Aug. 30, 1966 R. F. OXLEY 3,270,148

ELECTRIC SWITCH WITH FLEXIBLE SNAP ACTION CONTACT ELEMENTS

Filed Sept. 18, 1964 2 Sheets-Sheet 1

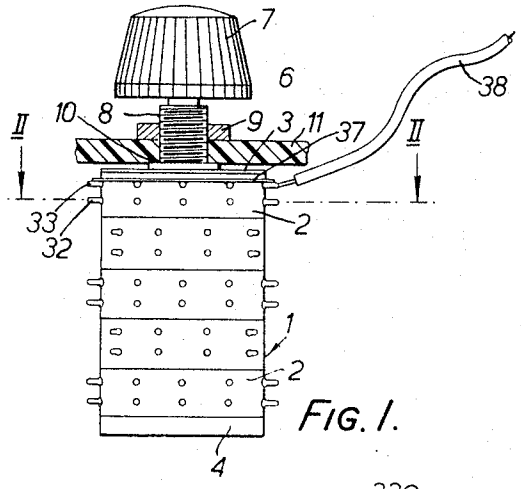


FIG. 1.

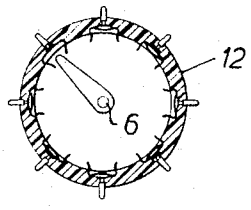


FIG. 2.

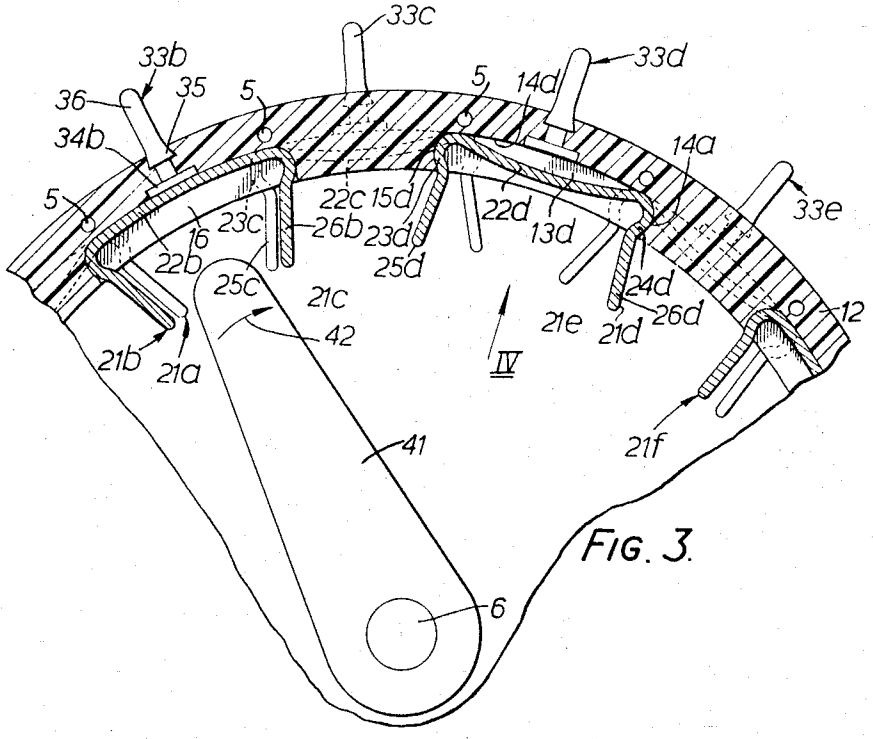


FIG. 3.

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ELECTRIC SWITCH WITH FLEXIBLE SNAP ACTION CONTACT ELEMENTS

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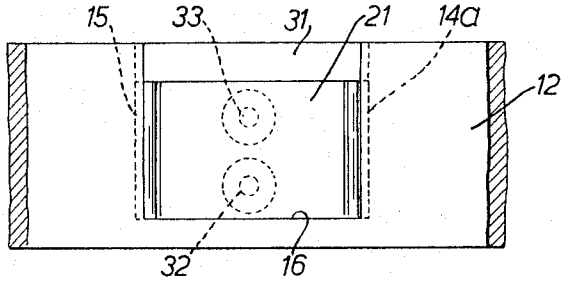


FIG. 4.

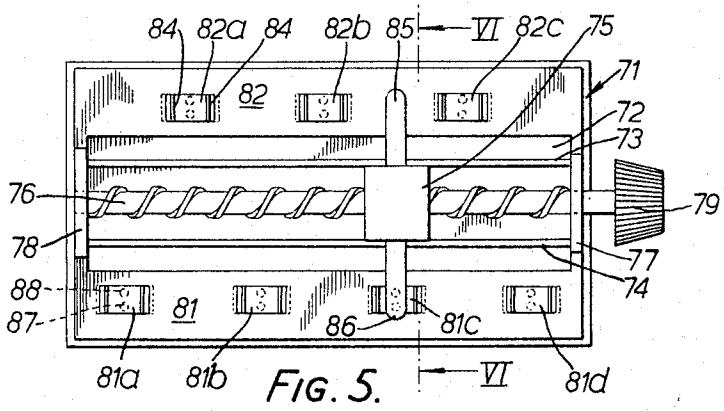


FIG. 5.

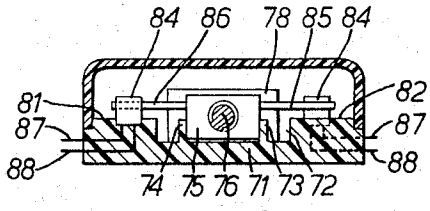


FIG. 6.

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United States Patent Office 3,270,148
Patented August 30, 1966

3,270,148

ELECTRIC SWITCH WITH FLEXIBLE SNAP ACTION CONTACT ELEMENTS

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Filed Sept. 18, 1964, Ser. No. 397,477
Claims priority, application Great Britain, Sept. 19, 1963, 36,963/63; May 28, 1964, 22,151/64
12 Claims. (Cl. 200—14)

This invention relates to multi-contact electrical switches such as rotary switches, and it is an object of the invention to provide a simple multi-contact electrical switch which is snap-acting. The majority of multi-contact switches have moving contacts which wipe the stationary contacts and are thus not snap acting. Certain forms of snap acting multi-contact rotary switches are known but these are clumsy, require considerable mechanical power for operation and are only suitable for low tension use.

According to the present invention, a multi-contact electric switch comprises a number of switch elements each of which has a bowed flexing portion having two positions of stability and arranged to make an electric connection in at least one of the positions and each of which has a pair of trigger members both projecting generally in the same direction from the flexing portion, one on each side of the centre of the bowed portion, and an operating element arranged to move relative to the switch elements to successively engage the two trigger members of each switch element in turn to cause the flexing portions of the switch elements to successively snap from one position of stability to the other and back again.

Preferably each switch element is of integral construction and approximates to the shape of a capital pi(Π), the ends being held at a distance apart which results in bowing of the central portion. Thus the switch elements may be of strip such as spring steel but other cross-sections, such as rod or wire, and other materials such as plastics are possible. Instead of the switch element being simply bowed by its ends being held together by an external component the switch element may have the ends of the bowed portion held by integral and unbowed portions of the switch member. For example the bowed portion may be provided by a dished centre portion surrounded by an undished periphery. Alternatively the switch element may comprise three strips connected together at each end, the central strips being longer than the other two and thus being bowed.

In a preferred construction in which the switch elements are of strip form, there is a connecting portion between the flexing portion and each trigger member which is part cylindrical and which is carried by and surrounds, or more preferably, is surrounded by a bearing surface on a body member. The body member may have recesses receiving the switch members and affording the bearing surfaces.

Many different electrical arrangements are possible. In the preferred arrangement the flexing portion of each switch element carrier or constitutes a conductive connecting element arranged to engage a pair of spaced terminals when the flexing portion is in one of its two positions of stability. Thus when the switch elements are mounted in recesses in a body member, there may be a pair of terminals in each recess. It would be possible to arrange for each switch element to cooperate with two pairs of terminals, one pair being interconnected in each position of stability of the flexing portion. Each switch element may cooperate with only one terminal and itself be permanently connected to another terminal.

In the preferred arrangement, the switch is a rotary switch and the switch elements are arranged circumferentially around an axis and there is an operating element such as a finger, mounted for rotation relative to the switch elements about the axis.

Preferably the trigger members extend generally towards the axis, i.e. in the plane of movement of the operating member, but they may extend axially, i.e. perpendicularly to the plane of movement of the operating member. In an alternative arrangement the switch is a linear switch with the switch elements arranged in one or more rows.

In a preferred arrangement, the switch elements are arranged in at least two rows, the switch elements of the two rows operating in staggered but overlapped relationship to give a make-before-break mode of operation.

The invention may be carried into practice in various ways but two particular multi-contact snap acting electric switches will now be described by way of example with reference to the accompanying drawings, in which:

FIGURE 1 is a side elevation of a rotary switch mounted on a panel with part of the panel broken away;

FIGURE 2 is a cross-section of the switch shown in FIGURE 1 taken on the line II—II of FIGURE 1;

FIGURE 3 is a fragmentary cross section similar to FIGURE 2 and taken on the same line but to an enlarged scale;

FIGURE 4 is a fragmentary elevation taken on the line IV of FIGURE 3;

FIGURE 5 is a plan view of a second form of switch, in this case the switch being a linear switch; and

FIGURE 6 is a cross section of the switch shown in FIGURE 5 taken on the line VI—VI of FIGURE 5.

Referring now to FIGURES 1 to 4 of the drawings, there is shown a rotary switch which includes a hollow cylindrical switching portion **1** made up of five identical switch assemblies **2**, a top end cover **3** and a bottom end cover **4**. These components are held together by a number of throughbolts which pass through apertures **5** visible in FIGURE 3. A shaft **6** is mounted in concentric apertures in the end covers **3** and **4** and extends upwardly beyond the upper cover **3** and has a knob **7** fixed to its upper end. A threaded sleeve **8** surrounds the shaft **6** and is fixed to the upper surface of the upper cover **3**. The sleeve passes through an aperture in a panel **11** and the panel is gripped between a nut **9** and a shoulder **10** on the sleeve to secure the switch **1** to the panel.

As the five switching assemblies **2** are identical only the upper assembly will be described in detail. The assembly includes a body member **12** providing an outer wall in the form of a cylinder whose axial length is small compared with the diameter. The body member **12** is formed as a plastic moulding. The outer surface of the body member **12** is cylindrical but the inner surface has eight grooves or recesses **13** formed in it. Each recess has a part-cylindrical inner wall **14** and curved undercut end walls **14***a* and **15**. As can be seen in FIGURE 4 each recess is open at the upper end but is closed at the other end to form a shelf **16**.

Each recess receives a spring member **21** which constitutes a switch element. For convenience of later description, the six spring members visible in FIGURE 3 have been given the references **21***a* to **21***f* and the various parts of these spring members and the corresponding recesses **13** are given the same identifying letters. Each spring member **21** is formed of thin springy strip metal of a width slightly less than the depth of the recess **13** into which it is to be fitted. The spring member **21** has a main flexing portion **22**, bearing portions **23** and **24** at the ends of the flexing portion **22** and trigger members **25** and **26** which extend inwards from the bearing portions **23** and **24**. The distance between the two bearing portions **23** and **24** is, in the unstressed state of the spring

member **21**, slightly greater than the corresponding distance between the end walls **14***a* and **15** of the recess **13** into which the spring member is to be placed. Accordingly when the spring member is placed in the recess the flexing portion **22** can either be bowed either inwards towards the centre of the cylinder as in the case of spring member **21***d* as shown in FIGURE 3 or bowed outwards away from the centre of the cylinder as in the case of spring member **21***b* in FIGURE 3. In the latter position the flexing portion **22** rests against the cylindrical wall **14** of the recess. Each spring member is retained in the recess in which it is positioned by an arcuate cover member **31** (see FIGURE 4) which has curved ends to correspond to the end walls **14***a* and **15** and arcuate sides to correspond to the cylindrical surface **14** of the recess and the inner surface of the body member **12** respectively. Thus, when in position, the closure member **31** forms an upper shelf above the spring member **21** corresponding to the integral shelf **16** provided by the portion of the body member **12** below the spring member **21**.

Each spring member **21** is effective, when it is in the condition in which it is bowed outwardly, electrically to connect two radially extending terminals **32** and **33**. Each switching element thus has two rings of eight circumferentially evenly spaced terminals, the two rings being axially displaced from one another. These terminals which are moulded into the body member **12** have a flat head portion **34** to engage with the spring members **21**, an enlargement **35** to retain the terminal in the moulding **12** and radially projecting portion **36** to which a wire may be connected by soldering or wrapping. By way of example all the terminals **33** of the upper switching element shown in FIGURE 1 are connected by a circumferential wire **37** which is connected by a lead wire **38** to a source of electricity. With this arrangement the source can be connected selectively to each of the lower terminals **32** of the upper switching element **2** in turn.

The main shaft **6** carries one radial finger **41** for each switching element, the level of each finger on the shaft being such that it is level with the switching members **21** of the respective switching elements. All five fingers project from the shaft in the same direction.

The operation of the top two switching elements **2** of the switch shown in FIGURES 1 to 4 will now be described in detail, particular reference being made to FIGURE 3 starting from the position of the finger **41** shown. In this condition the switching element **21***a* is in the off position while the switching element **21***b* is in the on position, that is to say the switching member **21***b* is bowed outwardly so that the contacts **32***b* and **33***b* are electrically connected together by the flexing portion **22***b* of the switching member **21***b*. If the shaft is rotated in the direction of the arrow **42** the finger **41** will first engage the trigger member **25***c* of the switching element **21***c*. This trigger member will be rocked anti-clockwise as viewed in FIGURE 3 about the bearing portion **23***c* of this switching element until the flexing portion **22***c* snaps to its radially outward position in which the contacts **32***c* and **33***c* are inter-connected. At this time the switching member **21***b* still connects the contacts **32***b* and **33***b*. Further rotation of the finger **41** will cause the finger to engage the further trigger member **26***b* of the switching element **21***b* thus rocking this trigger member anti-clockwise until at a certain stage the flexing portion **22***b* is caused to snap inwards so that the connection between the contacts **32***b* and **33***b* is broken with a snap action. Further rotation of the fingers will cause the flexing member **22***d* to make a connection between the terminals **32***d* and **33***d* and then the connection between the terminals **32***c* and **33***c* will be broken. This sequence will be continued as the shaft **6** is rotated, pairs of terminals **32** and **33** being successively connected together and disconnected, the breaking of a connection made by a given spring member in the top switching assembly occurring shortly after the making of a connection by the next spring member in sequence in the switching assembly immediately below. The three lower switching assemblies of the switch shown in FIGURE 1 are similarly staggered and connections will be made and broken at the same time as the corresponding connections are made and broken in the top two switch assemblies.

The switch shown in FIGURES 5 and 6 operates on similar principles to that shown in FIGURES 1 to 4 but is a linearly operated switch instead of a rotary switch. The switch includes a rectangular base member **71** having a central longitudinally extending rectangular well or recess **72**. Extending the length of the well are a pair of ribs **73** and **74** between which travel a slide block **75**. The slide block has a threaded bore through which extends a longitudinally extending coarsely threaded drive shaft **76** which is mounted in apertures in bearing brackets **77** and **78**. The shaft **76** has a knob **79** and rotation of the knob will cause the nut **75** to move longitudinally along the base **71**. The shelf **81** on one side of the well **72** has four spaced rectangular recesses **81***a* to **81***d* while the shelf **82** on the other side of the well has three recesses **82***a* to **82***c* which are staggered with respect to the recesses **81***a* to **81***d*. These recesses correspond to the recesses **16** of the switch shown in FIGURES 1 to 4 and each contains a spring member identical with the spring members **21** of FIGURES 1 to 4. The switching elements **83** have trigger-members **84** which project upwardly out of the apertures and can be engaged by fingers **85** and **86** which project outwardly from the block **75**. Moulded into the base member **71** to cooperate with each of the switching members **83** are pairs of terminals **87** and **88** the ends of which are exposed in the bases of the recesses **81** and **82** and which can be connected together by the flexing portions of the spring members.

The operation of the linear switch is similar to that of the rotary switch shown in FIGURES 1 to 4. Thus, as the knob **79** is rotated, the slide block **75** and hence the fingers **85** and **86** are moved linearly past the trigger members **84** of the spring members **81** and **82**. Accordingly the flexing portions of the spring members are changed successively from one of their positions of stability to the other and back again to successively make and break the connections between the terminals **87** and **88**.

What I claim as my invention and desire to secure by Letters Patent is:

1. A multi-contact electric switch comprising a body, a plurality of switch elements mounted on said body, each switch element having a bowed flexing portion having two positions of stability and a pair of trigger members projecting generally in the same direction from opposite ends of the flexing portion, a plurality of fixed electrical contacts mounted on said body each positioned to be engaged by one of said flexing portions when said flexing portion is in one of its two said positions of stability, and an operating element mounted on said body for movement relative to said switch elements to successively engage the two trigger members of each switch element in turn to cause the flexing portions of said switch elements to successively snap from one position of stability to the other and back again.

2. A switch according to claim **1** which includes support means holding the ends of the flexing portion of each switch element at a distance apart which results in bowing of the flexing portion.

3. A switch as claimed in claim **1** in which each switch element approximates to the shape of a capital pi (II).

4. A switch as claimed in claim **1** in which the flexing portion and the trigger members of each switch element are integral with one another.

5. A switch as claimed in claim **4** in which each switch element is made in the form of a shaped strip.

6. A switch as claimed in claim **5** which includes a body member having a plurality of bearing surfaces each switch element being mounted on said body member and

having a connecting portion between the flexing portion and each trigger member which is part cylindrical and is carried by one of said bearing surfaces.

7. A switch as claimed in claim **6** in which each said bearing surface surrounds the connecting portion carried by it.

8. A switch as claimed in claim **7** in which said body member has recesses receiving the switch elements and affording said bearing surfaces.

9. A switch as claimed in claim **8** in which there is at least one electric terminal in the base of each recess positioned to be contacted by the flexing portion of the switch element received in the recess when in one of positions of stability.

10. A multi contact electric switch comprising a body, a plurality of switch elements mounted in a circle on said body about an axis, each switch element having a bowed flexing portion having two positions of stability and a pair of trigger members projecting generally in the same direction from the flexing portion, a plurality of fixed electrical contacts mounted on said body each positioned to be engaged by one of said flexing portions when said flexing portion is in one of its two said positions of stability, and an operating element mounted on said body for rotation about said axis, said operating element having an engaging portion positioned at a radius from said axis to successively engage the two trigger members of each switch element in turn to cause the flexing portions of said switch elements to successively snap from one position of stability to the other and back again.

11. A multi contact electric switch comprising a body, a first series of switch elements mounted in a circle on said body about an axis, a second series of switch elements mounted in a circle on said body about said axis and axially spaced from said first series, each switch element having a bowed flexing portion having two positions of stability and a pair of trigger members projecting generally in the same direction from the flexing portion, a plurality of fixed electrical contacts mounted on said body each positioned to be engaged by one of said flexing portions when said flexing portion is in one of its two

said positions of stability, and an operating element mounted on said body for rotation about said axis, said operating element having a first engaging portion for engaging the trigger members of the switch elements of said first series and a second engaging portion for engaging the trigger members of the switch elements of said second series to successively engage the two trigger members of each switch element in turn to cause the flexing portions of said switch elements to successively snap from one position of stability to the other and back again, the relative positions of the switch elements of the first series and the first engaging portion and the switch elements of the second series and the second engaging portion being staggered.

12. A multi contact electric switch comprising a body, a plurality of switch elements mounted in a straight row on said body, each switch element having a bowed flexing portion having two positions of stability and a pair of trigger members projecting generally in the same direction from the flexing portion, a plurality of fixed electrical contacts mounted on said body each positioned to be engaged by one of said flexing portions when said flexing portion is in one of its two said positions of stability, and an operating element mounted on said body for linear movement along said row, said operating element having an engaging portion positioned to successively engage the two trigger members of each switch element in turn to cause the flexing portions of said switch elements to successively snap from one position of stability to the other and back again.

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