it may be assumed that the speed of shaft 12 is 1 R. P. M., however, the speed of operation is unimportant although certain shaft speeds may prove more satisfactory in practice than others for certain applications. This particular motor as shown can be operated clockwise or anti-clockwise at will, by sending current

through either coil 6 or coil 7. In this description as noted, it will be assumed that the passing of current through coil 6, will result in a counter clockwise movement of shaft 12 as indicated by the arrow on the side of coil 6, while passing current through coil 7 will result in a clockwise movement of shaft 12, as indicated by the arrow on coil 7.

The shaft 12 carries a disc 13 which is held by friction on the shaft by means of the spring 14 and the nut 15. On account of this friction the disc 13 will turn with the shaft 12, as long as it is free to move. However, the movement of the disc with the shaft is restricted and limited in clockwise direction by the suitably supported mechanical stop 16 being engaged or abutted by a notch, shoulder, or ear 17 on the disc 13. In the counter clockwise direction, its movement is restricted by the mechanical stop 18 being engaged by a corresponding shoulder or notch 19 on the disc 13. Two glass bulbs or tubes 20 and 21, respectively, are clamped to the disc 13, preferably toward the upper or top position thereof, with their longitudinal axes out of parallelism or alignment. These two fully enclosed glass bulbs contain each a small amount of mercury. Four electric contacts, two in each end, extend from the inside of each bulb, and bear reference characters respectively from 22 to 28 inclusive, and of which contact 25 is a double contact having a leg in each of the two bulbs 20 and 21.

The outer periphery of the disc, preferably the lower half thereof, between the ears or shoulders 17 and 19, has a contour formed of arcs described about the axis of shaft 12 and the axis of the disc, but on different radii. Thus the right hand side of the disc as shown in the drawing has a cam surface 29 extending from ear 17 to almost the vertical diameter of the disc in the position shown in Fig. 1, of a small radius, while the left hand side of the disc has a cam surface 30 extending from ear 19 to almost the termination of cam surface 29 of larger radius, while the small step or shoulder 36 formed in the center of the disc between the ends of cam surfaces 29 and 30 is described on a radius representing, preferably one half of the sum of the radii of surfaces 29 and 30. If the disc is disposed as shown in Fig. 1, the step or shoulder 36 will be disposed with the vertical diameter passing through the surface 36.

The insulated block 31 serves as a support for the three flexible contact arms 32, 33, and 34. The mechanical arrangement of these contacts in relation to the disc 13 is such that the cam 35 on contact 33 slides on the bottom surface of disc 13. When the disc 13 is in the mid-position as shown on the drawing, Fig. 1, no contact is made by 33 with either 32 or 34. If disc 13 is moved clockwise the cam 35 drops off 36 and due to its spring tension it raises up and makes contact with 34. If the disc 13 is moved counter clockwise from its center position the cam 35 will be forced down as it passes under the section 30 of the disc and make contact with contact 32. In Figs. 2 and 3 are shown the position of the contacts 32, 33 and 34 in the extreme left and right positions.

In Fig. 1, 37, 38 and 39 designate, respectively, three electric lights which may be of different colors, say 37 is green and stands for low temperature or negative condition, 38 is white and stands for right temperature or neutral or normal condition, and 39 stands for red and means too high temperature or positive condition.

These three lights enable an operator to manually make the necessary manipulation of valves or other regulating devices, in order to try to maintain the proper temperature or normal condition with the white light burning. If automatic control is desired the current that lights the three lights respectively can be used to manipulate valves, dampers, or other devices mechanically, thus eliminating the human element. The lights will be designated broadly, therefore, as electric devices.

The glass bulbs 20 and 21 as will be noticed are so arranged that when cam 35 on contact 33 rests on notch or step 36, the globule of mercury in each bulb lies in that end of each bulb, that meet in the center in this position owing to the angular divergence of two tubes. It will be noticed that a metallic connection is completed from contact 24 through mercury in bulb 21 to contact 25 from contact 25 to mercury in bulb 20 to contact 26. If disc 13 is tilted counter-clockwise, the mercury in both bulbs will take the position as shown in Fig. 2. It will be noticed that the mercury in bulb 21 remains in the same position as shown in Fig. 1, but the mercury in bulb 20, due to the tilting of disc 13, shifts to the other end of the bulb, thereby opening the metallic connection between 24 and 26, but establishing a new connection between 27 and 28. In Fig. 3, the disc 13 is tilted clockwise and in this case the mercury in bulb 21 shifts and opens the connection from 24 to 26 whereas it makes a connection between 22 and 23, thus the three different positions of the disc 13; left tilted position Fig. 2, mid-position Fig. 1 and right tilted Fig. 3, each closes a separate set of contacts and automatically breaks anyone of the two other connections that were closed in the previous position. The angular relation between the two bulbs 20 and 21 is generally such (as shown) that only one of these contacts can be made and one circuit completed at any one time, although there may be occasions when the bulbs may have to be so mounted in relation to each other that the contacts and flow of current through each circuit overlap more or less.

For certain purposes it might be desired to have the contacts mounted in a single tube instead of a pair of tubes, in which event a tube like that shown at 21' in Fig. 4 might be used. The operation is as follows:

The position in which the apparatus is shown in Fig. 1 is the mid-position in general called the neutral or normal position where the temperature or condition is as desired, that is when the instrument arm 3 does not make contact at either 4 or 5. The light or control circuit, therefore, is as follows: from line 40 current will pass through wire 41 to wire 42 to contact 24, through mercury in bulb 21 to contact 25, through mercury in bulb 21 to contact 26 to wire 43, to lamp or electric device 38, to wire 44, to wire 46 and back to the other side of the line and the lamp or device 38 will burn or function indicating that the temperature or condition where thermostat or responsive indicator 1 is located is within the desired limit.

If now the temperature or condition, where thermostat or indicator 1 is located, drops below the desired limit pointer 3 will swing over and make contact with contact 4. This action establishes a circuit as follows: From line 40 through wire 48, magnet coil 6, wire 49, wire 50, contact 4, pointer 3, thermostat 1, and wire 51 back to the other line 47. This circuit through coil 6

starts the motor operating in counter-clockwise direction. Due to the friction between shaft 12 and disc 13 the disc turns with the shaft until the notch 19 engages stop 18 and the motor continues to turn so long as current continues to pass through coil 6, however, the disc remains stationary. While this operation takes place two things happen, first the tilted bulbs 20 and 21 take the position shown in Fig. 2 and as explained above the circuit through 24, bulb 21 to double contact 25, to 26, is broken and consequently the white light 38 goes out, but a circuit is formed by the mercury in bulb 20 between wire 27 and 28, therefore following wiring diagram on Fig. 1 current will pass from line 40 to wire 41 to contact 27 through mercury in bulb 20 to contact 28, through wire 52, through light or device 37 wire 53, through wire 44 and 46 back to the other line 47 and light or device 37 will burn or function indicating that the temperature or condition where thermostat or indicator 1 is located is low or negative. The other condition that changes by the anti-clockwise movement of the disc 13, while contact is made by pointer 3 to contact 4 and, as explained above, coil 6 is energized, is that cam 35 is forced downward by the high section 30 of the disc 13. By this action a contact is made between 32 and 33 as shown in Fig. 2. Assuming this connection being made while looking at wiring diagram on Fig. 1, the following circuit of fractional power or less current strength is closed or established: from line 47 to wire 48, 54, through coil 7, wire 55, 56, 57, contact 32, contact 33, wire 58, resistor 59, wire 60, back to other line 47. This current passing through coil 7 tends to oppose the movement in anti-clockwise direction of the shaft 12, but due to the resistance 59 in this circuit the force of magnet coil 6 is stronger and the coils 6 and 7 and the resistance 60 are so proportioned that regardless of the opposing force from magnet 7 to the shaft 12, the motor will continue to operate in an anti-clockwise direction so long as current of full strength passes through coil 6. If, however, now it is assumed that due to the green light 37 being lit manual adjustment is made to raise the temperature surrounding thermostat 1 or automatic devices are actuated to effect the same end, and therefore pointer 3 ultimately assumes a position away from contact 4. From the foregoing this break between pointer 3 and contact 4 cuts the current off to coil 6. This leaves the above described opposing fractional current or circuit of less current strength through coil 7 free to operate the motor in opposite direction or clockwise until the disc 13 has been moved back into the position shown in Fig. 1, where cam 35 again falls down on the notch 36 due to the spring tension upward, thereby breaking the current passing, as explained above, through from 32 to 33, through coil 7 and the motor stops the disc in this normal mid-position, with circuit to light 37 broken, but with the circuit to light 38 closed, so that it lights, indicating that the temperature or condition again has been brought back to normal.

If now the temperature where the thermostat is located goes up, or the condition becomes positive, the movement of the pointer 3 towards the right will eventually make contact with contact 5 and thereby complete or establish a circuit from line 47 to wire 51, connection 2, thermostat 1, pointer 3, contact 5, wire 56, 55, coil 7, wires 54 and 48 back to the other side of the line 40. The motor will now operate the shaft 12 and disc 13 in clockwise direction until notch 17 on disc 13

abuts stop 16, when the disc stops moving shaft 12 may continue to operate so long as contact is made between pointer 3 and contact 5, or so long as the temperature is high or condition positive. The disc 13 will then be in position as shown in Fig. 3, with the mercury in bulb 21 breaking the circuit between contact 24 and 26 and light 38, but closing a circuit through contact 22, the mercury and contact 23, thereby establishing the following circuit: from line 40 to wire 41, 42, contact 22, mercury in bulbs 1, contact 23, wire 61, lamp 39, wire 46, and back to the other side of the line at 40, thereby lighting up lamp 39 indicating that the temperature is high or the condition positive.

The cam 35 will slide up on surface 29 on disc 13 and on account of its spring tension make contact with contact 34 as shown in Fig. 3. This will close a fractional circuit or one of less current strength from line 47 to wire 60, resistor 59, wire 58, contact 33, contact 34, wire 62, 50, 49, through coil 6, and wire 48, back to other line 40. This current through coil 6 will now oppose the clockwise operation of the motor but cannot stop it, due to the reduction of strength by passing resistor 59, however, the minute the temperature or condition changes to break the circuit at the thermostat, between pointer 3 and contact 5 disrupting the circuit through coil 7, the current through resistor 59 and coil 6 will start the motor in anti-clockwise direction until the disc 13 has been moved back to its mid-position, where cam 35 is forced up on notch 36, thereby breaking the contact between 34 and 33 which disrupts the circuit passing through coil 6, hence the motor stops again in the mid-position or neutral position with all circuits broken except the circuit from line 40 to wire 41, contact 24, mercury in bulb 21, contact 25, mercury in bulb 20, contact 26, wire 43, through lamp 38, wire 44, 46, 47 and back to the other line leaving the light 38 burning to indicate that the temperature or condition at the thermostat 1 is within the limits for which the thermostat or indicator is adjusted.

It will be obvious that the voltage of the lines supplying the circuits through lamps or electric devices 37, 38 and 39, may readily be much higher than that necessary to secure the operation of the reversible motor, although for purposes of illustration only all circuits are shown as arising from a common line.

The above described motor relay is but one of the applications and modifications of my invention, particularly designed for use with contact measuring gauges or condition responsive devices where it is essential to arrange to do something in any one of the three cases when the temperature is low or condition negative when it is normal and when it is high or the condition is positive. It prevents chattering action of the circuits it controls through its mercury contacts because the flickering of the thermostat contacts only makes the disc oscillate minutely back and forth without being able to influence the position of the mercury in the bulbs before a firm make or break is established on or by the instrument gauge.

In the above described design of my invention the small amount of the current required by the motor coils 6 and 7 must be made and broken by the contacts on the thermostat, however, this current can be made very small and most control instrument contacts can withstand the breaking of this faint current.

I claim as my invention:

1. In a motor operated relay for establishing a plurality of circuits independent of but in predetermined relation to the relative conditions in the operating circuit, comprising a motor having two opposite fields, means establishing a circuit through one field while the other field is not energized to drive the motor in one direction, means establishing a circuit through the last mentioned field while the first mentioned field is not energized to drive the motor in the opposite direction, means establishing circuits in both fields simultaneously, and means for varying the current strength of one circuit during the simultaneous establishment to cause one circuit to overpower the other to turn the motor against the urge of one circuit, and means selectively establishing a plurality of secondary circuits in response to the rotations of said motor.

2. In combination, a condition responsive contact maker, a reversible motor having two opposing fields, means establishing circuits selectively by the contact maker through the respective opposing fields of said motor to cause rotation of the motor, and means operable pursuant to the opening of the selected circuit to maintain a circuit through the other of the respective fields to cause a desired opposite rotation of said motor and means selectively establishing a plurality of secondary circuits in response to the rotations of said motor.

3. In a motor operated relay for establishing a plurality of circuits independent of, but in predetermined relation to the relative conditions in the operating circuit, comprising a reversible motor having a pair of opposed fields, a contact maker, means for establishing a circuit through a selected field to cause rotation of the motor in a desired direction through operation of the contact maker, and means operable subsequent to the establishment of said circuit to establish a circuit through the other previously unselected field of said motor but of less current strength than the first circuit, the said last mentioned means being so arranged as to maintain the second mentioned circuit after the first circuit is broken to cause the motor to operate in the opposite direction for a desired extent and means selectively establishing a plurality of secondary circuits in response to the rotations of said motor.

4. In combination a two way circuit maker having a neutral position, a reversible motor having two opposing fields, a pivoted member driven by the motor through a partial rotation only, a two way circuit maker having a neutral position, which circuit maker is responsive to the position of the pivoted member, means establishing a full current circuit through the first mentioned circuit maker selectively through one field of the motor, and means establishing a circuit of less current strength through the other field of the motor through the second mentioned circuit maker.

5. In a motor driven relay for establishing a plurality of circuits independent of, but in predetermined relation to the relative conditions in the operating circuit, comprising a circuit controller selectively controlling a plurality of secondary circuits, a reversible motor operatively associated with the circuit controller, the circuit controller having a mid-position, a condition responsive circuit maker, means arranged to establish a primary driving circuit selectively through the motor upon the operation of the circuit maker to move the circuit controller from mid-position

in a selected direction, and means arranged to establish an opposite primary driving circuit in said motor effective upon the opening of said circuit maker to reverse said motor to return the circuit controller to its mid-position.

6. In a motor operated relay for establishing a plurality of circuits independent of, but in predetermined relation to the relative conditions in the operating circuit, comprising a reversing motor having two opposite fields, means establishing a full current circuit in one field, and means establishing a circuit of weaker current strength relative the first circuit in the other field, said means arranged to maintain the weaker current driving circuit after the full current driving circuit is broken and means selectively establishing a plurality of secondary circuits in response to the rotations of said motor.

7. In combination, a condition responsive circuit maker, having a neutral position in which no contact is made, a reversible motor having two opposing fields, means having a neutral position and two secondary positions and being in driven relation to said motor, connections, and a power source, a circuit maker controlled by said means, the arrangement being such that the first mentioned circuit maker establishes circuits in one field of the motor such as will actuate same in a desired direction to move said means from its neutral position to a secondary position, the connections and said second mentioned circuit maker also so arranged that upon the disruption of the circuit in the motor through the opening of the first mentioned circuit maker to neutral position another circuit functions in the other field of the motor to operate the motor in the opposite direction to return said means to neutral position.

8. In combination in a motor operated relay, a condition responsive circuit maker, a reversible motor, a support, means connecting the support with the motor for oscillation in response to rotation of the motor, a circuit maker carried by the support, a cam switch operable by the support, a source of current, and connections connecting the source of current to the condition responsive circuit maker and to the respective fields of the motor, so as to establish driving circuits therein, connections from the source of current through the cam switch to selectively establish circuits in the respective fields of the motor and said last mentioned circuits being effective to reversely drive the motor when the first mentioned driving circuits are broken.

9. In a motor operated relay, a reversible motor, a shaft driven thereby, a disc frictionally driven by the shaft, ears on the disc, stops in position to be abutted by the respective ears to limit the movement of the disc, a cam surface on the edge of the disc, a cam switch having contacts and having wiping engagement with the cam surface of the disc and selectively contacting opposite contacts as the disc oscillates, a condition responsive circuit maker, connections to a source of current and the last mentioned circuit maker and to the fields of the motor to selectively energize a field to drive the motor in one direction, a resistor interposed in the line between the source of current and the cam switch, and connections from the resistor and the cam switch to the fields of the motor, the cam switch operative to energize the opposite field of the motor pursuant to the closing of the initial driving circuit by the condition responsive circuit maker and which circuits through the resistor are operative to reversely

drive the motor upon opening of the condition responsive circuits.

10. In a motor operated relay, a motor having two opposite fields and a device having a limited oscillation in response to running of the motor in either direction, means for selectively closing a circuit through either of the two fields according to the direction in which it is desired to have the device oscillate, a two position switch having a neutral non-contacting position in operative relation to the device and arranged selectively to establish a circuit of less current strength through the other field of the motor which selection is dependent upon the direction of oscillation of said device from the neutral position, and said switch arranged to maintain the last mentioned circuit after the first mentioned circuit is broken to cause the motor to run in the opposite direction to return said device to neutral position.

11. In a motor operated relay, a condition responsive circuit maker movable between two contacts, a reversing motor, switch mechanism selectively controlling a plurality of secondary circuits, and arranged in operative association with the motor, means operable when the circuit maker engages one contact to establish a full current circuit in the motor urging it in one direction, and thus causing switch mechanism to function to close one of said secondary circuits, means operable upon rotation of the motor to close or establish a circuit of less current strength through the motor in the opposite direction but insufficient to balance the first mentioned circuit in the motor, and said means operable subsequent to the disengagement from the contact of the condition responsive circuit maker to cause the motor to run oppositely and said means automatically actuated to open said less current circuit of less current strength after a predetermined interval, and said switch mechanism so arranged as to open the first of the several secondary circuits and to close another in synchronism with the said interval.

12. A motor operated relay comprising in combination three electrical devices arranged for energization respectively in accordance with conditions indicated by a condition responsive circuit maker, a condition responsive circuit maker having two contacts and an off position, switch mechanism arranged selectively to establish circuits in the respective devices, movable means arranged for three positions, the switch mechanism operatively associated with the said means and automatically operable according to the position of said means, a reversing motor, means operatively associating the movable means and the motor whereby rotation of the motor determines the position of said means, connections arranged with the several parts and so arranged that engagement of either contact by the circuit maker establishes a full current circuit in the appropriate side of the motor which will cause it to rotate in the direction proper to actuate said movable means to a position such as to actuate the switch mechanism to close the appropriate secondary circuit to the appropriate device, and means automatically actuated to establish a less current circuit of less current strength in the other half of said motor to urge the motor in the opposite direction, said means arranged to maintain said less current circuit of less current strength after the circuit maker has disengaged the contact to cause an opposite rotation of said motor to move said movable means to the appropriate position to energize the switch mechanism.

nism to establish the appropriate secondary circuit through another electrical device.

13. In a motor operated relay, a reversible motor, a disc frictionally driven thereby, the periphery of the disc having surfaces of three different radii, a pair of stationary contacts, a spring contact between the contacts tending to move toward one of said stationary contacts, means on the spring contact in engagement with the periphery of the disc and engaging one or the other or neither of the contacts according to the portion of the surface with which it engages, a circuit maker establishing a full circuit through one portion of the motor to urge the motor in one direction, the disc movable with the motor until the spring contact engages an appropriate stationary contact, a resistor in series with the spring contact and the connectors being such that such engagement of the stationary contact establishes a circuit of less current strength through the other half of the motor to urge the motor in the opposite direction the extent of periphery of the disc being such that the circuit of less current strength is maintained for an appreciable interval after the full current circuit through the motor has been disrupted in order to return the motor and disc in the opposite direction until the spring contact is moved from its engagement with the stationary contact.

14. A motor operated relay comprising a reversible motor, a contact carrying partly rotating member, means for introducing automatically by means of the rotating member resistors in the circuits for the motor whereby the field current strength of the motor is reduced to approximately one-half but not any more than to retain sufficient strength to function the motor and the contact carrying member, further means for introducing current to the motor through the opposite field of full current strength so that the circuit of the half current strength is overpowered and motion takes place in the opposite direction as long as this full current strength field current is maintained, and so arranged that when this full strength current through the opposite field is eliminated the current through the opposing fields of the low current strength will immediately start to move the device in the opposite direction in accordance with the desired limitations due to construction.

15. In a motor operated relay in combination, means establishing two primary operating circuits, means establishing three operated secondary circuit conditions, means operatively associated with the primary circuits, means to establish a predetermined secondary circuit condition when one of the primary circuits is closed, said last mentioned means arranged to establish another predetermined secondary circuit condition when the other of the said primary circuits is closed means establishing opposing primary circuits effective upon the disruption of an associated primary circuit, and said last mentioned means arranged for predetermined altering of the respective secondary circuit condition when the corresponding primary circuit is broken.

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