Aug. 4, 1936. R. R. CHAPPELL ET AL 2,049,688

CONTROL MECHANISM FOR RECORDING DEVICES

Filed April 1, 1931 2 Sheets-Sheet 1

Fig. 2.

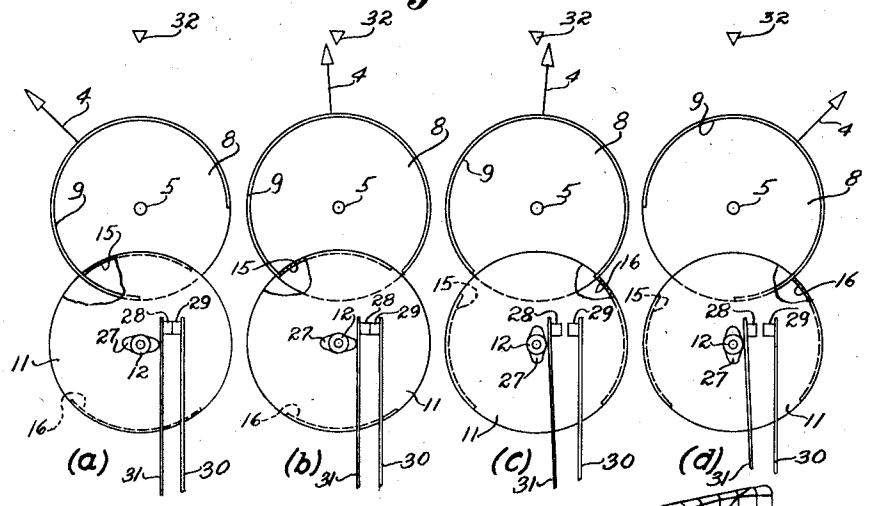


Fig. 1.

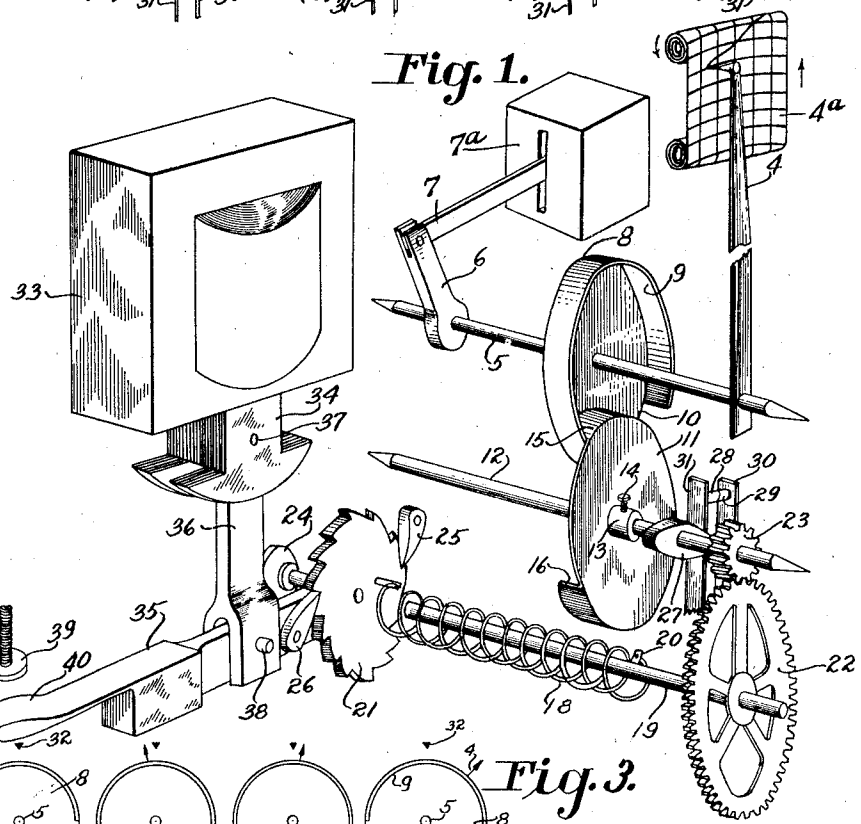
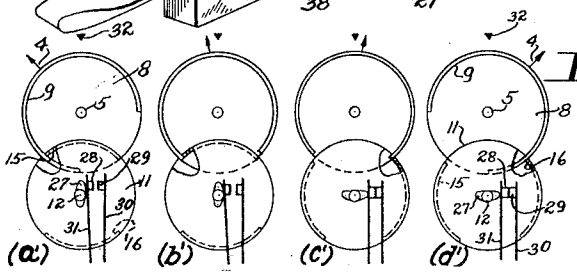


Fig. 3.



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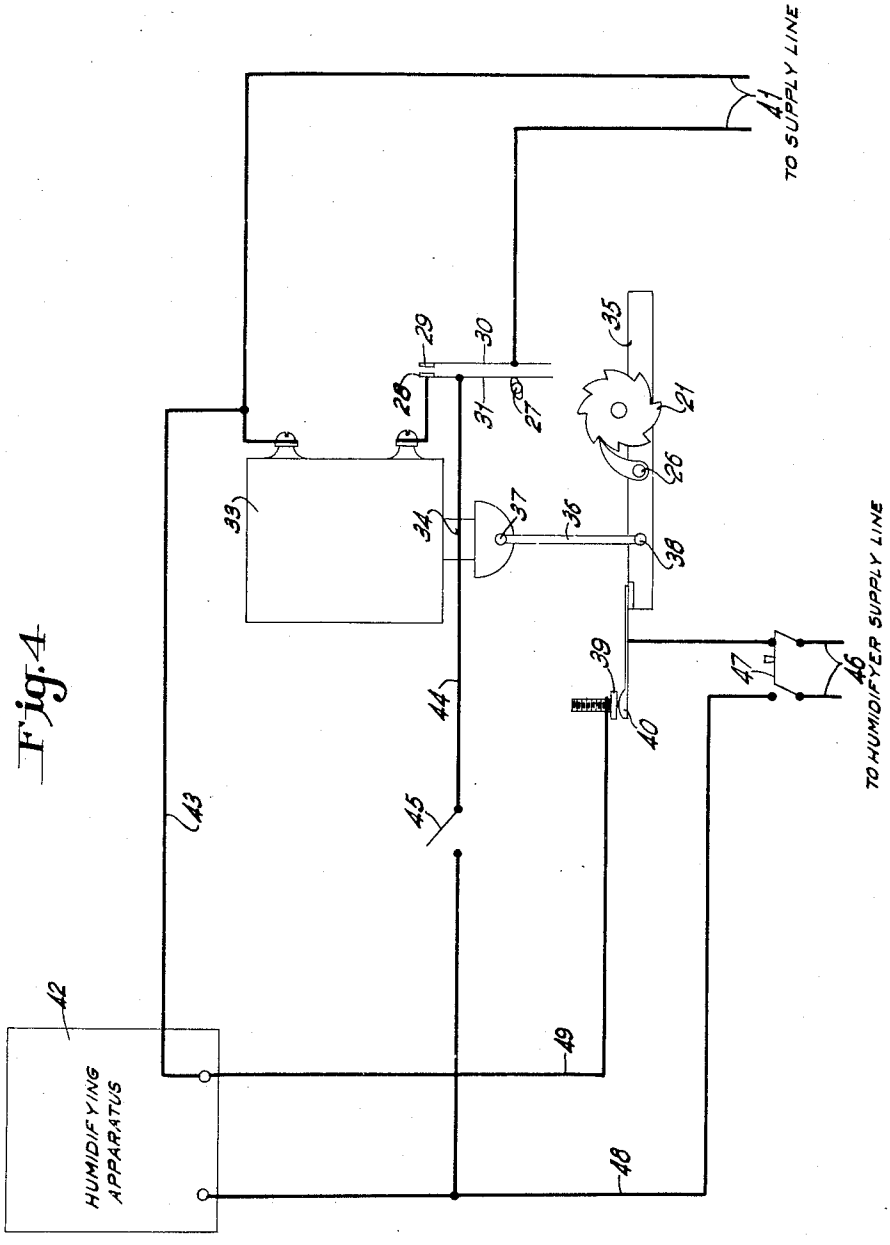

Fig. 4

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2,049,688

CONTROL MECHANISM FOR RECORDING DEVICES

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Application April 1, 1931, Serial No. 527,026

10 Claims. (Cl. 200—87)

The present invention relates to control mechanisms adapted to be employed with recording and indicating devices and more particularly to a control mechanism arranged to close and open an electrical circuit.

Generally, in recording and indicating devices which are arranged to close and/or open an electrical circuit at predetermined intervals, whereby auxiliary devices are rendered effective or ineffective, the usual indicating hand or pointer or recording pen moves very slowly and any electrical contacting device connected directly to, or arranged to be directly actuated by the pointer or recording pen through suitable transmission means, has a tendency therefore, to make or break an electrical circuit very slowly. This arrangement has been found to be highly impractical because such slow motion of the electrical contacts results in arcing and irregular contacting which produces burned-out contacts and chattering of control relays operated thereby. Further, when such slow moving contacts are employed in locations where they are subject to vibrations, the operation thereof is even more seriously affected.

One of the objects of the present invention is to provide a novel control mechanism in which the foregoing difficulties are substantially eliminated.

Another object is to provide in a control mechanism embodying a slow moving control member, novel means whereby electrical contacts are made to rapidly open or close upon the control member reaching a predetermined position.

Another object is to provide in a control mechanism embodying a control member and electrical contacts adapted to be actuated at predetermined positions of said member, novel means whereby energy may be stored up during the time that the contacts are closed and may be released at a later predetermined time to rapidly open said contacts.

A further object is to provide in combination with a recording or indicating device embodying an electrical contacting mechanism for rendering auxiliary apparatus effective or ineffective at predetermined intervals during the operation of the device, novel means for quickly opening or closing said contacts whereby burning of said contacts is prevented.

A still further object of the invention is to provide a novel escapement device arranged to rapidly actuate electrical contacts by the operation of a relatively slow moving control member at predetermined positions of the latter for rendering auxiliary apparatus effective or ineffective.

Still another object is to provide a novel and improved mechanism which is relatively simple in construction, highly efficient in operation, easily and economically manufactured and capable of adjustment for either rapidly closing or rapidly opening an electrical circuit by the operation of a relatively slow moving control member.

The above as well as other objects and advantages of the invention will appear more fully hereinafter from a consideration of the detailed description which follows, taken together with the accompanying drawings, wherein is illustrated one embodiment of the invention. It is to be expressly understood, however, that the drawings are for purposes of illustration and description only and are not designed as a definition of the limits of the invention, reference being had for this purpose to the appended claims.

In the drawings, wherein like reference characters refer to like parts in the several figures,

Fig. 1 is a perspective view, more or less diagrammatic, of one form of control mechanism embodying the present invention;

Fig. 2 is a diagram illustrating the cycle of operation of the control mechanism for rapidly opening an electrical circuit;

Fig. 3 is a view similar to Fig. 2 showing the control mechanism arranged for rapidly closing an electrical circuit; and

Fig. 4 is a circuit diagram embodying the present invention.

The control mechanism of the invention is adapted to be employed with any suitable auxiliary apparatus which is arranged to be operated electrically upon the occurrence of a predetermined condition or at a predetermined time, and is particularly adapted for rapid operation from a slow moving control member.

In the embodiment illustrated, the control mechanism is shown, for example, employed in a recording hygrograph embodying a slow moving control member in the form of a recording pen or indicator actuated from a sensitive element constituted by human hairs stretched to their full length on a rack (not shown) which are adapted to expand and contract in accordance with the percentage of humidity in the atmosphere. Upon the recording pen reaching a predetermined position, i. e., when a certain percentage of humidity is present in the atmosphere, the control mechanism is arranged to render some suitable air conditioning apparatus effective or ineffective.

In the form shown in Fig. 1, reference numeral

4 designates the recording pen or indicator, which is secured to a shaft 5 and arranged to traverse a record or chart 4a. It is obvious that a suitable dial may be substituted for the chart if desired. Secured to the shaft is a link 6, having pivotally connected thereto an arm 7 which may be arranged to be actuated by the sensitive elements as, for example, the human hairs mentioned above and shown diagrammatically at 7a. Upon operation of the sensitive elements, the arm 7 is caused to actuate the shaft 5 and with it the recording pen or indicator 4.

Means are provided whereby, upon a predetermined position being reached of the recording pen 4, auxiliary apparatus may be rendered operative, and in the form shown said means are constituted by a disc or wheel 8 mounted upon and rotatable with the pointer shaft 5 and having a peripheral flange 9 which is partly cut away as at 10. The disc 8 is so mounted upon its shaft that it may be rotated thereon to adjust its position relative to the pointer in order to set the point at which the auxiliary apparatus is to be operated. After this position is determined, the disc is locked to the pointer shaft and, like the pointer or pen, rotates therewith. Arranged to be locked with the disc 8 against the flange 9 thereof, is an escapement wheel 11 which is mounted on and rotatable with a countershaft 12 and is provided with adjusting means constituted by a hub 13 and a set screw 14 whereby the position of the wheel may be adjusted in any angular relation in respect to the shaft. The escapement wheel 11 is provided with projecting arcuate flanges 15 and 16, the first of which is adapted to engage the internal surface of the flange 9, while the second is adapted to engage the external surface of said flange after the wheel is actuated, as will appear more fully hereinafter.

Means are now provided for maintaining the escapement wheel 11 in engagement with the flange 9 of the disc 8 against the action of a force produced by stored energy whereby upon rotation of the disc 8 and the pointer 4 by means of the control arm 7, the escapement wheel is caused to be suddenly released and disengaged from the internal surface of the flange 9 of disc 8 by the action of the stored energy when the pointer 4 has reached a predetermined position, and to engage the external surface of said flange.

In the embodiment illustrated, said energy storing means comprise a coil spring 18, one end of which is secured to a countershaft 19 as indicated at 20, and the other end of which is secured to a ratchet wheel 21 which is adapted to be rotated independently of the countershaft 19 for storing energy in the spring 18. The tension of the spring 18 is transmitted to the escapement wheel 11 through a gear 22 secured to and rotatable with the countershaft 19 and arranged to mesh with a pinion 23 carried by the countershaft 12. The spring 18 is initially placed under tension by means of a thumb screw 24 secured to or formed integral with the ratchet wheel 21, the latter being prevented from being actuated by the tension of the spring by means of pawls 25 and 26.

It will now be seen that as the pointer 4 is actuated by means of the control arm 7 through the pointer shaft 5, the disc 8 is rotated and as the latter reaches a predetermined position, the flange 15 of the escapement wheel 11 is disengaged from the internal surface of the flange 9 at which instant the stored energy in the spring 18 is transmitted to the shaft 12 through the gear 22 and pinion 23, thereby causing the escapement wheel 11 to rapidly rotate through approximately 90 degrees, at which time the flange 16 of the escapement wheel is caused to engage the external surface of the flange 9 on disc 8. This rapid snap action of the escapement wheel 11 is employed to rapidly open or close a pair of electrical contacts of a circuit including novel means whereby auxiliary apparatus may be rendered operative or inoperative when the pointer 4 has reached a predetermined position and the spring 18 may be simultaneously wound as the auxiliary apparatus is brought into operation. To this end a cam member 27 is secured to or formed integrally with the countershaft 12 and is adapted in one position, for example as that shown in Fig. 1, to maintain a pair of relatively movable contacts 28 and 29 closed and in another position, that is, when the escapement wheel 11 has moved so that flange 16 engages the external surface of the flange 9, the contacts 28 and 29 are open. Contact 29 is carried by the fixed arm 30 while the contact 28 is carried by a spring arm 31 which is movable relative to fixed arm 30 by the action of the cam member 27. Contact arms 30 and 31 are electrically connected to the circuit including the novel means whereby continuous operation of the device embodying the present invention is assured, and the auxiliary apparatus simultaneously controlled as will be pointed out more fully hereinafter.

The sequence of actions which takes place as the pointer or recording pen 4 makes its travels across the chart or scale is shown in Fig. 2. In the position (a) the pointer is shown in a position well beyond the point indicated at 32 at which it is desired to render the auxiliary apparatus ineffective, for example. The contacts 28 and 29 are shown closed, due to the position of the cam member 27, and the flange 15 of the wheel 11 is shown locked against the inner surface of the flange 9. Furthermore, when conditions are such that the pointer 4 is in the region at which it is desired to maintain the contacts closed, the locking of the escapement wheel will always be against the inner face of the flange 9 and therefore nothing can possibly shift the proper relation of the contacts so that they may be opened when the pointer position indicates that they should be closed.

In the diagram (b) the pointer is shown approaching the critical point 32 at which point the disc 8 is about to unlock and release the escapement wheel 11 by the action of the energy stored in the spring 18.

In the position (c) the pointer is shown just past the critical point with the contacts now open and the second flange 16 of the escapement wheel locked against the external surface of the flange 9. This function takes place with a rapid snap action to suddenly open the contacts. It is to be noted here that care should be taken to so form and shape the surfaces of flange 9 and the flanges 15 and 16 that the disc escapement wheel 11 cannot possibly drive the disc 8. In other words, the escapement wheel must have no impulse planes and the entire escapement must be dead.

In the position (d) the pen or pointer is shown well beyond the critical point with the contacts open. It will be apparent from the diagrams a, b, c, and d, that the escapement mechanism operates without in any way hampering the freedom of the instrument to operate as either a recorder or indicator, and the wheel

11 is always actuated in the same direction, for example, counter-clockwise in the drawing, so that when the pointer again reaches the position shown in diagram (a) the flange 16 is then locked against the internal surface of flange 9, and upon a subsequent actuation of the mechanism the flange 15 engages the internal surface of flange 9. In the opening of the contacts 28—29, as shown in position (c) of Fig. 2, only part of the energy initially stored in the spring 18 is used, the remainder of said stored energy being utilized to reclose contacts when pointer 4 and disc 9 return from position (d) to position (a). By hardening and polishing the surfaces of the flange 9 and the flanges 15 and 16 and by adjusting the driving spring 18 to give a light tension, the escapement mechanism does not add any appreciable friction to the instrument mechanism.

It will be apparent that after the sequence of actions, as shown in Fig. 2, has taken place, energy must again be stored in the spring 18 to maintain the tension of the spring on the escapement wheel 11, and to this end the novel means referred to hereinbefore are provided whereby upon the re-closing of the contacts 28 and 29, spring 18 is again wound up, and in the form shown said means comprise an electro-magnet or solenoid 33 which is adapted to be energized upon the closing of the contacts 28 and 29 by being connected to an electrical circuit controlled by the contacts in any suitable manner for example as shown in Fig. 4. An armature 34 is arranged in operative relation to the electro-magnet 33 and adapted to be actuated when the latter is energized by the closing of the contacts 28 and 29. A lever 35 is drivably connected to the armature 34 by means of a link 36 one end of which is pivoted to the armature, as indicated at 37, and the other end of which is preferably forked and pivotally connected to the lever 35, as indicated at 38. The pawl 26 is pivoted on the lever 35 and arranged so that upon the actuation of the lever 35 by the electro-magnet 33, the ratchet 21 is caused to advance one tooth, for example, thereby winding the spring 18. When the contacts 28 and 29 are open, the electro-magnet 33 becomes de-energized and the armature 34 is dropped by the action of gravity, thereby returning the lever 35 to normal position and causing the pawl 26 to engage a succeeding tooth on the ratchet 21 so that the latter may again be actuated to wind the spring upon the next energization of the electro-magnet. It will be apparent that the number of teeth on the ratchet must be so selected that the latter advances as much at each closing of the contacts as the gear 22 rotates in imparting one-half of a revolution (with a 2-flanged escapement wheel) to the pinion 23.

In the event that the power to be controlled by the mechanism is not very great, the contacts 28 and 29 may be sufficient for the purpose and the electrical circuit of the auxiliary apparatus may then be connected in parallel with the electro-magnet 33 for simultaneous energization thereof. However, if it be desired to break heavier currents, the electro-magnet 33 may be employed as a relay for an electrical switch which in the form shown in Fig. 1 may be constituted by a fixed contact 39 and a movable contact 40 secured to or formed integral with the lever 35. In the latter arrangement, contacts 28 and 29 are then employed only for the purpose of energizing the electro-magnet 33 while the contacts 39 and 40 control the operation of the auxiliary apparatus which it is desired to control.

If it be desired to cause the contacts 28 and 29 to be rapidly closed instead of being rapidly opened for any given direction of motion of the pen or pointer 4, it is only necessary to loosen the screw 14 and shift the position of the wheel 11 with respect to the cam member 27 substantially 90 degrees so that the flange 15 is in engagement with the flange 9 when the contacts are in open position as may readily be seen from the diagrams in Fig. 3 wherein is illustrated the sequence of actions for rapidly closing the contacts when the pointer 4 reaches a predetermined position.

In the diagram (a') electrical contacts are initially opened when the flange 15 is locked against the inner surface of the flange 9. In the diagram (b') the pointer 4 is shown approaching the critical point at which the flange 15 is about to be disengaged from the inner face of the flange 9, and in diagram (c') the escapement wheel 11 has been released and the flange 16 thereof is in engagement with the external surface of the flange 9. The contacts 28 and 29 are closed due to the rotation of the cam 27 into the position indicated. In the diagram (d') the pointer 4 is beyond the critical position and ready to be moved in the opposite direction due to a change of conditions produced by the function of the auxiliary apparatus.

It is to be again noted that the rotation of the escapement wheel 11 is always in one direction, for example, counter-clockwise in the illustrated embodiment, although the control member or indicator rotates in either direction.

Referring now to Fig. 4, there is shown a circuit diagram embodying the present invention, whereby upon energization of the electro-magnet 33 the auxiliary apparatus to be controlled is simultaneously operated. The electro-magnet 33 is arranged to be energized from a supply line 41 through contacts 28—29 when the latter are closed. If, as pointed out hereinbefore, the auxiliary apparatus to be controlled does not require much power, i. e., if a large current is not required, contacts 28—29 can be made to directly open and close the controlling circuit of the auxiliary apparatus and for this purpose the auxiliary apparatus shown diagrammatically at 42 is connected in parallel relation with the electro-magnet 33 by means of the leads 43 and 44, the former being connected to one side of the supply line 41 and the latter being connected to the contact arm 31. A switch 45 is provided in the lead 44 for disconnecting the supply line 41 when it is not desired to use the latter. If, however, greater power is required to control the auxiliary apparatus 42, then a separate supply line 46 is provided which furnishes current to the auxiliary apparatus 42 independently of the supply line 41 through a double-pole single-throw switch 47, and leads 48 and 49. Interposed in the lead 49 are the stationary or fixed contact 39 and the movable contact 40, the latter being actuated by the armature 34 of the electro-magnet 33 through the link 36. When the independent supply line 46 is used to furnish power to the auxiliary apparatus 42, then the switch 45 is left open and the switch 47 is closed, but if it be desired to use the supply line 41 to furnish power to the auxiliary apparatus 42, then the switch 45 is closed and switch 47 opened.

From the foregoing, it will be apparent that as the control arm 7 moves the pointer 4, the disc

is also rotated therewith, and as the critical point is reached by the pointer when moving in a given direction, the escapement mechanism functions in one instance (Fig. 2) to open the electrical contacts, thereby rendering the auxiliary apparatus inoperative either directly through the contacts 28—29 and supply line 41, or indirectly through contacts 39—40 and supply line 46, or if desired as in the other instance (Fig. 3), to close the contacts, thereby rendering the auxiliary apparatus operative at predetermined time according to the position of the pointer for which the mechanism is set. In either case, the closing of the contacts 28—29 also functions to energize the electro-magnet 33 thereby rewinding the spring 18 so that the escapement mechanism is reset for another cycle of operation.

There is thus provided a novel control mechanism adapted to be employed with a slow moving control member whereby electrical contacts are made to rapidly open or close upon the control member reaching a predetermined position. Novel means are also provided for automatically resetting the control mechanism for a succeeding cycle of operation.

While only one embodiment of the invention has been illustrated and described, changes and modifications which will now appear to those skilled in the art, may be made without departing from the scope of the invention. For example, the escapement device may be made to take various mechanical forms and the entire arrangement may be modified and rearranged to suit particular conditions of operation. Reference is therefore to be had to the appended claims for a definition of the limits of the invention.

What is claimed is :

1. In control apparatus including means automatically responsive to changes in conditions or operations, means for controlling said conditions or operations, a slow moving member connected to and operated by said change-responsive means in accordance with said changes in conditions or operations, an electrical contact device including relatively movable contacts, an electrical circuit for connecting a source of electric current to said condition controlling means through said contacts whereby said controlling means may be rendered operative or inoperative, and means operated by said slow moving member when the latter reaches a predetermined position representing a predetermined change in said conditions or operations for rapidly operating said relatively movable contacts whereby arcing across and burning of said contacts is substantially prevented, the combination of energy storing means for producing a snap action of said contact operating means, manually operable means for initially storing energy in said energy storing means, means for transmitting said stored energy to said contact operating means when the latter is rendered effective at the predetermined position of said slow moving member, and means rendered effective by the closing of said contacts for again storing energy in said energy storing means.

2. In control apparatus including means automatically responsive to changes in conditions or operations, means for controlling said conditions or operations, a slow moving member connected to and operated by said change-responsive means in accordance with said changes in conditions or operations, an electrical contact device including relatively movable contacts, an electrical circuit for connecting a source of electric current to said condition controlling means through said contacts whereby said means may be rendered operative or inoperative, and means operated by said slow moving member when the latter reaches a predetermined position representing a predetermined change in said conditions or operations for rapidly operating said relatively movable contacts with a snap action to prevent arcing across and burning of said contacts, the combination with said contact operating means, of electrical means effective upon closing of said contacts for automatically resetting said contact operating means.

3. In control apparatus including means automatically responsive to changes in conditions or operations, means for controlling said conditions or operations, a slow moving member connected to and operated by said change-responsive means in accordance with said changes in conditions or operations, an electrical contact device including relatively movable contacts, an electrical circuit for connecting a source of electric current to said condition controlling means through said contacts whereby said means may be rendered operative or inoperative, and means operated by said slow moving member when the latter reaches a predetermined position representing a predetermined change in said conditions or operations for rapidly operating said relatively movable contacts with a snap action to prevent arcing across and burning of said contacts, the combination with said contact operating means, of electromagnetic means rendered effective by the operation of said contacts for resetting said contact operating means.

4. In control apparatus including means automatically responsive to changes in conditions or operations, means for controlling said conditions or operations, a slow moving member connected to and operated by said change-responsive means in accordance with said changes in conditions or operations, an electrical contact device including relatively movable contacts, an electrical circuit for connecting a source of electric current to said condition controlling means through said contacts whereby said controlling means may be rendered operative or inoperative, and means actuated by said slow moving member, the combination of means normally in locking engagement with said actuated means but adapted to be released when said slow moving member reaches a predetermined position for rapidly operating said relatively movable contact, energy storing means associated with said last-mentioned means for transmitting energy stored therein to said last-mentioned means when the latter is released from said member actuated means whereby said relatively movable contacts are operated with a snap action, manually operable means for initially storing energy in said energy storing means, and electrical means rendered effective by the closing of the contacts for automatically storing energy in said energy storing means after the initially stored energy has been expended.

5. A control mechanism comprising a control member, a pair of relatively movable electrical contacts, and means associated with said member and contacts for operating the latter by the former, said means including an escapement device comprising a pair of escapement wheels in engagement with each other during the time the contacts are inoperative and which become disengaged to operate the contacts, a cam operatively connected to and movable with one of the escapement wheels and associated with said contacts whereby, upon disengagement of the wheels, said cam is effective to operate said contacts, and energy storing means operative upon operation of

said contacts whereby energy is stored up during the time the contacts are inoperative and is released at a later time to rapidly disengage said escapement wheels for operating said electrical contacts with a snap action.

6. A control mechanism comprising a control member, a pair of relatively movable electrical contacts, and means associated with said member and contacts for operating the latter by the former at predetermined positions thereof, said means comprising a shaft adapted to be driven by the control member, a second shaft, an escapement wheel on each of said shafts, respectively, and engaged with each other until the predetermined position of the control member is reached and adapted to be disengaged after that position is reached, energy storing means associated with said second shaft and effective upon operation of the contacts whereby energy is stored up during the time the contacts are inoperative and is released at a later time to operate the second shaft upon disengagement of the escapement wheels for operating said contacts with a snap action, and electrical means effective upon operation of said contacts whereby energy is stored in said energy storing means.

7. A control mechanism comprising a control member, a pair of relatively movable electrical contacts, and means associated with said member and contacts for operating the latter by the former at predetermined positions thereof, said means comprising a shaft adapted to be driven by the control member, a second shaft, an escapement wheel on each of said shafts, respectively, and engaged with each other until the predetermined position of the control member is reached and adapted to be disengaged after that position is reached, a cam on said second shaft and associated with the contacts whereby, upon disengagement of said escapement wheels, said cam is effective to operate said contacts, energy storing means associated with said second shaft and effective upon operation of the contacts whereby energy is stored up during the time the contacts are inoperative and is released at a later time to operate the second shaft upon disengagement of the escapement wheels for operating said contacts with a snap action, and electrical means effective upon operation of said contacts whereby energy is stored in said energy storing means.

8. A control mechanism comprising a control member, a shaft connected to and operated by said control member, a second shaft, an escapement wheel on each of said shafts, respectively, and engaged with each other until the control member reaches a predetermined position and disengaged after that position is reached, a cam on said second shaft, a pair of relatively movable electrical contacts arranged to be operated by the cam upon disengagement of said escapement wheels, and energy storing means effective upon operation of said contacts whereby energy is stored up during the time the contacts are inoperative and is released at a later time upon disengagement of said escapement wheels for rapidly actuating said cam to operate said contacts, said energy storing means comprising a third shaft geared to the second shaft, a solenoid adapted to be energized upon closing of the contacts, a pawl and ratchet associated with the solenoid and operated thereby upon energization thereof, and a spring adapted to be wound by the pawl and ratchet and having one end connected to the ratchet and its other end connected to the third shaft whereby, upon disengagement of the escapement wheels, said spring is effective to rapidly rotate the third shaft for driving the second shaft to operate the contacts by the cam with a snap action.

9. A control mechanism comprising a control member, a shaft connected to and operated by said control member a second shaft, an escapement wheel on each of said shafts, respectively, and engaged with each other until the control member reaches a predetermined position and disengaged after that position is reached, a cam on said second shaft, a pair of relatively movable electrical contacts arranged to be operated by the cam upon disengagement of said escapement wheels, and energy storing means effective upon operation of said contacts whereby energy is stored up during the time the contacts are inoperative and is released at a later time upon disengagement of said escapement wheels for rapidly actuating said cam to operate said contacts, said energy storing means comprising a third shaft geared to the second shaft, a solenoid adapted to be energized upon closing of the contacts, a pawl and ratchet associated with the solenoid and operated thereby upon energization thereof, and a spring adapted to be wound by the pawl and ratchet and having one end connected to the ratchet and its other end connected to the third shaft whereby, upon disengagement of the escapement wheels, said spring is effective to rapidly rotate the third shaft for driving the second shaft to operate the contacts by the cam with a snap action, and means for applying an initial tension on the spring.

10. A control mechanism comprising a control member, a shaft connected to and operated by said control member a second shaft, an escapement wheel on each of said shafts, respectively, and engaged with each other until the control member reaches a predetermined position and disengaged after that position is reached, a cam on said second shaft, a pair of relatively movable electrical contacts arranged to be operated by the cam upon disengagement of said escapement wheels, and energy storing means effective upon operation of said contacts whereby energy is stored up during the time the contacts are inoperative and is released at a later time upon disengagement of said escapement wheels for rapidly actuating said cam to operate said contacts, said energy storing means comprising a third shaft geared to the second shaft, a solenoid adapted to be energized upon closing of the contacts, a pawl and ratchet associated with the solenoid and operated thereby upon energization thereof, and a spring adapted to be wound by the pawl and ratchet and having one end connected to the ratchet and its other end connected to the third shaft whereby, upon disengagement of the escapement wheels, said spring is effective to rapidly rotate the third shaft for driving the second shaft to operate the contacts by the cam with a snap action, means for applying an initial tension on the spring, and a second pair of relatively movable electrical contacts arranged to be operated by and upon energization of the solenoid for controlling an auxiliary circuit.

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