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2,631,205

SNAP ACTION MECHANISM

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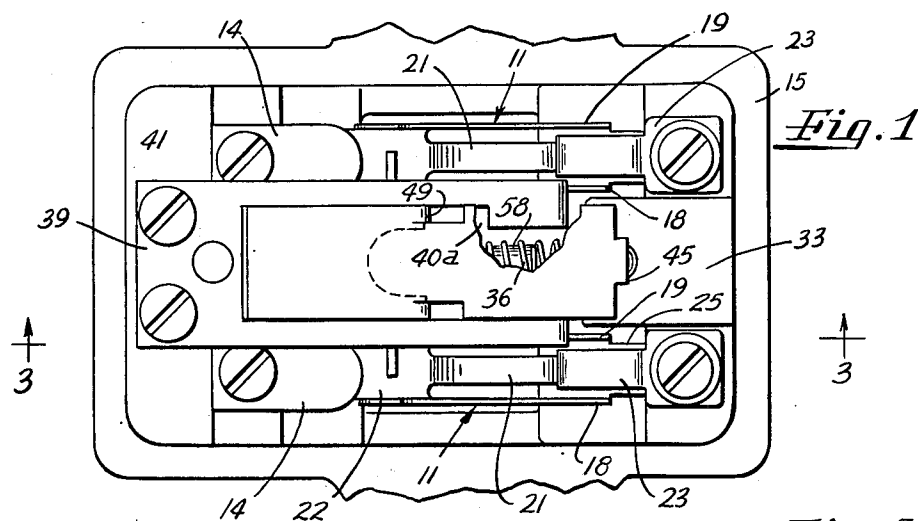


Fig. 1

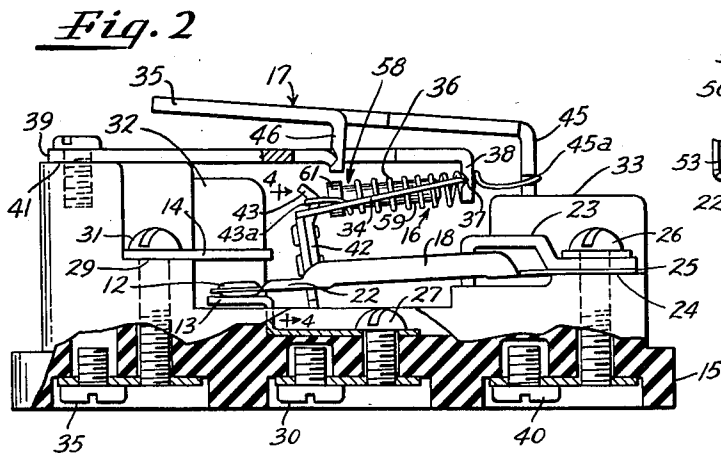


Fig. 2

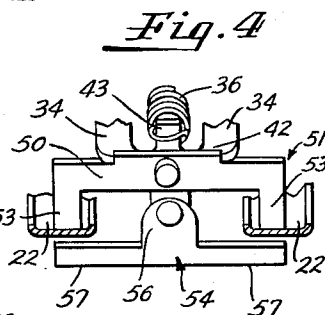


Fig. 4

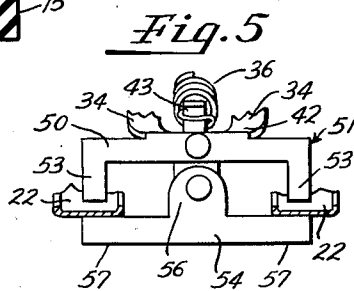


Fig. 5

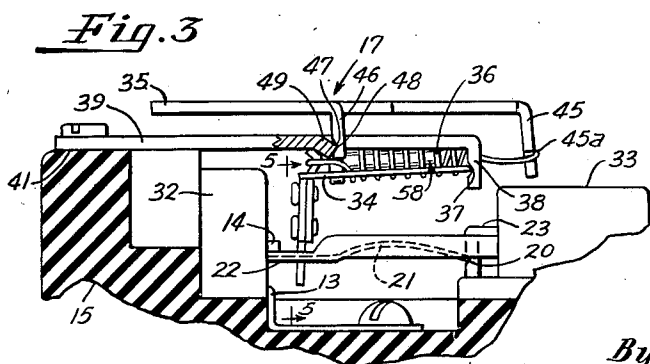


Fig. 3

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UNITED STATES PATENT OFFICE

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SNAP ACTION MECHANISM

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6 Claims. (Cl. 200—67)

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This invention relates to snap action devices and more particularly to improvements in snap action devices of the type disclosed in application, Serial No. 613,284 filed August 29, 1945, which is now U. S. Patent No. 2,487,374, issued November 8, 1949, in which at least one driven snap spring system is actuated by a driving spring system.

A general object of this invention is to provide a device of the character described having novel actuating means providing improved operating characteristics.

Another object of this invention is to provide a switch of the character described having novel means for actuating the driving spring system that requires a minimum of applied force to actuate the system.

Another object of this invention is to provide a snap acting device having a relatively longer life than prior mechanisms of like character.

Another object of this invention is to provide a snap action switch having mobile contacts mounted on a driven spring system for movement between fixed contacts and novel means for minimizing bounce and chatter of the mobile contacts as they move into engagement with the fixed contacts.

Yet another object of this invention is to provide a snap action switch having a plurality of spaced mobile contacts movable between spaced fixed contacts and novel means for interconnecting the driving spring system with the driven spring system which insures a uniform contact pressure between the mobile and fixed contacts in one position of the mobile contacts and effects simultaneous disengagement of the mobile contacts from said position upon actuation of the driving spring system.

Other objects and advantages of the invention will become apparent from the following detailed description taken in connection with the accompanying drawings, in which—

Figure 1 is a top plan view of an electric switch embodying the present invention;

Fig. 2 is a side elevational view of the switch shown in Figure 1 in its normal position with portions cut away to show the terminal construction;

Fig. 3 is a fragmentary sectional view taken along the line 3—3 in Figure 1 showing the actuating member in a different operating position than in Fig. 2;

Fig. 4 is a sectional view taken substantially along the line 4—4 of Fig. 2, and

Fig. 5 is a sectional view taken substantially along the line 5—5 of Fig. 3.

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The invention is shown embodied in a double pole double throw switch. In general the switch of the embodiment shown comprises a pair of driven snap spring systems 11 each carrying a mobile contact 12 movable with a snap motion between opposed stationary contacts 13 and 14, a driving spring system designated generally by the numeral 16 for driving the pair of spring systems 11 and a pivotally mounted lever 17 movable between preselected positions for actuating the spring system 16. The contacts 13 and 14 also form stops limiting the movement of the free ends of the spring systems 11 and 16.

As best seen in Figures 1 and 2 the spring systems 11 are mounted on a suitable base 15 of insulating material in side by side relation in a substantially common plane. Each of the snap spring systems 11 comprises (see Figure 1) spaced tension members 18 and 19 and a compression member 21 disposed between the spaced tension members 18 and 19. At one end the tension members 18 and 19 and the compression member 21 of each spring system 11 are interconnected to form an end 22, shaped to support the mobile contact 12 and free to move between the opposed contacts 13 and 14. At the opposite end the compression member 21 is received in a recess 20 (see Fig. 3) formed on an anchor 23, the latter being secured to a shoulder 24 (see Fig. 2) on the base 15, as by a screw 25. This construction provides a pivotal mounting for the compression member 21. At the opposite end, the tension members 18 and 19 are interconnected by a bridging portion 25 and are mounted in a cantilever fashion, as by having the bridging portion 25 disposed between the anchor 23 and the shoulder 24. The mountings for the compression members 21 and the tension members 18 and 19 are such that movement of the tension members 18 and 19 past the pivotal support 20 of the compression member 21 of each spring system 11 causes each mobile contact 12 to move out of engagement with one fixed contact and to snap into engagement with the opposed fixed contact.

Each contact 13 is in the form of a Z-shaped member as shown in Fig. 2 suitably secured on the base 15, as by a screw 27, to have a portion disposed to be engaged by the contacts 12. Each contact 14 is in the form of a flat leaf member secured on a shoulder 29 of the base, as by a screw 31, so that a portion overlies and is in spaced relation to the contact 13. With this construction the contacts 12 engage the contacts 13 in one position of each spring system 11 and

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engage the contacts 14 in the other position of each spring system 11. The fixed contacts 13 and 14 and the mobile contacts 12 may be connected to external circuits through the mounting screws 27, 31 and 26 and conventional terminals 39, 35 and 40 positioned in recesses formed on the bottom of the base 15 and in electrical conductive relation respectively with the mounting screws. Insulating barriers 32 and 33, respectively, projecting upwardly from the base 15, at opposite ends of the spring systems 11 separate the spring systems to minimize arcing between the respective contacts.

In this embodiment of the invention the driving spring system 16 is mounted on the base 15 to overlie the spring systems 11. In general the spring system 16 includes spaced compression members 34 and a tension member 36. At one end the compression members 34 are received in transversely extending grooves 37 (see Fig. 3) formed on depending fingers 38 of a rigid bracket 39. The latter bracket is secured on a shoulder 41 formed on the base 15, adjacent the free ends 22 of the spring systems 11, in a cantilever fashion and in general overlies the spring systems 11 and 15. At their opposite ends the compression members 34 are interconnected by a crosspiece 42 (see Fig. 2) disposed between the base 15 and the bracket 39 and forming a portion movable between preselected positions. At one end the tension member 36, which in this instance is in the form of a coil spring, has an end looped over an ear 43 projecting upwardly from the crosspiece 42 to provide a pivotal mounting 43a. The opposite end of the tension member 36 is looped over an arm or a depending end 45 of the lever 17 to provide a pivotal mounting at 45a, the bracket 39 being formed with a slot 40a at its outer end (see Figure 1) to permit this connection and movement of the lever 17 to be hereinafter described. The lever 17 as shown, overlies and is pivotally mounted on the bracket 39 so that movement of the lever about its pivotal mounting moves the end of the tension member 36 mounted on the lever 17 relative to the pivotal recesses 37 of the compression members 34 to actuate the driving snap spring system 16. To effect the pivotal mounting of lever 17 in this embodiment of the invention, the lever 17 is formed with depending leg portions 46 spacing the lever 17 above the bracket 39 and having recesses 47 shaped to receive knife edges 48 formed by bending tabs 49 downwardly along opposite sides of the slot 40a. Movement of the end 45 of the lever 17 supporting the tension member 36 is limited in one direction by engagement of the lever 17 with the upper surface of the insulating barrier 33. Movement of the lever 17 in the opposite direction is limited by engagement of the operating arm or free end 35 of the lever 17 with the bracket 39.

Another phase of the invention is concerned with novel means for interconnecting the driving spring system 16 with the driven spring systems 11. As best shown in Figs. 4 and 5 the connection comprises an inverted U-shaped member 51 having a bridging portion 50 rigidly attached to the crosspiece 42 as by a rivet and having the ends of its leg portions 53 engageable with the upper sides of the free ends 22 of the spring systems 11, and an inverted T-shaped member 54 having its stem portion 56 pivotally mounted on the crosspiece 42 and its laterally extending arms 57 engageable with the opposite sides of the free ends 22 of the spring systems 11. When the leg portions 53 engage the free ends 22 of the

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driven spring systems 11 the arms 57 are spaced from the free ends. Similarly when the arms 57 engage the free ends 22 the legs 53 are spaced from the free ends 22. This construction thus provides a lost motion connection between the driving spring 16 and the driven springs 11. The legs 53 in effect form rigid anvils or hammers for striking the free ends 22 for simultaneously disengaging the mobile contacts 12 from engagement with the contacts 14 with a hammerblow. The pivotal connection of the T-shaped member 54 insures that a uniform pressure is applied to both contacts 12 when the arms 57 engage the free ends 22.

Another aspect of the invention is concerned with minimizing the bounce of the contacts 12 when they initially engage either of the spaced contacts 13 or the spaced contacts 14. In this embodiment of the invention this is effected by a slug 58 being disposed in the coil spring 36. As best shown in Figs. 2 and 3 the slug comprises a cylindrical portion 59 and a head portion 61. The cylindrical portion has a diameter that is approximately two to three thousandths inches smaller than the inside diameter of the coil spring. The head portion 61 has a diameter larger than the internal diameter of the coil spring 36 so as to position the slug and prevent movement of the slug into the interior of the coil spring. The slug 58 may be formed from copper or other suitable material. With a switch construction of the above character it has been found that the tendency of the mobile contacts to bounce or chatter is substantially, if not entirely eliminated.

The operation of the foregoing switch construction may be readily understood with the following description with reference to Figs. 2-5. In Figs. 2 and 4 the spring systems 11 and 16 are in their normal position and the mobile contacts 12 engage the fixed contacts 13. The lever 17 is biased by the tension coil spring 36 so that the end 45 of the lever 17 supporting the tension member 36 is urged into engagement with the top of the barrier 33. The leg portions 53 of the inverted U-shaped insulating member 51 engage the free ends 22 of the spring systems 11 and augment the force of the latter tending to cause the mobile contacts 12 to be forced against the contacts 13 with a positive pressure. To actuate the switch a force is applied to the free end 35 of the lever 17 so that the lever 17 is moved in a counterclockwise direction as seen in Fig. 2 about its pivotal support determined by the depending legs 46 of the lever and the knife edges 48. Counterclockwise movement of the lever 17 moves the connection between the lever 17 and the tension member 36 relative to the pivotal support of the compression members 34 (recesses 37 on the depending arms 38) so that the spring system 16 is moved through its axis of unstable equilibrium or moves overcenter. As soon as the spring system 16 goes overcenter the crosspiece 42 moves between its preselected positions with a snap action. As a consequence the arms 57 of the inverted T-shaped member 54 move, with preliminary lost motion, into engagement with the underside of the free ends 22 of the spring systems 11. The arms 57 in effect form anvils which strike the movable free ends 22 so that movement of the mobile contacts 12 away from fixed contacts 13 is initiated by a hammerblow action. When the contacts 12 engage the contacts 14 the arms 57 of the inverted T-shaped member 54 urge

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the contacts 12 into engagement with the contacts 14. The pivotal mounting of the member 54 insures that a uniform pressure is applied between the respective mobile contacts 12 and the fixed contacts 14. As best seen in Fig. 2 when the point 45a is raised by rotation of lever 17 in a counterclockwise direction until the tension centerline of the spring 36 passes above the point 37 the driving spring system snaps to the position shown in Fig. 3 carrying the driven spring systems 11 overcenter and bringing the mobile contacts into engagement with stationary contacts 14. In this position the arms 57 bear against the lower sides of the ends 22 and the contacts 14 prevent further upward movement of the point 43a. Furthermore the parts are so proportioned that the point 45a cannot be moved in a counterclockwise direction to an extent sufficient to bring the points 43a, 48 and 45a into alignment and therefore the tension centerline of the spring 36 can never pass the point 48. As a consequence the lever 17 is always biased to return to the position shown in Fig. 2, and when the operating pressure is removed from the lever 17 the latter returns to its normal position. The operation of the switch in the reverse direction of movement of the lever 17 is substantially the same as that previously described with the exception that it takes place in the reverse order. Thus, the connection between the tension member 36 and the lever 17 is moved relative to the pivotal recess 37 of the compression member 34 or through the overcenter position of the spring system. As a result the crosspiece 42 of the spring system 16 is moved between its preselected positions with a snap action in the opposite direction. The leg portions 53 are thus moved relative to the free ends 22 through the lost motion connection and strike the spring systems 11 with a hammerblow to disengage the contacts 12 from the contacts 14. The rigid construction and connection of the U-shaped member 51 with the crosspiece 42 insures that when the snap spring system 16 is actuated both contacts 12 are simultaneously moved out of engagement with the contacts 14. At the completion of the snap action motion the contacts 12 and lever 17 assume the position shown in Fig. 2. The slug 59 disposed in the coil spring 36 reacts with the latter to tend to eliminate chatter and bounce as the contacts 12 move into engagement with the fixed contacts 13 and 14.

It is to be understood that since the lever 17 is mounted on a pivot, which is substantially friction free, and is biased to its normal position by the coil spring 36, the only force required to actuate the spring system is that required to overcome the biasing force of the spring. Thus a minimum of applied force is required in the actuation of the driving spring system 16.

I claim:

1. In a snap action device of the type having a pair of independent spring systems arranged in side by side relationship and each having a first end free to move between opposed stops, the combination of a compression member, a tension member interconnected at one end with said compression member to form a second free end in spaced relation to said first free ends and movable between opposed positions with a snap action, spaced abutment means mounted on said second free end and engageable with the free ends of the independent spring systems to form a lost motion driving connection

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between said first and second free ends, said spaced abutment means in each position of the first free ends forming a stop defining one of said opposed positions for said second free end, means for mounting the opposite end of the compression member, a lever formed with a first depending arm at one end supporting the opposite end of the tension member to define with the compression member a driving snap spring system having an axis of maximum stress, said lever also being formed with a second depending arm intermediate its ends for pivotally mounting the lever, pivotal movement of said lever displacing said first depending arm to move said opposite end of the tension member through said axis of maximum stress to actuate the driving spring system and move said second free end between its opposed positions with a snap action, and spaced abutment means engageable with said lever for limiting movement of said one end of the lever between opposed positions on one side of an axis of stress defined by the second free end and the pivotal mounting for the lever to bias the lever in one direction of movement.

2. In a snap action device of the type having at least one independent spring system supported on a base and having an end free to move into preselected rest positions with a snap action, the combination of a first stressed member, a second stressed member interconnected at one end with said first stressed member and forming an end free to move between preselected positions with a snap action, a bracket mounted on said base to overlie said free end of the stressed members, said bracket being formed with means for fixedly pivotally mounting the opposite end of the first stressed member, said bracket defining a pivotal knife edge spaced from said mounting for the opposite end of the first stressed member, a lever formed at one end with a first depending arm interconnected with the opposite end of the second stressed member to support the same, said lever also being formed with a second depending arm intermediate its ends formed with a pivotal recess receiving said knife edge on said bracket to pivotally mount the lever thereon, pivotal movement of the lever effecting displacement of said first depending lever arm to move said opposite end of the second stressed member past said opposite end of the first stressed member to effect snap action movement of the free end of the driving spring system, and spaced abutment means mounted on said free end of the driving spring system and engageable with the free end of said independent snap spring in at least one of its rest positions for urging the free end into said rest positions and movable relative to said free end of said independent spring system upon snap movement of said free end of the driving spring system to initiate movement of the free end of said independent spring system with a hammerblow snap action.

3. The structure of claim 2 further characterized by abutment means formed by a portion of said bracket interposed in the path of the lever on the opposite side of the pivot thereof from said first depending lever arm for limiting movement of the lever to prevent movement of said opposite end of the second stressed member beyond an axis defined by the interconnected end of said stressed members and the pivotal mounting for the lever.

4. The combination in a snap action device of a base, a first stressed member, a second stressed

member movable between preselected positions interconnected at one end with said first stressed member and forming an end free to move between preselected positions with a snap action, means for mounting the opposite end of the first stressed member, a lever having a first end and a second end, means mounted on said base acting on an intermediate portion of said lever to provide a pivotal mounting for the lever about which the second end is movable to move the first end, said first end of the lever supporting the opposite end of the second stressed member to define with said first stressed member a spring system and movable to move the centerline of the second stressed member past the mounting means for the first stressed member to actuate the spring system, one of said stressed members being a coil spring, and a slug mounted in said coil spring comprising a headed portion and a cylindrical portion, said cylindrical portion being of substantially the same diameter as the inside diameter of the coil spring and disposed therein and said headed portion abutting against an end of the coil spring to prevent axial movement of the slug into the coil, said slug coacting with said coil spring to minimize bounce and chatter of the free end of the independent spring system as it moves into its respective rest positions.

5. In a snap action device of the type having at least one independent spring system supported on a base and having an end free to move into preselected rest positions with a snap action, the combination of a first stressed member, a second stressed member interconnected at one end with said first stressed member and forming an end free to move between preselected positions with snap action, one of said stressed members being formed as a coil spring, an elongated mass extending interiorly of said coil spring lengthwise thereof to be supported thereby for minimizing bounce and chatter of the free end of the independent spring system as it moves into its respective rest positions, a bracket mounted on said base to overlie said free end of the stressed members, said bracket being formed with means for fixedly pivotally mounting the opposite end of the first stressed member, a lever formed at one end with a first depending arm interconnected with the opposite end of the second stressed member to support the same, said lever also being formed with a second depending arm intermediate its ends coacting with said bracket to pivotally mount the lever thereon, pivotal movement of the lever effecting displacement of said first depending lever arm to move said opposite end of the second stressed member past said opposite end of the first stressed member to effect snap action movement of the free end of the driving spring system, and spaced abutment means mounted on said free end of the driving spring system and engageable with the free end of said independent spring system in at least one of its rest positions for urging the free end into said rest positions and movable relative to said free end of said independent spring system upon snap movement of said free end of the driving spring system to initiate movement of the free end of said independent spring system with a hammerblow snap action.

6. In a snap action device of the type having a pair of independent spring systems supported on a base and each having an end free to move into preselected rest positions with snap action, the combination of a first stressed member, a second stressed member interconnected at one end with said first stressed member and forming an end free to move between preselected positions with snap action, a bracket mounted on said base to overlie said free end of the stressed members, said bracket being formed with means for fixedly pivotally mounting the opposite end of the first stressed member, said bracket defining a pivotal knife edge spaced from said mounting for the opposite end of the first stressed member, a lever formed at one end with a first depending arm interconnected with the opposite end of the second stressed member to support the same, said lever also being formed with a second depending arm intermediate its ends formed with a pivotal recess receiving said knife edge on said bracket to pivotally mount the lever thereon, pivotal movement of the lever effecting displacement of said first depending lever arm to move said opposite end of the second stressed member past said opposite end of the first stressed member to effect snap action movement of the free end of the driving spring system, pivotally mounted abutment means mounted on said free end of the driving spring system and engageable with one side of the free ends of said independent snap springs in one of their rest positions, and abutment means rigidly mounted on the free end of the driving spring system in spaced relation to the pivotally mounted abutment means and engageable with the free ends of the independent spring systems on the side thereof away from that engaged by the pivotally mounted abutment means in the other rest position of said free ends of the independent spring systems, said rigidly and pivotally mounted abutment means forming a lost motion connection between the driving and independent spring systems, said rigidly mounted abutment means effecting simultaneous movement of the free ends of the independent spring systems from said one rest position with a hammerblow snap action upon actuation of the driving spring system.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,000,052	Thordarson	Aug. 8, 1911
1,909,037	Armstrong	May 16, 1933
1,910,510	Warner	May 23, 1933
1,924,639	Corcoran	Aug. 29, 1933
1,995,620	Monroe	Mar. 26, 1935
2,277,111	Johnson	Mar. 24, 1942
2,486,061	Ransome	Oct. 25, 1949
2,487,374	Riche et al.	Nov. 8, 1949

FOREIGN PATENTS

Number	Country	Date
148,964	Great Britain	Sept. 15, 1921