

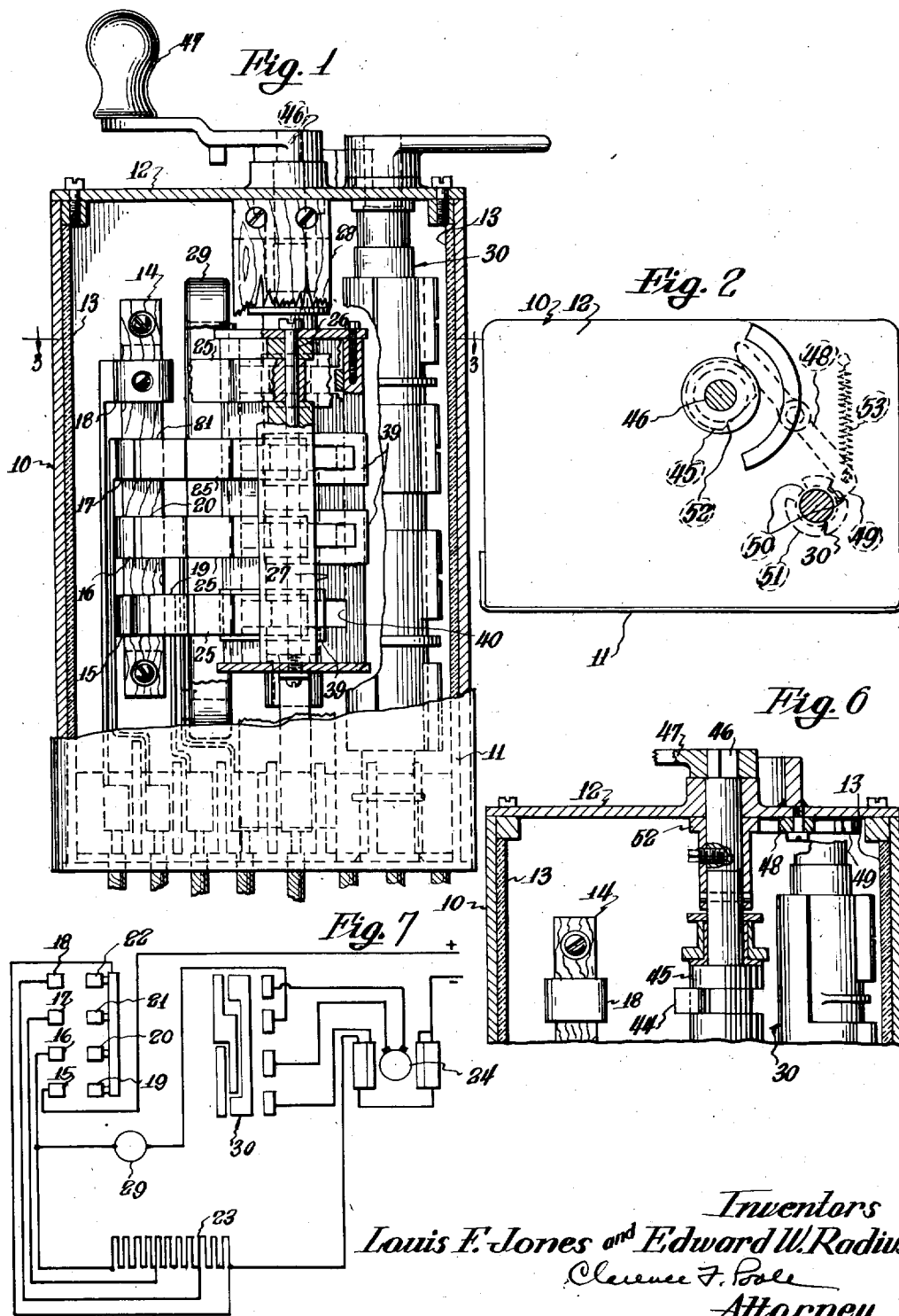
Oct. 29, 1935.

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2,018,958

DEVICE FOR CONTROLLING ELECTRIC CIRCUITS

Original Filed June 17, 1933 2 Sheets-Sheet 1



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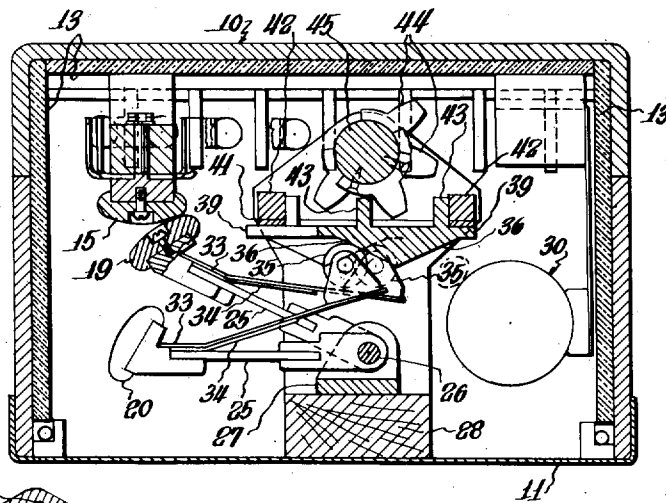


Fig. 3

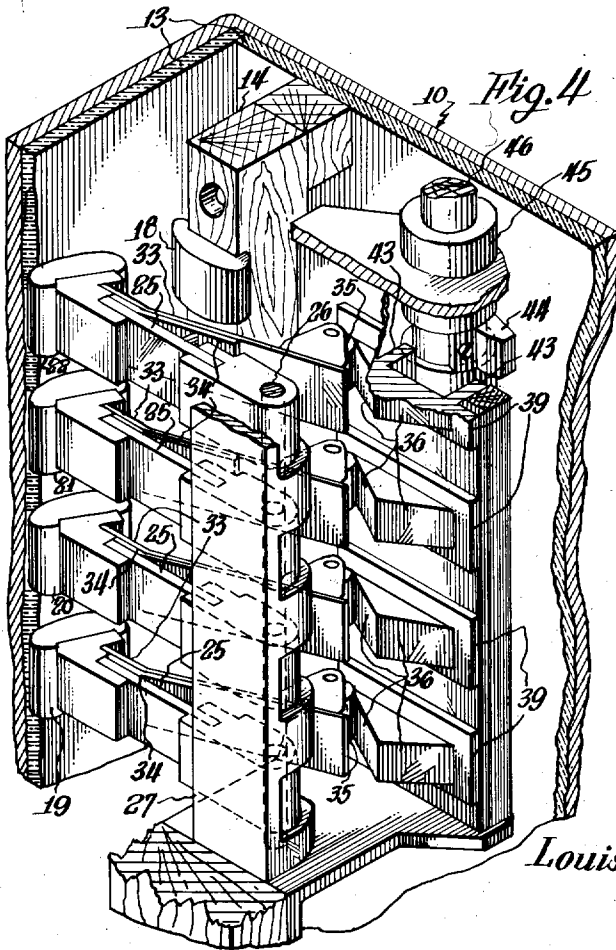


Fig. 4

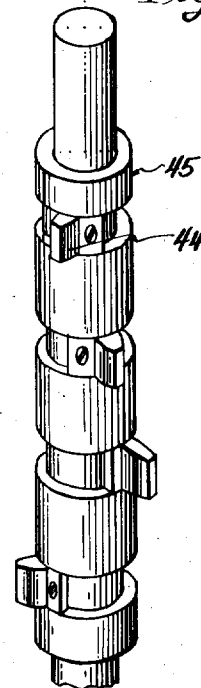


Fig. 5

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## UNITED STATES PATENT OFFICE

2,018,958

## DEVICE FOR CONTROLLING ELECTRIC CIRCUITS

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Application June 17, 1933, Serial No. 676,234  
Renewed March 18, 1935

19 Claims. (Cl. 200—6)

This invention relates to improvements in devices for controlling electric circuits and more particularly to controllers adapted for use in mines where service requirements are severe, for progressively cutting a resistance into or out of a motor circuit, although not limited to such use alone.

The principal objects of our invention are to provide a simplified and improved mechanical controller of the multiple contact type, together with an improved mechanical means for actuating the contacts for positively engaging said contacts so as to quickly make or break the circuit and locking them in an open or closed position, which controller is arranged with a view towards simplicity, accessibility, and efficiency and flexibility in operation.

Our invention may be more clearly understood with reference to the accompanying drawings wherein:

Figure 1 is a top plan view of one embodiment of our invention with the cover and certain other parts broken away and shown in section to more clearly show the details of our invention;

Figure 2 is a front end view of the device shown in Figure 1 with certain parts broken away and shown in section;

Figure 3 is a transverse sectional view taken substantially along line 3—3 of Figure 1;

Figure 4 is an enlarged fragmentary isometric view of the embodiment of our invention shown in Figure 1, with certain parts broken away and in section to more clearly show the details thereof;

Figure 5 is an enlarged isometric view showing the operating drum in detail;

Figure 6 is an enlarged detail horizontal sectional view of the device shown in Figure 1, showing certain details of the invention not shown in Figure 1; and

Figure 7 is a wiring diagram of the embodiment of our invention illustrated in Figure 1.

Like numerals refer to like parts throughout the various figures.

With reference now in particular to the drawings, the embodiment of our invention illustrated includes a casing 10 having a cover 11 and a detachable end wall 12. Suitable insulating material, generally indicated by reference character 13, is carried along the inside of the bottom and side walls of said casing and the end wall opposite the detachable end wall 12, to prevent short circuits between the conductors or contacts and said casing, and to prevent arcing and burning of said casing.

A main contact board 14 is secured to the bot-

tom of the casing 10 by means of machine screws in a suitable manner. Said contact board may be made from suitable insulating material, such as impregnated wood, and has stationary contacts 15, 16, 17 and 18 secured thereto. Said contacts are adapted to be progressively engaged by movable contacts 19, 20, 21 and 22, respectively, for closing the circuit from the main line and progressively cutting a resistance 23 out of the circuit for a motor 24.

The movable contacts are mounted on the free ends of swinging arms 25, 25 pivotally mounted on a shaft 26 for swinging movement about an axis parallel to the plane of the engaging surface of said contacts. Said shaft is mounted in a suitable support bracket 27 mounted on an insulating board 28 which is secured to the casing 10 in a suitable manner.

A blow-out coil 29 is provided for blowing out the arc upon breaking of the circuit between any one of said stationary and movable contacts. As herein shown, said blow-out coil is connected in series with the stationary contact 16 and the circuit to the motor 24. Said blow-out coil encircles the arms 25 adjacent the point of contact of said movable and stationary contacts so as to pull the arc away from said contacts upon breaking of the circuit thereby.

A reverse drum 30 is provided for reversing the direction of rotation of the motor 24. Said reverse drum is of the usual construction, so will not herein be shown or described in detail, and is interlocked with the mechanism for engaging the movable contacts with the stationary contacts in a manner which will hereinafter be more fully described.

Referring now to Figures 3 and 4 which show in detail the novel mechanism for engaging the movable contacts with the stationary contacts and locking said contacts in an engaged or disengaged position, the construction of the operating mechanism for one of said contacts only will herein be described in detail, since the construction and operation of the operating mechanism for each of said contacts is the same.

The movable contact 19 extends across the free end of the arm 25 at an angle with respect thereto and its contact face forms a continuous engaging surface adapted to engage the stationary contact 15. Said contacts are so arranged that said engaging surface is unbroken by holes formed by countersink for the screws which secure said contacts to their respective arms and contact board, and said contacts are

so formed that they may readily be reversed when worn.

A resilient member 33, such as a piece of spring steel of a leaf construction, is secured 5 to the arm 25 in a suitable manner adjacent said movable contact. Said leaf spring extends from said movable contact along said arm in a general direction towards the shaft 26, but diverging angularly away from said arm. Said 10 resilient member is reinforced by another resilient member 34 for a portion of its length. A rider member or roller 35 is carried by said resilient member adjacent the free end thereof and is adapted to ride along and engage inclined 15 plane surfaces 36, 36 of a cam member 39 spaced from the shaft 26 and movable in a plane parallel to the axis of said shaft. Said inclined surfaces, as herein shown, are so formed that they converge toward a peak adjacent the center of said 20 cam. Said cam member may be rotatable but, as herein shown, is mounted for rectilinear movement in a slot 40 formed in a member 41 extending in a plane generally parallel to the contact arms 25, 25 when in a disengaged position. The 25 member 41 is secured to a suitable insulating member 42, which insulating member is in turn secured to the casing 10 in a suitable manner on the side thereof opposite the cover 11. Spaced projections 43, 43 extend from the cam member 39 into the slot 40 and are adapted to be 30 engaged by a tooth 44 secured to and extending radially from a rotatable drum 45. Said rotatable drum is insulated from and carried on a shaft 46, which shaft is journaled in the casing 10 in a suitable manner for pivotal movement 35 about an axis parallel to the axis of pivotal movement of said contact arms. Said shaft has a squared end which is adapted to be engaged by a handle 47 for operating said drum and moving said cam member upon engagement of the 40 tooth 44 with the inside surface of one of the spaced projections 43.

The arrangement is such that after the tooth 44 has moved the cam member 39 a certain 45 distance along the slot 40, the roller 35 engaged with one of the inclined faces of said cam member by the resilient member 33, will exert a pressure against said face and move said cam member the remaining distance along said slot. 50 The length of the tooth 44, with respect to the length of the projections 43, 43 is such that said tooth may clear said projections when said cam member has been moved to one extreme end or the other of said slot, permitting rotation of the 55 drum 45 beyond said projection. Thus, the movable contacts may be progressively actuated in the desired order by means of one operating drum.

As said cam is moved along said slot by its 60 associated tooth, said rider engages and moves upwardly along one inclined surface thereof which flexes the leaf spring members 33 and 34. As said rider reaches the peak of said cam, it moves towards the axis of rotation of the arm 65 25 against said leaf spring members and beyond a dead center position with respect to the pivotal axis of said arm. At this point said leaf spring members are flexed to a maximum degree and reacting against said cam, pivot said arm about its 70 axis of connection to the shaft 26 and engage said contacts. Upon engagement of said contacts and continuation of movement of said cam, said rider member moves down the opposite slope of said cam, and said leaf spring members 75 acting against said opposite slope of said cam,

move said cam in the slot 40 a distance sufficient to permit said tooth to clear its associated projection 43 in the hereinbefore described manner. Disengagement of said contacts from each other is effected in a similar manner, although 5 the parts are moved in an opposite direction with respect to each other.

It should be noted with reference to Figure 3, that when the movable contact 19 is engaged with the stationary contact 15, that the roller of the 10 rider member 35 is engaged with one of the sloped sides of the cam member 39. Pressure of said rider member against said cam member exerted through the leaf spring members 33 and 34, holds said cam member in an extreme position of the slot 40. The reaction of said spring 15 members against said cam member also locks said movable contact in engagement with said stationary contact. In a like manner, when said contacts are disengaged from each other, they 20 are locked in such a position by said rider and leaf spring members.

The teeth 44, 44 are spaced radially about the drum 45 for progressively actuating the cam 25 members 39, 39 and any desired arrangement of said teeth may be had to permit any number of movable contacts to progressively engage any number of stationary contacts in any desired sequence.

Suitable interlocking mechanism of a simplified construction is provided for interlocking 30 the reverse drum 30 with the rotatable drum 45 to prevent operation of said reverse drum when any of the movable contacts are in an engaged position with any of the stationary contacts, and 35 to prevent rotation of said rotatable drum upon movement of said reverse drum. Said interlocking means may be of any type, but is herein preferably shown as being a lever 48 pivoted to the end wall 12 of the casing 10 and having a 40 toothed end 49 adapted to engage any one of a plurality of notches 50 formed in a collar 51 secured to said reverse drum. The opposite end of said lever is adapted to engage a cam 52 secured to the rotatable drum 45. A spring member 53 is 45 interposed between the end wall 12 and end of said lever having the toothed portion 49 thereon. Said spring is adapted to disengage said toothed portion from any one of the notches 50 when the end of said lever opposite said spring is disposed adjacent the flat portion of the cam 52. 50

It may now be seen that a new and improved multiple contact controller has been provided wherein the movable contacts are positively engaged with or disengaged from the stationary 55 contacts and locked in either an engaged or disengaged position with respect thereto in a novel and simple manner, and that the arrangement is such that the stationary contacts may be engaged by the movable contacts in any desired 60 sequence by changing the arrangement of the teeth 44 on the drum 45.

While we have herein shown and described one form in which our invention may be embodied, it will be understood that the construction or arrangement of the various parts may be altered or 65 changed without departing from the spirit and scope thereof. Furthermore, we do not wish to be construed as limiting ourselves to the particular form shown, excepting as it may be limited 70 by the appended claims.

We claim as our invention:

1. In an electric current controller, a rectilinearly movable cam having sloped engaging surfaces converging towards a peak, means for rec- 75

rectilinearly moving said cam comprising a rotatable member, a stationary contact, a movable contact including a pivoted arm having a contact member thereon, and means for engaging or disengaging said contacts upon movement of said cam and locking said contacts in fixed relation with respect to each other when said cam is stationary comprising a resilient member secured to said arm adjacent said contact, said resilient member extending towards the axis of pivotal movement of said arm in an angular direction away from said arm and having a free end having an engaging member thereon adapted to engage said cam.

2. In an electric current controller, a rectilinearly movable cam having sloped engaging surfaces converging towards a peak, means for rectilinearly moving said cam comprising a rotatable member, a stationary contact, a movable contact including a pivoted arm having a contact member thereon, and means for engaging or disengaging said contacts upon movement of said cam and locking said contacts in fixed relation with respect to each other when said cam is stationary comprising a leaf spring member secured to said arm adjacent said contact, said leaf spring member extending towards the axis of pivotal movement of said arm in an angular direction away from said arm and having a free end having an engaging member thereon adapted to engage said cam.

3. In an electric current controller, a rectilinearly movable cam having sloped engaging surfaces converging towards a peak, means for rectilinearly moving said cam comprising a rotatable member, a stationary contact, a movable contact including a pivoted arm having a contact member thereon, and means for engaging or disengaging said contacts upon movement of said cam and locking said contacts in fixed relation with respect to each other when said cam is stationary comprising a resilient member secured to said arm adjacent said contact, said resilient member extending towards the axis of pivotal movement of said arm in an angular direction away from said arm and having a free end having a roller thereon, spaced from the plane surface of said member, adapted to engage said cam.

4. In an electric current controller, a rectilinearly movable cam having sloped engaging surfaces converging towards a peak, means for rectilinearly moving said cam comprising a rotatable member, a stationary contact, a movable contact including a pivoted arm having a contact member thereon, and means for engaging or disengaging said contacts upon movement of said cam and locking said contacts in fixed relation with respect to each other when said cam is stationary comprising a leaf spring member secured to said arm adjacent said contact and extending towards the axis of pivotal movement of said arm in an angular direction away from said arm and having a free end having a roller thereon adapted to engage said cam.

5. In an electric controller, a stationary contact, a movable contact engageable with said stationary contact and carried for pivotal movement with respect thereto about an axis spaced therefrom, and means for engaging said movable contact with or disengaging said movable contact from said stationary contact and locking said movable contact in an engaged or disengaged position with respect to said stationary contact comprising a member fixed to and extending angularly from the contact end of said movable con-

tact in a general direction towards the axis of pivotal movement of said movable contact, but having a free end spaced from the axis of pivotal movement of said movable contact, a rectilinearly movable cam having sloping sides converging towards a peak, and means on said member engageable with said cam whereby movement of said cam in one direction will move said means past dead center position with respect to the axis of pivotal movement of said movable contact and engage said contacts, and movement of said cam in an opposite direction will disengage said contacts.

6. In an electric controller, a stationary contact, a movable contact engageable with said stationary contact and carried for pivotal movement with respect thereto about an axis spaced therefrom, and means for engaging said movable contact with or disengaging said movable contact from said stationary contact and locking said movable contact in an engaged or disengaged position with respect to said stationary contact comprising a yieldable member fixed to and extending angularly from the contact end of said movable contact in a general direction towards the axis of pivotal movement of said movable contact, but having a free end spaced from the axis of pivotal movement of said movable contact, a rectilinearly movable cam having sloping sides converging towards a peak, and means on said yieldable member engageable with said cam whereby movement of said cam in one direction will move said means past dead center position with respect to the axis of pivotal movement of said movable contact and engage said contacts, and movement of said cam in an opposite direction will disengage said contacts.

7. In an electric controller, a stationary contact, a movable contact engageable with said stationary contact and carried for pivotal movement about an axis spaced therefrom, and means for engaging said movable contact with or disengaging said movable contact from said stationary contact and locking said movable contact in an engaged or disengaged position with respect to said stationary contact comprising a yieldable member fixed to and extending angularly from said movable contact in a general direction towards the axis of pivotal movement of said movable contact, but having a free end spaced from the axis of pivotal movement of said movable contact, a movable cam having sloping sides converging towards a peak, a roller on the free end of said member adapted to ride on said cam whereby movement of said cam in one direction will flex said yieldable member and move said roller past dead center position with respect to the axis of pivotal movement of said movable contact and engage said movable contact with said stationary contact, and movement of said cam in an opposite direction will disengage said movable contact from said stationary contact.

8. In an electric controller, a stationary contact, an arm pivotally movable in a plane perpendicular to the plane of contact of said stationary contact, a movable contact on the end of said arm, and means for positively engaging said movable contact with or disengaging said movable contact from said stationary contact comprising a movable cam having sloping sides converging towards a peak, a leaf spring member rigidly secured to and extending angularly from said movable contact in a general direction towards the axis of pivotal movement of said arm and having a free end adjacent, but spaced from

- the pivotal axis of said arm, a roller on the free end of said spring member adapted to ride along the sloping sides of said cam in such a manner that movement of said cam will flex said spring member and move said roller and spring member past a dead center position with respect to the axis of pivotal movement of said arm for positively engaging said movable contact with said stationary contact.
9. A circuit controlling mechanism comprising a stationary contact, a movable contact mounted on the free end of a pivotally movable arm, a leaf spring member extending angularly rearwardly from said movable contact, an engaging member on the end of said leaf spring member, and means for pivotally moving said arm for engaging said movable contact with or disengaging said movable contact from said stationary contact comprising a movable cam member having sloping plane sides converging to a peak and having operative engagement with said engaging member.
10. A circuit controlling mechanism comprising a stationary contact, a movable contact mounted on the free end of a swinging arm, a leaf spring member extending angularly from said movable contact in a general direction towards the axis of pivotal movement of said arm, an engaging member on the free end of said leaf spring member, and means for swinging said arm for engaging said movable contact with or disengaging said movable contact from said stationary contact comprising a rectilinearly movable cam member having sloping plane sides converging to a peak and having operative engagement with said engaging member, and means for rectilinearly moving said cam member comprising a rotatable drum having operative engagement with said cam member.
11. A circuit controlling mechanism comprising a stationary contact, a pivoted arm, a movable contact on the free end of said arm, a leaf spring member secured to said arm adjacent said movable contact and extending angularly therefrom, an engaging member on the end of said leaf spring member, means for pivotally moving said arm for engaging said movable contact with or disengaging said movable contact from said stationary contact comprising a movable cam member having sloping plane sides converging to a peak and having operative engagement with said engaging member, a pair of spaced projections extending from said cam member on the opposite side thereof from its peak, a rotatable drum, and a tooth on said drum engageable with one of said projections for moving said cam in one direction and the other of said projections for moving said cam in an opposite direction upon opposite rotation of said drum.
12. A circuit controlling mechanism comprising a stationary contact, a pivoted arm, a movable contact on the free end of said arm, a leaf spring member extending along said arm and diverging angularly away from said arm, an engaging member on the free end of said leaf spring member, means for pivotally moving said arm for engaging said movable contact with or disengaging said movable contact from said stationary contact comprising a rectilinearly movable cam member having sloping plane sides converging to a peak and adapted to be engaged by said engaging member, a pair of spaced projections extending from said cam member in an opposite direction from its peak, a rotatable

drum, and a tooth on said drum engageable with one of said projections for moving said cam in one direction, and the other of said projections for moving said cam in an opposite direction upon opposite rotation of said drum, the length of said tooth and the length of said projections being such that said tooth may clear either one of said projections when said cam has been moved to either of its extreme positions and permit rotation of said drum beyond said projection.

13. A circuit controlling mechanism comprising a stationary contact, a pivoted arm, a movable contact on the free end of said arm, a leaf spring member extending along said arm and diverging angularly away from said arm, an engaging member on the free end of said leaf spring member, means for pivotally moving said arm for engaging said movable contact with or disengaging said movable contact from said stationary contact comprising a rectilinearly movable cam member having sloping plane sides converging to a peak and adapted to be engaged by said engaging member, a pair of spaced projections extending from said cam member in an opposite direction from its peak, a rotatable drum having a tooth thereon engageable with one of said projections for moving said cam in one direction, and the other of said projections for moving said cam in an opposite direction upon opposite rotation of said drum, the length of said tooth and the length of said projections being such that said tooth will clear either one of said projections, depending upon the direction of rotation of said drum, and permit rotation of said drum beyond said projections, and the relationship of the angles of the plane surfaces of said cam with respect to said engaging member being such that said leaf spring member will complete rectilinear movement of said cam member after said tooth has been rotated to such a position as to be disengaged from said projection.

14. In a multiple controller, a plurality of stationary contacts, a plurality of pivotally movable contacts engageable with said stationary contacts, and means for engaging said movable contacts with said stationary contacts in a predetermined sequence comprising a leaf spring member extending angularly from each of said movable contacts, a rider member on the end of each of said leaf spring members, a plurality of rectilinearly movable cams, each of said cams being adapted to be engaged by one of said rider members and having sloping plane sides converging toward a peak, each of said cams being so arranged that when its associated rider member is at the lower portion of one side thereof, its associated contact is locked in an open position, and when said rider member is at the lower portion of the opposite side thereof, its associated contact is locked in a closed position, and means for rectilinearly moving said cams including a pair of spaced projections extending from each of said cams, a drum having radially spaced teeth thereon, each of said teeth being engageable with one of said projections, the length of each of said teeth and the length of each of said projections being such that each tooth will clear the projections of its associated cam after it has moved said cam a certain distance and permit further rotation of said drum for actuating said movable contacts in a predetermined sequence.

15. A circuit controlling mechanism comprising a stationary contact, a pivoted arm having a contact on the free end thereof adapted to engage said stationary contact, a leaf spring

member extending angularly from said movable contact, an engaging member on the end of said leaf spring member, and means for pivotally moving said arm for engaging said movable contact with or disengaging said movable contact from said stationary contact comprising a rectilinearly movable cam member having sloping plane sides converging to a peak adapted to be engaged by said engaging member on the end of said leaf spring member, a pair of spaced projections extending from said cam member in an opposite direction from its peak, and means for rectilinearly moving said cam including a rotatable drum and a tooth on said drum engageable with one of said projections for moving said cam in one direction, and the other of said projections for moving said cam in an opposite direction upon opposite rotation of said drum, the length of said tooth and the length of said projections being such that said tooth will clear either one of said projections depending upon the direction of rotation of said drum and permit further rotation of said drum, and the relationship of the angles of the plane surfaces of said cams with respect to said engaging member on the end of said leaf spring member being such that said leaf spring member will complete rectilinear movement of said cam member and permit each of said teeth to clear its associated projection.

16. In an electric switch, a stationary contact, an arm pivoted for movement about an axis parallel to a plane parallel to the contact surface of said stationary contact and having a contact on the free end thereof adapted to engage said stationary contact, means for pivotally moving said arm for engaging its associated contact with said stationary contact or for disengaging said associated contact therefrom comprising a movable cam having sloping plane sides converging towards a peak, a resilient member rigidly fixed to and extending from said contact in the same general direction as said arm but diverging angularly away therefrom, and a rider on the end of said resilient member adapted to ride along said cam and flex said resilient member upon movement of said cam.

17. In an electric switch, a stationary contact, an arm pivoted for movement about an axis par-

allel to a plane parallel to the contact surface of said stationary contact and having a contact on the free end thereof, means for pivotally moving said arm for engaging said movable contact with said stationary contact or for disengaging said movable contact therefrom comprising a movable cam having sloping plane sides converging towards a peak, a resilient member rigidly fixed to and extending from said contact on said arm in the same general direction as said arm but diverging angularly away from said arm, and means on the free end of said resilient member adapted to ride along said cam and flex said resilient member as said means engages one plane surface of said cam, and release flexion of said resilient member as said means rides over the peak of said cam and lock said contacts in fixed relation with respect to each other when at the lower ends of either of said plane surfaces.

18. In an electric current controller, a movable cam having sloped engaging surfaces converging towards a peak, means for moving said cam, a stationary contact, a movable contact including a pivoted arm having a contact member thereon, and means engaging said cam for engaging or disengaging said contacts upon movement of said cam and locking said contacts in an open or closed position comprising a resilient member extending along said arm from a point adjacent said contact and diverging angularly away therefrom, and having means on its free end for engaging said cam.

19. In an electric current controller, a movable cam having sloping engaging surfaces converging towards a peak, means for moving said cam, a stationary contact, a movable contact including a pivoted arm having a contact member thereon, and means engaging said cam for engaging or disengaging said contacts upon movement of said cam and locking said contacts in an open or closed position comprising a leaf spring member secured to and extending along said arm from a point adjacent said contact and diverging away therefrom, and having a free end adapted to engage said cam.

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