

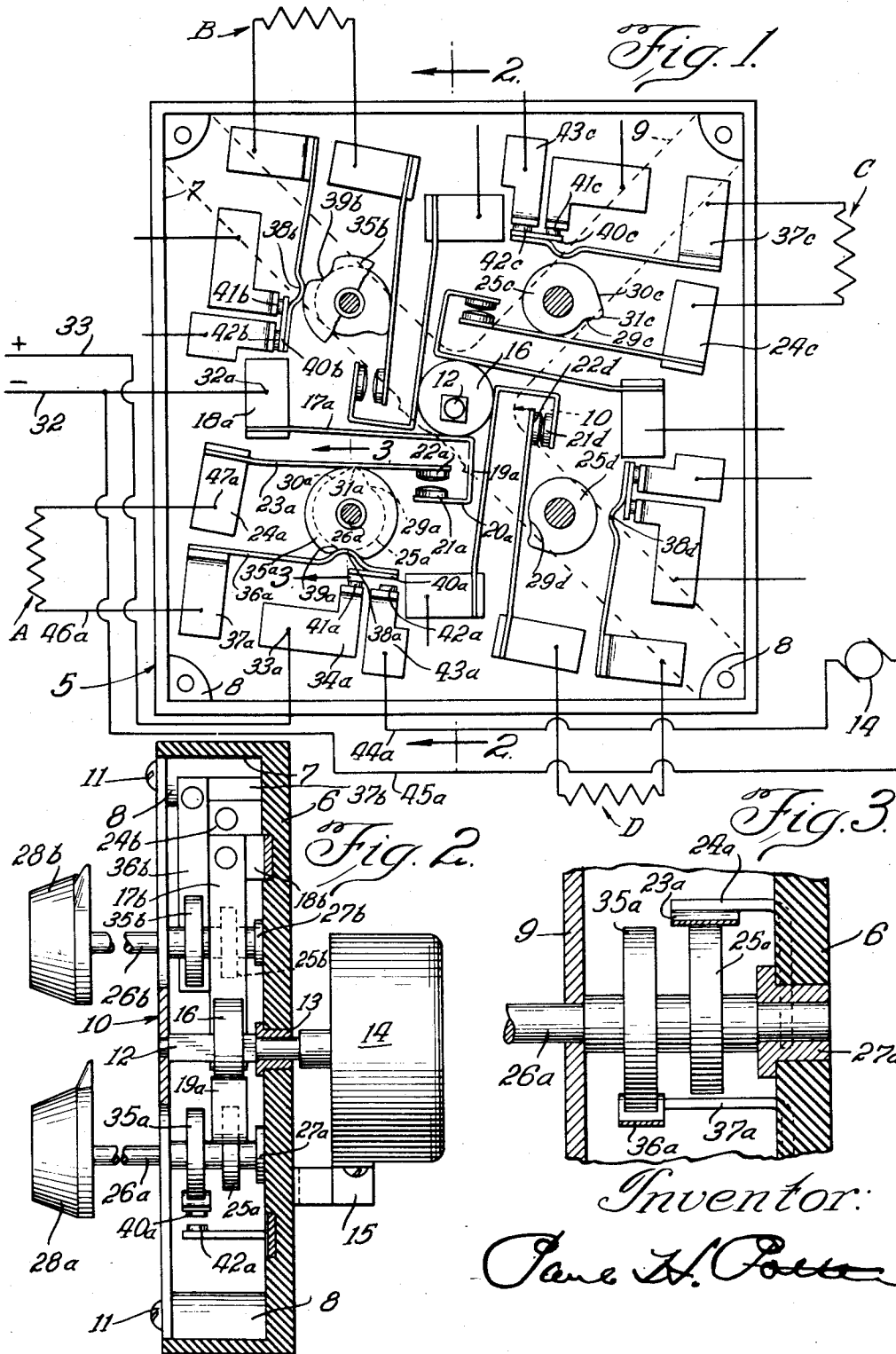
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INFINITELY VARIABLE SWITCH

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INFINITELY VARIABLE SWITCH

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My invention relates to electric current controllers of the type wherein the amount of current supplied is regulated by intermittently interrupting the circuit and varying the duration or frequency of the interruption, the invention having reference more particularly to a multiple circuit controller wherein a single interrupter affords differential variation of current supply through each circuit.

The principal objects of my invention are to provide an improved multiple circuit controller of the above mentioned type; to minimize the number of operating parts; to insure timing of the periods of current flow in each circuit so that the current flow periods in the several circuits occur consecutively; to simplify the construction of the controller, and permit embodiment thereof in compact form, these and other objects being accomplished as pointed out hereinafter and as shown in the accompanying drawing, in which:

Fig. 1 is a top plan view of a multiple circuit controller constructed in accordance with my invention, but without cover or control knobs;

Fig. 2 is a sectional view of the controller taken on the line 2—2 of Fig. 1; and

Fig. 3 is an enlarged fragmentary sectional view on the line 3—3 of Fig. 2.

Referring to the drawing in which I have, for illustrative purposes, shown the controller in a form suitable for use in electric ranges to individually control four separate heating units or resistances represented at A, B, C and D respectively, the reference numeral 5 indicates the controller case which is preferably made of insulating material and of shallow square form with a bottom wall 6, surrounding side walls 7 and corner reinforcements 8. These corner reinforcements 8 terminate slightly below the top of the case to accommodate thereon the ends of the four arms 9 of a spider 10 which said arm ends may be secured to the corner reinforcements 8 by screws 11 or in any other convenient manner. The case may have a cover (not shown), attached in any conventional way or the cover may be omitted, as for example when used in an electric range which may be made with a panel behind which the controller is mounted with the heating unit controls projecting therethrough.

A shaft 12 is located centrally in the case 5 with one end projecting through a bearing 13 in the bottom wall 6 of the case and the latter end of the shaft is connected by a suitable coupling with the shaft of a small motor 14 which is mounted on a bracket 15 on the bottom wall

6 of the case and operates the shaft 12 at a constant rate of speed. An eccentric cam 16 is fixed on the shaft 12 within the case and serves as a common actuator by which all four circuits to the heating units A, B, C and D are intermittently opened and closed, each for individually variable intervals of time according to the desired amount of heat.

A separate circuit controlling mechanism is provided for each heating unit, each of which mechanisms includes a switch for the motor 14 and a circuit breaker operated by the eccentric cam 16 and each mechanism also includes a manually adjustable cam by which a contact which cooperates with the circuit breaker is adjustable to vary the length of time of engagement of the circuit breaker therewith.

These four separate circuit controlling mechanisms are alike and the corresponding parts thereof are similarly numbered in the drawing but distinguished from one another by the suffix a, b, c, or d according to the respective heating unit A, B, C or D to which they pertain. Only one of these mechanisms will be described therefore and it will be understood that each of the others of the four separate circuit controlling mechanisms is the same.

Referring to the controlling mechanism for the circuit through which current is supplied to the heating unit A, the circuit breaker thereof comprises a spring arm 17^a which is fixed at one end to a metal bracket 18^a which in turn is secured to the bottom wall 6 of the case 5 so that the outer end of the spring arm bears at a tension against the peripheral face of the cam 16. Thus the outer end of this spring arm 17^a is caused to swing outwardly in each revolution of the shaft 12 a definite distance corresponding to the eccentricity of the cam 16.

The outer end of said spring arm 17^a has an outturned portion 19^a with a depending extremity 20^a to the inner face of which is secured a contact 21^a which cooperates with another contact 22^a on one end of a spring arm 23^a which has the other end fixed to a metal bracket 24^a which in turn is secured to the bottom wall 6 of the case 5 so that said spring arm 23^a bears at a tension against the periphery of a cam 25^a.

This cam 25^a is fixed on a stem 26^a which is journaled at one end in a bearing 27^a of the bottom wall 6 and the other end of said stem is journaled in and projects through one of the spider arms 9 and has a knob 28^a on the outer end. The stem 26^a is manually operable by the knob 28^a to make almost an entire revolution,

and the cam 25^a is formed so that at one limit of its rotary adjustment with the stem 26^a the spring arm 23^a bears against the periphery of the cam 25^a at the point 29^a where the cam radius is such that the spring arm 23^a is in such position that the eccentric cam 16 does not impart sufficient swinging movement to the spring arm 17^a to move its contact 21^a away from the contact 22^a. Thus in this position of the cam 25^a the contacts 21^a and 22^a remain constantly engaged.

From the point 29^a the radius of the cam 25^a is gradually increased therearound to the point 30^a at which point the radius is such as to hold the spring arm 23^a in a position in which its contact 22^a is engaged by the contact 21^a only when the spring arm 17^a is in the fully retracted position against the portion of the peripheral face of the cam 16 least distant from the axis of the shaft 12 and thus in each revolution of the shaft 12 and cam 16 the contact 21^a will have only momentary engagement with the contact 22^a. As the cam 25^a is adjusted so that the spring arm 23^a bears against the cam surface between the points 30^a and 29^a the duration of engagement of the contacts 21^a and 22^a is gradually varied from the momentary engagement at the point 30^a to continuous engagement at the point 29^a.

Just beyond the point 30^a and between that point and the point 29^a, the cam 25^a has a projection 31^a which engages the spring arm 23^a in the final counter-clockwise movement of the cam 25^a (as it is viewed in Fig. 1) and this projection 31^a is such that when engaged with the spring arm 23^a in such final position the spring arm 23^a is held in a position in which the contact 22^a thereof cannot be engaged by the contact 21^a of the spring arm 17^a.

Current is supplied for energizing the heating unit or resistance A from a pair of feed wires 32 and 33, the former of which is connected as at 32^a with the metal bracket 18^a of the spring arm 17^a while the other feed wire 33 is connected as at 33^a to a metal bracket 34^a which, through instrumentalities hereinafter described is connectible with one end of the resistance of the heating unit A while the other end of said resistance is connected as at 47^a with the metal bracket 24^a of the spring arm 23^a. Thus when the metal bracket 34^a is connected with the resistance A and the contacts 21^a and 22^a are engaged, current is supplied from the feed wires 32 and 33 to the resistance A, the circuit from the feed wires 32 and 33 to the resistance A being however, interruptible by separation of the contacts 21^a and 22^a.

These contacts 21^a and 22^a are separated when the cam 25^a is turned to the position in which this particular cam is shown wherein the projection 31^a thereof is engaged with the spring arm 23^a and this position will hereinafter be referred to as the "off" position since no current is supplied to the heating unit A in this position of the cam.

From this "off" position the cam 25^a can only be moved in a clockwise direction and it may be adjusted therefrom in such direction to any desired position up to the final limit of such clockwise movement (see cam 25^a) at which place the spring arm 23^a is opposite the point 29^a and the contact 22^a positioned so that the contact 21^a cannot be disengaged therefrom, and in this position of the cam 25^a, which is hereinafter referred to as the "high" position, current is sup-

plied constantly to the heating unit A which is then operating at full heat.

When the cam 25^a is adjusted so that the spring arm 23^a bears thereagainst at the point 30^a (see cam 25^a), which will hereinafter be referred to as the "low" position, the contact 21^a engages the contact 22^a only momentarily in each revolution of the cam 16 and as current then is supplied to the heating unit only at intervals corresponding to the rate of rotation of the shaft 12 and only momentarily at such intervals, only a small amount of current is supplied and the heating unit A will then operate at its lowest heat.

When the cam 25^a is adjusted so that the spring arm 23^a bears thereagainst at some point between the points 29^a and 30^a, (see cam 25^a) the duration of engagement of the contacts 21^a and 22^a, and the amount of current supplied to the heating unit A will depend upon the radius of the cam at that particular point of engagement, the form of the cam 25^a being such that any duration of engagement of the contacts 21^a and 22^a may be obtained from the momentary engagement thereof in the "low" position to the constant engagement thereof in the "high" position and accordingly by adjustment of the cam 25^a (by operating the knob 28^a) the heating effect of the heating unit A can be gradually and infinitely varied.

It is desirable that the motor 14 should operate only when one or more of the heating units A, B, C or D are energized and accordingly each of the controlling mechanisms of said units has a switch operatively associated therewith through which current is supplied to the motor 14.

Referring again to the control mechanism of the heating unit A, in connection with which there is shown a motor switch like that employed in connection with the other three control mechanisms, the reference numeral 35^a indicates a circular cam disk which is fixed on the shaft above the cam 25^a and 36^a a spring arm which is secured to a metal bracket 37^a which is mounted on the bottom wall 6 of the case 5 so as to bear at a tension against the periphery of the disk 35^a. This spring arm 36^a is formed with a bulge 38^a which in the off position of the cam 25^a and its knob 28^a engages a corresponding recess 39^a in the periphery of the cam disk 35^a so that the spring arm 36^a occupies a retracted position in the "off" position of the knob 28^a and is projected outwardly therefrom immediately upon movement of the knob 28^a from the "off" position and is held in such outwardly projected position by the circular periphery of the cam disk 35^a in all positions of the knob 28^a except in the "off" position thereof.

A contact plate 40^a is attached to the outer end of the spring arm 36^a in a position to bridge across the contacts 41^a and 42^a when the spring arm 36^a is in the outwardly projected position, the contact 41^a being on the bracket 34^a hereinbefore referred to and the contact 42^a on a separate bracket 43^a mounted on the bottom wall 6 of the case 5.

The bracket 34^a is connected with the feed wire 33 and the bracket 43^a has a conductor 44^a leading therefrom to the motor 14 which is also connected to the other feed wire 32 by the conductor 45^a so that when the contact 40^a is closed against the contacts 41^a and 42^a the circuit is established to the motor 14 which is then operated until the knob 28^a is returned to the "off" position in which the bulge 38^a of the spring arm is

retracted into the recess 39^a of the cam disk and the contact plate 40^a disengaged from the contacts 41^a and 42^a.

To prevent energizing of the heating unit A except when the motor 14 is operating, the conductor 33 which leads to one end of the resistance of the heating unit A is connected therewith through the contacts 41^a, 42^a and the bridging contact 40^a, the bracket 37^a having a conductor 46^a leading therefrom to the heating unit A and the bracket 34^a being connected, as hereinbefore described, to the conductor 33.

Thus the switch 40^a, 41^a, 42^a which serves to control the operation of the motor 14 serves also to control the energizing of the unit A and the motor 14 accordingly must necessarily operate whenever the unit A is energized.

All of the brackets 43^a, 43^b, 43^c and 43^d are connected with the motor and likewise all of the brackets 34^a, 34^b, 34^c and 34^d are connected with the conductor 33 so that the motor 14 is necessarily operated when any of the knobs 28^a, 28^b, 28^c and 28^d are turned from the "off" position and moreover all of the brackets 18^a, 18^b, 18^c and 18^d are connected with the conductor 32 so that each unit A, B, C and D is independently operable although the circuit interrupter of each unit is operated from the same actuator, namely the cam 16. Moreover it will be noted that the four interrupters 17^a, 17^b, 17^c and 17^d are arranged at uniformly spaced intervals around the cam 16 so that the interrupting operations thereof occur consecutively, thereby not only minimizing the load on the motor 14, but also distributing the energizing periods of interrupted operation of the units A, B, C and D at equal intervals in each cycle of rotation of the cam 16 and contributing to uniformity of load on the power lines.

While I have shown and described my invention in a preferred form, I am aware that various changes and modifications may be made therein without departing from the principles of my invention, the scope of which is to be determined by the appended claims.

I claim as my invention:

1. In a device for independently controlling a plurality of electrical circuits, the combination of a mating pair of cooperable contacts for each circuit by the engagement and separation of which contacts the current supply in the respective circuit is controlled, a common actuator operable successively on a contact of each pair to cause intermittent engagement and disengagement thereof with its mating contact in cycles varying infinitely from constantly engaged to constantly disengaged, at least one contact of each pair being independently adjustable, and means for adjusting said adjustable contact of each pair to infinitely vary the duration of engagement thereof with its mating contact, to maintain the said contacts constantly engaged or constantly disengaged independently of said common actuator.

2. In a device for independently controlling the supply of current to a plurality of electrically operable units, the combination of a plurality of pairs of mating contacts each pair of which controls the supply of current to a different one of said units, a common interrupter for said contacts comprising a cam operable successively on a contact of each pair to intermittently make and break the contact thereof, means for individually varying the duration of intermittent contact of each pair of contacts for periods of time ranging from constant engagement of the contacts to con-

stant disengagement thereof and means operable to selectively interrupt the current supply to each pair of contacts irrespective of the operative position of the actuating means.

3. In a device for independently controlling the supply of current to a plurality of electrically operable units, the combination of a continuously operated cam, a separate pair of contacts for each unit, each pair of contacts having a member operable by the cam to cause intermittent engagement and disengagement of the respective pair of contacts and said members being uniformly spaced about the cam, means for individually varying the duration of intermittent engagement of the contacts of each pair for periods of time ranging infinitely from constant engagement to constant disengagement, each unit having a different pair of said contacts associated therewith to control the supply of current thereto and means operable to selectively interrupt the current supply to each pair of contacts irrespective of the operative position of the actuating means.

4. In a device for independently controlling a plurality of electrical circuits, the combination of a separate cam means and a separate pair of contacts for each circuit, a single cam having the pair of contacts arranged at spaced intervals therearound, said single cam being cooperable consecutively with each pair of contacts to vary the amount of current supplied to the respective unit and each said cam means being manually adjustable to individually vary the duration of contact separation of the respective pair of contacts for varying the amount of current supplied to the respective circuit and a motor by which the common actuator is operated, said motor having a separate switch operatively associated with each cam means for controlling the operation of the motor.

5. In a device for independently controlling a plurality of electrical circuits, the combination of a separate current regulator for each circuit, and a common actuator for the current regulators having the current regulators uniformly arranged therearound and successively operable thereby, said common actuator being adapted to individually actuate said current regulators for periods of time varying infinitely from constant operation of the said regulators to constant inoperation thereof.

6. In a device for independently regulating a plurality of electrical circuits, a plurality of pairs of contacts each controlling an electrical circuit, at least one contact of each of said pairs being movable into and out of engagement with its mate, a common operating means for intermittently actuating said movable contacts into and out of engagement with their respective mates, and means associated with each of said pairs for infinitely varying the periods of intermittent engagement of the contacts thereof effected by said common operating means and for maintaining the said contacts constantly engaged or constantly disengaged independently of said common operating means.

7. In a device for independently regulating a plurality of electrical circuits, a plurality of pairs of contacts each controlling an electrical circuit, at least one contact of each of said pairs being movable into and out of engagement with its mate, a common operating means for intermittently and successively actuating said movable contacts into and out of engagement with their respective mates, and means associated with each of said pairs for individually and infinitely vary-

ing the periods of intermittent engagement of the contacts thereof effected by said common operating means and for maintaining the said contacts constantly engaged or constantly disengaged independently of said common operating means.

8. In a device for independently regulating a plurality of electrical circuits, a plurality of pairs of contacts each controlling an electrical circuit, at least one contact of each of said pairs being movable into and out of engagement with its mate, a common operating means in the form of a rotating power driven cam for intermittently actuating said movable contacts into and out of engagement with their respective mates, means associated with each of said pairs for infinitely varying the periods of intermittent engagement of the contacts thereof effected by said common operating means and for maintaining the said contacts constantly engaged or constantly disengaged independently of said common operating means, and means cooperatively associated with said latter means for disestablishing a source of power for said common operating means when said contacts are in constantly disengaged relation.

9. In a device for periodically supplying current for selectively variable lengths of time, the combination of two oppositely biased switch elements each normally tending to engage the other, a constantly operable actuator by which one of said elements is periodically movable in a direction away from the other element, manually adjustable means against which one of said elements is biased and by which the duration of periodic current supply is selectively variable, and means associated with said adjustable means and operable in one position of the latter for disestablishing a source of power for said actuator.

10. In a device for periodically supplying cur-

rent for selectively variable lengths of time, the combination of two oppositely biased switch elements each normally tending to engage the other, a constantly operable actuator by which one of said elements is periodically movable in a direction away from the other element, and manually operable means by which the latter element is adjustable away from the other element to vary the duration of contact of the elements with one another, or to maintain said elements constantly disengaged irrespective of the operative position of the said actuator.

11. In a device for periodically supplying current for selectively variable lengths of time, the combination of two cooperatively associated oppositely biased switch elements, a constantly operable actuator by which one of said elements is periodically movable toward and away from the other element, and manually operable means by which the latter element is adjustable with respect to the first element to vary the duration of contact of the elements with one another, or to maintain said elements constantly disengaged irrespective of the operative position of the said actuator.

12. In a device for periodically supplying current for selectively variable lengths of time, the combination of two switch elements at least one of which is biased toward and normally tends to engage the other, a constantly operable actuator by which said biased element is periodically movable in a direction away from the other element, and manually operable means by which the latter element is adjustable away from the biased element to vary the duration of contact of the elements with one another, or to maintain said elements constantly disengaged irrespective of the operative position of the said actuator.

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