March 3, 1964 G. F. ERICKSON 3,123,688

SWITCHES FOR COIN SEPARATORS

Filed April 24, 1959 2 Sheets-Sheet 1

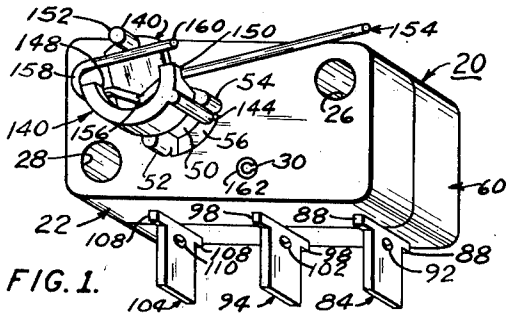


FIG. 1.

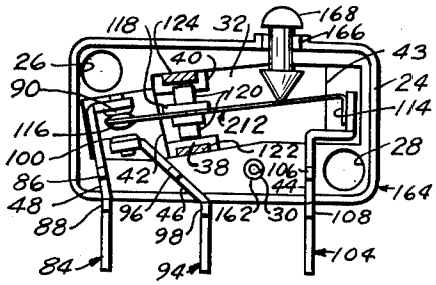


FIG. 10.

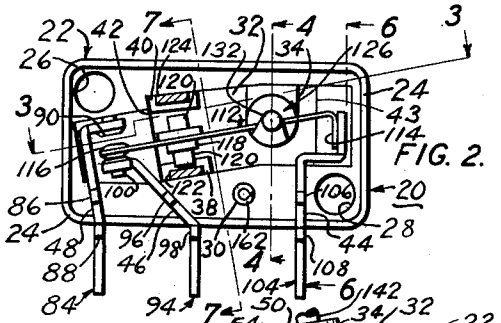


FIG. 2.

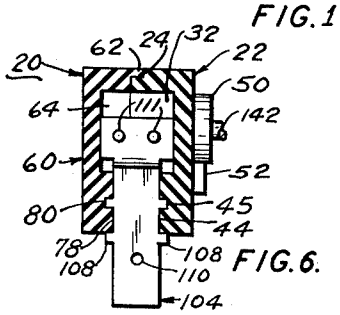


FIG. 6.

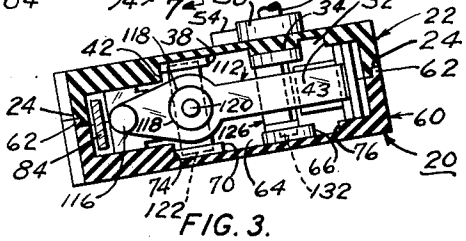


FIG. 3.

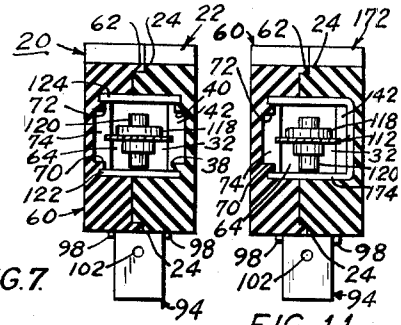
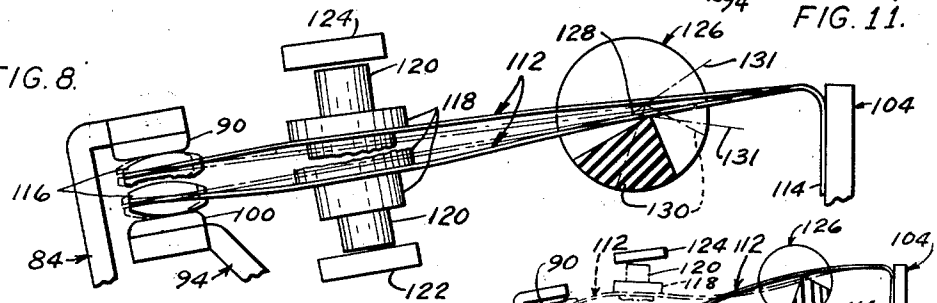


FIG. 7.

FIG. 11.

FIG. 8.



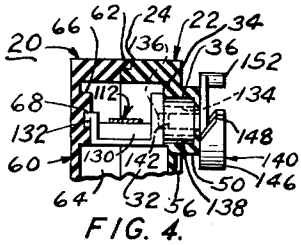


FIG. 4.

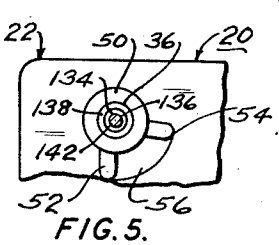


FIG. 5.

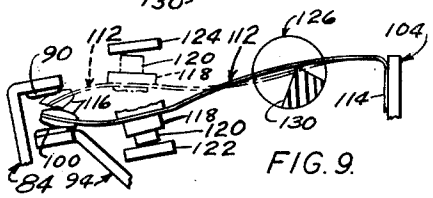


FIG. 9.

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SWITCHES FOR COIN SEPARATORS

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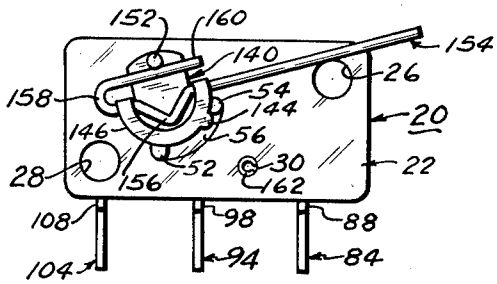

FIG. 12.

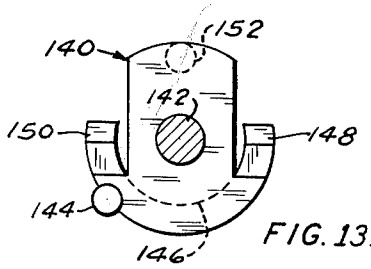

FIG. 13.

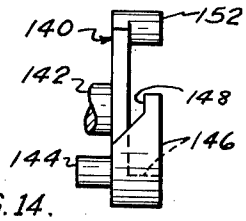

FIG. 14.

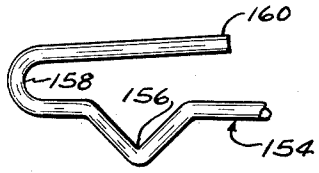

FIG. 15.

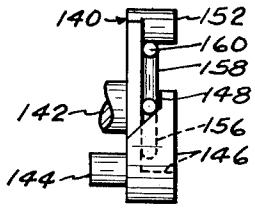

FIG. 16.

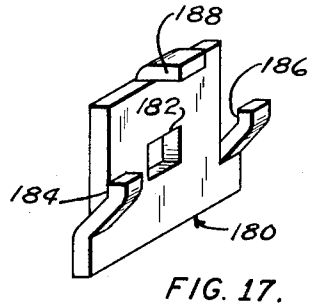

FIG. 17.

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3,123,688
SWITCHES FOR COIN SEPARATORS

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Filed Apr. 24, 1959, Ser. No. 808,669
5 Claims. (Cl. 200—67)

This invention releates to improvements in coin separators. More particularly, this invention relates to improvements in small electric switches.

It is therefore an object of the present invention to provide an improved, small electric switch.

It is desirable, in many electrically-controlled devices, to have electric switches that are small and inexpensive but that are certain in operation. To provide certainty of operation, it is desirable to have those switches operate with a snap action. Also, to provide certainty of operation, it is desirable to keep the contacts of those switches free of "skins" or coatings of oxides or sulfides. The present invention provides a switch that is certain in operation because it provides a switch that operates with a snap action and that keeps its contacts free of "skins" or coatings of oxides or sulfides. It is therefore an object of the present invention to provide a small and inexpensive switch which operates with a snap action and which keeps its contacts free of "skins" or coatings of oxides or sulfides.

The switch provided by the present invention is enabled to operate with a snap action because it mounts its movable contact on a flexible leaf spring and also mounts a permanent magnet on that flexible leaf spring. That magnet will bias the movable contact toward whichever fixed contact that movable contact abuts at any given time. That magnet will move through a path of movement bounded by two stationary pole pieces, and it will normally be adjacent one of those pole pieces and will normally hold the movable contact adjacent one of the fixed contacts of the switch. That magnet will resist any and all movement of the movable contact away from that one fixed contact until it has been moved far enough away from that one pole piece to be closer to the other pole piece; and thereafter that magnet will bias itself toward the other pole piece and thereby bias the movable contact toward the other fixed contact. As a result, the magnet will resist its movement during the first half of that movement but will aid the rest of that movement, and it will thereby resist the first part of the movement of the movable contact while aiding the rest of that movement. In doing so, the magnet enables the switch to operate with a snap action. Not only will the magnet provide a snap action for the switch but it will also assure good electrical engagement between the movable contact and the two fixed contacts of the switch.

The movable contact is mounted adjacent one end of the flexible leaf spring, and the permanent magnet is mounted on that spring intermediate that contact and the other end of that spring. The actuator for the switch acts upon the flexible leaf spring, and that actuator acts upon that spring intermediate the magnet and that other end of that spring. As a result, the magnet applies biasing forces to the flexible leaf spring intermediate the actuator and the movable contact. Because it acts intermediate that actuator and that movable contact, the magnet acts as an instantneous center of rotation, and as a fulcrum, for the portion of the flexible leaf spring intermediate that movable contact and that actuator. Consequently, when the actuator tends to move the flexible leaf spring so it will move the movable contact away from either of the fixed contacts, the portion of the flexible leaf spring intermediate the actuator and the movable contact will tend to rotate about the magnet. The flexible

leaf spring is made quite thin, preferably from four to six thousandths of an inch thick, and therefore the portion of that spring which is intermediate the magnet and the actuator will bow toward the direction of movement and thereby permit the portion of that spring intermediate the actuator and the movable contact to tend to rotate about the magnet; and that rotation will momentarily urge the movable contact into even tighter engagement with the adjacent fixed contact. Not until the actuator has bent the flexible leaf spring so far that its resistance to further bending is greater than the holding force provided by the magnet will the flexible leaf spring be able to move the movable contact away from the adjacent fixed contact; and until that moment, the bending action of the actuator has coacted with the fulcrum-like action of the magnet to increase the normal pressure between the movable contact and the adjacent fixed contact. This increased pressure is desirable because it minimizes and virtually prevents the arcing that occurs in many switches between the movable contact and an adjacent fixed contact as those contacts are about to separate. This fulcrum-like action of the actuator, and the resultant increase in contact pressure, will be experienced whether the movable contact is in engagement with the normally-closed fixed contact or the normally-open fixed contact of the switch provided by the present invention; and therefore arcing is minimized or prevented both in the making and the breaking of the electrical circuits controlled by that switch. It is therefore an object of the present invention to provide a switch with a thin, readily flexible leaf spring that has a permanent magnet intermediate the movable contact carried by that spring and the actuator for that spring.

The bowing of the portion of the flexible leaf spring intermediate the magnet and the actuator, prior to the movement of the movable contact away from the adjacent fixed contact, stores energy in that portion of that spring; and as soon as the holding force of the magnet is overcome, that stored energy causes the free end of the spring to move in whip-like fashion toward the other fixed contact. In doing so, that energy separates the movable contact from the one fixed contact so rapidly and so abruptly that it minimizes and virtually avoids arcing at that one fixed contact. Further, in doing so, that energy causes the movable contact to strike the other fixed contact so sharply that any "skin" or coating of oxide or sulfide will be penetrated and broken. It is therefore an object of the present invention to provide a flexible leaf spring with a portion that bows in the direction of movement to store energy prior to the separation of the movable contact from an adjacent fixed contact and that subsequently utilizes that energy to provide a whip-like movement of the movable contact toward the other fixed contact of the switch.

The bowing of the portion of the flexible leaf spring, intermediate the magnet and the actuator, in the direction of movement is also desirable because it rotates the axis of the magnet relative to the adjacent pole piece. That rotation moves one side of the end face of the magnet away from that pole piece to reduce the holding force exerted by the magnet and thereby enables the energy stored in the bowed portion of the flexible leaf spring to move the movable contact toward the other fixed contact. Without that rotation of the axis of the magnet, the force which the actuator would have to apply to the flexible leaf spring would be high; and this would be objectionable because that actuator is sometimes moved by lightweight coins and such coins would not have sufficient mass to provide sizeable forces. However, with the rotation of the axis of the magnet that occurs when the portion of the spring, intermediate the magnet and the actuator, bows in the direction of movement, even the

lightest coin can enable the actuator to move the flexible leaf spring and thereby move the movable contact into engagement with the other fixed contact. It is therefore an object of the present invention to provide a magnet that rotates its axis prior to the separation of the movable contact from the adjacent fixed contact of the switch.

The magnet is mounted on the flexible leaf spring in such a way that it will never engage the pole piece to which it will be closely adjacent when the movable contact is engaging the normally-open fixed contact. As a result, the restorative forces, that are stored in that spring with the normally-closed fixed contact. It is therefore an object of the present invention to mount the magnet on the flexible leaf spring in such a way that the magnet will not engage the adjacent pole piece whenever the movable contact is engaging the normally-open fixed contact.

As the flexible leaf spring moves the movable contact into engagement with the normally-open contact, it will also move the magnet toward one of its pole pieces. The attraction of that magnet for that pole piece will be such that even though the movable contact engages and is held by the normally-open fixed contact, the magnet will move still closer to that pole piece. The resultant bowing of that portion of the flexible leaf spring, which is intermediate the actuator and the movable contact, will assure full contact pressure between the movable contact and the normally-open fixed contact.

The magnet can be mounted on the flexible leaf spring so it can be closely adjacent, or can even engage, the adjacent pole piece whenever the movable contact is engaging the normally-closed fixed contact. However, that pole piece will be disposed beyond the position which the magnet will occupy at the instant the movable contact moves into engagement with the normally-closed fixed contact as it moves away from the normally-open fixed contact. As a result, the magnet will continue on beyond that position before it comes to rest; and, in doing so, it will bow the portion of the spring intermediate the actuator and the movable contact and thereby firmly urge the movable contact against the normally-closed fixed contact. Consequently, the magnet will bow the flexible leaf spring, and thereby assure full contact pressure, whether the movable contact abuts the normally-open fixed contact or the normally-closed fixed contact of the switch.

The bowing of the flexible leaf spring after the movable contact has engaged the normally-open fixed contact or the normally-closed fixed contact will cause that movable contact to move laterally across the faces of those fixed contacts. The resultant wiping action helps keep the contacts free of "skins" or coatings of oxides or sulfides.

The magnet constitutes an appreciable mass on the flexible leaf spring, and that mass facilitates the bowing of that spring as the magnet continues to move toward its pole pieces after the movable contact has engaged and been held by one or the other of the fixed contacts. That mass also helps the movable contact strike the fixed contacts sharply enough to penetrate and break the "skins" or coatings of oxides or sulfides on the surfaces of the contacts.

The flexible leaf spring of the switch provided by the present invention is secured to one of the terminals of that switch by rivet-like members. That spring has a sharp bend intermediate the portion thereof which is riveted to that terminal and the portion thereof which carries the magnet and the movable contact. The rivet-like members secure the riveted portion of the flexible leaf spring to the terminal in such a way that whenever the actuator applies bending forces to that spring it tends to force the riveted portion of that spring toward the terminal. This is desirable because it enables the terminal to give full support to the riveted portion of the flexible leaf spring during those periods when the actuator is applying bending forces to that spring.

The switch provided by the present invention can be equipped with a rotatable shaft, and that rotatable shaft can be equipped with a switch arm. It is desirable to make switches by production line methods, and it is frequently necessary to use different kinds of switch arms for different installations and uses. The present invention makes it possible to produce the switches by production line methods and yet equip them with individually and selectively different switch arms by providing a connector for the rotatable shaft of the switches which can readily receive switch arms of different sizes and shapes. It is therefore an object of the present invention to provide a connector for switches which can have switch arms of different shapes and configurations readily assembled with it.

Other and further objects and advantages of the present invention should become apparent from an examination of the drawing and accompanying description.

In the drawing and accompanying description, three preferred embodiments of the present invention are shown and described but it is to be understood that the drawing and accompanying description are for the purpose of illustration only and do not limit the invention and that the invention will be defined by the appended claims.

In the drawing,

FIG. 1 is a perspective view of one preferred embodiment of switch that is made in accordance with the principles and teachings of the present invention,

FIG. 2 is a view of the switch of FIG. 1, as that switch has been rotated one hundred and eighty degrees about a vertical axis and as one half of the housing of that switch has been removed,

FIG. 3 is a sectional view of the switch of FIG. 1, and it is taken along the broken plane indicated by the line 3—3 in FIG. 2,

FIG. 4 is a sectional view through a portion of the switch of FIG. 1, and it is taken along the plane indicated by the line 4—4 in FIG. 2,

FIG. 5 is a partially broken, partially sectioned, view of the switch of FIG. 1 and it is taken through the rotatable shaft of that switch,

FIG. 6 is a sectional view through the switch of FIG. 1, and it is taken along the broken plane indicated by the line 6—6 in FIG. 2,

FIG. 7 is another sectional view through the switch of FIG. 1, and it is taken along the plane indicated by the line 7—7 in FIG. 2,

FIG. 8 is a greatly enlarged, partially sectioned, partially broken-away view through the switch of FIG. 1, and it shows several positions of the flexible leaf spring,

FIG. 9 is an enlarged, partially sectioned, partially broken-away view through the switch of FIG. 1, and it shows further positions of the flexible leaf spring,

FIG. 10 is a partially sectioned view of a modified form of switch that is made in accordance with the principles and teachings of the present invention,

FIG. 11 is a sectional view through another modified form of switch that is made in accordance with the principles and teachings of the present invention,

FIG. 12 is a front elevational view of the switch of FIG. 1,

FIG. 13 is an enlarged, partially sectioned view of the connector provided for the switch of FIG. 1,

FIG. 14 is a partially broken-away side elevational view of the connector of FIG. 13,

FIG. 15 is a partially broken-away view of a switch arm that is usable with the connector of FIGS. 13 and 14.

FIG. 16 is a partially broken-away end view of the connector of FIGS. 13 and 14 and of the switch arm of FIG. 15 as they are assembled together, but it shows the switch arm rotated one hundred and eighty degrees about a vertical axis from the position it occupies in FIG. 12, and

FIG. 17 is a perspective view of a connector that can be mounted on a lever or other mechanism.

Referring to the drawing, in detail, the numeral 20 generally denotes one preferred form of switch that is made in accordance with the principles and teachings of the present invention. That switch has a housing which consists of two prismatic half-housings; and one of those half-housings is denoted by the numeral 22. A rabbet 24 is provided at the periphery of the half-housing 22, as shown particularly by FIGS. 3, 4, 6 and 7. A cylindrical opening 26 extends transversely through the half-housing 22, and a second cylindrical opening 28 also extends transversely through that half-housing. The openings 26 and 28 are made large enough to accommodate bolts or screws of standard diameters and lengths. A cylindrical opening 30, which is smaller than either of the cylindrical openings 26 and 28, also extends transversely through the half-housing 22. The openings 26 and 28 are at the opposite ends of a diagonal of the half-housing 22, and the opening 30 is located below that diagonal.

The numeral 32 denotes a large recess within the half-housing 22; and that recess is generally rectangular in configuration, and its long axis generally parallels the long axis of that half-housing. A boss 34 is formed at the interior of the recess 32, as shown particularly by FIG. 3. An opening 36 extends through that boss and through the wall of the half-housing 22 on which the boss 34 is formed. That opening is shown particularly by FIG. 4.

A rib 38 extends upwardly from the bottom of the recess 32, and that rib defines a socket. That socket is generally rectangular in configuration, and it abuts one of the side walls of the recess 32. A similar rib 40 extends upwardly from the bottom of the recess 32, and that rib defines a second socket. That second socket also is generally recangular in configuration, and it abuts the opposide side wall of the recess 32. The two sockets are in alinement with each other, and the left-hand edges of the ribs 38 and 40 abut a step 42 in the recess 32. That step is shown particularly by FIGS. 2 and 3. A step 43 is provided at the opposite end of the recess 32, as shown particularly by FIGS. 2 and 3.

The half-housing 22 is provided with a slot 44 that is parallel to the short axis of that half-housing; and that slot extends from the recess 32 to the bottom face of that half-housing. That slot has a notch 45 contiguous to it, as shown particularly by FIG. 6. A slot 46 is formed in the half-housing 22, and that slot is disposed to the left of the slot 44, as the half-housing 22 is viewed in FIG. 2. The slot 46 inclines upwardly and to the left from the point where it opens to the exterior of the half-housing, and it extends inwardly to the recess 32. That slot has a notch, similar to the notch 45, but that notch is not shown. A slot 48 is formed in the half-housing 22, and that slot is disposed to the left of the slot 46; and that slot also inclines upwardly and to the left from the point where it opens to the exterior of that half-housing. The slot 48 also has a notch, not shown, similar to the notch 45 of the slot 44.

The half-housing 22 has a circular boss 50 at the exterior thereof, and that boss is shown particularly by FIGS. 3, 4 and 6. The opening 36 is large adjacent the inner end of that boss and is small adjacent the outer end of that boss. A stop 52 is provided on the exterior of the half-housing 22, and that stop extends downwardly from the boss 50. A stop 54 also is provided on the exterior of the half-housing 22; and that stop extends to the right of the boss 50, as that boss is viewed in FIGS. 1 and 5. A pie-shaped recess 56 is provided in the exterior of the half-housing 22, and that recess is intermediate the stops 52 and 54.

The other half-housing of the switch 20 is denoted by the numeral 60; and it has openings which are comparable to, and are alined with, the openings 26, 28 and 30 in the half-housing 22. Furthermore, the half-housing 60 has a peripheral flange 62 that projects outwardly from that

half-housing; and that flange seats in the rabbet 24 of the half-housing 22. The engagement between the rabbet 24 and the flange 62 is close and precise, and it precisely alines and registers the two half-housings 22 and 60.

The half-housing 60 has a large recess 64 which is complementary to, and which is the mirror image of, the recess 32 in the half-housing 22. A boss 66 is provided at the bottom of the recess 64, and that boss is generally alined with the boss 34 at the bottom of the recess 32 of the half-housing 22. A shallow, cylindrical socket 68 is provided at the inner face of the boss 66, and that socket is shown particularly by FIG. 4.

A rib 70 projects from the bottom of the recess 64, and that rib defines a socket. That socket is generally rectangular in configuration; and it will be in register with the socket defined by the rib 38, whenever the two half-housings are assembled together. A rib 72 also projects from the bottom of the recess 64, and that rib defines a second socket. That second socket is generally rectangular in configuration; and it will be in register with the socket defined by the rib 40, whenever the two half-housings are in assembled relation. The ribs 70 and 72 abut a step 74 adjacent one end of the recess 64 in the half-housing 60. A second step 76 is provided adjacent the other end of that recess.

The numeral 78 denotes a slot in the half-housing 60 which is complementary to the slot 44 in the half-housing 22. That slot has a notch 80 which is comparable to, and which is alined with, the notch 45 in the half-housing 22. Two other slots, not shown, are provided in the half-housing 60; and those slots are complementary to, and are alined with, the slots 46 and 48 in the half-housing 22. Those other two slots have notches which are comparable to, and are alined with, the notches of the slots 46 and 48 in the half-housing 22.

The numeral 84 denotes a terminal of a metal, such as a cupreous metal, that has good conductivity. That terminal is formed with two pairs of laterally-extending projections 86 and 88. Further, that terminal is formed with a shallow bend and with a sharp bend intermediate the ends thereof. The shallow bend enables part of the terminal 84 to project from the half-housing 22 at right angles to the bottom of that half-housing and yet have the adjacent portion of that terminal lie within the inclined slot 48. The sharp bend, intermediate the ends of the terminal 84, enables the upper end of that terminal to be at ninety degrees to the inclined portion of that terminal.

The projections 86 on the terminal 84 are in register with and fit into the notches, not shown, which are contiguous to the slot 48 and to its counterpart in the half-housing 60. The projections 88 are disposed immediately adjacent the bottom faces of the half-housings 22 and 24, as shown particularly by FIG. 1. The projections 86 and 88 prevent endwise shifting of the terminal 84 relative to the half-housings 22 and 24. Also, the terminal 84 has a thickness which is closely comparable to the thickness of the slot 48 in the half-housing 22 and to the thickness of the counterpart of that slot in the half-housing 60. As a result, the terminal 84 is held against wobbling or tilting when it is assembled with the two half-housings of the switch 20. A rivet-like contact 90 has the shank thereof fixed within an opening in the upper end of the terminal 84, and that contact is mounted so its contacting face projects downwardly from the lower face of the upper end of that terminal.

An opening 92 is provided in that portion of the terminal 84 which extends below the bottoms of the half-housings 22 and 60. That opening can accommodate a lead where that lead is to be soldered to the terminal. That projecting portion of the terminal can also receive one of the standard wiring clips that are held in engagement with terminals by tensile or compressive forces.

The numeral 94 denotes a second terminal of a metal having good conductivity; and that terminal has two bends intermediate its ends. Each of those bends forms

an angle of approximately forty five degrees; and one of those bends enables a portion of the terminal **94** to project downwardly from the bottoms of the two half-housings **22** and **60** at right angles while permitting the adjacent portion of that terminal to lodge within the inclined slot **46** and in the counterpart slot in the half-housing **60**. The other of those bends permits the upper end of the terminal **94** to be parallel to the upper end of the terminal **84**.

The terminal **94** is provided with two pairs of laterally-extending projections **96** and **98**; and the projections **96** lodge within the notch of the slot **46** and within the notch of the counterpart slot. The projections **98** abut the bottom faces of the half-housings **22** and **60**, as shown particularly by FIG. 1. Projections **96** and **98** prevent endwise shifting of the terminal **94** relative to the half-housings **22** and **24**; and that terminal is made thick enough so it fits snugly within the slot **46** and its counterpart slot.

The upper portion of the terminal **94** supports a rivet-like contact **100** which confronts, but is spaced from, the contact **90** carried by the upper end of the terminal **84**. An opening **102** is provided in that portion of the terminal **94** which projects below the bottoms of the half-housings **22** and **60**; and that opening can accommodate a lead.

The numeral **104** denotes a third terminal of a metal having high conductivity. That terminal has two ninety degree bends intermediate the ends thereof; and both of those bends are adjacent the upper end of that terminal. As a result, the terminal **104** projects at right angles from the bottoms of the half-housings **22** and **60** and also extends into and through the slot **44** in a straight line. The first bend in the terminal **104** is adjacent the inner end of the slot **44**; and the second bend is adjacent the right-hand end of the recess **32**, as that recess is viewed in FIG. 2. The portion of the terminal **104** above the second bend is wider than the rest of that terminal, as indicated particularly by FIG. 6. That wide portion has two rivet-like members **111** punched out of it, and those rivet-like members extend to the left of that wide portion as the terminal **104** is viewed in FIG. 2.

The terminal **104** has two pairs of projections **106** and **108**; the projections **106** extend into the notches **45** and **80** which are contiguous with the slots **44** and **78** in the half-housings **22** and **60**. The projections **108** are disposed adjacent the bottom faces of the half-housings **22** and **60**, as shown particularly by FIGS. 1 and 6. An opening **110** is provided in the terminal **104** below the level of the projections **108**, and that opening can receive a lead.

The numeral **112** generally denotes an elongated, flexible leaf spring of springy metal. That flexible leaf spring has a sharp bend adjacent the right-hand end thereof, as that spring is viewed in FIG. 2. That bend forms an acute angle, and it defines a securing portion **114** and an elongated cantilever portion. The securing portion **114** has two openings which telescope over the rivet-like members **111** on the wide portion of the terminal **104**. Once those two openings have been telescoped over those rivet-like members, those members are riveted over to permanently secure the spring **112** to the terminal **104**.

The cantilever portion of the flexible leaf spring **112** extends generally parallel to the long axis of the recesses **32** and **64** in the half-housings **22** and **60**; and its left-hand end is disposed between the contacts **90** and **100**. That left-hand end of the cantilever portion of the spring **112** carries a movable contact **116** which can selectively engage the fixed contact **90** or the fixed contact **100**.

The cantilever portion of the spring **112** has a wide portion intermediate the ends thereof as shown particularly by FIG. 3; and that wide portion has an opening which accommodates a shouldered sleeve **118**. That shouldered sleeve is made of a yieldable plastic material, and it is made so it telescopes readily into the opening in the wide portion of the spring **112**. A permanent magnet **120** of cylindrical form has a diameter that is slightly larger than the unstressed inner diameter of the shouldered sleeve **118**; and when that permanent magnet is pressed into the shouldered sleeve **118**, it will expand that sleeve and permanently assemble that sleeve and the magnet **120** with the spring **112**.

The yieldable nature of the shouldered sleeve **118** is important because the spring **112** must be made quite thin, to enable it to be bent by light-weight coins; and such a thin spring can not withstand severe stresses. Specifically, to enable the spring **112** to be bent by light-weight coins, that spring is made about four to six thousandths of an inch thick; and, as a result, the portions of that spring which define the opening for the sleeve **118** and the magnet **120** can not be very strong. However, the yieldability of the sleeve **118** keeps the portions of the spring **112**, which define that opening, from being subjected to unduly heavy stresses; and hence the sleeve **118** effectively and safely secures the magnet **120** to the spring **112**.

The numeral **122** denotes a plate of magnetic material which has one end thereof seated in the socket defined by the rib **38** and which has the other end thereof seated in the socket defined by the rib **70**. A similar plate **124** of magnetic material has one of the ends thereof seated in the socket defined by the rib **40** and has the other end thereof seated in the socket defined by the rib **72**. Because these plates are of magnetic material, they will serve as pole pieces for the magnet **120**; and that magnet will, whenever it is adjacent one of them, bias itself toward that one plate.

The flexible leaf spring **112** is given an initial configuration that enables it, whenever the terminal **104** is solidly seated in the slots **44** and **78** of the half-housings **22** and **60**, to bias the movable contact **116** into engagement with the fixed contact **100** on the terminal **94**. That contact thus constitutes the normally-closed fixed contact of the switch, and the contact **90** constitutes the normally-open fixed contact of that switch. Whenever the movable contact **116** is adjacent the fixed contact **100**, the magnet **120** will be closely adjacent, and may even be touching, the pole piece **122**; and the magnetic lines of flux from that magnet will assist the biasing force of the spring **112** to hold the movable contact **116** in intimate engagement with the fixed contact **100**.

The numeral **126** generally denotes the rotatable actuator that is provided to move the cantilever portion of the flexible leaf spring **112** upwardly, and thereby move the movable contact **116** into engagement with the normally-open fixed contact **90**. That rotatable actuator has a pivot-like projection **132** which seats in the shallow, cylindrical recess **68** in the boss **66** of the half-housing **60**; and it has a cylindrical portion **134** which is equipped with a metal sleeve **138**, as shown particularly by FIG. 4. The cylindrical portion **134** has a recess **136** therein, as shown by FIG. 4; and that recess and the pivot-like portion **132** define an axis of rotation **128**. The diameter of the metal sleeve **138** is less than that of the inner end of the opening **36** in the boss **34** and in the boss **50**; and that sleeve does not engage the interior of that opening.

The rotatable actuator **126** is provided with an eccentric portion **130** which is of triangular cross section. That eccentric portion is spaced to one side of the axis **128** of the actuator **126**, as shown particularly by FIG. 8; and that eccentric portion constitutes the principal connection between the two portions **132** and **134** of the actuator **126**.

The numeral **140** generally denotes a connector which is intended to interconnect the actuator **126** with a switch arm **154**. That connector has a cylindrical projection **142** extending rearwardly from it, and that cylindrical projection is dimensioned to have a press fit with the recess **136** in the cylindrical portion **134** of the actuator **126**. Such a fit has been found to be adequate to prevent accidental relative rotation between that connector and that actuator and yet to permit any desired rotative ad-

justment in the positions of those parts. The projection 142 on the connector 140 telescopes within, and bears against the small diameter, outer end of the opening 36. As a result, the projection 142 acts as the right-hand bearing for the actuator 126, as that actuator is viewed in FIG. 4. The sleeve 138 insures the maintenance of the press fit between the projection 142 and the recess 136.

The connector 140 has a stop 144 which extends rearwardly from it, and that stop is disposable between the two stops 52 and 54 at the exterior of the half-housing 22. The stop 144 is in register with the recess 56, intermediate the stops 52 and 54, and that recess keeps the rear face of the stop 144 from rubbing against the exterior of the half-housing 22.

An arcuate projection 146 is provided at the front of the connector 140, and the ends of that arcuate projection are cut away to provide abutments 148 and 150. The rear faces of those abutments are spaced forwardly of the plane of the connector 140. A third abutment 152 extends forwardly from the plane of that connector, and that third abutment is disposed approximately midway between, but above the level of, the two abutments 148 and 150.

The switch arm 154 has a V-shaped bend 156 and also has a U-shaped bend 158, as shown particularly by FIG. 15. The U-shaped bend 158 spaces a short arm 160 above, but closely adjacent to, the V-shaped bend 156. The portion of the arm 154 to the right of the V-shaped bend 156, as that arm is viewed in FIG. 15, can have any desired length or configuration. The V-shaped bend is dimensioned to extend down toward the bottom of the arcuate projection 146 and to permit the portions at the opposite sides thereof to fit behind the abutments 148 and 150 on the arcuate projection. The short arm 160 will then engage the under face of the abutment 152. The normal spacing between the short arm 160 and the V-shaped bend 156 of the switch arm 154 is greater than the spacing between the abutment 152 and the abutments 148 and 150; and this means that the U-shaped bend 158 must be compressed as the arm 154 is assembled with the connector 140. The restorative forces within that U-shaped bend will apply holding forces to the arm 154 and to the connector 140 that will fully prevent accidental separation of that arm from that connector. If desired, the abutment 152 could have a notch formed in the under surface thereof to accommodate part of the upper surface of the short arm 160; but such a notch has not been found to be necessary.

The numeral 162 denotes a split tube which can be compressed and then telescoped into the opening 30 in the half-housing 22 and in the opening in half-housing 60 which is in alinement with the opening 30. That split tube will apply frictional forces to the half-housings 22 and 60 and completely prevent accidental separation of those half-housings from each other.

The flexible leaf spring 112 normally responds to the sharp bend therein and to the magnetic attraction between the magnet 120 and the pole piece 122 to hold the movable contact 116 in intimate engagement with the fixed contact 100. At such time, the cantilever portion of the flexible leaf spring 112 will be in its lower, solid-line position in FIG. 8; and it will act upon the eccentric portion 130 of the actuator 126 to move that eccentric portion down to its solid-line position in FIG. 8.

To move the movable contact 116 up out of engagement with the fixed contact 100 and into engagement with the fixed contact 90, the actuator 126 will be rotated in the counter clockwise direction in FIGS. 2 and 8, as by having a coin strike and move the free end of the switch arm 154. Such rotation will cause the eccentric portion 130 to start moving from its solid-line position in FIG. 8 to its dotted-line position in FIG. 8, and will thus cause the uppermost edge of that eccentric portion to rise upwardly. In doing so, that uppermost edge will apply an upwardly directed force to the flexible leaf spring 112

intermediate the securing portion 114 and the magnet 120. That upwardly directed force will be resisted by the magnet 120, because that magnet will tend to hold itself adjacent the pole piece 122; and therefore the uppermost edge of the eccentric portion 130 will cause the portion of the spring 112 intermediate the magnet 120 and that uppermost edge to bow upwardly, all as shown by solid lines in FIG. 9. That upward bowing will be in the desired direction of movement of the spring 112, but it will cause the portion of the spring 112 intermediate the movable contact 116 and the actuator 126 to tend to rotate in the counter clockwise direction about the magnet 120, and it will thereby urge the movable contact 116 into even tighter engagement with the fixed contact 100. Also in moving upwardly, the uppermost edge of the eccentric portion 130 will cause the magnet 120 to rotate its axis relative to the plane of the pole piece 122; and such rotation will weaken the holding force between that magnet and that pole piece. Moreover as the uppermost edge of the eccentric portion 130 moves upwardly it will store energy in that portion of the spring 112 which is intermediate the actuator 126 and the magnet 120; and by the time the eccentric portion 130 reaches the dotted-line position of FIG. 8, the rotation of the magnet 120 will have been great enough to weaken the holding force between that magnet and the pole piece 122 to the point where the energy stored in that portion of the spring 112 will be able to, and will, overcome that holding force. Thereupon the flexible leaf spring 112 will move its cantilever portion upwardly in whip-like manner and thereby move the movable contact 116 up into engagement with the fixed contact 90.

The movable contact 116 will initially engage the fixed contact 90 when the flexible leaf spring 112 reaches its upper dotted-line position in FIG. 8; and at that time the movable contact 116 will be in its upper dotted-line position in FIG. 8. However, the flexible leaf spring 112 will not stop in its upper dotted-line position and instead, will continue to move upwardly to its upper solid-line position in FIG. 8; and it will do so because of the attraction which the magnet 120 has for the pole piece 124 and because of the momentum of that magnet. As the flexible leaf spring 112 moves up to its upper solid line position in FIG. 8, it will draw the movable contact 116 across the face of the fixed contact 90, thereby moving that movable contact from its upper dotted-line position to its upper solid-line position in FIG. 8. In doing so, that movable contact will provide a wiping action between the movable and fixed contacts 116 and 90. That wiping action will tend to clean away any "skins" or coatings of oxides or sulfides that may have formed on the surfaces of the contacts 116 and 90. Moreover, the momentum of the magnet 120 will coact with the magnetic attraction between that magnet and the pole piece 124 to cause the movable contact 116 to strike the fixed contact 90 a sharp blow. That blow will penetrate and break up any "skins" or coatings on the surfaces of those contacts.

As long as the uppermost edge of the eccentric portion 130 is in the dotted-line position of FIG. 8, it will cause the cantilever portion of the flexible leaf spring 112 to urge the movable contact 116 into intimate engagement with the fixed contact 90. At such time, the magnet 120 will help urge that movable contact into intimate engagement with that fixed contact; and consequently there will be little or no contact resistance between the contacts 116 and 90.

As the free end of the switch arm 154 is released, as by the coin rolling off of that free end, the restorative force within the flexible leaf spring 112 will tend to return that spring, and the movable contact 116 thereon, to their normal positions. The magnet 120 will, however, resist that tendency because of the holding force between it and its pole piece 124. The interaction between that restorative force and that holding force will cause the portion of the flexible leaf spring 112 which is intermediate the actuator

126 and the magnet 120 to bow downwardly, as shown by dotted lines in FIG. 9. Such bowing is in the direction of the desired movement of the spring 112, but it will cause the portion of the spring 112 which is intermediate the movable contact 116 and the actuator 126 to tend to rotate in the clockwise direction about the magnet 120, and it will thereby urge the movable contact 116 into even tighter engagement with the fixed contact 90. That downward bowing will also cause the magnet 120 to rotate its axis relative to the plane of the pole piece 124; and such rotation will weaken the holding force between that magnet and that pole piece. Continued downward bowing of the portion of the spring 112 which is between the actuator 126 and the magnet 120 will rotate that magnet to such an extent relative to its pole piece 124 that the holding force between that magnet and that pole piece will be unable to match the restorative force within the spring 112. Thereupon the flexible leaf spring 112 will move its cantilever portion downwardly in whip-like manner and thereby move the movable contact 116 down into engagement with the fixed contact 100.

The movable contact 116 will initially engage the fixed contact 100 when the flexible leaf spring 112 reaches its lower dotted-line position in FIG. 8; and at that time the movable contact 116 will be in its lower dotted-line position in FIG. 8. However, the flexible leaf spring 112 will not stop in its lower dotted-line position and, instead, will continue to move downwardly to its lower solid-line position in FIG. 8; and it will do so because of the attraction which the magnet 120 has for its pole piece 122 and because of the momentum of that magnet. As the flexible leaf spring 112 moves down to its lower solid-line position in FIG. 8, it will draw the movable contact 116 across the face of the fixed contact 100, thereby moving that movable contact from its lower dotted-line position to its lower solid-line position in FIG. 8. In doing so, that movable contact will provide a wiping action between the movable and fixed contacts 116 and 100. That wiping action will tend to clean away any "skins" or coatings of oxides or sulfides that may have formed on the surfaces of those contacts. Moreover, the momentum of the magnet 120 will coact with the magnetic attraction between that magnet and the pole piece 122 to cause the movable contact 116 to strike the fixed contact 100 a sharp blow. That blow will penetrate and break up any "skins" or coatings on the surfaces of those contacts.

The ready flexibility of the spring 112 thus coacts with the mounting of the elongated magnet 120 on that spring intermediate the actuator 126 and the movable contact 116 to provide an increase in contact pressure whenever the movable contact is about to be shifted, to provide a whip-like movement of that spring when that movable contact does shift, to provide a sharp blow that will penetrate and break any "skins" or coatings of oxides or sulfides on the surfaces of the contacts, and to provide a subsequent wiping action that will clean any "skins" or coatings of oxides or sulfides from the surfaces of the contacts. In this direct and straightforward manner, the present invention assures full certainty of operation for the switch.

The rivet-like members 111 hold the securing portion of the flexible leaf spring 112 against the wide portion of the terminal 104; and that wide portion will give full support to that securing portion as the actuator 126 moves the cantilever portion of the spring 112 upwardly. Hence there is no tendency for the flexing portion of the spring 112 to "work" adjacent the rivet-like members 111. As a result, those rivet-like members 111 will not fatigue and break away, and neither will the openings in the securing portion of the spring 112 that receive those rivet-like members.

In assembling the switch provided by the present invention, the metal sleeve 138 is telescoped over the cylindrical portion 134 of the actuator 126 and then the two of them are telescoped into the opening 36 in the half-housing 22. The projection 142 of the connector 140 is then pressed into the recess 136 in the cylindrical portion 134. The sleeve 118 and the magnet 120 are assembled with the flexible leaf spring 112 and that spring is assembled with the terminal 104. Thereafter that terminal is set in its slot 44; and as it is so set, the cantilever portion of the spring 112 will be placed in overlying relation to the actuator 126. The terminals 84 and 94 are then set in the slots 48 and 46, respectively. The plates 122 and 124 then have their ends seated in the sockets defined by the ribs 38 and 40. Thereupon the half-housing 60 can be placed in engagement with the half-housing 22, and the split tube 162 can be telescoped into the opening 30 and into the corresponding opening in the half-housing 60. Once this has been done, a switch arm of the desired configuration can be assembled with the abutments 148, 150 and 152 of the connector 140.

The arm 154 is easily assembled with the connector 140 by pressing the short arm 160 toward the V-shaped bend 156, and then setting the V-shaped bend 156 within the aera defined by the arcuate projection 146. Subsequent release of the pressure on the short arm 160 will enable that arm to press against the abutment 152 and thereby hold the switch arm 154 against dislodgment from the connector 140.

FIG. 10 discloses a half-housing 164 that is generally similar to the half-housing 22. That half-housing has a rabbet 24, an opening 26, an opening 28, an opening 30, a recess 32, a rib 38, a rib 40, a slot 44, a slot 46 and a slot 48 that are identical to the identically-numbered parts of half-housing 22. Further, the half-housing 164 is equipped with terminals 84, 94 and 104, contacts 90, 100 and 116, magnet 120, sleeve 118, and pole pieces 122 and 124 that are identical to the identically-numbered parts with which the half-housing 22 is equipped. However, the half-housing 164 does not have bosses 34 and 50, does not have the opening 36, does not have the stops 52 and 54, and does not have the recess 56. Instead, that half-housing has an opening 166 at the upper face thereof, and that opening accommodates a plunger-like actuator 168. Further, the spring 212 has a slightly different bend intermediate its securing and cantilever portions than does the spring 112; and consequently the spring 212 biases the movable contact 116 against the fixed contact 90. This means that the actuator 168 acts downwardly rather than upwardly on the spring 212. In all other respects the operation of the spring 212 is the same as the operation of the spring 112 of half-housing 22. A half-housing that is the mirror image of the half-housing 164 will be assembled with the latter half-housing to complete the switch.

FIG. 11 discloses a switch that is identical to the switch 20 except for the elimination of the ribs 38 and 40 in the half-housing 172 and for the substitution of a U-shaped element 174 for the two pole pieces 122 and 124. The use of the U-shaped element 174 reduces the overall reluctance of the path for the flux lines from the magnet 120, and thereby increases the holding force between that magnet and the two poles of that element.

The numeral 180 generally denotes another connector which can receive an arm such as the arm 154. The connector 180 is provided with an opening 182 through it, and that opening can accommodate a suitable projection on a movable or fixed element. That projection will thereby hold the connector 180 in assembled relation with that movable or fixed element. The connector 180 has abutments 184 and 186 formed thereon by a stamping or casting operation, and those abutments are comparable to the abutments 148 and 150 of connector 140 which are also made by a stamping or casting operation. The abutment 188 is comparable to the abutment 152; and the abutments 184, 186 and 188 can receive and hold an arm such as the arm 154. That arm can be used for any one of a number of purposes, as for example, to support or suspend objects, to act as a feeler or gage, to act as a rebounding surface, to act as an area-defining element,

or to do any one of a number of different functions. The connector **180** thus constitutes a device which facilitates the ready assembly and disassembly of an arm with another element.

The switch provided by the present invention has a remarkably high ratio between its contact pressure and its operating torque. Specifically that switch has contact pressures of between eight and ten grams while having operating torques of between one and one half and two gram inches. Such a switch is operable by even very light coins and yet has little or no contact resistance.

The pole pieces **122** and **124** are not set parallel to each other but instead are set to parallel the end faces of the magnet **120** when that magnet is in its upper and lower positions, as shown by FIG. 8. The U-shaped pole piece **174** can also, if desired, have its ends set so they will be parallel to the end faces of that magnet when that magnet is in its upper and lower positions. Where that is done the holding forces exerted by the magnet **120** are effectively increased.

The upper faces of the eccentric portion **130** of the actuator **126** are planes that subtend an acute angle. Those faces abut to define a sharp surface or edge that can engage the under face of the flexible leaf spring **112**; and such a sharp surface is desirable. In the first place, it will provide a minimum area of engagement between the eccentric portion **130** and the flexible leaf spring **112**, and will thereby reduce the frictional resistance that occurs as that surface slides along relative to the flexible leaf spring **112** during rotation of the actuator **126**. In the second place, it enables the actuator to rotate a considerable number of degrees while keeping the faces of the two planes out of engagement with the under side of the flexible leaf spring **112**. The overall rotation of the actuator **126** will be limited by the engagement of the stop **144**, on the connector **140**, with the stops **52** and **54** on the half-housing **22**.

The sharp edge on the eccentric portion **130** is disposed between the fixed end of the flexible leaf spring and the axis of rotation of the actuator **126**. This is desirable because it enables a relatively stiff portion of the flexible leaf spring **112** to engage the eccentric portion **130** and to provide the restoring torque for the actuator **126**.

The sharp edge of the eccentric portion **130** and the axis of rotation of the actuator **126** define a line **131**; and that line is extended in the normal and rotated positions of the actuator **126** in FIG. 8 to make is readily visible. That line inclines relative to the flexible leaf spring **112**; inclining downwardly to the right and intersecting the flexible leaf spring **112** when the actuator is in the solid line position of FIG. 8. That line inclines upwardly to the right and intersects the flexible leaf spring **112** when the actuator **126** is in the dotted line position of FIG. 8. The fact that the line **131** starts below the flexible leaf spring **112** and passes upwardly through the plane of that flexible leaf spring to a point above that spring is desirable because it means that the cosine of that line will not vary a great deal as the actuator **126** rotates. Such a small variation minimizes the amount of sliding which will occur between the sharp edge of the eccentric portion **130** and the flexible leaf spring **112** as the actuator **126** rotates; and this means that there will be a minimum of frictional resistance to the rotation of the actuator **126**.

Whereas the drawing and accompanying description have shown and described several preferred embodiments of the present invention, it should be apparent to those skilled in the art that various changes may be made in the form of the invention without affecting the scope thereof.

What I claim is:

1. An electric switch that has a fixed contact, a second fixed contact, an elongated flexible leaf spring, a movable contact that is secured to and carried by said spring, said spring holding said movable contact in register with said fixed contacts and biasing said movable contact toward said first said fixed contact, an actuator that can engage said spring, an elongated magnet that is mounted on and carried by said spring, spaced poles that coact with said magnet to bias said magnet and said spring toward two spaced positions, said movable contact being in engagement with said first said fixed contact and said magnet being adjacent one of said poles whenever said magnet and said spring are in one of said spaced positions, said movable contact being in engagement with said second fixed contact and said magnet being adjacent the other of said poles whenever said magnet and said spring are in the other of said spaced positions, said magnet being intermediate said movable contact and said actuator, said actuator being movable to engage said spring and to bow that portion of said spring which is intermediate said magnet and said actuator in the direction of movement of said spring toward said other spaced position and thereby cause said portion of said spring intermediate said actuator and said movable contact to rotate in one direction about said magnet and provide a momentary increase in the contact pressure between said movable contact and said first said fixed contact, said bowing of the first said portion of said spring causing said magnet to rotate relative to said one pole and thereby reduce the holding force between said magnet and said one pole, said bowing of the first said portion of said spring storing energy in the first said portion of said spring and said energy overcoming said reduced holding force to move said spring toward said other spaced position in whip-like manner, said spring and said magnet causing said movable contact to strike said second fixed contact a sharp blow and then continuing to move further to permit said magnet to closely approach said other pole, said spring shifting said movable contact across the surface of said second fixed contact during said further movement, said actuator being movable in the opposite direction to enable said spring to move back to the first said spaced position, said spring responding to said movement of said actuator in said opposite direction to bow the first said portion of said spring in the direction of movement of said spring toward said first said spaced position and thereby cause the second said portion of said spring to rotate in the opposite direction about said magnet and provide a momentary increase in the contact pressure between said movable contact and said second fixed contact, said bowing of the first said portion of said spring causing said magnet to rotate relative to said other pole and thereby reduce the holding force between said magnet and said other pole, said spring overcoming the second said reduced holding force to move said spring toward said first said spaced position in whip-like manner, said spring and said magnet causing said movable contact to strike said first said fixed contact a sharp blow and then continuing to move further to reach said first said spaced position to permit said magnet to closely approach the first said pole, said spring shifting said movable contact across the surface of said first said fixed contact during said further movement to said first said spaced position, said magnet being closer to said one pole whenever said magnet and said spring are in said first said spaced position than it is to said other pole whenever said magnet and said spring are in said other spaced position.

2. An electric switch that has a fixed contact, a second fixed contact, an elongated flexible leaf spring, a movable contact that is secured to and carried by said spring, said spring holding said movable contact in register with said fixed contacts and biasing said movable contact toward said first said fixed contact, an actuator that can engage said spring and apply forces to said spring, a magnet that is mounted on and carried by said spring, spaced poles that coact with said magnet to bias said magnet and said spring toward two spaced positions, said movable contact being in engagement with said first said fixed contact and said magnet being adjacent one of said poles whenever

said magnet and said spring are in one of said spaced positions, said movable contact being in engagement with said second fixed contact and said magnet being adjacent the other of said poles whenever said magnet and said spring are in the other of said spaced positions, said magnet being intermediate said movable contact and said actuator, said actuator bowing that portion of said spring which is intermediate said magnet and said actuator in the direction of movement of said spring toward said other spaced position and thereby causing said portion of said spring intermediate said actuator and said movable contact to rotate in one direction about said magnet and provide a momentary increase in the contact pressure between said movable contact and said first said fixed contact, said bowing of the first said portion of said spring storing energy in the first said portion of said spring and said energy overcoming the holding force between said magnet and said one pole to move said spring toward said other spaced position in whip-like manner, said spring and said magnet causing said movable contart to strike said second fixed contact a sharp blow and then continuing to move further to permit said magnet to closely approach said other pole, said spring shifting said movable contact across the surface of said second fixed contact during said further movement, said actuator enabling said spring to move back to the first said spaced position, said spring bowing the first said portion thereof in the direction of movement of said spring toward said first said spaced position and thereby causing the first said portion of said spring to rotate in the opposite direction about said magnet and provide a momentary increase in the contact pressure between said movable contact and said second fixed contact, said spring overcoming the holding force between said magnet and said other pole to move said spring toward said first said spaced position in whip-like manner, said spring and said magnet causing said movable contact to strike said first said fixed contact a sharp blow and then continuing to move further to reach said first said spaced position to permit said magnet to closely approach the first said pole, said spring shifting said movable contact across the surface of said first said fixed contact during said further movement to said first said spaced position.

3. An electric switch that has a fixed contact, a second fixed contact, an elongated flexible leaf spring, a movable contact that is secured to and carried by said spring, said spring holding said movable contact in register with said fixed contacts and biasing said movable contact toward said first said fixed contact, an actuator that can engage said spring and apply forces to said spring, a magnet that is mounted on and carried by said spring, spaced poles that coact with said magnet to bias said magnet and said spring toward two spaced positions, said poles being spaced apart a distance proportionately greater than the distance between said fixed contacts, whereby said spring can bend and permit said magnet to continue to move toward, but to stop short of, said poles after said movable contact has engaged said fixed contacts, said movable contact being in engagement with said first said fixed contact and said magnet being adjacent one of said poles whenever said magnet and said spring are in one of said spaced positions, said movable contact being in engagement with said second fixed contact and said magnet being adjacent the other of said poles whenever said magnet and said spring are in the other of said spaced positions, said magnet being intermediate said movable contact and said actuator, said actuator moving said spring toward said other spaced position, said magnet causing said movable contact to strike said second fixed contact a sharp blow and then bending said spring to closely approach but stop short of said other pole, said spring shifting said movable contact across the surface of said second fixed contact as it bends, said actuator enabling said spring to move back to the first said spaced position, said magnet causing said movable contact to strike said first said fixed contact a sharp blow and then bending said spring in the opposite direction to closely approach but stop short of the first said pole, said spring shifting said movable contact across the surface of said first said fixed contact as it bends in said opposite direction.

4. An electric switch that has a fixed contact, an elongated flexible leaf spring, a movable contact that is secured to and carried by said spring, said spring holding said movable contact in register with said fixed contact, an actuator that engages said spring and applies forces to said spring to move said movable contact away from said fixed contact, an elongated magnet that is mounted on and carried by and extends transversely of said spring so said magnet can have the axis thereof generally parallel to the path of movement of said magnet, and a pole that coacts with said magnet to bias said magnet and said spring toward a predetermined position wherein said movable contact is in engagement with said fixed contact and said magnet is adjacent said pole, said magnet being intermediate said movable contact and said actuator, said actuator bowing that portion of said spring which is intermediate said magnet and said actuator in the direction of movement of said spring away from said predetermined position and thereby causing said portion of said spring intermediate said actuator and said movable contact to rotate about said magnet and provide a momentary increase in the contact pressure between said movable contact and said fixed contact, said bowing of the first said portion of said spring causing said magnet to rotate relative to said pole and thereby reduce the holding force between said magnet and said pole, said bowing of the first said portion of said spring storing energy in the first said portion of said spring and said energy overcoming said reduced holding force to move said spring away from said predetermined position in whip-like manner, said actuator being adapted to free said spring to enable said magnet and said spring to move back to said predetermined position, said spring and said magnet causing said movable contact to strike said fixed contact a sharp blow and then continuing to move further to reach said predetermined position to permit said magnet to closely approach said pole, said spring shifting said movable contact across the surface of said fixed contact during said further movement to said predetermined position.

5. An electric switch that has a fixed contact, an elongated flexible leaf spring, a movable contact that is secured to and carried by said spring, said spring holding said movable contact in register with said fixed contact, an actuator that engages said spring and applies forces to said spring to move said movable contact away from said fixed contact, a magnet that is mounted on and carried by said spring, and a pole that coacts with said magnet to bias said magnet and said spring toward a predetermined position wherein said movable contact is in engagement with said fixed contact and said magnet is adjacent said pole, said magnet being intermediate said movable contact and said actuator, said actuator bowing that portion of said spring which is intermediate said magnet and said actuator in the direction of movement of said spring away from said predetermined position and thereby causing said portion of said spring to rotate about said magnet and provide a momentary increase in the contact pressure between said movable contact and said fixed contact, said bowing of said portion of said spring storing energy in said portion of said spring and said energy overcoming the holding force between said magnet and said pole to move said spring away from said predetermined position in whip-like manner, said actuator being adapted to free said spring to enable said magnet and said spring to move back to said predetermined position, said spring and said magnet causing said movable contact to strike said fixed contact a sharp blow and then continuing to move further to reach said predetermined position to permit said magnet to closely approach but stop short of said pole, said spring shifting said movable contact across

the surface of said fixed contact during said further movement to said predetermined position.

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