May 3, 1949. E. F. KOHL 2,469,336

SWITCH OR LIKE APPARATUS

Filed Nov. 8, 1944 4 Sheets-Sheet 1

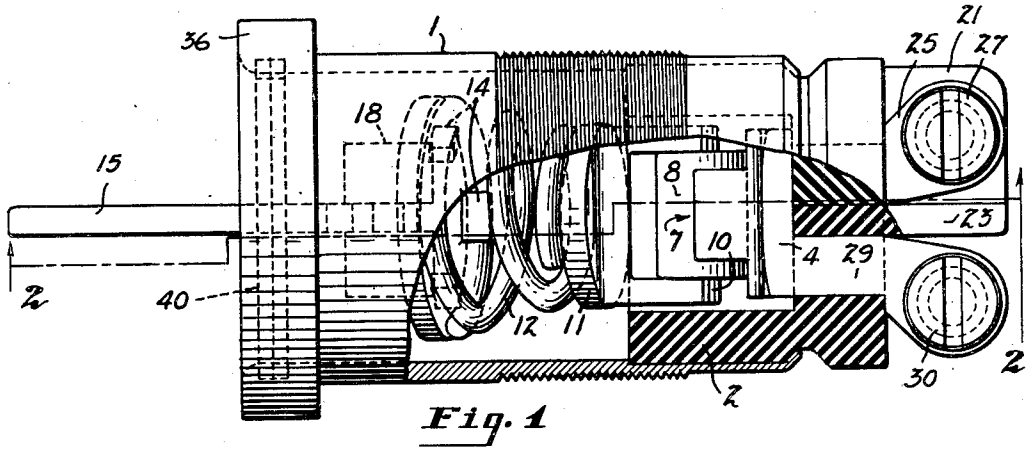

Fig. 1

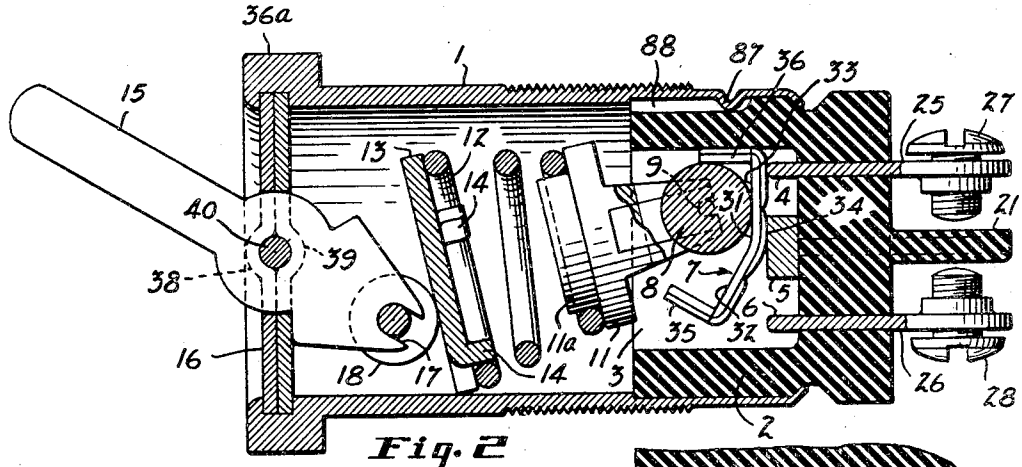

Fig. 2

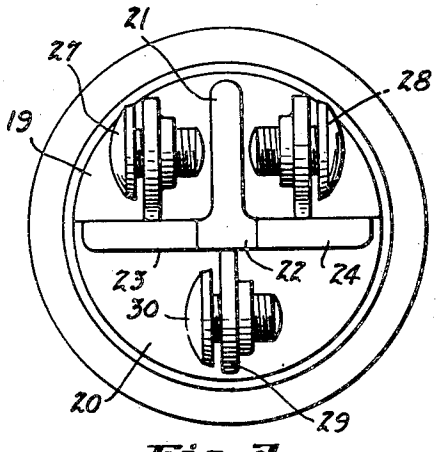

Fig. 3

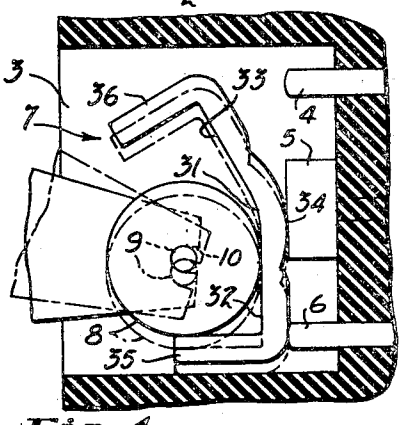

Fig. 4

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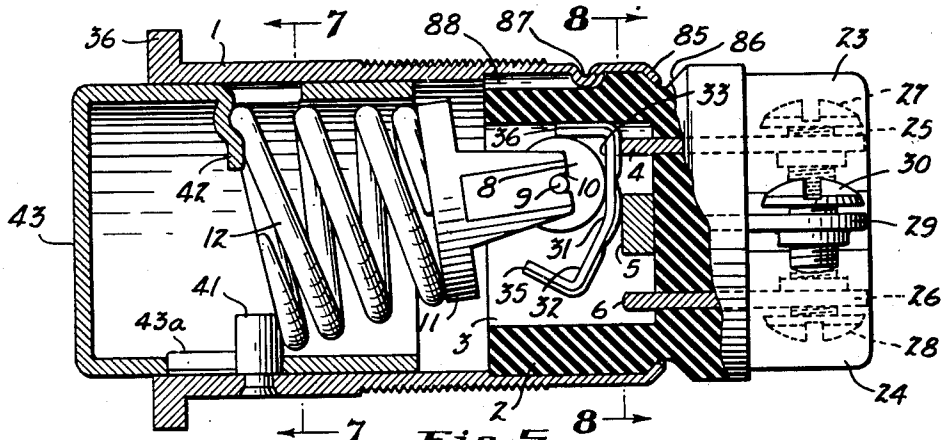

Fig. 5

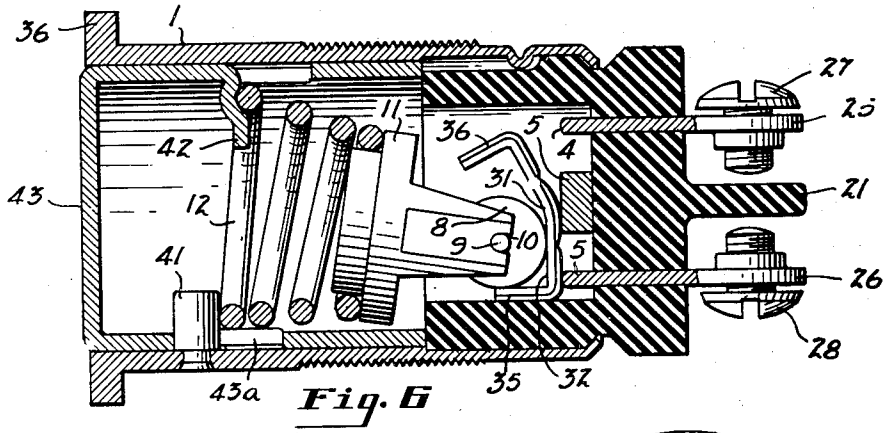

Fig. 6

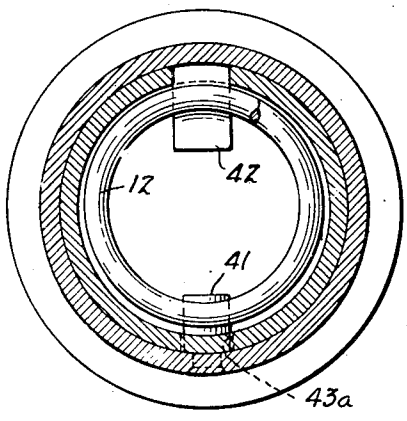

Fig. 7

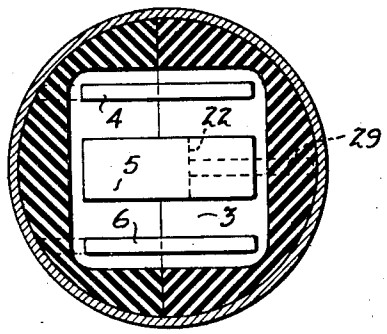

Fig. 8

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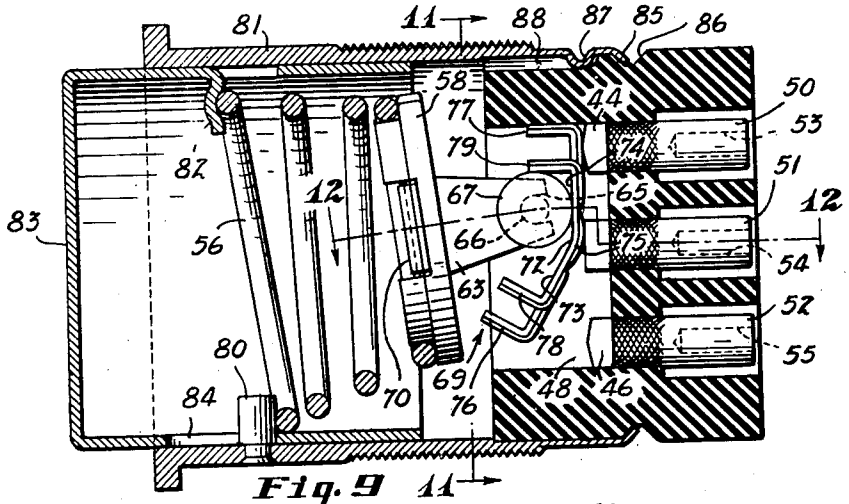

Fig. 9

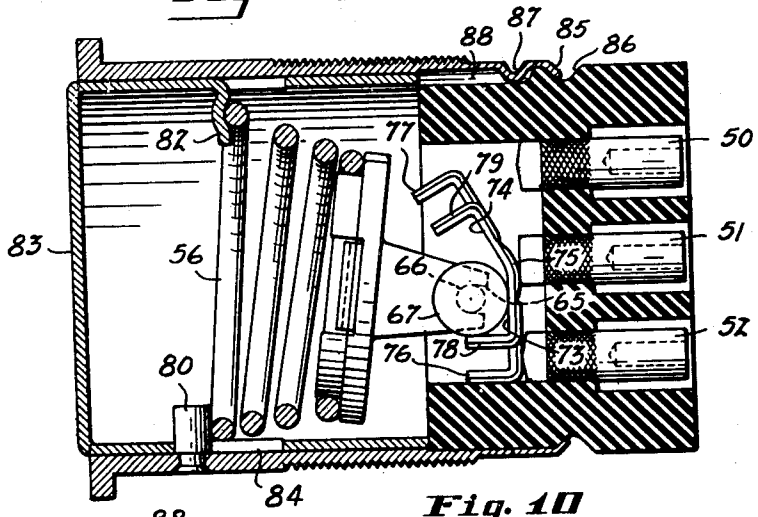

Fig. 10

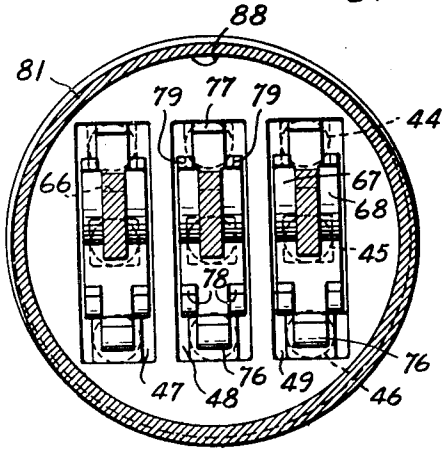

Fig. 11

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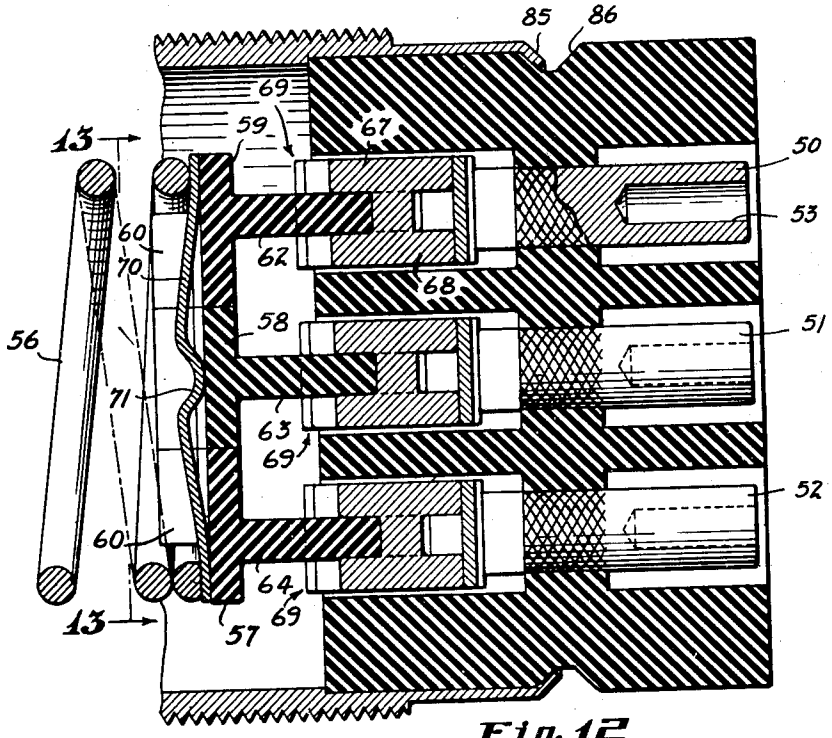

Fig. 12

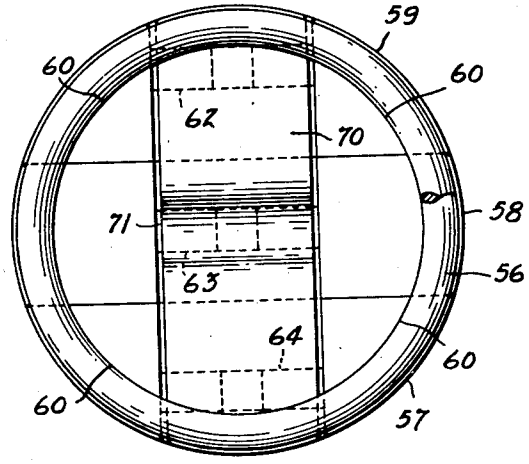

Fig. 13

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UNITED STATES PATENT OFFICE

2,469,336

SWITCH OR LIKE APPARATUS

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Application November 8, 1944, Serial No. 562,496

16 Claims. (Cl. 200—68)

1

My invention relates to apparatus for controlling the movement of contacts, valve parts, or the like. More particularly it relates to an electrical switch.

In apparatus which has heretofore been provided for controlling the movement of contacts, valve parts or the like, a spring has been provided to shift an arm carrying a contact or valve part into or from engagement with another contact or valve part upon movement of an actuating arm. For instance, in electrical switches of this type, a movable contact carried by one arm is maintained in engagement with a stationary contact by means of a spring having one end connected to the contact carrier and its opposite end connected to an actuating arm and when the actuating arm is moved to such position that the parts approximate or reach dead center, the movable contact is forced from engagement with the stationary contact with a snap motion.

While toggle switches of the type specified have been extensively utilized in commercial practice, they are not entirely satisfactory because thin arms or blades are utilized as the current-carrying member and consequently when it is desired to establish and interrupt a circuit traversed by high current, it is necessary to provide a comparatively large switch. There is a distinct demand, however, at the present time for comparatively small switches and while small switches of the type specified may be employed to interrupt and establish circuits traversed by low currents, they require the utilization of delicate parts which are expensive to fabricate and difficult to assemble. In such switches, it is also apparent that as the actuating member is moved toward dead center, the pressure upon the movable contact is decreased, thereby increasing the contact resistance and the heating incident thereto. In such switches, chattering at the contacts may and does frequently occur just prior to the movement of the movable contact from the stationary contact.

Practically all switches of the snap acting or toggle type as constructed at the present time are also affected by even ordinary vibration. This vibration is caused principally by the fact that only a comparatively small amount of the operating pressure is finally transmitted as contact pressure and this is particularly true when the operating movement of the actuating member is the same or less than the working air gap of the switch. This lack of a firm positive contact pressure also permits vibration or bouncing of

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the movable contact when it is thrown quickly, such as by a snap motion, into engagement with a stationary contact which causes sparking, high resistance, and wear at the contacts. Furthermore, considerable difficulty has been experienced in adapting commercial snap acting switches of the present type for use in relays or in multiple pole switches.

It is the aim of the present invention to provide an improved device in which a movable member is maintained in engagement with a stationary member under comparatively high pressure by resilient means, the direction of the force of which changes upon movement of an actuating means to abruptly disengage the movable member from the stationary member and while I do not desire to limit my invention to apparatus of any particular type, my improved device is particularly suitable for use as an electrical switch in which the movable member and stationary member are electrical contacts. When my improved device is utilized as a switch, the contact pressure is comparatively high when the contacts are in engagement with each other and this contact pressure is maintained until the movable contact leaves the stationary contact. When the movable contact is in engagement with the stationary contact, my improved switch will consequently be free from vibration and vibration or bouncing of the movable contact when it is forced rapidly into engagement with the stationary contact will also be eliminated. In my improved switch, the actuating means may also be constructed so that the movable member quickly returns to its original position when the force upon the actuating means is released.

I also preferably provide three stationary contacts, one of which is continuously in engagement with the movable contact so that a circuit may be established between one of the stationary contacts and the common contact when the movable contact is in one position and between the other stationary contact and the common contact when the movable contact is in a different position. In such arrangement, it is not necessary for the current to flow through a spring or through thin arms or blades and consequently my improved switch has a greater current-carrying capacity than switches of the toggle type of the same size. Since no spring blades or thin arms are required, it is also apparent that a comparatively small switch may be provided which is composed of parts that may be readily fabricated and easily assembled. My invention also contemplates providing an improved elec-

trical switch in which the movable contact is of special form and is of the roving type so that during actuation of the switch it may be rocked upon one stationary contact and a portion forced into engagement with another stationary contact, whereupon the movable contact is then slidable over the stationary contacts to provide a wiping action to remove oxides or other corrosive material from the contacts.

It is therefore an object of my invention to provide an improved device in which one part may be moved into and from engagement with a stationary part under the influence of a resilient member and in which the major or predominant component of the force of the resilient member is directed toward holding the movable part in engagement with the stationary part when the members are in engagement with each other.

Another object of my invention is to provide an improved electrical switch in which a movable contact is normally maintained in engagement with a stationary contact under the influence of a resilient member, the direction of the force of which is changeable and the major or predominant component of the force of which is directed toward holding the movable contact in engagement with the stationary contact when the contacts are in engagement with each other and in which the resilient member is movable to a position in which the direction of its force is abruptly changed to disengage the movable contact from engagement with the stationary contact.

Another object of my invention is to provide an improved electrical switch in which a contact is movable into and from engagement with a stationary contact under the influence of resilient means, the direction of the force of which is changeable and in which the major or predominant component of the force of the resilient means is directed toward causing the movable contact to engage the stationary contact as it approaches the stationary contact to thereby prevent vibration or bouncing of the movable contact when it is moved into engagement with the stationary contact.

Another object of my invention is to provide an improved electrical switch in which a movable contact is normally maintained in engagement with a stationary contact under the major or predominant component of the force of a movable resilient spring, the direction of the force of which spring may be changed to abruptly disengage the movable contact from the stationary contact and in which the movable contact and spring are returnable to their original positions when the force upon the actuating means is released.

Another object of my invention is to provide an improved electrical switch in which a contact is selectively movable to and from engagement with each of a pair of stationary contacts under the influence of a movable resilient means, the direction of the force of which changes during movement of the resilient means and which is so disposed with respect to the movable contact that the major or predominant component of its force is directed in maintaining the movable contact in firm seating engagement with the stationary contact with which it is engaged to thereby prevent vibration of the movable parts of the switch.

A further object of my invention is to provide an improved electrical switch in which a contact is first rockable upon a stationary contact to cause its engagement with a second stationary contact and is then slidable over the stationary contacts to provide a wiping action.

A still further object of my invention is to provide an improved switch in which a movable contact is rockably mounted upon an intermediate stationary contact disposed between two other stationary contacts and a portion of which movable contact is adapted to be forced into engagement with either of the other stationary contacts upon the change of the direction of force of a resilient means.

Other objects and advantages of my invention will be apparent as the specification proceeds.

My invention will be better understood by reference to the accompanying drawings in which:

Fig. 1 is an elevational view of one form of my improved switch with parts broken away to show adjacent structure;

Fig. 2 is a cross sectional view on the line 2—2 of Fig. 1;

Fig. 3 is an end view showing the arrangement of the terminal bars;

Fig. 4 is a detail fragmentary view of a portion of the switch, showing the movable parts in a position different from that shown in Fig. 1 and with the movable contact in full lines when it is moved to contact-engaging position and in dotted lines after it has been slid to its final position;

Fig. 5 is a cross sectional view with parts in elevation of a modified form of my switch;

Fig. 6 is a view similar to that shown in Fig. 5 with the parts in a different position;

Fig. 7 is a cross sectional view on the line 7—7 of Fig. 5 looking in the direction of the arrows;

Fig. 8 is a cross sectional view on the line 8—8 of Fig. 7;

Fig. 9 is a cross sectional view of another form of my improved switch;

Fig. 10 is a view similar to that shown in Fig. 9 but showing the parts in a different position;

Fig. 11 is a cross sectional view on the line 11—11 of Fig. 9;

Fig. 12 is a cross sectional view on the line 12—12 of Fig. 9; and

Fig. 13 is a detail plan view as seen from a plane passing through the line 13—13 of Fig. 12 as viewed in the direction of the arrows.

Although my improved device may be utilized for various purposes, such as for opening and closing ports or moving valve parts into and from engagement with each other, as illustrated in the drawings it is shown in the form of an electrical switch.

As illustrated in Figs. 1 to 4 of the drawings, the switch is enclosed in a tubular housing 1 provided at one end with a block of insulating material which extends into the housing in the form of a sleeve 2 provided interiorly with a substantially rectangular side walls as shown more particularly in Fig. 8 to form a chamber 3 to receive first, second, and third aligned stationary contacts 4, 5 and 6, a movable contact 7, and a roll 8 provided with a shaft 9 which is journalled at opposite ends in recesses 10 formed in the legs of a carriage 11 composed of a suitable electrical insulating material, the upper portion of which extends above chamber 3 and provides an abutment 11*a* for one end of a resilient means, such as coil spring 12. The other end of coil spring 12 bears against an abutment 13 provided with inwardly extending teats 14 to hold spring 12 in place and is movable by suitable actuating means, such as a lever or actuator 15 which is pivotally mounted in a cover

16 and provided with a recess 17 to receive a shaft connected between a pair of rolls 18 which bear upon abutment 13. As illustrated, roll 8 constitutes means for engaging the movable contact 7 and is movable relative to the movable contact.

The block of insulating material may be formed in any desired manner and of any suitable insulating material, such as a phenolic condensation product, and if desired the contacts may be molded in the insulating material. As shown more particularly in Fig. 3, it is formed of a pair of sections 19 and 20, section 19 being provided with an outwardly extending rib 21 which terminates in a rectangularly-shaped block 22 that fits into a recess in section 20 which is also provided with outwardly extending ribs 23 and 24 arranged on opposite sides of block 22. Section 19 is provided with rectangularly-shaped slots to receive terminal bars 25 and 26 which as shown are formed integral with contacts 4 and 6, respectively. It will be noted that terminal bars 25 and 26 are arranged upon opposite sides of insulating rib 21 and as illustrated are provided with screws 27 and 28, respectively, to maintain suitable conductors in place. In a like manner, section 20 is provided with a rectangularly-shaped slot to receive terminal bar 29 of contact 5 which is insulated from terminal bars 27 and 28 by ribs 23 and 24 and block 22. Terminal bar 29 is also provided with a screw 30 to maintain a suitable conductor in place.

Contacts 4, 5 and 6 extend angularly from their respective terminal bars as illustrated more particularly in Figs. 1 and 8 and terminate a short distance from the opposite side walls. Contacts 4 and 6 are each also spaced a short distance from its adjacent side wall as illustrated more particularly in Figs. 2 and 8, and for strengthening purposes as well as for economical reasons, the movable contact 7 is preferably bimetallic. For instance, the portion engaged by roll 8 is formed of a comparatively strong and inexpensive material, such as bronze, and the portion which engages the contacts is formed of a highly conductive material, such as silver.

When movable contact 7 is in one position, it engages stationary contacts 4 and 5 and when it is in a different position it engages stationary contacts 6 and 5 and in its movement from contacts 4 and 5 to contacts 5 and 6, the central portion is first rocked upon contact 5 to cause it to engage contact 6 and it is then slid upon contacts 5 and 6 to provide a wiping action of the movable contact on the stationary contacts and in a like manner when contact 7 is moved from engagement with contacts 6 and 5 to engagement with contacts 5 and 4, it is first rocked upon contact 5 and is then slid upon contacts 5 and 4 to cause a wiping action of the movable contact upon stationary contacts 4 and 5 and while the movable contact may be constructed in any desirable manner to effect these results, as illustrated in the drawings, it has a central apex 31 from which oppositely inclined portions or arms 32 and 33 extend and the silver member has two flat portions to selectively engage contacts 6 and 4, respectively, and a central portion 34 to engage contact 5 which has an outer convex surface to facilitate its rocking action. The opposite ends of the movable contact are also provided with outwardly inclined portions, such as flanges 35 and 36, for engagement by the roll 8.

When the movable contact 7 is in the position shown in Fig. 2 of the drawing, rolls 18 are arranged to compress the portion of spring 12 which is opposite to flange 16 to a greater extent than other portions and consequently the major or predominant component of the force of spring 12 is directed toward maintaining one of the flat arms or portions of contact 7 in engagement with contacts 4 and 5 and flange 36 against one of the side walls of chamber 3, thus preventing vibration of the parts and providing a circuit between contacts 4 and 5. When it is desired to interrupt the circuit between contacts 4 and 5 and establish a circuit between contacts 6 and 5, lever 15 is actuated to cause rolls 18 to ride upon movable abutment 13, releasing part of the tension on the portion of spring 12 opposite to flange 36 and compressing that portion of the spring which is opposite to flange 35 to a greater extent than the remaining portion of the spring to thereby change the direction of the force of spring 12 to force roll 8 toward flange 35. During the movement of actuator 15, the component of the force of spring 12 directed against engaging means or roll 8 to maintain movable contact 7 in engagement with stationary contact 4 is first increased until substantially all the force of spring 12 is directed against roll 8 to maintain arm 33 of movable contact 7 in engagement with stationary contact 4 and even after the direction of the force of spring 12 has been changed sufficiently to initiate movement of roll 8 over the inner surface of contact 7, a major component of the force of spring 12 acts through engaging means 8 to hold arm 33 of contact 7 in engagement with contact 4 until roll 8 passes apex 31 of the movable contact to engage inclined arm 32 of the movable contact to rock it upon stationary contact 5 and force the flat portion or arm 32 of the movable contact into engagement with stationary contact 6. It will be particularly noted, however, that when roll 8 engages arm 32 to cause disengagement of arm 33 of movable contact 7 from stationary contact 4, it is travelling at a high rate of speed and the direction of the force of spring 12 is rapidly changing due to the change in the inclination of means, such as carriage 11, which is associated with both the spring 12 and the roll 8, to accelerate the motion of roll 8, and consequently when roll 8 engages arm 32 of the movable contact 7, it causes a rapid disengagement of arm 33 of movable contact 7 from stationary contact 4 and a rapid engagement of arm 32 with stationary contact 6. Roll 8 then engages flange 35 and slides contact 7 over contacts 5 and 6 with a wiping action until the movable contact finally comes to rest in the position shown in dotted lines in Fig. 4 in which position the major or predominant component of the force of spring 12 maintains movable contact 7 in engagement with stationary contacts 6 and 5 to establish a circuit between these contacts.

When lever 15 is moved back to its original position, it will of course be understood that a reverse operation takes place, the movable contact 7 first rocking upon stationary contact 5 to cause engagement of the flat portion 33 of movable contact 7 with stationary contact 4. And during movement of actuator 15, the component of the force of spring 12 which maintains the portion or arm 32 of movable contact 7 in engagement with stationary contact 6 is first increased until substantially all the force of

spring 12 is directed against engaging means or roll 8 to maintain the portion 32 of movable contact 7 in engagement with stationary contact 6 and even after the actuator 15 has been moved a sufficient distance to change the direction of the force of spring 12 sufficiently to initiate movement of roll 8, a major or predominant component of the force of spring 12 still acts through roll 8 to hold portion 32 of movable contact 7 in engagement with stationary contact 6 until roll 8 passes apex 31 and engages arm 33 of the movable contact at which time roll 8 is travelling at high speed which is being constantly accelerated by the rapid change in the direction of the force of spring 12 due to change in the inclination of means, such as carriage 11, which is associated with the roll 8 and the spring 12. Roll 8 then engages an outwardly extending portion on the movable contact, such as flange 36, to slide movable contact 7 over contacts 5 and 4 with a wiping action.

In the operation of the switch, it will of course be understood that if it is desired to establish and interrupt only one circuit, either contact 4 or contact 5 may be utilized as a stop.

The housing 1 may, if desired, be threaded to a suitable support, such as a plate or socket, and is provided with a flange 36*a* to engage the support, and the lever or actuator 15 may be pivotally mounted in cover 16 in any suitable manner. As illustrated, cover 16 consists of two plates provided with an opening to receive lever 15 and with arcuate-shaped portions 38 and 39 arranged on opposite sides of the opening to form substantially cylindrically-shaped recesses to receive the opposite ends of a shaft 40 upon which lever 15 is pivoted.

Another modification of my invention is shown in Figs. 5 to 8 of the drawings. In this modification, instead of providing an adjustable abutment as shown at 13 in Figs. 1 and 2, one portion of the spring engages a stationary member, such as a substantially cylindrical knob or projection 41 secured to and extending inwardly from housing, 1 and another portion of the spring engages an inwardly extending tongue 42 on an actuator, such as a plunger 43, which is slidably mounted in housing 1. As shown, plunger 43, which is of the push button type, is provided with a rectangularly-shaped opening 43*a* arranged oppositely to tongue 42, the end edges of which extend inwardly and outwardly relative to tongue 42 and consequently when the spring is in the position shown in Fig. 5, the edge of the metal adjacent the inner end of the slot engages knob 41 and the portion of spring 12 opposite to flange 36 of the movable contact is compressed to a greater extent than the other portions as shown in Fig. 5 and the major or predominant component of the force of spring 12 is directed toward maintaining the portion 33 of movable contact 7 in engagement with stationary contacts 4 and 5 and flange 36 of the movable contact in engagement with one of the side walls of chamber 3, thereby preventing vibration of the movable parts of the switch and providing an electrical circuit between contacts 4 and 5.

The remaining parts of the switch are similar to those shown in Figs. 1 to 4, inclusive, of the drawings and consequently they have been designated by the same numerals.

To actuate the switch, plunger 43 is pushed inwardly and the direction of the force of spring 12 is changed, causing roll or engaging means 8

to pass over movable contact 7 to first rock it upon stationary contact 5 and force the arm or portion 32 of the movable contact into engagement with stationary contact 6. During the inward movement of actuator 43, it will be apparent that the direction of the force of spring 12 is first changed until substantially the entire force of the spring is directed toward maintaining the arm 33 of movable contact 7 in engagement with stationary contact 4 and even after the direction of spring 12 is changed sufficiently to cause engaging means or roll 8 to move relative to movable contact 7, a major or predominant component of the force of spring 12 acts through roll 8 to hold arm 33 of movable contact 7 in engagement with stationary contact 4 until roll 8 passes apex 31 at which time roll 8 is moving at a high rate of speed which is being constantly accelerated by the rapid change in the direction of means associated with spring 12 and roll 8, such as carriage 11, and consequently there will be a rapid disengagement of arm 33 of movable contact 7 from stationary contact 4 and a rapid engagement of arm 32 of movable contact 7 with stationary contact 6. The roll then engages flange 35 to slide the movable contact over stationary contacts 5 and 6 with a wiping action. In this construction, it will be noted that when plunger or actuator 43 is held inwardly, the major or predominant component of the force of the spring maintains movable contact 7 in engagement with stationary contacts 5 and 6, thus preventing vibration of the movable parts of the switch, and also that any over travel of actuator 43 will be absorbed by spring 12. When the force upon plunger 43 is released, spring 12 acts upon tongue 42 to return the plunger to its original position, thus forcing tongue 42 outwardly beyond knob 41 which knob limits the outward movement of one portion of the spring and during this return movement, the movable contact 7 first rocks upon stationary contact 5 to cause its flat portion or arm 33 to engage contact 4, after which the roll 8 engages flange 36 and slides movable contact 7 upon stationary contacts 5 and 4. During the outward movement of actuator 43, it will be noted that the major or predominant component of the force of spring 12 acts through the means engaging the movable contact, such as roll 8, to maintain arm 33 of the movable contact 7 in engagement with stationary contact 4 until roll 8 is moved beyond apex 31 and consequently roll 8 is moving at a high speed which is being constantly accelerated by the rapid change in the direction of the force of spring 12 when arm 32 of movable contact 7 is disengaged from stationary contact 4 and arm 33 of the movable contact 7 is forced into engagement with stationary contact 6. The rapid change in the direction of spring 12 is of course caused by the change in the inclination of means associated with the spring 12 and roll 8, such as carriage 11. In the switch shown in Figs. 1 to 4 and during movement of the switch shown in Figs. 5 to 8 from its position as shown in Fig. 5 to its position shown in Fig. 6, it will be apparent that the force of spring 12 which maintains the movable contact in engagement with the stationary contact increases until movement of roll 8 is initiated and a predominant component of the force of spring 12 maintains movable contact 7 in engagement with stationary contact 4 until the roll passes apex 31 and even when the switch shown in Figs. 5 to 8 is in the

position shown in Fig. 6 and actuator 43 is released, there is no diminution of the force of spring 12 which maintains movable contact 7 in engagement with stationary contact 6 until roll 12 passes beyond apex 31. In the type of switch shown in Figs. 5 to 7, it will also be apparent that if it is desired to interrupt and establish only one circuit, one of the stationary contacts may be utilized as a stop.

My improved switch may also be easily modified to interrupt and establish a plurality of circuits as illustrated in the modification shown in Figs. 9 to 13 of the drawings. In this modification, aligned first, second and third spaced stationary contacts 44, 45 and 46 are arranged in each of three rectangularly-shaped chambers 47, 48 and 49 formed in an insulating block extending into one end of the housing and each contact 44, 45 and 46 is provided with a terminal bar 50, 51 and 52, respectively, which, as illustrated, has a knurled portion so that it may be more effectively retained in the molded material, and each of the terminal bars is provided with a bore 53, 54 and 55, respectively, to receive conductors, not shown.

In this modification, the carriage which forms an abutment for the inner portion of spring 56 is composed of three segments 57, 58 and 59, see Figs. 12 and 13, which are formed of a suitable electrical insulating material, such as a molded phenolic condensation product, and are provided with abutments 60 to maintain spring 56 in place. Each segment is also provided with an inwardly extending leg 62, 63 and 64, respectively, which terminates in a bifurcated portion forming a recess 65 to receive a shaft 66 connected to means which engage the movable contacts and are movable relative thereto, such as a pair of rolls 67 and 68, which bear upon each of the respective movable contacts 69.

It will be noted that spring 56 engages segments 57 and 59 over a greater area than segment 58 and therefore has a tendency to exert a greater force upon segments 57 and 59 than upon segment 58. To equalize the pressure of the spring upon the segments, an auxiliary spring 70 is therefore preferably provided having an inwardly bowed central portion 71 which bears against segment 58 with its opposite ends resting upon segments 57 and 59 and being engaged by the lower portion of spring 56.

As in prior modifications, the movable contacts may be formed of a bimetallic material, the inner portion of each movable contact being preferably formed of a comparatively strong inexpensive material, such as bronze upon which rolls 67 and 68 ride and the outer portion which engages the stationary contacts being formed of a highly conductive material, such as silver. The bronze member of each of the movable contacts has a central apex 72 and oppositely inclined flat arms or portions 73 and 74 so that when one portion of the movable contact engages stationary contacts 44 and 45, the other portion is disengaged from stationary contact 46. The highly conductive member also has flat faces for engaging contacts 44 and 46 but its central portion 75 is preferably convex in shape so that its rocking movement upon stationary contact 45 is facilitated.

The central longitudinal portion of the movable contact 69 is longer than the two outside portions and terminates at its opposite ends in inwardly turned portions, such as flanges 76 and 77. The shorter outside portions of each movable contact also terminates in inwardly turned portions, each as flanges 78 and 79.

As illustrated in Fig. 9, each of the movable contacts 69 has a portion or arm 73 which is in engagement with a stationary contact 44 and a stationary contact 45 and is held in such position by resilient means, such as spring 56, one portion of which engages a stationary member, such as knob 80 affixed to and extending inwardly from the housing 81 and another portion of which engages a tongue 82 extending radially inwardly from actuator plunger 83 and oppositely to tongue 74 the plunger is provided with a rectangularly-shaped slot 84 which extends outwardly and inwardly from tongue 82. It will be noted that when the metal of the plunger adjacent the inner edge of slot 84 engages knob 80, the major or predominant component of the force of spring 56 is directed toward maintaining the arm 74 of each of the movable contacts 69 in engagement with their respective stationary contacts 44 and 45. When plunger 83 is moved inwardly, however, tongue 82 is forced inwardly beyond knob 80 and the direction of the force of spring 56 is changed to move rolls 67 and 68 of each segment over the inner portion of the movable contact with which it is associated, causing them to engage the inclined faces 73 of the movable contacts to force the portion 73 of each of the movable contacts into engagement with the respective stationary contacts 46. During the inward movement of actuator 83, the component of the force of spring 56 which maintains the portion of arm 74 of each of the movable contacts 69 in engagement with the respective stationary contacts 44 is increased until further inward movement of actuator 83 inclines spring 56 to such a position that a component of its force initiates movement of rolls 67 and 68 and even after rolls 67 and 68 are in motion, the major component of the force of spring 56 maintains movable contacts 69 in engagement with stationary contacts 44 until rolls 67 and 68 engage inclined parts 73 of the movable contacts at which time rolls 67 and 68 are moving at high speed which is being accelerated by the rapid change in the direction of the force of spring 56 which is caused by the change in the inclination of means associated with the rolls 67 and 68 and spring 56, such as the carriage 56, 57 and 58. The rolls therefore serve to quickly disengage the movable contacts 69 from stationary contacts 44 and force arms 73 of the movable contacts rapidly into engagement with stationary contacts 46. The rolls then engage outwardly extending portions, such as flanges 78, on each of the movable contacts to slide the movable contact 69 upon stationary contacts 45 and 46 with a wiping action to the position shown in Fig. 9.

It will be noted that when the parts are in this position, the major or predominant force of spring 56 is directed toward maintaining the arm 73 of each of the movable contacts 69 in engagement with the respective stationary contacts 46, thus preventing vibration of the parts, and that any overtravel of the force upon the plunger is absorbed by spring 56. When the force upon the plunger is released, spring 58 forces plunger 83 outwardly to a position in which tongue 82 is positioned outwardly relative to knob 80, thereby changing the direction of the force of spring 56 and causing rolls 67 and 68 to pass over and rock movable contacts 69 upon the respective stationary contacts 45 to force a portion of each movable contact into engagement with its respective stationary contact 44 and during this movement a major component of the force of spring 56 maintains the arms or portions 73 of the movable

contacts 69 in engagement with stationary contacts 46 until rolls 67 and 68 move beyond apex 72 and consequently rolls 67 and 68 are moving rapidly when they strike inclined arms 74 of the movable contacts and their motion is being accelerated by the change in the direction of the force of the spring when they engage inclined arms or portions 74 of the movable contacts to disengage the arms 74 of movable contacts 69 from stationary contacts 46 and force arms 73 of movable contacts 69 into engagement with stationary contacts 44. It will be noted that during the actuation of the switch, the change in the direction of the force of spring 56 is accelerated by the change in the inclination of carriage 57, 58 and 59 which is associated with both the rolls 67 and 68 and the spring 56. The rolls then engage outwardly extending means, such as flanges 79, of the movable contacts 69 to slide the movable contacts with a wiping action over contacts 45 and 44 until the flange 77 on the central portion of each movable contact engages the end wall of its respective chamber.

In all the modifications, the insulation block is prevented from longitudinal movement by an inwardly bevelled portion 85 of the housing which is received within an annular groove 86 in the insulating material and angular movement is prevented by an inwardly extending boss 87 on the housing which fits in a slot 88.

In the form of the invention shown in Figs. 9 to 13, it will be understood that if it is only desired to interrupt and establish three circuits, the stationary contacts at one end of each slot may be utilized as stops. It will also be apparent that if it is desired to maintain movable contacts 69 in engagement with stationary contacts 45 and 46, an actuator such as shown in Figs. 1 to 4, may be utilized. Other modifications of my invention will of course be apparent to those skilled in the art and it will be understood that I contemplate by the appended claims to cover any such modifications as fall within the true purpose and scope of my invention.

What I claim is:

1. An electrical switch comprising a stationary contact, a contact movable into and from engagement with the stationary contact, means engaging the movable contact to hold it in engagement with the stationary contact and being movable relative to the movable contact to disengage the movable contact from the stationary contact, resilient means associated with said engaging means, means including an actuator for biasing said resilient means to a position in which a component of the force of said resilient means is directed toward maintaining said engaging means in a position to hold the movable contact in engagement with the stationary contact, and said actuator being movable to compress a portion of said resilient means to a greater extent than other portions to incline said resilient means to a second position in which one component of its force moves said engaging means over the movable contact to disengage the movable contact from the stationary contact and the other component of its force acts through said engaging means to hold the movable contact in engagement with the stationary contact until the movable contact is disengaged from the stationary contact, and the inclination of said resilient means in its second position relative to the stationary contact being such that the component of the force of the resilient means which acts through said engaging means to hold the movable contact in engagement with the stationary contact is not less than the component of the force of said resilient means originally directed for a like purpose until said engaging means is in motion relative to said movable contact.

2. An electrical switch comprising a stationary contact, a contact having a first portion movable from and into engagement with the stationary contact and a second portion extending at an angle to the first portion, means engaging the movable contact and being movable relative thereto, a coil spring associated with said engaging means, means including a movable actuator for maintaining said spring under compression and biasing it to a position in which at least the major component of the force of said spring is directed toward maintaining said engaging means in a position to hold the first portion of the movable contact in engagement with the stationary contact and said actuator being movable to compress a portion of said coil spring to a greater extent than other portions to incline said spring to a second position in which a minor component of the force of said spring moves said engaging means over the movable contact and the major component of the force of said spring acts through said engaging means to hold the first portion of the movable contact in engagement with the stationary contact until said engaging means strikes the second portion of the movable contact to disengage the first portion of the movable contact from the stationary contact.

3. An electrical switch comprising a stationary contact, a contact having a first portion movable from and into engagement with the stationary contact and a second portion inclined at an angle to the first portion, means engaging the movable contact and being movable relative thereto, a coil spring associated with said engaging means, means including an actuator for maintaining said spring under compression and biasing it to a position in which at least the major component of the force of said spring is directed toward maintaining said engaging means in a position to hold the first portion of the movable contact in engagement with the stationary contact, said actuator being movable to compress a portion of said spring to a greater extent than other portions to incline said spring to a second position in which a minor component of the force of said spring moves said engaging means over the movable contact while a major component of the force of said spring acts through said engaging means to hold the first portion of the movable contact in engagement with the stationary contact until said engaging means strikes the second portion of the movable contact to disengage the first movable contact from the stationary contact, and means associated with said engaging means and said spring for increasing the component of the force of said spring which moves the engaging means over the movable contact during movement of said engaging means to thereby accelerate the travel of said engaging means over the movable contact.

4. An electrical switch comprising first and second spaced secondary contacts, a movable contact having a central portion provided with an outer convex surface which is rockably mounted on the second stationary contact and having first and second arms extending in opposite directions from the central portion which are arranged at an angle to each other, the first of which is movable into and from engagement with the first stationary contact, means engaging the

movable contact and being movable relative thereto, a coil spring associated with said engaging means, means including a movable actuator for maintaining said spring under compression and biasing it to a position in which at least the major component of the force of said spring is directed toward maintaining said engaging means in position to hold the first arm of said movable contact in engagement with the first stationary contact, and said actuator being movable to compress one portion of said spring to a greater extent than other portions and to incline said spring to a position in which a minor component of the force of said spring moves said engaging means over the movable contact while the major component of the force of said spring acts through said engaging means to hold the first portion of the movable contact in engagement with the stationary contact until said engaging means strikes the second portion of the movable contact to rock the movable contact on the second stationary contact to disengage the first arm of the movable contact from the first stationary contact.

5. An electrical switch comprising first, second, and third stationary contacts, a movable contact having a central portion rockably mounted on the second stationary contact and first and second arms extending at an angle to each other, the first arm being movable into and from engagement with the first stationary contact and the second arm being movable into and from engagement with the third stationary contact, means engaging the movable contact and being movable relative thereto, a coil spring associated with said engaging means, means including a movable actuator for maintaining said spring under compression and biasing it to a position in which at least the major component of the force of said spring is directed toward maintaining said engaging means in a position to hold the first arm of said movable contact in engagement with the first stationary contact, and said actuator being movable to a second position to compress one portion of said spring to a greater extent than other portions and to incline said spring to a second position in which a minor component of the force of said spring moves said engaging means over the movable contact while the major component of the force of said spring acts through said engaging means to hold the first portion of the movable contact in engagement with the first stationary contact until said engaging means strikes the second arm of the movable contact to rock the movable contact upon the second stationary contact and move the first arm rapidly out of engagement with the first stationary contact, and means associated with said engaging means and said spring for rapidly changing the inclination of said spring to increase the component of the force of said spring which moves the engaging means over said movable contact until the second arm of the movable contact engages the third stationary contact.

6. An electrical switch comprising first and second spaced stationary contacts, a movable contact having a central portion rockably mounted on the second stationary contact and having first and second arms extending in opposite directions from the central portion which are arranged at an angle to each other, the first of which is movable into and from engagement with the first stationary contact, means engaging the movable contact and being movable relative thereto, a coil spring associated with said engaging means, means including an actuator for maintaining said spring under compression and biasing it to a position in which at least the major component of the force of said spring is directed toward maintaining said engaging means in a position to hold the first arm of said movable contact out of engagement with the first stationary contact when said actuator is in one position, said actuator being movable to a second position to compress one portion of said spring to a greater extent than other portions and to incline said spring to a position in which a minor component of the force of said spring moves said engaging means over the movable contact while the major component of the force of said spring acts through said engaging means to hold the second portion of the movable contact out of engagement with the stationary contact until said engaging means strikes the first arm of the movable contact to rock the movable contact on the second stationary contact to move the first arm rapidly into engagement with the first stationary contact, and said movable contact having a portion adapted to be engaged by said engaging means for sliding the movable contact upon the stationary contacts after the first arm is moved into engagement with the first stationary contact.

7. An electrical switch comprising first, second, and third spaced stationary contacts, a movable contact having a central portion rockably mounted on the second stationary contact and having first and second arms extending from the central portion which are arranged at an angle to each other, the first arm being movable into and from engagement with the first stationary contact and the second arm being movable into and from engagement with the third stationary contact, means engaging the movable contact and being movable relative thereto, a coil spring associated with said engaging means, means including an actuator for maintaining said spring under compression and biasing it to a position in which at least the major component of the force of said spring is directed toward maintaining said engaging means in a position to hold the first arm of the movable contact in engagement with the first stationary contact, and said actuator being movable to a second position to compress one portion of said spring to a greater extent than other portions and to incline said spring to a position in which a minor component of the force of said spring moves said engaging means over the movable contact while the major component of the force of said spring acts through said engaging means to hold the movable contact in engagement with the stationary contact until said engaging means strikes the second arm of the movable contact to rock the movable contact on the second stationary contact and to move the second arm of the movable contact into engagement with the third stationary contact, means associated with said engaging means and said spring for rapidly changing the inclination of said spring to increase the component of the force of said spring which moves the engaging means over said movable contact until the second arm of the stationary contact engages the third stationary contact, and said movable contact having a portion which is adapted to be engaged by said engaging means for sliding the movable contact upon the second and third stationary contacts after the second arm is moved into engagement with the third stationary contact.

8. An electrical switch comprising a stationary

contact, a contact having a first portion movable from and into engagement with said movable contact and a second portion arranged at an angle to the first portion, a roll engaging the movable contact and being movable relative thereto, a carriage associated with said roll, a movable abutment, a coil spring interposed between said carriage and said abutment, an actuator engaging one portion of said abutment and being effective in biasing said spring to a position in which the major component of the force of said spring is directed toward maintaining said roll in a position to hold the first portion of the movable contact in engagement with the stationary contact, said actuator being movable over said abutment to compress one portion of said spring to a greater extent than other portions and to incline said spring to a position in which a minor component of the force of the spring moves said carriage and roll relative to the movable contact and the major component of the force of said spring acts through said roll to hold the first portion of the movable contact in engagement with the stationary contact until said roll strikes the second portion of the movable contact, and means associated with said carriage for engaging and increasing the inclination of said spring during the movement of said carriage to increase the component of the force of said spring which moves said roll over the movable contact.

9. An electrical switch comprising a stationary contact, a movable contact having a first portion movable into and from engagement with the stationary contact and a second portion arranged at an angle thereto, means engaging the movable contact and being movable relative thereto, resilient means associated with said engaging means, means including an actuator for maintaining said resilient means under compression and biasing it to position in which at least the major component of the force of said spring is directed toward maintaining said engaging means in a position to hold the movable contact in engagement with the stationary contact, said actuator being movable when pressure is applied thereto to compress a portion of said resilient means to a greater extent than other portions and incline it to a position in which a minor component of the force of said resilient means moves said engaging means relative to said movable contact and the major component of the force of said resilient means acts through said engaging means to hold the first portion of the movable contact in engagement with the stationary contact until said engaging means strikes the second portion of the movable contact, and said resilient means being effective in returning said actuator to its original position when the force upon said actuator is released, and said biasing means including said actuator being so arranged relative to said resilient means that a component of the force of the resilent means is effective in moving said engaging means over said movable contact to return the movable contact to its original position during the return of said actuator to its original position.

10. An electrical switch comprising first, second, and third stationary contacts, a contact having a central portion rockably mounted on the second stationary contact and first and second arms extending from the central portion which are arranged at an angle to each other, the first being movable into and from engagement with the first stationary contact and the second being movable into and from engagement with the third

stationary contact, means engaging the movable contact and being movable relative thereto, a coil spring associated with said engaging means, means including a stationary member engaging a portion of said spring and a movable actuator engaging another portion thereof opposite to that engaged by said stationary member for maintaining said spring under compression and biasing it to a position in which at least the major component of the force of said spring is directed toward maintaining said engaging means in a position to hold the movable contact in engagement with the first stationary contact, said actuator being movable to compress the portion of the spring engaged thereby to a greater extent than other portions to change the bias of said spring and incline it to a position in which a minor component of the force of said spring moves said engaging means relative to the movable contact and the major component of the force of said spring acts through said engaging means to hold the first arm of the movable contact in engagement with the stationary contact until said engaging means strikes the second arm of the movable contact to move it into engagement with the third stationary contact, and said movable contact having a portion which is adapted to be engaged by said engaging means for sliding the movable contact upon the second and third stationary contacts with a wiping action after the second arm of the movable contact is rocked into engagement with the third stationary contact and said spring being effective in returning said actuator to its original position when the force upon said actuator is released and said stationary member and said actuator being so arranged relative to said spring that a component of the force of said spring is effective in moving said engaging means over said movable contact to return the movable contact to its original position during the return of said actuator to its original position.

11. An electrical switch comprising a plurality of spaced stationary contacts, a movable contact for each stationary contact having a first portion movable into and from engagement with its respective stationary contact and a second portion arranged at an angle thereto, means engaging each of the movable contacts and being movable relative thereto, a coil spring associated with said engaging means, means including an actuator for maintaining said spring under compression and biasing it to a position in which at least the major component of the force of the spring is directed toward maintaining each of said engaging means in a stationary position to hold the first portion of each of the movable contacts in engagement with its stationary contact, and said actuator being movable to a second position to compress one portion of said spring to a greater extent than other portions and incline it to a position in which a minor component of the force of said spring simultaneously moves each of said engaging means relative to its movable contact and a major component of the force of said spring acts through said engaging means to hold the first portion of each of the movable contacts in engagement with its respective stationary contact until each of said engaging means strikes the second portion of its movable contact to simultaneously move the first portion of each of the movable contacts from engagement with its respective stationary contact.

12. An electrical switch comprising a plurality of spaced stationary contacts, a movable contact

for each stationary contact having a first portion movable from and into engagement with its respective stationary contact and a second portion arranged at an angle thereto, means engaging each of the movable contacts and being movable relative thereto, a coil spring associated with said engaging means, means including an actuator for maintaining said spring under compression and biasing it to a position in which at least the major component of the force of the spring is directed toward maintaining each of said engaging means in a stationary position to hold the first portion of each of the movable contacts in engagement with its stationary contact, means associated with said spring for equalizing the pressure of the spring on said engaging means, said actuator being movable to a second position to compress one portion of said spring to a greater extent than other portions and to incline it to a position in which a minor component of the force of the spring simultaneously moves each of said engaging means relative to its movable contact and a major component of the force of said spring acts through each of said engaging means to hold the first portion of each of the movable contacts in engagement with its respective stationary contact until each of said engaging means strikes the second portion of its movable contact to simultaneously move the first portion of each of the movable contacts from engagement with its respective contact, and means associated with said engaging means and said spring for increasing the inclination of the spring to increase the component of the force of the spring which is directed toward moving said engaging means over the movable contact during movement of said engaging means.

13. An electrical switch comprising a plurality of series of aligned stationary contacts, each series of which includes a first, second, and third contacts, a movable contact for each series of stationary contacts having a central portion rockably mounted on the second contact of each series, a first arm movable into and from engagement with the first stationary contact of its series, and a second arm inclined at an angle to the first arm which is movable into and from engagement with the third stationary contact of its series, means engaging each of the movable contacts and being movable relative thereto, a coil spring associated with said engaging means, means including an actuator for biasing said spring to a position in which at least the major component of the force of said spring is directed toward maintaining said engaging means in a stationary position to hold each of the movable contacts in engagement with the first and second contacts of its respective series, said actuator being movable to a second position to compress a portion of said spring to a greater extent than other portions and to incline said spring to a position in which a minor component of the force of said spring simultaneously moves each of said engaging means relative to its movable contact and the major component of the force of said spring acts through each of said engaging means to hold the first portion of each of the movable contacts in engagement with its respective stationary contact until each of said engaging means strikes the second arm of its movable contact to simultaneously move the first portion of the movable contact from engagement with its respective first stationary contact and into engagement with its respective third stationary contact, and means associated with said engaging means and said

spring for increasing the inclination of the spring during movement of said engaging means to thereby increase the component of the force of the spring directed toward moving said engaging means over the respective movable contacts.

14. An electrical switch comprising a plurality of series of aligned stationary contacts, each series including first, second, and third contacts, a movable contact for each series of stationary contacts having a central portion rockably mounted on the second contact of its series, a first arm movable into and from engagement with the first stationary contact of its series, and a second arm inclined at an angle to the first arm which is movable into and from engagement with the third stationary contact of its series, means engaging each series of movable contacts and being movable relative thereto, a coil spring associated with said engaging means, means including an actuator for biasing said spring to a position in which at least the major component of the force of said spring is directed toward maintaining said engaging means in a stationary position to hold each of the movable contacts in engagement with the first and second stationary contacts of its respective series, said actuator being movable to a second position to compress a portion of said spring to a greater extent than other portions and to incline it to a position in which a minor component of the force of said spring simultaneously moves each of said engaging means relative to its movable contact and the major component of the force of said spring acts through said engaging means to hold the first portion of each of the movable contacts in engagement with its respective stationary contact until each of said engaging means strikes the second arm of its movable contact to simultaneously move the first portion of each of the movable contacts from engagement with its respective first stationary contact, means associated with said engaging means and said spring for increasing the inclination of the spring during movement of said engaging means to thereby increase the component of the force of the spring directed toward moving said engaging means over the movable contacts, and means associated with the opposite ends of each movable contact which is adapted to be engaged by its movable engaging means for sliding each of the movable contacts with a wiping action upon the second contact and one of the other contacts of its series when the movable contact is moved into engagement therewith.

15. Apparatus of the class described comprising a stationary part, a part movable into and from engagement with the stationary part, means engaging the movable part to hold it in engagement with the stationary part and being movable relative to the movable part to disengage the movable part from the stationary part, resilient means associated with said engaging means, means including an actuator for biasing said resilient means to a position in which a component of the force of said resilient means is directed toward maintaining said engaging means in a position to hold the movable part in engagement with the stationary part, and said actuator being movable to compress a portion of said resilient means to a greater extent than other portions to incline said resilient means to a second position in which one component of its force moves said engaging means over the movable part to disengage the movable part from the stationary part and the other component of its force acts through said engaging means to hold the movable part in

engagement with the stationary part until the movable part is disengaged from the stationary part, and the inclination of said resilient means in its second position relative to the stationary part being such that the component of the force of the resilient means which maintains the movable part in engagement with the stationary part is not less that the component of the force of said resilient means originally directed for a like purpose until said engaging means is in motion relative to said movable part.

16. Apparatus of the class described comprising a stationary part, a part having a first portion movable from and into engagement with the stationary part and a second portion extending at an angle to the first portion, means engaging the movable part and being movable relative thereto, a coil spring associated with said engaging means, means including a movable actuator for maintaining said spring under compression and biasing it to a position in which at least the major component of the force of said spring is directed toward maintaining said engaging means in a position to hold the first portion of the movable part in engagement with the stationary part and said actuator being movable to compress a portion of said spring to a greater extent than other portions to incline said spring to a second position in which a minor component of the force of said spring moves said engaging means over the

movable part and the major component of the force of said spring acts through said engaging means to hold the first portion of the movable part in engagement with the stationary part until said engaging means strikes the second portion of the movable part to disengage the first portion of the movable part from the stationary part.

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