Feb. 18, 1941. A. L. JUDSON 2,232,243

ELECTRIC SWITCHING MECHANISM

Filed June 24, 1939 2 Sheets-Sheet 1

FIG. 1

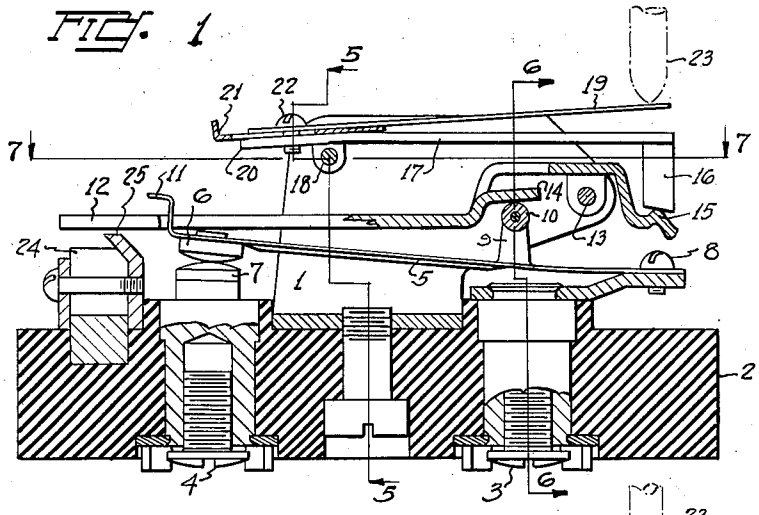


FIG. 2.

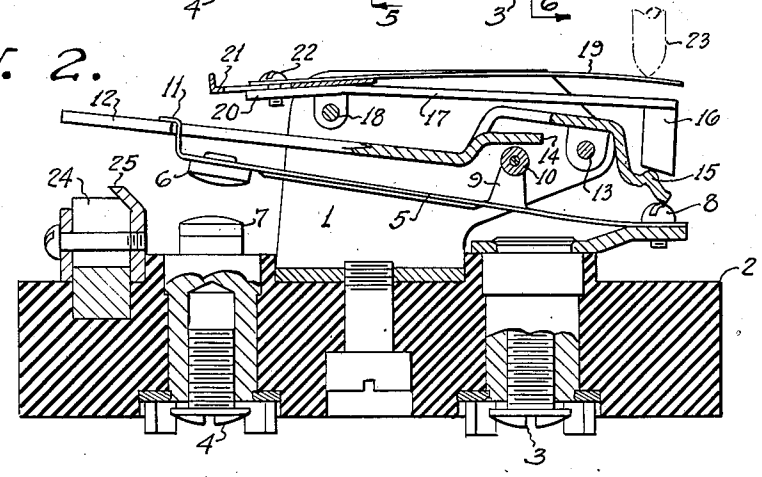
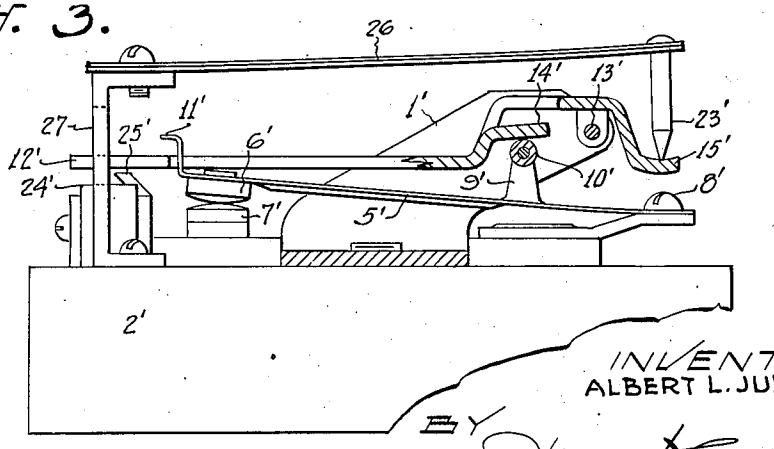


FIG. 3.



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Feb. 18, 1941. A. L. JUDSON 2,232,243

ELECTRIC SWITCHING MECHANISM

Filed June 24, 1939 2 Sheets-Sheet 2

FIG. 4.

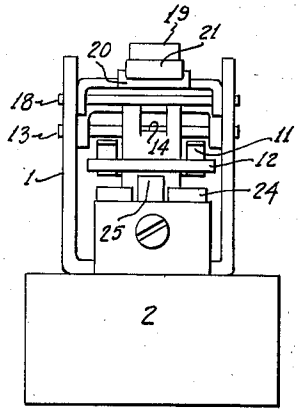


FIG. 5.

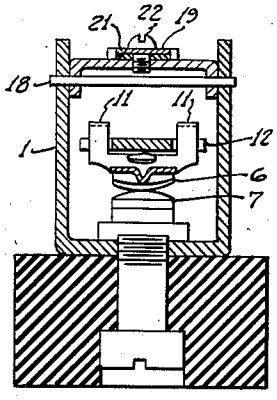


FIG. 6.

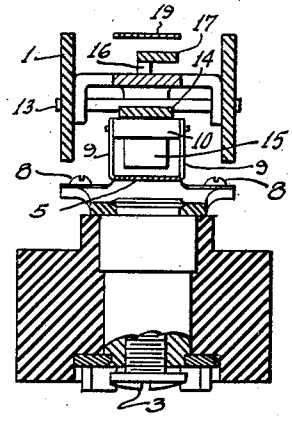


FIG. 7.

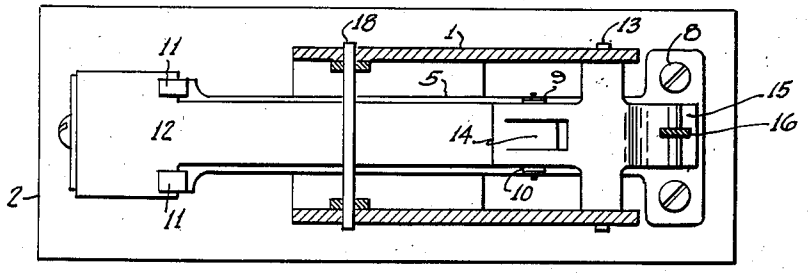
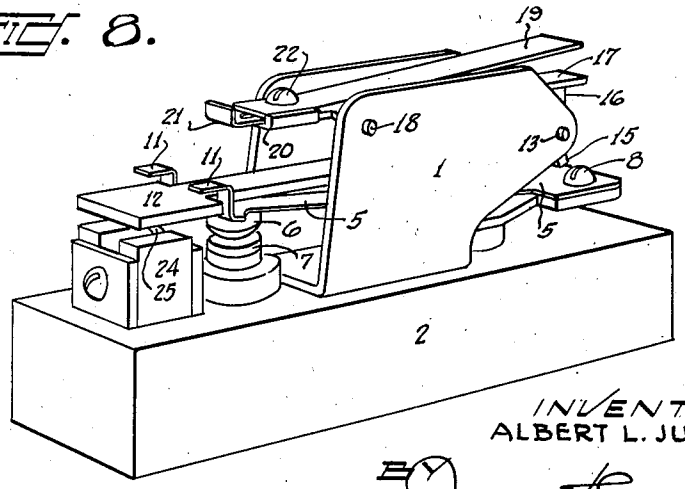


FIG. 8.



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UNITED STATES PATENT OFFICE

2,232,243

ELECTRIC SWITCHING MECHANISM

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Application June 24, 1939, Serial No. 280,937

10 Claims. (Cl. 200—67)

This invention relates to improvements in electric switching mechanisms of that type commonly employed with condition affected elements and more particularly to that type of snap-action electric switches employing resilient forces opposed by magnetic attraction to provide snap-action.

Objects of the invention are the provision for firm make of contact, and a rapid break of contact with a minimum of mechanical energy input in which may be readily incorporated a condition-affected element, and certain other advantageous features apparent in the following disclosure.

In the drawings:

Figure 1 represents a view of a longitudinal vertical section of the switch in the closed adjustment.

Figure 2 represents a view in longitudinal vertical section showing the switch as the parts appear in the open adjustment.

Figure 3 represents a longitudinal vertical section of an alternative form of the switch in which a bimetallic thermostat-element is substituted for one of the parts shown in the other two figures.

Figure 4 is an end elevation as viewed from the left in Figure 1.

Figure 5 is a sectional end view taken on the line 5—5 of Figure 1.

Figure 6 is a sectional end view taken on the line 6—6 of Figure 1.

Figure 7 is a sectional plan view taken along the line 7—7 of Figure 1.

Figure 8 is a perspective view of the invention.

Referring now more particularly to the drawings:

The essence of this invention resides in the means arranged and adapted to employ a spring switch arm in double strain in connection with certain rigid, pivotally mounted elements to provide for an enhanced celerity of movement of the contact point in the opening operation and a firm contact pressure in the closed adjustment. Considering that the amount of energy used to operate the switch is of a small, fixed quantity, improved action requires that this actuating energy be resolved in a novel manner to effect the desired results.

A frame 1 is secured to a dielectric base 2 in which are fixed suitable terminals 3 and 4 electrically connected to a spring switch-arm 5 carrying a contact point 6 and a fixed contact point 7, respectively. The switch-arm 5 is normally formed in the shape in which it is shown in Figure 2, that is to say, of such a form as would provide for the separation of the contact points 6 and 7 as shown in Figure 2. The fixed end of the spring 5 is secured to the frame 1 by screws as 8. Intermediate the ends of the spring 5, a pair of laterally spaced journals as 9 are formed integrally upon the spring and rotatably support a small roller 10 journalled therein. Rigidity is imparted to that portion of spring 5 between the journals 9 and the contact 6 by a longitudinal rib depressed in the spring.

The free end of the spring is formed with an offset portion 11 adapted to engage in its upward movement the armature 12 pivotally mounted at 13 and formed in detail with a tongue 14 in close proximity to the axis of mounting 13, adapted to bear upon the roller 10, and a rearwardly extending bearing point 15 upon which a thrust-member 16 bears. Were the switch arm 5 not biased upwardly the portion 11 through its engagement with armature 12 would constitute a lost motion coupling. Because of the bias no such coupling is present. Actually the portion 11 is provided solely as a safety breaker and is not intended to engage armature 12 until switch arm 5 is at its free or upper limit, the switch arm reaching this position prior to the armature because of its lesser mass. Were the projection 11 to be removed in Figure 2, no change would result, since switch arm 5 is shown in its normal undistorted position. The sole purpose of projection 11 is to forcibly open the contacts by impact in case of sticking or welding. The thrust-member 16 is formed integrally upon the free end of the lever 17, in turn pivotally mounted on the frame 1 at 18. A spring 19 is mounted upon a rearward extension 20 of the lever 17 in combination and in contact with a rigid slide 21 longitudinally adjustable along the screw 22 to alter the effective length of the spring 19. An actuator which may be a push button or other convenient means to apply a force to actuate the switch is indicated by the broken line figure 23.

Switches of this type used in conjunction with condition control apparatus are required to respond to a relatively fixed energy input represented in different applications by different forces and different distances through which the forces act. The slide 21 allows of adjusting the effective length of the spring 19, to adapt the switch for use with a variety of condition registering actuators in which the force and distance factors are of variant values.

When the switch is in the closed adjustment,

the spring 5 is subjected to flexure. As the armature 12 is attracted to the permanent magnet 24, prior to closure relatively great force is brought to bear upon the roller 10 and is of such magnitude as to bring the contact points 6 and 7 together, and further, to strain the spring 5 out of its normal rectilinear form to that form in which it is shown in Figure 1.

Because of the attitude of the surface of the tongue 14 which contacts the roller 10 as referred to the arcuate paths traversed thereby respectively, a valuable mechanical advantage is provided. The tongue 14 may be disposed, as experience indicates, in such an attitude as will provide for a relatively great amplitude of movement of the armature 12 and a relatively small and consequently more forcible movement of the roller 10, switch-arm 5, and hence of the contact 6.

This mechanical advantage, it will be recognized, is not of a constant value for all positions of the affected parts. This characteristic accrues from the particular relative disposition of the roller 10, the axis of the pivotal mounting 13 and the fixed end of the switch arm 5, and is availed of to provide a heavy contacting pressure, or make, and a relatively rapid movement of the point 6 after the contact is broken, while requiring relatively little energy input to effect the break.

Opening of the switch is effected by a deflection of the spring 19 in response to a force applied at the free end thereof. At a certain limit of flexure of the spring 19, determined by the strength of the magnet 24 acting on the armature 12, the potential energy thus invested is resolved into certain dynamic forces in the parts actuated thereby.

The armature 12 is forced upwardly against the attraction of the permanent magnet 24, which force attenuates very rapidly and at a faster rate than that attenuation characteristic of the spring 19, providing for a more efficacious value of the total force relied upon to accelerate the armature 12 from a state of rest to that desirable velocity at which the electrical contact is broken.

It will be apparent that movement of the contact 6 would occur simultaneously with that movement of a point in the armature 12 in apposition therewith if the spring 5 were a rigid member by virtue of the rigid connection provided for by the tongue 14, roller 10 and journals 9. Since, however, the spring 5 is not rigid, between screws 8 and journals 9, and is strained, or bowed, downwardly, as shown in Figure 1, the armature 12 will move initially in rapid acceleration without causing any movement of the contact point 6. The strain in spring 5, however, will be in a measure relieved by the upward movement of the tongue 14 and ultimately the contact point 6 will rise away from the stationary point 7 at a rapidly accelerated rate due to the proportionately great force exerted by the spring 5 in returning to its normal position as shown in Figure 2.

Now it is to be observed that as the pressure upon the roller 10 is relieved, the strain in the spring 5 will act to supplement the force of the spring 19 in accelerating the movement of the armature 12. Relieving the strain on spring 5 operates to allow it to raise the point 6, effecting a clean and instantaneous separation of the points 6 and 7 in a kind of whipping action.

The offset portion 11 of the spring 5 serves as a safety breaker, the utility of which is well known. It is conceivable that under conditions of abnormal current flow, the contacts 6 and 7 might fuse lightly together or the contact spring 5 lose part or all of its initial tension due to heating. Should the contacts fail to open in the normal manner from either cause, the motion of armature 12 will be directly imparted to contact 6 through engagement with offset portion 11. It is to be noted particularly that this engagement will occur as the armature is moving at a rapid rate with an impact of sufficient force to tear apart the contacts when lightly fused and provide a quick and effective break under abnormal conditions.

This engagement of the armature 12 with the extension 11 does not normally occur until after the points 6 and 7 have been separated by the resolution of the potentials invested in the switch-arm 5 as described.

In the alternative form shown in Figure 3, a bimetallic element 26 replaces the spring 19 of the switch as shown in Figures 1 and 2 and contains within itself the means of storing potential energy, in the form of strains, to perform a function identical with that of the spring 19, in addition to its inherent properties of registering temperature variations. Other parts of the switch, which are similar to the parts used in the other form are indicated by similar numerals with prime exponents. This bimetallic element is conveniently mounted upon a standard 27 rigidly secured to the base 2'.

While I have shown a particular form of embodiment of my invention I am aware that many minor changes therein will readily suggest themselves to others skilled in the art without departing from the spirit and scope of the invention.

Having thus described the invention, what I claim as new and desire to protect by Letters Patent is:

1. In a switch mechanism a stationary contact, a resilient member, a movable contact carried by said resilient member and normally biased thereby, an oscillatory armature, coupling means adapted to connect said resilient member and said armature, said coupling means being associated with said member and said armature at points of reduced movement, respectively, a magnet cooperating with said armature normally to displace said movable contact in opposition to its bias and switch operating means associated with said armature in opposition to said magnet.

2. In electric switches, normally separated stationary and spring-mounted contacts, magnetically urged means bearing angularly upon the spring-mounting for the one of said contacts adapted to wedgingly constrain the said contacts together, and resilient means associated in opposition with said magnetically urged means to separate the said contacts.

3. In electric switches, normally separated stationary and spring-mounted contacts, magnetically urged means bearing angularly upon the spring-mounting for the one of said contacts near the extremity of the spring mounting and adapted to constrain the said contacts together and further to strain the said spring-mounting beyond that value at which the said contact is perfected, and resilient means associated in opposition with said magnetically actuated means to suddenly remove the constraint of said spring-mounting to effect the separation of the said contacts.

4. In electric switches, normally separated stationary and spring-mounted contacts, magnetically urged means bearing angularly upon the spring-mounting for the one of said contacts at a point of reduced movement and adapted to constrain the said contacts together, and a resiliently coupled condition-affected element associated in opposition with said magnetically urged means to separate the said contacts.

5. In electric switches, normally separated stationary and spring-mounted contacts, magnetically urged variable rate mechanical means including a cam portion disposed at a point of reduced movement thereof and bearing upon the spring-mounting for the one of said contacts to constrain the said contacts together, and resilient means associated in opposition with said magnetically urged means to separate the said contacts.

6. In electric switches, normally separated stationary and spring-mounted contacts, magnetically urged means bearing upon the spring-mounting for the one of said contacts at a point removed from the contact and adapted to constrain the said contacts together, and resilient means associated in opposition with said magnetically urged means to separate the said contacts, wherein said magnetically urged means is fitted with a delayed-action engagement for said spring-mounting near the contact fixed thereto whereby said contacts may be forcibly separated in an emergency.

7. In electric switches, normally separated stationary and spring-mounted contacts, magnetically urged means bearing upon the spring mounting for the one of said contacts adapted to constrain the said contacts together, resilient means associated in opposition with said magnetically urged means to separate the said contacts and means associated with and adapted to vary the spring rate of said resilient means.

8. In a switch, a stationary contact, a resilient member supported at one of its ends and biased away from the stationary contact, a movable contact mounted upon said resilient member, a magnet, an armature in the field of said magnet and oscillatory about a point spaced from the support for said resilient member, said armature including a cam portion, a projection formed on the resilient member between its supported end and the contact and disposed in the path of said cam, the paths of travel of said cam and said projection crossing at an angle to cause movement of said armature under the urge of said magnet to close said contacts and further deflect said resilient member.

9. In electric switches, a stationary contact, a movable contact carried by a spring member and normally separated from the stationary contact, a roller journaled near the fixed end of the spring mounting for the movable contact, a magnetically attracted pivoted member having a tongue projecting therefrom near the pivot, said tongue being arranged to engage said roller with increasing advantage and thereby close and strain said contacts in response to the magnetic attraction, and resilient means arranged in opposition to said magnetically influenced member to separate the contacts abruptly.

10. In a switch mechanism, a stationary contact, a resilient member having a movable contact at one of its ends and fixed at its opposite end, a roller journaled on said resilient member near its fixed end, a magnet, an oscillatory armature influenced by said magnet, said armature including a tongue angularly projecting therefrom near the center of oscillation, said tongue being arranged to engage said roller tangentially with increasing advantage upon movement of the armature under the attraction of the magnet to thereby close and strain together said contacts abruptly, and resilient means bearing upon said armature in opposiiton to said magnet for opening said contacts in one abrupt motion.

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