March 22, 1960 H. J. TYLER 2,929,891

SNAP ACTING SWITCH

Filed Jan. 13, 1958 7 Sheets-Sheet 1

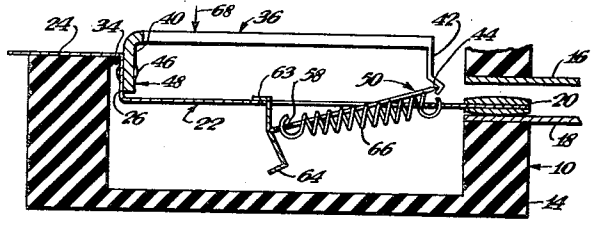


Fig. 1.

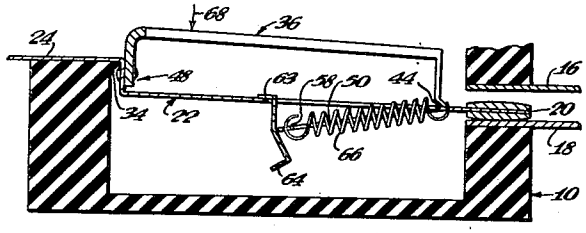


Fig. 2.

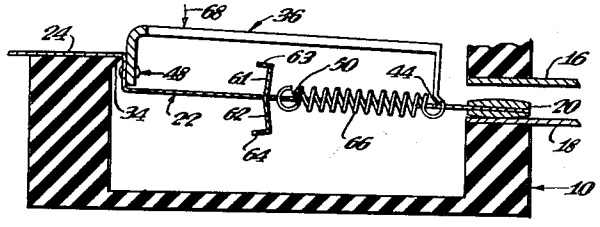


Fig. 3.

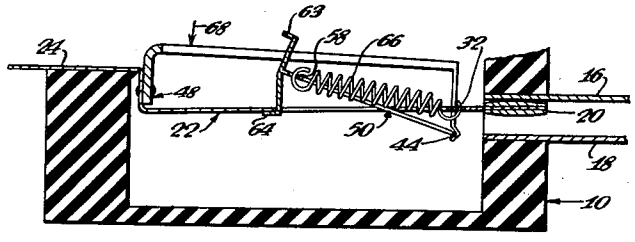


Fig. 4.

March 22, 1960 H. J. TYLER 2,929,891

SNAP ACTING SWITCH

Filed Jan. 13, 1958 7 Sheets-Sheet 2

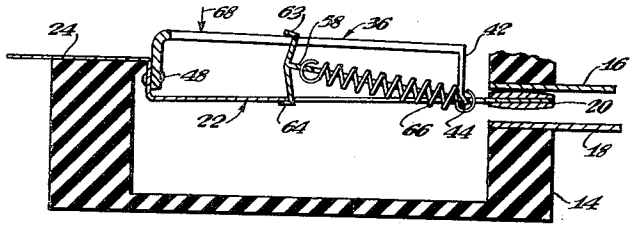


Fig. 5.

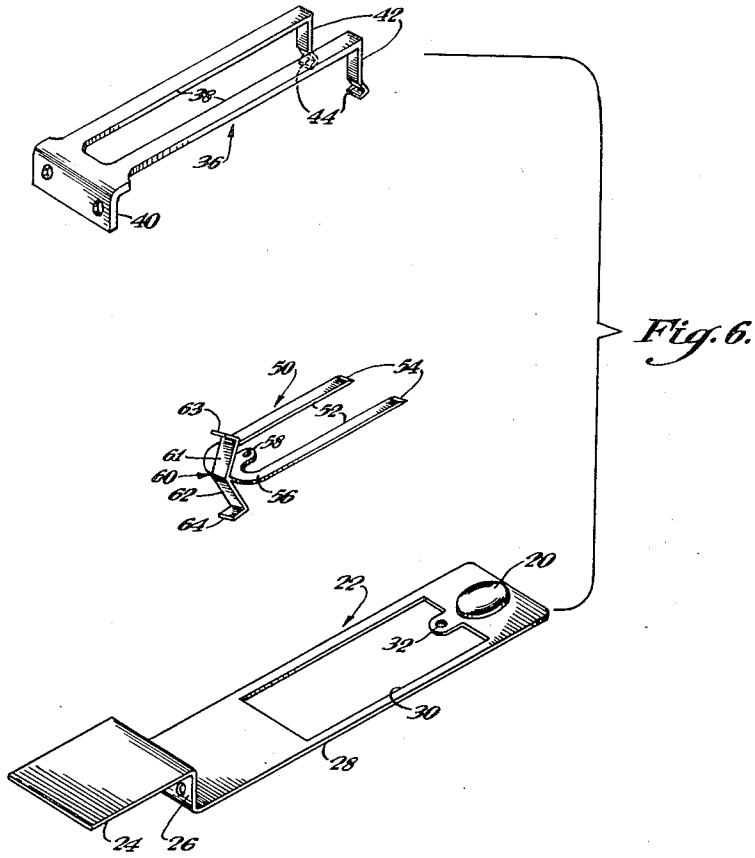


Fig. 6.

March 22, 1960 H. J. TYLER 2,929,891

SNAP ACTING SWITCH

Filed Jan. 13, 1958 7 Sheets-Sheet 3

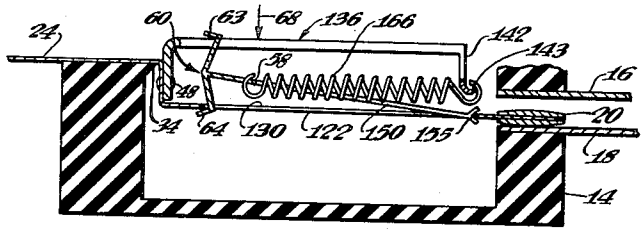


Fig. 7.

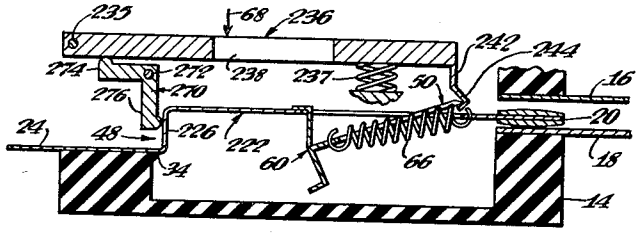


Fig. 8.

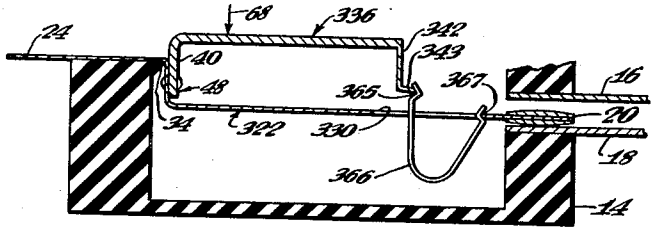


Fig. 9.

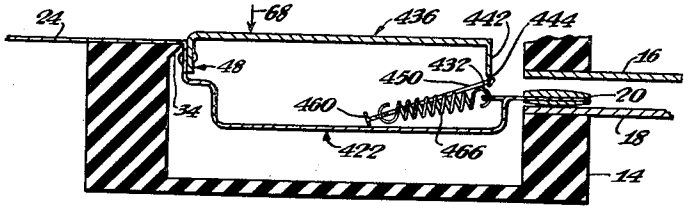


Fig. 10

March 22, 1960 H. J. TYLER 2,929,891

SNAP ACTING SWITCH

Filed Jan. 13, 1958 7 Sheets-Sheet 4

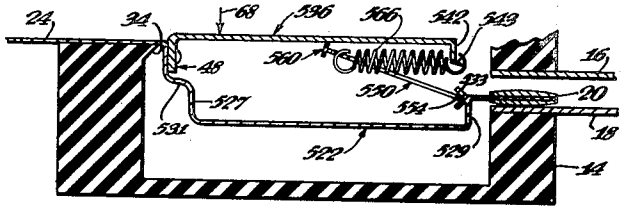


Fig. 12.

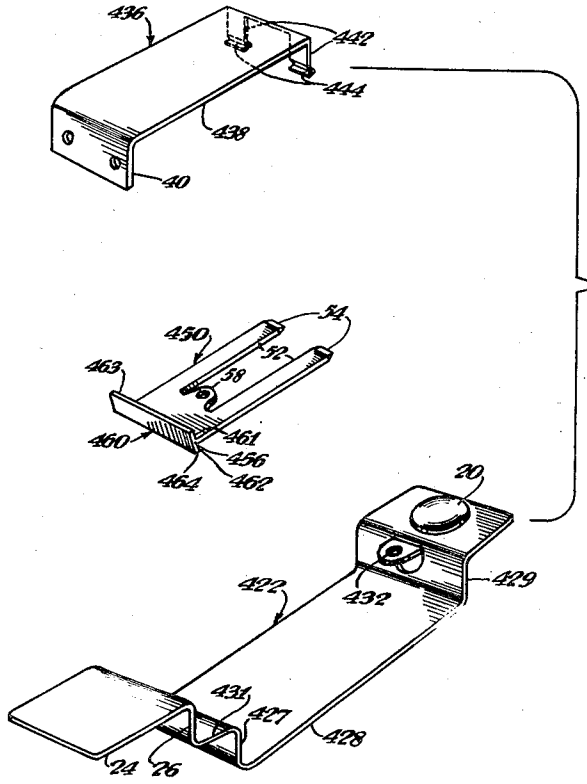


Fig. 11.

March 22, 1960 H. J. TYLER 2,929,891

SNAP ACTING SWITCH

Filed Jan. 13, 1958 7 Sheets-Sheet 5

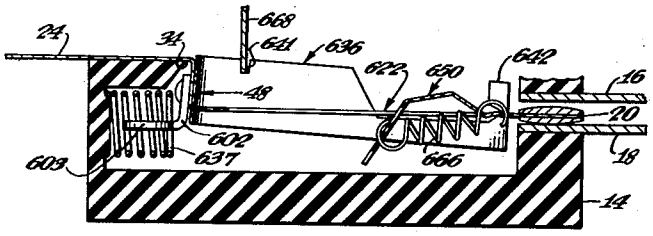


Fig. 13.

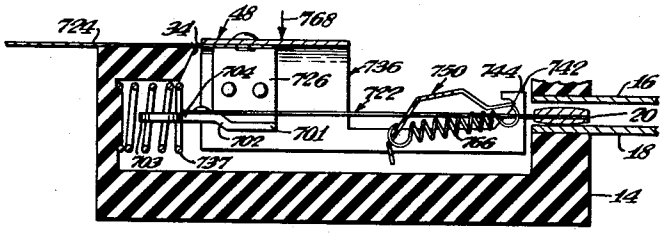


Fig. 15.

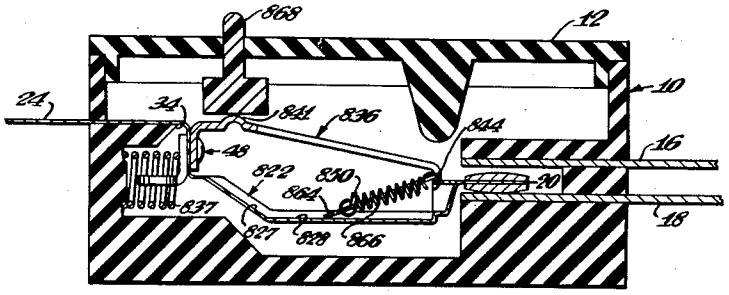


Fig. 17.

March 22, 1960 H. J. TYLER 2,929,891

SNAP ACTING SWITCH

Filed Jan. 13, 1958 7 Sheets-Sheet 6

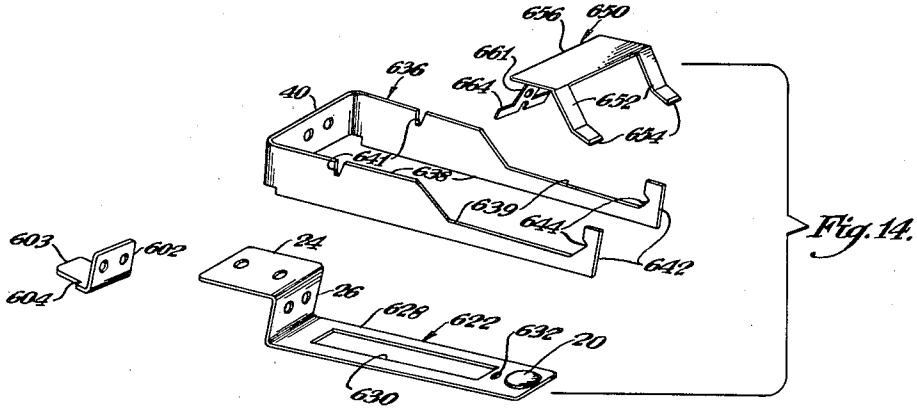


Fig. 14.

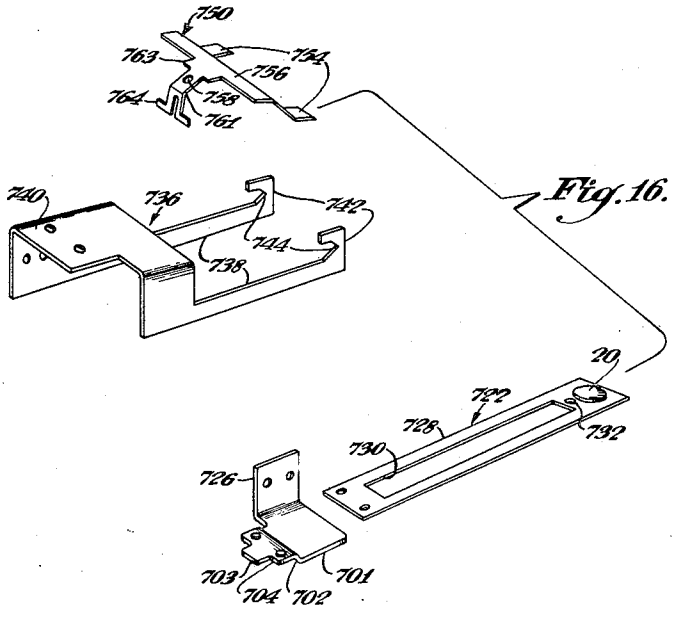


Fig. 16.

March 22, 1960 H. J. TYLER 2,929,891

SNAP ACTING SWITCH

Filed Jan. 13, 1958 7 Sheets-Sheet 7

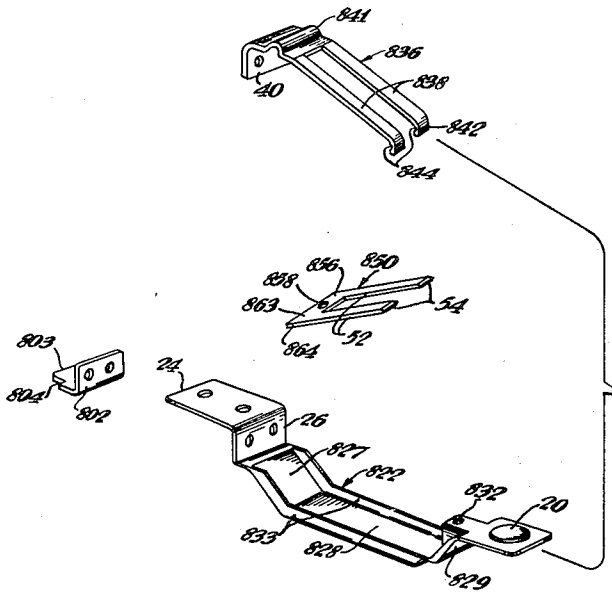


Fig. 18.

United States Patent Office 2,929,891 Patented Mar. 22, 1960

2,929,891

SNAP ACTING SWITCH

Hugh J. Tyler, Jeannette, Pa., assignor to Robertshaw-Fulton Controls Company, Richmond, Va., a corporation of Delaware

Application January 13, 1958, Serial No. 708,497

15 Claims. (Cl. 200—67)

This invention relates to a snap acting mechanism and more particularly to a miniature heavy-duty snap acting switch in which a force is applied to an actuating member in one direction to move a contact carrier in an opposite direction with a snap action.

An object of this invention is to move the free end of an actuated member in a snap acting mechanism in two directions.

This invention has another object in that the free end of an actuated member in a snap acting mechanism is movable in a direction opposite to an applied force and in a direction substantially perpendicular to the applied force.

This invention has a further object in that the applied force in a snap acting switch is utilized to maintain substantial contact pressure until the instant of snap over and to produce a contact wiping action.

It is another object of this invention to apply a wiping action force on the movable contact of a snap acting switch without interfering with the contact pressure force.

It is another object of this invention to produce a wiping action between the mating contacts in a snap acting switch by transverse movement of the movable contact arm.

An additional object of this invention is to construct a snap acting miniature switch that is simple, economical, compact, and capable of maintaining a minimum switch differential while being responsive to a small operating force.

In carrying out this invention, the actuating member and the actuated member of a snap acting mechanism have free ends with portions that are interconnected by resilient means so that movement of the actuating member by an applied force moves the resilient means beyond an overcenter position causing the free end of the actuated member to move with a snap action in a direction opposite to the applied force. An operable connection between portions of the other ends of the actuating member and the actuated member causes the actuated member to move in response to the applied force and supply a wiping action to its free end in a direction substantially perpendicular to the snap action.

Other objects and advantages of this invention will become apparent from the following description taken in connection with the accompanying drawings, wherein:

Fig. 1 is a longitudinal section view of a snap acting switch embodying this invention showing the switch contacts in their normal position with a minimum operating force;

Fig. 2 is similar to Fig. 1 but showing the position of the parts with an increased applied force;

Fig. 3 is similar to Fig. 1 but showing the position of the snap acting mechanism as it moves through an overcenter position;

Fig. 4 is similar to Fig. 1 but showing the position of the contacts after the snap acting mechanism has been moved through its overcenter position;

Fig. 5 is similar to Fig. 2 but showing the contacts in their opposite mating position;

Fig. 6 is an exploded perspective view of the snap acting elements shown in Fig. 1;

Fig. 7 is a longitudinal section view of a modification of this invention;

Fig. 8 is a longitudinal section view of another modification of this invention;

Fig. 9 is a longitudinal section view of another modification of this invention;

Fig. 10 is a longitudinal section view of another modification of this invention;

Fig. 11 is an exploded perspective view of the snap acting elements shown in Fig. 10;

Fig. 12 is a longitudinal section view of another modification of this invention;

Fig. 13 is a longitudinal section view of another modification of this invention;

Fig. 14 is an exploded perspective view of the snap acting elements shown in Fig. 13;

Fig. 15 is a longitudinal section view of another modification of this invention;

Fig. 16 is an exploded perspective view of the snap acting elements shown in Fig. 15;

Fig. 17 is a longitudinal section view of another modification of this invention; and

Fig. 18 is an exploded perspective view of the snap acting elements shown in Fig. 17.

Referring more particularly to Fig. 1, a miniature switch housing is indicated generally at **10**, preferably formed of a molded plastic or like dielectric material and comprises a top member **12** (Fig. 17) secured to a base member **14** by any suitable means (not shown). A pair of fixed contacts **16** and **18** are mounted in spaced parallel relation on the base member **14** and extend through a wall thereof to be electrically connected to conventional lead wires. Movable contact means **20** comprising a pair of contacts are secured to opposite sides of a contact pressure lever arm **22** adjacent its free end which is disposed in the space between fixed contacts **16** and **18** for movement therebetween.

The contact carrying arm **22** is a generally rectangular strip made of good conducting material, such as copper or the like. As is illustrated in Fig. 6, arm **22** comprises a mounting portion **24**, a vertical offset portion **26** extending downwardly therefrom and a rigid actuated portion **28** having a rectangular opening **30**. A shoulder portion shown as an apertured tab **32** extends into opening **30** from the end thereof which is adjacent the movable contact **20**. The mounting portion **24** is secured to base **14** (Fig. 1) in such a manner that the exposed end of portion **24** protrudes from housing **10** on the side opposite the fixed contacts **16** and **18** and is adapted to be electrically connected to a conventional lead wire. The inner end of mounting portion **24** overlies a small ledge **34** of tapering cross-section formed as an integral extension of base member **14** and defines an axis of rotation for a purpose to be described hereinafter.

As is illustrated in Fig. 6, an inflexible strip **36** in the form of a generally inverted U-shaped actuating lever comprises a pair of spaced parallel arm members **38** being joined at one end with a downwardly extending connecting portion **40** and having at their opposite ends a pair of downwardly extending leg members **42**. The extremity of each leg member **42** is provided with a V-shaped bearing notch **44** that serves as a pivot point. It is to be understood that reference to a pivot point is to be construed as including a pivot axis for the purposes of this invention. The length of the actuating lever **36** is smaller than the strip **22** so that the pivot point **44** is movable through the confines of the rectangular opening **30** relative to the strip **22**; however, the length is such

that the pivot point 44 extends slightly rearward of apertured tab 32 away from the movable contact 20. The connecting portion 40 is fastened to the vertical offset portion 26 of the strip 22 by any suitable means, such as rivets 46, to constitute a flexible hinge connection, indicated generally at 48, between the adjacent ends of strip 22 and strip 36.

A rigid toggle link, indicated generally at 50 in Fig. 6, comprises a pair of spaced parallel arm members 52 having a pair of knife edges 54 on one end and being joined at the opposite end by an arcuate portion 56 which has an apertured tab 58 on its inner periphery extending between and parallel to the arms 52. Toggle link stop means 60 formed on the outer periphery of arcuate portion 56 includes a pair of oppositely extending vertical members 61 and 62 having a pair of lugs 63 and 64 extending perpendicularly of their respective ends. The vertical members 61 and 62 are inclined slightly inwardly from the vertical to converge toward the plane of the arms 52 and the tab 58.

In order to make an operable connection between the free ends of the strips 22 and 36, resilient means in the form of a tension coil spring 66 is incorporated with the toggle link 50. One end of coil spring 66 is hooked through the apertured tab 32 on the strip 22 and its opposite end is hooked through the apertured tab 58 on the toggle link 50. The size of the toggle link 50 is smaller than the size of the rectangular opening 30 in which link 50 moves relative to the strip 22. The link 50 is disposed within the confines of the rectangular opening 30 with the knife edge 54 on one end engaging the V-shaped notches 44 on the strip 36 for pivotal movement therein and with the stop lugs 63 and 64 on the other end engaging the respective lower and upper surfaces (Figs. 1 and 4) of that part of strip 22 which defines the corresponding end of rectangular opening 30.

In the operation of the device illustrated in Fig. 1, an operating force, indicated by the arrow 68, is applied to the actuating lever 36. The arrow 68 is not to be construed as a vector representing magnitude and direction but only as an indication of the direction of the operating force. A conventional push button and cross bar (not shown) engaging lever arms 38 may be utilized for this purpose as well as various other arrangements well known to those skilled in the art. The spring force of the yieldable spring 66 is exerted on the free end of the actuated strip 22 whereby movable contact 20 is pulled down with a contact force into mating engagement with the lower fixed contact 18. The spring force is also exerted on toggle link 50 tending to rotate the same in a counterclockwise direction which rotation is prevented by the stop lug 63 engaging an edge of the actuated strip 22 and thus increasing the contact pressure force.

Fig. 2 illustrates the position of the operating elements when the operating force has been increased. Such an increase causes the pivot point 44 on lever 36 to move downwardly to its critical position where it lies in a plane coincident with the plane defined by the apertured tab 32 and the end of coil spring 66 hooked thereon. At this critical position, the spring force tending to rotate toggle link 50 is zero because the longitudinal axis of the coil spring 66 is in alignment between and disposed in a plane defined by the parallel toggle arms 52. However, the end of coil spring 66 which is hooked on toggle tab 58 is disposed in a plane beneath the plane of pivot point 44 so that the movable contact 20 is still being pulled downward into engagement with fixed contact 18 and the contact pressure force remains substantially unchanged from the conditions existing in Fig. 1. The distance traversed by pivot point 44 from Fig. 1 to Fig. 2 does not affect the contact force since the tension of coil spring 66 is not varied. Because of the rigidity of toggle link 50 any force exerted thereon by lever 36 at the pivotal connection therebetween is transmitted to the stop means 60 where the horizontal component of such force urges the vertical stop member 61 into engagement with the edge defining the corresponding end of rectangular opening 30 in strip 22 and the vertical component further urges stop lug 63 into engagement with strip 22 to add to the contact pressure force.

A further slight increase in the operating force 68 causes toggle link 50 to rotate in a clockwise direction to the position shown in Fig. 4 moving rapidly through the dead center position shown in Fig. 3. In Fig. 3, which represents the position of the elements at the instant of snap over, the contact force between contacts 18 and 20 is zero because the longitudinal axis of coil spring 66, the toggle arms 52, the pivot point 44 and the apertured tabs 32 and 58 are disposed on the same horizontal plane. During movement of lever 36 from the position shown in Fig. 1 to that shown in Fig. 3, a slight movement of strip 22 to the left is effected by the flexible hinge connection 48 so that movable contact 20 is provided with a wiping action relative to the fixed contact 18.

Movement of toggle link 50 through the position shown in Fig. 3 and the simultaneous movement of the coil spring 66 through its over center position causes the movable contact 20 on the free end of strip 22 to move with a snap action in a direction opposite to the direction of the actuating force exerted by lever 36. As is shown in Fig. 4, the toggle connected end of coil spring 66 is disposed above its actuated strip connected end so that the spring force exerted on the free end of strip 22 has a direction that is reversed relative to Fig. 1 and the movable contact 20 is held in engagement with the upper fixed contact 16.

The applied force 68, which is increased to effect the snap action of movable contact 20, also provides the movable contact 20 with a wiping action by causing the flexible hinge 48 to rotate clockwise about the axis of rotation 34. This wiping action produces a self-cleaning effect on the contact surfaces and is also effective as a shearing action to break a weld between contact surfaces that may have been formed during a previous contact making action. In the event a weld occurs, the wiping action is prevented until the force tending to rotate the flexible hinge 48 about the axis of rotation 34 is sufficiently great to shear the welded contact surfaces.

It is to be understood that the snap-acting elements in Fig. 4 could be retained in such a position and the applied force 68 removed from the actuator lever 36. However, in describing this invention, the snap-acting elements are returned to their original position shown in Fig. 1 in response to the decrease of applied force 68 as would occur in a thermostatic device. Accordingly, the operation of the snap-acting elements then proceeds in reverse to the above described operation for Figs. 1–4; thus, when the operating force is initially decreased, the pivot point 44 returns to its critical position as illustrated in Fig. 5, which is similar to Fig. 2 except that the elements are reversed. Further decrease in the operating force 68 causes the coil spring 66 to move from its over center position in Fig. 5 through its dead center position shown in Fig. 3 to its original position shown in Fig. 1 with the movable contact 20 moving with a snap action from the upper fixed contact 16 to the lower fixed contact 18.

In the following description of the various modifications of this invention, the same reference numerals will be used to designate identical parts and reference numerals with the addition of 100 will be used to designate similar parts of the different modifications. Thus, in Fig. 7, the movable portion of a contact carrying arm 122 is provided with a rectangular opening 130 that is longer than the opening 30 in the previous modification. An inflexible actuating lever 136 has a pair of downwardly extending leg members 142, the extremities of which are connected by a perpendicularly disposed cross tab 143. A toggle link 150 differs from the previously described link 50 by having a larger length for

cooperation with the longer opening 130 and by having an open V-shaped notch 155 on the free end of each of its pair of parallel arm members 152 (only one being shown). A tension coil spring 166 cooperates with toggle link 150 to form an operable connection between the actuated and actuating members 122 and 136. One end of coil spring 166 is hooked on the tab 143 of the inflexible lever 136 and its opposite end is hooked through the apertured tab 58 on the toggle link 150. The V-shaped notch 155 on the free end of each arm 152 serves as a pivot point for the toggle link 150 and engages the strip 122 at that portion defining the forward edge of the rectangular opening 130.

The modification in Fig. 7 operates in substantially the same manner as described above for Fig. 1. It is to be noted, however, that the lever connected end of the yieldable spring 166 is movable downward in response to the applied force 68 on the actuating lever 136. Thus, the pivot point 155 on the toggle link 150 does not move until snap action occurs. Furthermore, the stop lugs 63 and 64 are located a greater distance from the free end of the flexible strip 122 so that the pressure exerted against the strip 122 by the stop lugs 63 and 64 does not reduce the contact force between movable contact 20 and its mated one of the fixed contacts 16 and 18.

Another modification shown in Fig. 8 includes a flat inflexible actuator 236 having one end pivotally mounted at 235 and a pair of downwardly extending legs 242 (only one being shown) on the other end, the extremities of which are provided with V-shaped bearing notches 244 which serve as a pivot point. A return spring 237 is mounted in compression between an internal wall of casing 10 and the undersurface of actuator 236. The contact carrying arm 222 is similar to the arm 22 in Fig. 1 except that the offsetting portion 226 extends vertically upwardly from the mounting portion 24 which is located in a plane below the plane of the fixed contact 18. A flexible hinged connection 48 is formed by a bell crank lever 270 which is pivoted at 272 and has one arm 274 engaging the undersurface of actuating lever 236 and another arm 276 engaging the vertical portion 226 of arm 222. As is illustrated in Figs. 1–3, the flexible hinged connection 48 causes the wiping action of movable contact 20 to be toward the left, whereas the flexible hinged connection 48 in Fig. 8 causes the wiping action to be toward the right.

Operation of the modification illustrated in Fig. 8 is effected by a force 68 applied to actuating lever 236 causing the same to rotate clockwise about pivot 235 so that the pivot point 244 is movable in the same manner as previously described in connection with Fig. 1. Movement of lever 236 also causes bell crank lever 270 to rotate counterclockwise so that the flexible hinged connection 248 rotates clockwise about the axis of rotation 34. The results obtained by the snap acting switch in Fig. 1 are also obtained by the snap acting switch in Fig. 8 which utilizes separate elements that are readily connected into a thermostatic element lever system. Furthermore, this modification is readily adaptable for use with separate elements so that the wiping action force could be applied directly to contacts 16 and 18 for sliding the same relative to contact 20.

Another modification is shown in Fig. 9 wherein an inflexible actuating lever 336 is a generally U-shaped solid strip having a connecting portion 40 on one end and a leg member 342 on the other end. A tab 343 is bent substantially perpendicularly from the free end of the leg 342. A contact carrying arm 322 is provided with a rectangular opening 330 which is smaller than the previously described opening 30 in Fig. 1. An operable connection between the free ends of the strips 322 and 336 includes a generally U-shaped rolling spring 366 having V-shaped bearing notches 365 and 367 on respective ends of its leg portions; the notch 365 receives the tab 343 on the strip 336 to serve as a pivot point therefor and the notch 367 engages that portion of strip 322 which defines the forward edge of the rectangular opening 330. With spring 366 mounted in compression, the movable contact 20 is moved with a snap action when the applied force 68 causes the pivot point 365 to move downwardly below the plane of the notch 367. A wiping action of the contact 20 is effected by the strip 322 as previously described by means of the flexible hinged connection 48 which may also be utilized to function as a return spring when the applied force 68 is removed.

Figs. 10 and 11 illustrate another modification of this invention wherein the toggle link and resilient means move between the actuating and actuated strips, which permits manufacture of a very narrow switch mechanism for a miniature housing. A contact carrying conductor strip 422 (Fig. 11) has a free end carrying the movable contact means 20 and a mounting portion 24 extending perpendicularly from a vertical offsetting portion 26, as previously described in connection with Fig. 1. In addition, solid strip 422 comprises a central horizontal portion 428 with legs 427 and 429 extending vertically upwardly from opposite ends; vertical leg 427 terminates in an outwardly extending horizontal portion 431 which is joined to the vertical offsetting portion 26 and vertical leg 429 terminates in an oppositely outwardly extending horizontal portion which forms the free end of strip 422 containing the movable contact means 20. An apertured tab 432 is struck out of the vertical leg 429 and bent perpendicularly thereto to lie in a plane coincident with the free end of the strip 422. The vertical legs 427 and 429 cooperate with the central horizontal portion 428 to form an open-sided longitudinal recess in the strip 422.

An actuating lever 436, as shown in Fig. 11, is a generally inverted U-shaped solid strip with a horizontal member 438 having a downwardly extending connection portion 40 at one end and a pair of downwardly extending leg members 442 at its opposite end. The extremities of legs 442 are provided with V-shaped bearing notches 444 that serve as a pivot point.

A toggle link 450 is similar to link 50 in Fig. 1 except that stop means 460 comprises relatively short vertical members 461 and 462 having edges 463 and 464, respectively, to serve as stop lugs. The arm members 52 are joined at one end to a straight portion 456 having a straight edge from which the vertical members 461 and 462 extend in opposite directions to form a T-shape. Counterclockwise rotation of toggle link 450 about its pivot point 44 in the position shown in Fig. 10 is prevented by stop edge 464 engaging the actuated strip 422; clockwise rotation of toggle link 450 in a position reversed to Fig. 10 is prevented by stop edge 463 engaging the actuating strip 436.

During the operation of the device shown in Figs. 10 and 11, the pivot point 444 is moved downward in response to the applied force 68 to the critical point where pivot point 444 is aligned with apertured tab 432. A further slight increase in the applied force 68 actuates the toggle link 450 in a clockwise direction about the pivot point 444 causing the coil spring 466 to move rapidly through a dead center position to an over center position in which the stop edge 463 engages the undersurface of actuating lever 436. Because of the flexible hinge 48, the applied force 68 which causes the movable contact 20 to be moved in a vertical direction with a snap action, also causes the movable contact 20 to be moved in a horizontal direction with a wiping action. The vertical force is the vertical component of the force exerted by spring 466 and the horizontal force is the horizontal component of the force exerted by the flexible hinged connection 48 as described previously.

Another modification illustrated in Fig. 12 comprises a narrow switch mechanism and reverses the positions of a toggle link 550 and coil spring 566 from that described in Fig. 10, whereby the lever-connected end of

coil spring 566 is movable relative to the pivot point for the toggle link 550. A contact carrying strip 522 is constructed similar to the strip 422 in Fig. 11 except that tab 432 is replaced with a V-shaped member 533 which forms a pivot point for the knife edges 554 of the toggle link 550.

An actuating lever 536 in the form of a generally inverted U-shaped solid strip has the extremity of its leg member 542 bent outwardly into a tab 543. The toggle link 550 is constructed in the same shape as link 450 in Fig. 11. Yieldable means in the form of a tension coil spring 566 has one end hooked around tab 543 on the actuating strip 536 and an opposite end hooked through the apertured tab 58 on the toggle link 550.

The operation of the switch shown in Fig. 12 is similar to that previously described in connection with Fig. 7 except that the stop means 560 alternately engages the actuated and actuating strips 522 and 536 as determined by the alternate engagement of movable contact 20 with fixed contacts 16 and 18, respectively.

Another modification of this invention is illustrated in Figs. 13 and 14 wherein the actuated strip is disposed within the confines of the actuating strip. The actuated contact pressure lever arm 622 has a free end carrying the movable contact means 20 and a mounting portion 24 extending perpendicularly from a vertical offsetting portion 26, as previously described in connection with Fig. 1. The actuated strip 622 includes a rigid actuated portion 628 provided with a rectangular opening 630 that is longer than the opening 30 in Fig. 1. An inflexible actuating lever 636 comprises a connecting portion 40 and a pair of spaced parallel arm members 638 extending from the side edges thereof. As is illustrated in Fig. 14, the parallel arm members 638 are disposed in an edgewise manner, the upper edges of which are provided with a cut-out portion 639 along their upper edges. The free ends of arms 638 have upwardly extending leg members 642, each of which is provided with a V-shaped bearing notch 644 that serves as a pivot point. The upper edges of spaced arms 638 are notched at 641 to receive a bridge member 668 which applies an operating force to the actuating lever 636.

A toggle link 650 comprises a pair of spaced parallel arms 652 sloping downwardly from the forward edge of a straight portion 656 and terminating in knife edges 654. Toggle link stop means 660 has a vertical member 661 sloping downwardly from the rearward edge of the straight portion 656 and being disposed for movement within the slot 630. The ends of member 661 are provided with upper and lower cross pieces which serve as stop lugs; only lower lug 664 is shown in Fig. 14 and the upper stop lug 663 is similar to stop lug 763 in Fig. 16.

A generally L-shaped back-up plate has a vertical portion 602 affixed to the rear of vertical offsetting portion 26 and a horizontal portion 603 with a facet 604. A return spring 637 encircles horizontal portion 603 and is mounted in compression between the facet 604 and a circular wall portion of base 14.

Operation of the modification illustrated in Fig. 13 is similar to that previously described in connection with Fig. 1, and the positions of the operating elements are shown to correspond to the position illustrated in Fig. 2. In Fig. 13, the upper stop lug engages the edges of strip 622 which define the rectangular opening 630; when movable contact 20 engages the fixed contact 16, the lower stop lug 664 engages the undersurface of strip 622. Return action is aided by the return spring 637 which abuts the flexible hinge connection 48.

Another modification is illustrated in Figs. 15 and 16, and is shown as differing from the modification of Fig. 13 by separating the mounting portion 724 from the rigid actuated strip 728. As is shown in Fig. 16, the offsetting portion 726 is made integral with the back-up plate by means of horizontal plate 701. The back-up plate has a downwardly sloping section 702 so that the two horizontal portions 701 and 703 are offset from each other. The rigid actuated strip 728 is secured to horizontal portion 703 by any suitable means such as rivets. The vertical offsetting portion 726 is disposed along the side of strip 728 and is secured to an adjacent arm 738 of the actuating lever 736 by any suitable means such as rivets. The connecting end 740 of the lever 738 is horizontally disposed parallel to the mounting end 724 and is secured thereto by any suitable means such as rivets. In this modification, rigid portion 728, the back-up plate, offsetting portion 726, the lever connecting end 740, and the mounting portion 724 are all made of good conducting material, such as copper or the like.

As is illustrated in Fig. 16, a toggle link 750 is similar to link 650 in Fig. 14 and its vertical member 761 of the stop means is bent intermediate its ends so that the upper stop lug 763 and lower stop lug 764 are in convergent relation.

The position of the operating elements in Fig. 15 are shown to correspond to the position illustrated in Fig. 1; the operation of the modification illustrated in Figs. 15 and 16 is similar to that of the modification in Fig. 13 and the flexible hinge connection 48 in both such modifications operate in a manner similar to that described in connection with Fig. 1.

Another modification is illustrated in Figs. 17 and 18 wherein the toggle link and resilient means move between narrow actuating and actuated strips, which permits manufacture of a very narrow and flat switch mechanism for a miniature housing. A contact carrying conductor strip 822 has a free end carrying the movable contact means 20 and a mounting portion 24 extending perpendicularly from a vertical offsetting portion 26, as previously described in connection with Fig. 1. In addition, strip 822 comprises a central horizontal portion 828 with legs 827 and 829 sloping upwardly from opposite ends thereof; leg 827 is joined to the offsetting portion 26 and leg 829 is joined to the horizontal portion which forms the free end of strip 822 containing the movable contact means 20. An apertured tab 832 is formed as a part of leg 829 and lies in a plane coincident with the free end of strip 822. The legs 827 and 829 cooperate with the central horizontal portion 828 to form a longitudinal recess in the actuated strip 822. The solid horizontal portion 828, as well as its corresponding part in all previous modifications, is formed of any suitable material to prevent buckling thereof and in Fig. 18, side flanges 833 are integrally formed on each side of central portion 828 and the two legs 827 and 829 in order to enhance the rigidity thereof.

An actuating lever 836 has a pair of spaced parallel arms 838 joined at one end with a downwardly extending connecting portion 40 and bent at an opposite end to form downwardly extending leg members 842. The extremity of each leg member 842 is provided with a V-shaped bearing notch that serves as a pivot point 844. The actuating lever 836 is also provided in a projection 841 which is engaged by a plunger 868 for applying an operating force thereto.

A toggle link 850 is similar to link 450 shown in Fig. 11 but has been simplified by positioning an aperture 858 in the straight portion 856 and utilizing the upper and lower edges thereof as upper and lower stop lugs 863 and 864, respectively. Thus, counterclockwise rotation of toggle link 850 about its pivot point 844 in the position shown in Fig. 17 is prevented by stop edge 863 engaging the central horizontal portion 828 of strip 822; clockwise rotation of toggle link 850 in a position reversed to Fig. 10 is prevented by stop edge 864 engaging the actuating lever 836.

The flexible hinge connection 48 is provided with an L-shaped back-up plate having a vertical portion 802 affixed to the rear of offsetting portion 26 and a horizontal

portion 803 with a facet 804. A return spring 837 encircles horizontal portion 803 and is mounted in compression between facet 804 and a circular wall portion of base 14.

Operation of the device shown in Fig. 17 is similar to that described in connection with Fig. 10, and the positions of the operating elements are shown to correspond to the position illustrated in Fig. 1.

Inasmuch as various changes may be made in the arrangement and combination of parts and in the details of the constructions herein disclosed, it is intended that the foregoing descriptions and drawings be interpreted as illustrative and not in a limiting sense.

I claim:

1. In a snap acting mechanism, the combination comprising a strip having first and second oppositely disposed ends, means including resilient means and forming an operable connection with said strip adjacent the first end thereof, actuating means operatively connected to said first mentioned means whereby said resilient means is movable in one direction past a dead center position causing movement of the first end of said strip with a snap action, and the second end of said strip having a portion operably fastened to said actuating means to form a flexible connection therebetween whereby the first end of said strip is caused to move substantially perpendicular to the snap action movement.

2. In a snap acting mechanism, the combination comprising an actuated element having a mounting end and a movable end, an actuating element having opposite ends respectively disposed adjacent the ends of said actuated element, movable means including resilient means and having one part operatively connected to one of the ends of said actuating element for movement thereby and having another part operatively connected to said actuated element adjacent the movable end thereof whereby movement of said first mentioned means by said actuating element causes said resilient means to pass a dead center position to move the movable end of said actuated element in one direction with a snap action, and the mounting end of said actuated element having a connecting portion operably fastened to the other end of said actuating element whereby movement of the same causes the movable end of said actuated element to move in a direction substantially perpendicular to the direction of such snap action.

3. A snap acting mechanism comprising, an actuated arm having a mounting end provided with a flexible connecting portion adjacent the mounting end and having a free end provided with a shoulder portion adjacent the free end, an actuating lever having a connecting end disposed adjacent the said offset portion and a free end provided with a pivot means, means including spring means and having one part operatively connected to the said shoulder portion and an opposite part operatively connected to the said pivot means, said lever being movable when force is applied thereto to move the said pivot means beyond a critical position where the pivot means is in alignment with the said shoulder portion so that said spring means causes the free end of said arm to move with a snap action in a direction opposite to the force applied to said lever, and the connecting end of said lever being fastened to the flexible connecting portion of said arm so that when force is applied to said lever the free end of said arm is also moved in another direction.

4. A snap acting mechanism comprising, an actuated arm having a fixed end with an offsetting portion and a free end with a shoulder portion, an actuating lever having a connecting portion on one end and pivot means on an opposite end, a toggle member having connecting means on one end and pivot means on an opposite end engaging the pivot means on said lever, spring means mounted in tension between the connecting means on said toggle member and the shoulder portion on said arm, said lever being movable by an applied force to move both pivot means beyond a critical position where the connecting means and pivot means on said toggle member are in alignment with the shoulder portion on said arm so that said spring means causes the free end of said arm to move with a snap action in a direction opposite to the force applied to said lever and cause the said one end of said toggle member to swing simultaneously with the free end of said arm, and the offsetting portion of said arm being operably fastened to the connecting portion on said lever whereby movement of the same causes movement of the free end of said arm in a direction substantially perpendicular to the snap action thereof.

5. The combination as recited in claim 4 wherein said toggle member is provided with stop means on the said one end thereof to limit the swing of said toggle member.

6. In a snap acting mechanism, the combination comprising; an actuating arm having a downwardly extending connecting portion on one end and a downwardly extending leg means on the other end, pivot means disposed on the extremity of the leg means; an actuated member having a mounting portion on one end, a movable portion with a free end and a vertical offsetting portion extending upwardly from the movable portion to the mounting portion, an apertured tab extending from the free end of the movable portion toward the mounting portion; a toggle link having an apertured tab adjacent one end and pivot means on its other end engaging the pivot means on the leg means of said actuating arm; resilient means mounted in tension between the apertured tabs on said toggle link and said actuated member whereby a spring force is exerted on the free end thereof; said arm being movable by an applied force to move both pivot means beyond a critical position for swinging said toggle link and causing the spring force exerted on the free end of said actuated member to reverse its direction with a snap action; and, the connecting portion of said arm being operably secured to the vertical offsetting portion of said actuated member forming a flexible hinge whereby the same force applied to said arm causes the free end of said actuated member to move in another direction.

7. In a snap acting mechanism, the combination comprising; an actuating member having a pair of spaced parallel arms, a connecting portion extending downwardly from one end of said arms, and a leg member extending downwardly from each of the other ends of said arms, a cross tab joining the extremities of each leg member; an actuated member having a mounting portion, a movable portion and a vertical offsetting portion therebetween, a shoulder portion on said movable portion disposed inwardly from the free end thereof; a toggle link having an apertured tab adjacent one end and V-shaped bearing means on an opposite end in engagement with the shoulder portion on said actuated member and cooperating therewith to form pivot means; a coil spring mounted in tension between the apertured tab on said toggle link and the cross tab on said actuating member whereby a spring force tends to rotate said toggle link about said pivot means; stop means on said toggle link engaging said actuated member to prevent the rotation of said toggle link whereby the spring force is exerted on the free end of said actuated member; said actuating member being movable by an applied force to move the cross tab beyond a critical position where it is in alignment with said pivot means causing said toggle link to swing about said pivot means whereby the spring force exerted on the free end of said actuated member reverses its direction with a snap action; and the connecting portion of said actuating member being operably secured to the vertical offsetting portion of said actuating member causing the free end of said actuated member to move in another direction in response to the applied force on said actuating member.

8. In a snap acting switch, the combination comprising an actuating lever being pivotally mounted at one end and having a leg member extending downwardly from

an opposite end, pivot means disposed on the extremity of said leg member, an actuated member having a mounting portion, an offsetting portion extending from the mounting portion and a movable portion extending from the offsetting portion to a movable end, an operable connection including a toggle link and a coil spring connected thereto mounted between said lever and said actuated member with the toggle link engaging said pivot means on said lever and the coil spring connected to the movable portion of said actuated member whereby a spring force is exerted on the movable end of said actuated member, said lever being movable by an applied force causing said operable connection to move the free end of said actuated member with a snap action, and a bell crank lever pivotally mounted with one arm being movable by said actuating lever and another arm operable to bias the offsetting portion on said actuated member whereby the applied force on said actuating lever pivots said bell crank lever to move the free end of said actuated member with a wiping action.

9. In a snap acting mechanism, the combination comprising an actuating member and an actuated member disposed in superimposed relation, each of said members having connecting portions on opposite ends, a U-shaped rolling spring mounted in compression between the connecting portions on adjacent ends of said members whereby a force applied to said actuating member moves said spring through a dead center position subjecting said actuated member to a snap acting force, the other connecting portion of said actuated member comprising a flexible portion, and the other connecting portion of said actuating member being secured to said flexible portion whereby the same force applied to said actuating member subjects said actuated member to a wiping force.

10. In a snap acting mechanism, the combination comprising an actuating member having a connecting portion on one end and pivot means on an opposed end, a recessed actuated member having a movable end and a mounting portion on an opposite end, a vertical offsetting portion extending downwardly from said mounting portion, a substantially U-shaped portion extending between the movable end and the offsetting portion, an apertured tab extending inwardly from the movable end, a toggle link having an apertured tab adjacent one end and pivot means on an opposed end engaging the pivot means on said actuating member, a coil spring mounted in tension with opposed ends secured respectively in the apertured tabs on said toggle link and said actuated member whereby a spring force tends to swing said toggle link about its pivot means, stop means on said toggle link engageable with the U-shaped portion of said actuated member to prevent swinging of said toggle link whereby the spring force is transmitted to the movable end of said actuated member, said actuating member being movable by an applied force to move both pivot means beyond an aligned position with the apertured tab on said actuated member causing said toggle link to swing about its pivot means to a position where said stop means engages said actuating member whereby the spring force transmitted to the movable end of said actuated member reverses its direction with a snap action, and the connecting portion of said actuating member being operably secured to the offsetting portion of said actuated member forming a flexible hinge whereby the movable end of said actuated member moves with a wiping action in response to the force applied to said actuating member.

11. In a snap acting mechanism, the combination comprising an actuating member having a connecting portion on one end and a connecting tab on an opposite end, a recessed actuated member having a movable end and a mounting portion on an opposite end, a vertical offsetting portion extending downwardly from said mounting portion, a substantially U-shaped portion extending between the movable end and the offsetting portion, pivot means extending inwardly from the movable end of said actuated member, a toggle link having an apertured tab adjacent one end and pivot means on an opposed end engaging the pivot means on said actuated member, a coil spring mounted in tension with opposed ends secured respectively to the apertured tab on said toggle link and the connecting tab on said actuating member whereby a spring force tends to swing said toggle link about its pivot means, stop means on said toggle link engageable with said actuating member to prevent swinging of said toggle link whereby the spring force is transmitted to the movable end of said actuated member, said actuating member being movable by an applied force to move its connected tab beyond an aligned position with both pivot means causing said toggle link to swing about its pivot means to a position where said stop means engages the U-shaped portion of said actuated member whereby the spring force transmitted to the movable end of said actuated member reverses its direction with a snap action, and the connecting portion of said actuating member being operably secured to the offsetting portion of said actuated member forming a flexible hinge whereby the movable end of said actuated member moves with a wiping action in response to the force applied to said actuating member.

12. In a snap acting mechanism, the combination comprising an actuating lever and an actuated arm in superimposed relation, means including resilient means operatively connected between one pair of adjacent ends of said lever and said arm whereby movement of said lever causes said resilient means to pass a dead center position for moving said arm with a snap action in one direction, and means connecting the other pair of adjacent ends of said lever and said arm including a back-up plate having a pair of horizontal portions offset from each other, a vertical portion extending from one of the horizontal portions and being secured to the other end of said lever, the other end of said arm being secured to the other of the horizontal portions, and flexible mounting means for the said other end of said lever whereby the movement of said lever causes said connecting means to transmit a force for moving said arm in another direction.

13. The combination as recited in claim 2 wherein the mounting end of said actuated element includes a back-up plate having a horizontal portion, and a return spring exerting a biasing force on said back-up plate and said actuated element.

14. The combination as recited in claim 13 wherein said actuating element is provided with a notched upper edge and a bridge member engages said notched upper edge to apply an operating force to said actuating element.

15. The combination as recited in claim 13 wherein said actuating element is provided with a projection on its upper edge and a plunger member engages said projection to apply an operating force to said actuating element.

References Cited in the file of this patent

UNITED STATES PATENTS

1,796,854	Mayer	Oct. 16, 1934
2,418,068	Cornelius	Mar. 25, 1947
2,508,040	Ransome	May 16, 1950
2,537,682	Ljungfeldt	Jan. 9, 1951
2,589,563	Miller	Mar. 18, 1952
2,651,690	Raney	Sept. 8, 1953
2,700,079	Haydon	Jan. 18, 1955

FOREIGN PATENTS

985,620	France	Mar. 14, 1952