July 13, 1965 I. EPSTEIN 3,194,909

FAIL SAFE SNAP ACTING DISCONNECT SWITCH

Filed March 28, 1962 3 Sheets-Sheet 1

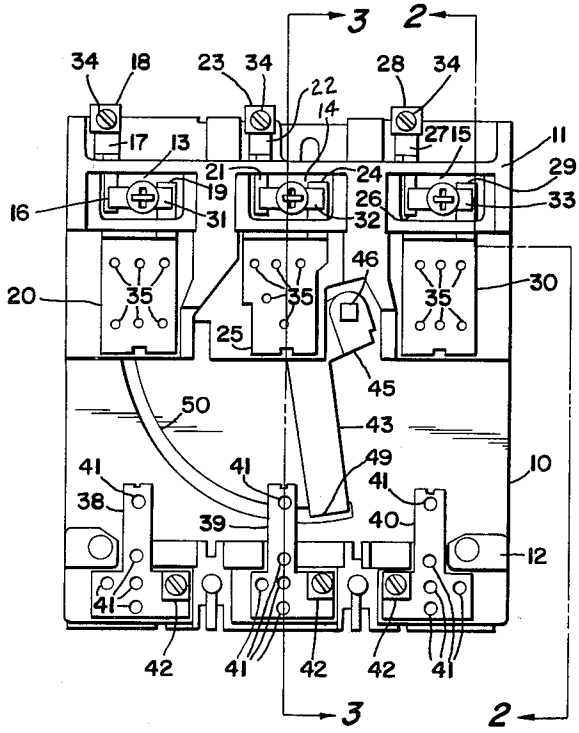


Fig. 1

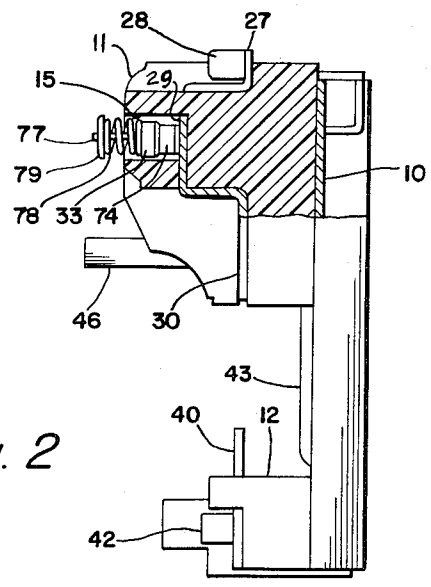


Fig. 2

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FAIL SAFE SNAP ACTING DISCONNECT SWITCH

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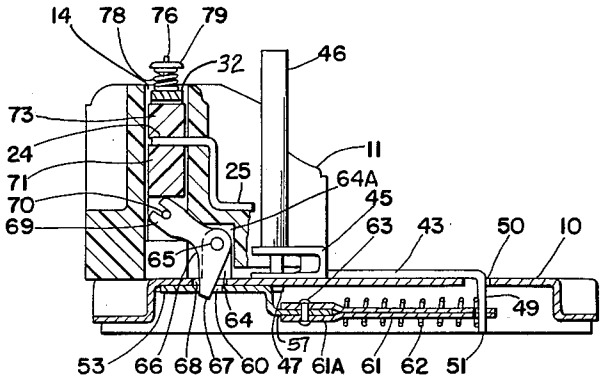


Fig. 3

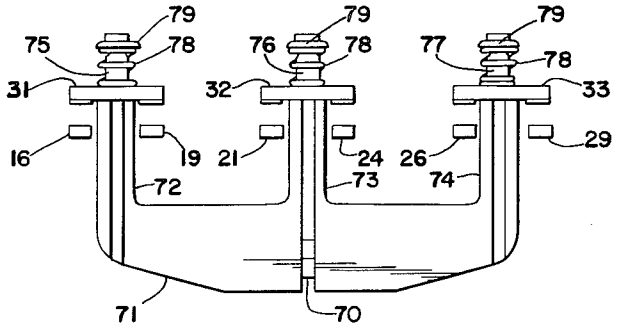


Fig. 4

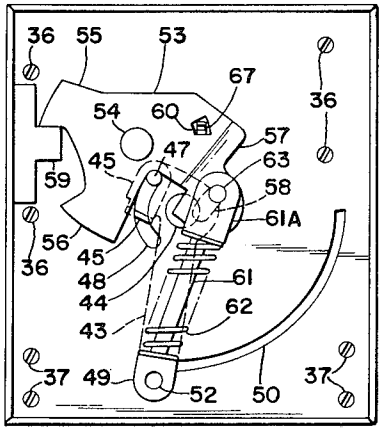


Fig. 5

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FAIL SAFE SNAP ACTING DISCONNECT SWITCH

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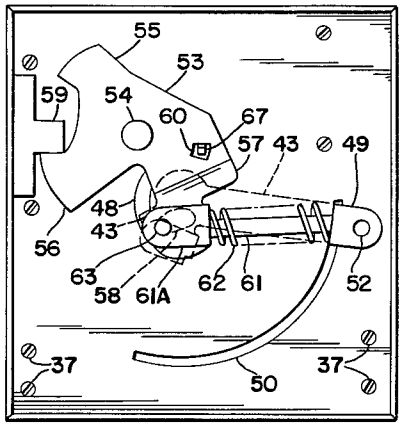


Fig. 6

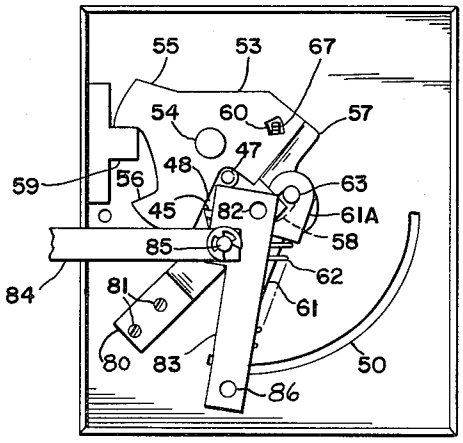


Fig. 7

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3,194,909

FAIL SAFE SNAP ACTING DISCONNECT SWITCH

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6 Claims. (Cl. 200—67)

My invention relates to electric switches and more specifically to a disconnect switch of the fusible and non-fusible type.

It is an object of my invention to provide a disconnect switch having contacts that are positioned in an arc chamber and yet wherein the position of said contacts is visible to the operator.

It is another object of my invention to provide a disconnect switch capable of readily and easily accommodating fuses of various ratings.

It is a further object of my invention to provide a disconnect switch wherein the contacts are opened or closed with a snap action.

It is still another object of my invention to provide a disconnect switch that is capable of being operated by means located at its front or means located at its side.

Still another object of my invention is to provide a disconnect switch having a minimum number of component parts and which may be easily assembled.

Still another object of my invention is to provide a switch that can be operated to the "off position" should the spring break when the switch is in the "on position."

It is still a further object of my invention to provide a switch wherein the operating means cannot be moved to the "off position" should the contacts of the switch become welded closed.

Still other objects of my invention will become apparent to those skilled in the art when the following specification is viewed in light of the accompanying drawings in which:

FIGURE 1 is a front view of the disconnect switch;

FIGURE 2 is a view taken on line 2—2 of FIGURE 1;

FIGURE 3 is a side view of the switch when viewed in the direction of arrows 3—3 in FIGURE 1 and with the fuse block removed and a portion of the contact housing removed to show the operating arm;

FIGURE 4 is a view of the contact arm and the associated stationary and movable contacts;

FIGURE 5 is a rear view of the switch showing the operating mechanism in the "off position";

FIGURE 6 is a rear view of the switch showing the operating mechanism in the "on position"; and

FIGURE 7 is a rear view of the switch with the operating mechanism in the "off position" and the additional mechanism required to make said disconnect switch side operated.

As shown in FIGURE 1, the disconnect switch consists of a base 10 having downward turned edges with a contact housing 11 mounted on one end thereof and a fuse block 12 mounted on the other end thereof. Contact housing 11 is formed of insulating material and has three arc chambers 13, 14 and 15 formed therein in spaced apart relation and opening outwardly thereof.

Arc chamber 13 has a stationary contact 16 therein which is formed on one end of bus member 17. Bus member 17 extends out of arc chamber 13 and upwardly from contact housing 11 and has a terminal 18 secured on its external end. A second stationary contact 19 is positioned in spaced apart relationship with stationary contact 16 and is formed on one end of a bus member 20. Bus member 20 extends out of arc chamber 13 and downwardly to be positioned on a portion of contact housing 11 for insulated support thereof.

Arc chamber 14 has a stationary contact 21 therein which is formed on one end of a bus member 22. Bus member 22 extends upwardly out of arc chamber 14 from contact housing 11 and has a terminal 23 secured on its external end. A second stationary contact 24 is positioned in spaced apart relationship with contact 21 and is formed on one end of a bus member 25. Bus member 25 extends downwardly out of arc chamber 14 to be positioned on a portion of contact housing 11 for insulated support thereof.

Arc chamber 15 has a stationary contact 26 therein which is formed on one end of a bus member 27. Bus member 27 extends upwardly out of arc chamber 15 from contact housing 11 and has a terminal 28 secured on its external end. A second stationary contact 29 is positioned in spaced apart relationship with stationary contact 26 and is formed on one end of a bus member 30. Bus member 30 extends downwardly out of arc chamber 15 to be positioned on a portion of contact housing 11 for insulated support thereof.

A movable contact 31 is positioned for reciprocal movement between two positions in arc chamber 13 by means to be described. In one position movable contact 31 bridges stationary contacts 16 and 19 and in the second position, it opens the circuit between said stationary contacts 16 and 19.

A movable contact 32 is positioned for reciprocal movement between two positions in arc chamber 14 by means to be described. In one position, movable contact 32 bridges stationary contacts 21 and 24 and in the second position, it opens the circuit between said stationary contacts 21 and 24.

A movable contact 33 is positioned for reciprocal movement between two positions in arc chamber 15 by means to be described. In one position, movable contact 33 bridges stationary contacts 26 and 29 and in the second position, it opens the circuit between said stationary contacts 26 and 29.

Terminals 18, 23 and 28 are of the type having a screw 34 for retaining a wire or wires thereby to provide an electrical connection.

Bus members 20, 25 and 30 have a plurality of holes 35 therein for the purpose of securing a plurality of different fuse clips thereon.

Contact housing 11 is secured to base 10 by means of screws 36 extending through base 10 and screwing into the bottom of contact housing 11 (see FIGURE 5).

Fuse block 12 is positioned on the other end of base 10 and is made of insulating material and is secured thereto by means of screws 37 extending through base 10 and screwing into the bottom of fuse block 12 (see FIGURE 5). Fuse block 12 has bus members 38, 39 and 40 positioned thereon in spaced apart relationship. Said bus members 38, 39 and 40 each have a plurality of holes 41 therein for securing a plurality of different fuse clips thereon. Each bus member has a terminal 42 positioned thereon for securing wires thereto to provide an electrical connection therewith.

The pairs of bus members, 20 and 38, 25 and 39, and 30 and 40, one of which is on the contact housing 11 and the other on fuse block 12, are aligned with each other to permit a fuse to be connected thereacross when appropriate fuse clips are individually mounted on said pairs of bus members. Also, fuse block 12 may be moved on base 10 so the switch may accommodate different size fuses.

The disconnect switch has a toggle lever arm 43 of general L-shaped rotatably secured to the front of base 10 by means of a pin 44 (see FIGURE 5) at the point of connection of its two legs. A portion of toggle lever arm 43 is positioned under contact housing 11. The

short leg 45 of L-shaped toggle lever arm 43 is formed in the shape of a U-bracket. Said U-bracket 45 has aligned holes in both legs thereof for receiving and securing thereto operating arm 46. A portion 47 of operating arm 46 extends through said U-bracket 45 and through an arcuate slot 48 in base 10. Operating arm 46 extends outward perpendicular to said base 10 and through a recess formed in contact housing 11 and is provided with suitable means for operating said switch from the front thereof. The purpose of U-bracket 45 is to provide two points of connection with operating arm 46 and thereby increase the strength thereof.

The end 49 of the other leg of toggle lever arm 43 is S-shaped in a direction to extend through an arcuate slot 50 in base 10. Thus, end 49 of toggle arm 43 is positioned below base 10. A slot 51 is punched in the middle bend of end 49 and a hole 52 is punched in the last bend for purposes to be described.

Thus, it is seen that when operating arm 46 is rotated, it moves in a path about pin 44 and causes toggle lever arm 43 to rotate about pin 44 through arcuate slot 50. The ends of slot 50 serve as a means for stopping the rotative movement of toggle lever arm 43 and operating arm 46.

As shown in FIGURE 5, a crank actuator 53 is rotatably attached by means of a pin 54 to the bottom of base 10. Crank actuator has two ears 55 and 56 formed on one side thereof and a downwardly and outwardly turned ear 57 (S-shaped) on the other side thereof. Ear 57 has a slot 58 (shown dotted) formed therein. A mechanical stop 59 is secured to the bottom of base 10 by welding or other suitable means and positioned between ears 55 and 56 to prescribe the limits for the rotative movement of crank actuator 53.

Crank actuator 53 has a slot 60 formed in the main body thereof and spaced at a distance from pin 54. The purpose of slot 60 will be described hereinafter.

Connected between end 49 of toggle lever arm 43 and crank actuator 53 is a lever arm 61. Lever arm 61 has a fork end 61A at one end thereof which straddles ear 57 of crank actuator 53. Lever arm 61 is rotatably secured to crank actuator 53 by means of a pin 63 which is inserted through slot 58. The other end of lever arm 61 is inserted through slot 51 in the downward turned end 49 of toggle lever arm 43. A spring 62 circumscribes a portion of lever arm 61 and reacts between said fork end 61A and the downward turned end 49 of toggle lever arm 43 to apply a rotative force on crank actuator 53 by means of pin 63. As shown in FIGURE 5, the force of spring 62 is in a direction to rotate crank actuator 53 about pin 54 in a counterclockwise direction, however, such movement is prevented by ear 55 engaging stop 59.

With reference to FIGURE 3, there is shown a support member 64 secured by suitable means on base 10 and projecting therefrom to be positioned in a recess 64A formed in the bottom of contact housing 11. Supporting member 64 has a pin 65 secured thereto and said pin 65 rotatably supports a crank 66. Crank 66 has one end 67 thereof which extends downward through an opening 68 in base 10 and into the slot 60 located in crank actuator 53. The other end 69 of crank 66 is fork-shaped and capable of receiving a pin 70 between the prongs of said fork. Legs 67 and 69 of crank 66 are at a suitable angle with each other for the purpose of transforming the rotative movement of crank actuator 53 into a vertical movement for pin 70.

Pin 70 is molded in contact carrier arm 71. Contact carrier arm 71 is located in an aperture in said contact housing 11 beneath the aforementioned arc chambers as shown in FIGURES 2 and 3. Contact carrier arm 71 itself is better shown in FIGURE 4.

Contact carrier arm 71 has three upwardly extending fingers formed on its top, 72, 73 and 74. Contact carriers 75, 76 and 77 are inserted in fingers 72, 73 and 74, respectively. Movable contacts 31, 32 and 33 are placed over contact guides 75, 76 and 77, respectively, and are resiliently held against the top side of said fingers by means of springs 78 which circumscribe said fingers. A spring retaining washer 79 is positioned over said fingers and retained thereto by well known means.

With the switch in the condition shown in FIGURE 1, that is, the contact open position, the mechanism at the rear of base 10 is in the position illustrated in FIGURE 5. To move the switch to its "on condition," it is only necessary that operating arm 46 be rotated clockwise as viewed in FIGURE 1. The rotation of operating arm 46 causes toggle lever arm 43 to move clockwise rotatably about its point of pivotal connection, pin 44. Toggle lever arm 43 rotates about pin 44 until its end 49 strikes the other end of arcuate slot 50, stopping any further movement of it or operating arm 46.

This operation as viewed in FIGURE 5 causes end 49 of toggle lever arm 43 to rotate in the counterclockwise direction through arcuate slot 50. Rotative force must be continually applied to rotating arm 46 until the center line axis of lever arm 61, pin 63 and pin 54 are all aligned with each other. Up until this time the force of spring 62 is in an upward direction to maintain crank actuator 53 in its original position with ear 55 against stop 59. Immediately upon passing the aforedescribed center line aligned position, pin 63 immediately moves to the other end of slot 58 causing the force of spring 62 to react on crank actuator 53 on its other side of its point of pivot, pin 54. This change in direction of the force of spring 62 causes crank actuator 53 to rotate clockwise about pin 54 until ear 56 engages stop 59 as is shown by FIGURE 6. It is to be noted that slot 60 in crank actuator 53 has been moved down due to the aforedescribed rotative movement.

The downward movement of slot 60 causes end 67 of crank 66 to move downward and rotating crank 66 about pin 65, thereby moving fork end 69 and 70 towards base 10. Contact operating arm 71 is thereby moved downward, causing movable contacts 31, 32 and 34 to engage with their respective stationary contacts. Additional downward movement of contact arm 71 is provided so springs 78 are compressed and thereby applying pressure between said movable and stationary contacts.

When the mechanism has passed over center, the resulting movement of the parts occur with a snap, causing the contacts to close with a "snap action."

Conversely, to move the switch from the "on position" to its "off position," operating arm 46 as viewed in FIGURE 1 is rotated in the counterclockwise direction. Again, this causes toggle lever arm 43 to rotate about pin 44 in the counterclockwise direction. This movement continues until end 49 of toggle lever arm 43 engages the other end of arcuate slot 50.

When viewed from the rear of base 10, the mechanism moves from the position indicated in FIGURE 6 to that indicated in FIGURE 5.

It is to be noted as viewed in FIGURE 6 the force of spring 62 reacts in a somewhat horizontal direction below the point of pivot for crank actuator 53.

As operating arm 46 is rotated counterclockwise, end 49 of toggle lever arm 43 as viewed in FIGURE 6 is rotated clockwise. Rotative force must be continually applied on operating arm 46 until the center line of lever arm 61, pin 63 and pin 54 are again aligned. At this instant, the force of spring 62 reacting on crank actuator 53 is directly against its point of rotative connection, pin 54. And up until this point said force of spring 62 has been in a direction under said point of rotation 54 and maintaining ear 56 of crank actuator 53 against stop 59 in the position shown.

Any further rotative movement of operating arm 46 causes the force of spring 62 to be applied to the other side of pin 54 and to ensure the desired positive snap action, pin 63 moves to the other end of slot 58 thereby

causing the force of spring 62 to react strongly against crank actuator 53 forcing it to rotate about pin 54 until ear 55 engages stop 59 as shown in FIGURE 5.

The rotation of crank actuator 53 from the position shown in FIGURE 6 to that shown in FIGURE 5 causes slot 60 therein to be moved upward. End 67 being positioned in said slot 60 is likewise moved, rotating crank 66 about pin 65 causing fork end 69 to move away from base 10 in an outward direction. Fork end 69 moves pin 70 with it forcing contact arm 71 to be moved outward. This disengages said movable contacts from their respective associated stationary contacts with a "snap action," thereby opening the circuit. It is to be noted that the force created by springs 78 assist in the snap movement of the mechanism and the opening of said contacts.

In the rotation from the "on position" to the "off position," that is from FIGURE 6 to FIGURE 5, the traversing of pin 47 through slot 48 serves two important safety features.

First, should spring 62 break while the switch is in its "on condition" the movement of operating arm 46 from its "on position" to the "off position" causes pin 47 to engage crank actuator 53 and force it to rotate to a certain degree about pin 54. This degree of rotation is sufficient to cause said movable contacts to disengage from said associated stationary contacts. Thus, the switch is forced by direct mechanical connection to be moved to its "off position."

Should the movable contacts become welded through arcing to their associated stationary contacts, it is undesirable and extremely dangerous to allow operating arm 46 to be moved to its "off position." This is prevented because of the aforedescribed mechanical contact of pin 47 with crank actuator 53. This physical contact of pin 47 prevents operating arm 46 and toggle lever arm 43 from being rotated far enough to allow the center line of lever arm 61 to go beyond the aforedescribed aligned center lined position. Therefore, since toggle lever arm 43 cannot move lever arm 61 beyond its over center position, the force of spring 62 will cause the mechanism to snap immediately back to the "off position" as soon as the rotative force is removed from operating arm 46.

With reference to FIGURE 7, there is shown additional mechanism should it be desired to operate the switch mechanism from the side. This mechanism consists of a stationary link 80 having an S-shape and which has one end secured to the underside of base 10 by means of screws 81 and the other end extends over the other mechanism. Rotatively attached to stationary link 80 by means of pin 82 is a lever arm actuator 83. Stationary link 80 is positioned to place pin 82 in the same axis as pin 44. A side operating arm 84 is rotatably secured to lever arm actuator 83 by means of a pin 85. Pin 85 is spaced away from pin 82 by the same distance that operating arm 46 is spaced away from pin 44.

The free end of lever arm actuator 83 is secured by a pin 86 in hole 52 in end 49 of toggle lever arm 43.

To operate the mechanism from the "off position" to the "on position," it is only necessary to supply a force on operating arm 84 in the direction towards the switch. This force causes lever arm actuator 83 to rotate about pin 82, and moves end 49 of toggle lever arm 43 with it. The switch mechanism then operates in the same manner as described when an operating arm is used in front of the switch.

To move the switch from its "on position" to its "off position," the force on operating arm 84 should be reversed. That is, the force should be pulling operating arm 84 away from the switch. This force draws lever arm actuator 83 with it and moves end 49 of toggle lever arm 43 through arcuate slot 50.

With this mechanism it is possible to transmit a straight line motion from the side or any angle to the switch to the rotative movement necessary to operate the switch. If an arcuate motion or direction of force is available, it can be connected directly to end 49 of toggle lever arm 43.

In the foregoing, I have described my invention only in connection with preferred embodiments thereof. Many variations and modifications of the principles of my invention within the scope of the description herein are obvious. Accordingly, I prefer to be bound not by the specific disclosure herein, but only by the appending claims.

I claim:

1. An electric switch comprising a base plate, an insulated housing mounted on the one side of said plate and having a plurality of arc chambers formed therein, a pair of stationary contacts supported in spaced apart relationship in each of said arc chambers, a movable contact associated with each pair of said stationary contacts and visibly supported in said arc chambers for reciprocal movement between a contact engaging and a contact disengaging position by a contact arm, said contact arm disposed in the recess in said housing perpendicular to said plate, a crank pivotally mounted on said base plate and located in said recess and having one end thereof connected to said contact arm and a second end thereof extending through a slot in said plate, a crank actuating member rotatively secured to the opposite side of said plate and positioned to engage the second end of said crank, a snap acting lever arm located at the opposite side of said plate, a pin pivoting the inner end of the lever arm to said crank actuating member, a toggle arm connected to the other end of said lever arm at the opposite side of said plate and rotatably secured thereto at the one side thereof, a spring circumscribing said lever arm and reacting between it and said toggle arm to provide a force for rotating said crank actuating member about said pin with a snap action, an operating arm secured to said toggle arm for imparting rotative movement thereto to actuate the snap acting lever arm and thereby effect engagement and disengagement of the contacts as the contact arm is actuated by the crank and crank actuating member.

2. An electric switch comprising a base plate, an insulated housing mounted on the one side of said plate and having a plurality of arc chambers formed therein, a pair of stationary contacts supported in spaced apart relationship in each of said arc chambers, a movable contact associated with each pair of said stationary contacts and visibly supported in said arc chambers for reciprocal movement between a contact engaging and a contact disengaging position by a contact arm, said contact arm disposed in a recess in said housing perpendicular to said plate, a crank pivotally mounted on said base plate and disposed within said recess and having one end thereof connected to said contact arm and a second end thereof extending through a slot in said plate, a crank actuating member rotatively secured to the opposite side of said plate and positioned to engage said second end of said crank, a snap acting lever arm located at the opposite side of said plate, a pin pivoting the inner end of the lever arm to said crank actuating member, a lever actuator connected to said lever arm, a stationary link secured to the opposite side of said plate and rotatably supporting the lever actuator, a spring circumscribing said lever arm and reacting between it and said lever actuator to provide a force for rotating said crank actuating member with a snap action, and an operating arm rotatably connected to said lever actuator in spaced relation to the connection to the link and projecting from the base plate in a plane parallel to the base plate, said operating arm being generally rectilinearly movable for imparting the required operating movement to the lever actuator and thereby effect opening and closing of the contacts as the contact arm actuator is actuated by the crank and crank actuating member.

3. An electric switch comprising a base plate, stationary and movable contact means associated with each other and mounted on one side of the base plate, a snap ac-

tuating mechanism mounted on the opposite side of the base plate and including a crank actuator with an arcuate slot therein rotatively pivoted to the base plate and snap acting means pivoted at its inner end to the actuator within said arcuate slot and adapted to rotate the actuator with a snap action, a toggle arm pivoted at the inner end to the base and secured at the outer end to the outer end of the snap acting means, an operating member secured to the toggle arm to rotate the same and effect actuation of the snap acting means when a center axis line extends through the pivots of the crank actuator and the snap acting means, and a crank secured to the base plate and extending therethrough in engagement at one end with the crank actuator of the snap actuating mechanism and at the other end with the movable contact means to open and close the contact means by a snap action when the toggle arm and snap actuating mechanism are actuated by the operating member.

4. An electric switch as set forth in claim **3** wherein the base plate has an arcuate slot therein at the location of the operating member, and an extension on the operating member projecting through the arcuate slot and disposed to engage the crank actuator when the operating member is rotated from an "on" to an "off" position and rotate the crank actuator with a sufficient degree of rotation to disengage the contacts in the event that the snap actuating mechanism fails to operate.

5. An electrical switch comprising a mounting plate-like base having a first side and a second side, an insulated housing mounted on the first side of the base, stationary contacts supported by said housing, a toggle arm located on the first side of the base and pivoted at its inner end to said base, and the base having an arcuate slot adjacent the outer end of the toggle arm, a projection on the outer end of the toggle arm extending through the arcuate slot towards a second side of the base, a crank actuator, pivot means pivoting the crank actuator to the base on the second side of the base, and said actuator having an outwardly turned ear at the inner end with an arcuate slot

therein and spaced ears at the outer end, a stop member secured to the base between the spaced ears of the actuator to regulate the rotational movement of the crank actuator, a lever arm secured at the outer end thereof to the projection of the toggle arm, a pin extending through the slot in the crank actuator and securing the inner end of the lever arm to the crank actuator, a spring assembled around the lever arm and adapted to apply a rotative force on the crank actuator, a crank supported at the first side of the base and having a projection extending through the base and into operative engagement with the crank actuator, a contact carrier arm reciprocally disposed at the first side of the base and coupled with the crank for reciprocation by the crank, movable contacts secured to the contact carrier and disposed to engage and disengage the stationary contacts upon reciprocation of the contact carrier, and an operating member secured to the toggle arm and extending outwardly from said base to actuate said arm and crank actuator, and movement of the operating member effecting snap action separation and engagement of the movable contacts and fixed contacts upon movement of the lever arm beyond a center line axis extending through the lever arm, and through the pin securing the lever arm and crank actuator together and the pivot means of the crank actuator.

6. The electric switch of claim **1** wherein each of said movable contacts is resiliently mounted on the contact arm with resilient means biasing the contacts to contact closed position.

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