Jan. 10, 1967 I. STRAUSS 3,297,156

ELECTRICAL SWITCH

Original Filed July 24, 1959

Fig. 1.

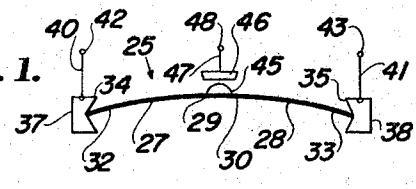


Fig. 2.

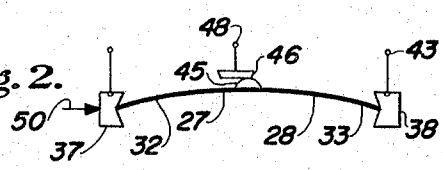


Fig. 3

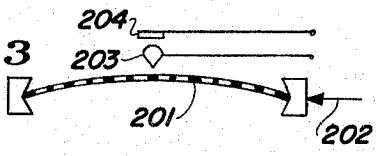


Fig. 4.

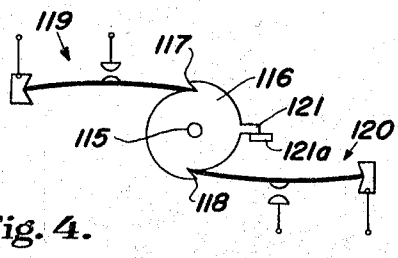


Fig. 5.

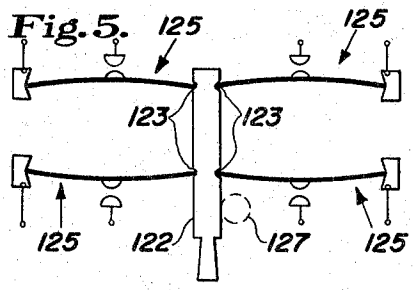


Fig. 6.

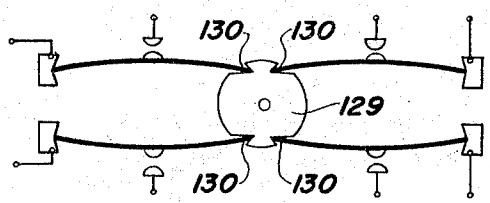


Fig. 8.

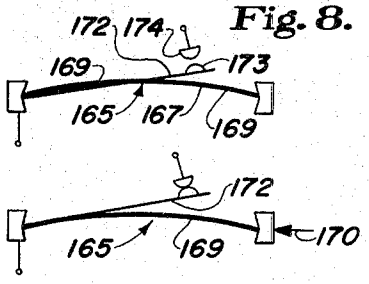


Fig. 9.

Fig. 7.

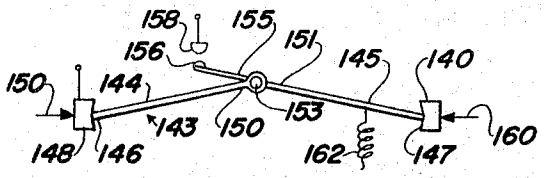


Fig. 10.

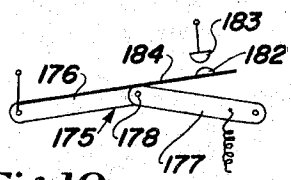
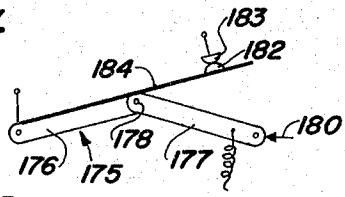


Fig. 11.



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ELECTRICAL SWITCH

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Original application Aug. 24, 1959, Ser. No. 835,631, now Patent No. 3,109,901, dated Nov. 5, 1963. Divided and this application Nov. 4, 1963, Ser. No. 321,208
6 Claims. (Cl. 200—67)

This application is a division of my copending application Ser. No. 835,631, filed Aug. 24, 1959, now Patent No. 3,109,901.

This invention relates to electrical switches, and more particularly to switches of the general class wherein the contact making member or means has a rate and extent of movement which is different from that of the operator member to which the operating force is directly applied.

An object of the present invention is to provide an improved electrical switch device wherein there is a large ratio between the movements of the contact-carrying member and the switch operating member while at the same time the switch structure is extremely simple, uncomplicated and economical to fabricate and manufacture.

Another object of the invention is to provide an improved and simplified quick-acting type electrical switch, wherein only a relatively small and slow operating movement is required to effect a quick-acting, large-magnitude movement of the contact means.

A further object of the invention is to provide an improved electrical switch in accordance with the foregoing, wherein one or several circuits may be controlled to either open or close the same with but extremely little force being required on the switch operator.

An additional object of the invention is to provide an improved switch mechanism as above characterized, having a large ratio of movement together with extreme simplicity, wherein there is obtained a desirable wiping action of the contacts, thereby to normally maintain the same in relatively clean and operative condition throughout an extended period of use.

A still further object of the invention is to provide an improved electrical switch device as set forth above, which may employ either a direct or indirect actuating or operating system and which is characterized by an elongate actuator device placed in operation by the application of a longitudinally directed force to either one of both ends of said device, to translate said force into a lateral movement of a portion of the device for causing circuit-controlling movement of one or several electrical contacts carried thereby.

Still another object of the invention is to provide an improved momentary-contact switch construction employing an elongate actuating device as outlined, wherein an inherent spring action is had, thereby to obviate the necessity for additional components for the purpose of returning the switch to an initial or starting position.

An additional object of the invention is to provide an improved simplified elongate switch actuator device as characterized, wherein a large ratio of movement exists between the relatively longitudinally directed end force which is applied to the device and the resultant lateral movement of the contact or contacts carried by the device.

In the drawings accompanying this specification similar characters of reference are used to designate like components wherever possible throughout the several views, in which:

FIG. 1 is a diagrammatic representation of a simple, single pole of a switch mechanism of the type used in this invention, the switch being shown in open-circuit position;

FIG. 2 is similar to FIG. 1 but shows the pole of the switch in closed-circuit position;

FIG. 3 shows a modified form of pole;

FIG. 4 shows a complete switch in diagrammatic form constructed according to the invention;

FIG. 5 shows a modified form of the switch of FIG. 4;

FIG. 6 shows another modified form of the switch of FIG. 4;

FIG. 7 shows a modified pole arrangement for the switches of FIGS. 4–6, the pole being shown in open position;

FIG. 8 shows another form of pole in open circuit position;

FIG. 9 shows the pole of FIG. 8 in closed position;

FIG. 10 shows another form of pole for the switch of FIGS. 4–6 in open circuit position; and

FIG. 11 shows the pole of FIG. 10 in closed-circuit position.

An understanding of the basic action underlying the switch mechanism of the present invention may be readily had by first referring to the structures shown in FIGS. 1 and 2. As illustrated in these figures, the switch comprises an elongate resilient blade member indicated generally by the numeral **25**, said member being also hereinafter referred to as an "elongate actuator device." While in FIGS. 1 and 2 and in other illustrated embodiments of the invention the elongate actuator device is constituted of a single resilient strip, the invention is not limited to such construction since the actuator device may be formed of a number of separate parts, as for example rigid arms pivotally connected together as described in detail below.

The elongate actuator device **25** may thus be considered as constituted of a pair of substantially aligned actuator arms **27** and **28**, having juxtaposed ends or end portions **29** and **30** respectively, the said end portions being operatively connected together. In the illustrated embodiments of FIGS. 1 and 2 the end portions **29, 30** of the arms **27, 28** are integral with each other, and accordingly the operable connection between said end portions is characterized by a certain degree of flexibility but with no looseness, free pivotal movement or play of any kind. As will be hereinafter brought out, in other forms of the invention the two arms making up the elongate actuator device may be pivotally secured together as by means of suitable pin connections.

As shown, the remote ends **32** and **33** of the arms **27, 28** are received in sockets **34** and **35** respectively provided in end mounting means or members **37, 38**. The end mounting means **37** and **38** may be connected by suitable leads **40** and **41** with electrical terminals **42, 43**, as shown.

The juxtaposed end portions **29, 30** of the arms **27, 28** have secured to them an electrical switch contact **45** which is cooperable and engageable with a stationary electrical contact **46** connected by means of a lead **47** with an electrical terminal **48**. It is to be noted that while for illustrative purposes the contact **45** is described as a separate part secured to the arms, the present invention nevertheless contemplates the provision of a contact surface which is a part of and integral with the arms themselves.

The elongate actuator device comprising the bowed flexible strip **25** may be formed of any suitable material, such as spring steel, spring brass or bronze, beryllium copper, stainless steel, etc. As illustrated in the figures, the actuator or strip **25** is always bowed, either to a greater or lesser extent, regardless of whether the switch contacts **45, 46** are engaged or separated. In FIG. 1 the switch contacts are shown in their separated posi-

tions, and in accordance with the present invention closure of the switch and engagement of the contacts **45**, **46** is effected in response to the application of a longitudinally directed operating force on either one or else both of the mounting means **37**, **38**.

In FIG. 2, such operating force is represented by the arrow **50**, applied to the left mounting member **37**. The application of the force **50** will cause an increased flexing of the actuator device **25**, whereby the center portion thereof, constituted of the arm ends **29**, **30** and the switch contact **45**, will be shifted laterally of the actuator device and in an upward direction until the contact **45** engages the cooperable stationary contact **46**.

It will be seen that with the novel and improved switch construction illustrated in FIGS. 1 and 2 a relatively small movement of either or both of the end mounting means **37**, **38** will result in a correspondingly greater lateral movement of the movable contact **45** whereby a desirable movement multiplying action is had. Thus, in response to a relatively short travel of one or both of the end mounting means, the movable contact may be caused to travel a correspondingly greater extent, and also to more rapidly move into engagement with the stationary contact **46**. Conversely, upon the removal of the operating force from the mounting means, the spring action of the actuator device **25** will restore it to the initial flexed condition shown in FIG. 1 and opening of the switch will be characterized by a relatively rapid movement of the contact **45** together with a great extent of movement, as compared with the movements of the end mounting means **37**, **38**. As is well-known in certain applications, the rapid separation of contact points or surfaces is beneficial in minimizing arcing, sparking and the like, and the present switch construction by virtue of the quick-break action, also has an advantage in this respect. In conjunction with the large ratio of movements, the quick-acting make and break and the wiping action of the contacts, the switch construction shown in FIGS. 1–4 has the added advantage of an inherent return force without requiring the utilization of separate springs or other biasing means, since the bowed member **25** may be formed with the desired bias to effect separation of the contacts **45**, **46** upon removal of the operating force from the end mounting means.

While the operation of the actuator devices per se is described in connection with FIGS. 1 and 2, the complete switch with which the present invention is concerned is shown in FIGS. 4–6. One embodiment of the invention is illustrated in FIG. 4, wherein a rotary shaft **115** is provided, carrying an operator disc **116** having notches **117** and **118**, in conjunction with elongate actuator devices **119**, **120**. It will be readily understood that counterclockwise turning of the disc **116** will effect a greater flexure of the devices **119**, **120** and closing of the switch circuits, and upon removal of the operating force from the disc **116** the resilience of the devices **119**, **120** will cause them to flex to a lesser degree, returning the operating disc **116** to its open circuit position. An arm **121** is carried by the operating disc **116** and is adapted to engage a fixed stop member **121***a* whereby the return movement of the operating disc may be stopped at a predetermined point.

In FIG. 5 an operating lever **122** has notches **123** accommodating the ends of elongate actuator devices **125**, in an organization where four separate circuits may be controlled. Counterclockwise turning movement of the lever **122** will effect a closing of the upper left and lower right switch devices, and clockwise movement of the lever **122** will effect an opening of such devices and a closing of the upper right and lower left switch devices. If, for example, only the upper left and lower right switch devices are employed and the other switch devices are omitted, stop **127** may be utilized for engagement with the lever **122** to provide the opposing or reactive force

which was removed by removal of the upper right and lower left switch devices.

FIG. 6 illustrates an organization quite similar to that of FIG. 13 except that the operating lever **122** is replaced by an operating disc or wheel **129**, having notches **130** which function in the manner of the notches **123** in the lever **122**. The operation of the switches in FIGS. 13 and 14 is otherwise similar.

Another type of actuator device for use in the switches of FIGS. 4–6 is illustrated in FIG. 7, wherein the elongate actuator device **143** comprises a pair of rigid arms **144**, **145**, the remote ends of said arms being received in sockets **146**, **147** respectively of and mounting means **148**, **149**. The juxtaposed end portions **150**, **151** of the rigid arms **144**, **145** may be operatively connected together by a pivotal connection employing a pivot pin **153**. One actuator arm, as for example, the arm **145** shown in FIG. 7 may have an extension **155** provided with a movable contact **156** which is cooperable with a stationary contact **158**. Upon the application of an operating force to one or both of the end mounting means, as indicated by the arrows **160** in FIG. 7, the movable contact **156** will be shifted laterally with respect to the actuator device, and will be brought into engagement with the stationary contact **158**, thereby to close the switch circuit. With this construction, a slightly greater mechanical advantage or multiplication of movement is had, whereby a larger and faster movement of the contact **156** is experienced with respect to the movement of the end mounting means **148**, **149** as effected by the operating force **160**. A return spring **162** may be provided, to effect opening of the switch circuit and straightening of the actuator arms **144**, **145** upon removal of the operating force **160**.

Another form of actuator device is illustrated in FIGS. 8 and 9. In this form, an elongate actuator device **165** is provided, in the form of a bowed strip, and such strip may be considered as being constituted of two actuator arms, each arm comprising a half of the strip. Thus, the center portion **167** or the strip **165** may be thought of as the junction or connection between the two actuator arms, which latter have been labeled **168** and **169** in the figures. Therefore, the juxtaposed end portions of the actuator arms **168**, **169** may be thought of as being operatively connected together at the mid-point **167** of the actuator device **165**, insofar as the action and functioning of the said device is concerned. For the center portion **167** of the actuator device will be shifted laterally at a greater speed and with a greater travel than one of the end mounting means of the switch mechanism, upon the application of an operating force (as shown by the arrow **170** in FIG. 9) thereto. Thus, the action of the elongate actuator device **165** is similar in many respects to the other forms of the invention described above.

In FIGS. 8 and 9 a separate contact carrying arm **172** is provided, having a movable contact **173** cooperable and engageable with a fixed contact **174**, the arm **172** being secured to an end portion of the actuator device **165**. In the figures, the contact carrying arm **172** is shown as secured to the left end portion of the actuator device. With this organization there is retained the resilient or spring action characteristic of a bowed actuator device while at the same time an even greater ratio of movement exists between the movable contact and the end mounting means to which the operating force is applied. Also, there is present a wiping action of the contacts upon their being engaged, and dimensions need not be critical inasmuch as the contact carrying arm **172** may also be made resilient, whereby it can yield after effecting engagement between the contacts **173** and **174**. A single operating force is indicated at **170**, resulting in an unbalanced arrangement.

Still another embodiment of the invention is illustrated in FIGS. 10 and 11, wherein an elongate actuator device **175** is provided, having rigid arms **176**, **177** which are pin connected together with a pin **178**. The arms **176**,

177 may be pivotally mounted at their remote ends, and an operating force 180 may be applied to one of the pivotal mounting pins, to effect lateral movement of the center portion of the actuator device, where the pivot pin 178 is located. A contact carrying arm 182 may be provided, secured to one of the actuator arms 176, 177, said carrier being provided with a movable contact 182 which is cooperable with a stationary contact 183, as shown. In FIGS. 10 and 11 the contact carrying arm or extension 184 is illustrated as carried by the left actuator arm 176 of the switch mechanism, and the contact carrier may be either rigid or else resilient, as will be understood. With this organization as with the embodiment of FIGS. 8 and 9 an added mechanical advantage is had in that an even greater ratio of movement exists between the operating force 180 and the movable contact 182. As shown, a return spring is provided to open the switch circuit and straighten the actuator arms 176, 177 upon removal of the operating force 180.

In the modified form of the switch actuator device, or pole, shown in FIG. 3 the actuator arm 201 is made of non-conductive material, such as plastic or the like. Upon the flexing of the arm by application of force 202 the actuator 201 will flex and shift in an upward direction to engage and move the movable contact 45, thereupon causing the movable contact 203 to engage the cooperable stationary contact 204, providing a circuit of which the actuating arm is not a part. It will be understood that while the actuating arm 201 has been described as being of non-conductive material, the same results may be obtained by providing an insulating cover over the metal arms hereinbefore described.

While in the description the contacts have been usually set forth as comprising separate parts, it is to be understood that the contacts may be an integral part of the switch arms, which themselves will then provide contact surfaces to equal advantage.

From the foregoing it will now be understood that I have provided by the present invention an extremely simple, sensitive and efficient electrical switch mechanism wherein relatively small operating forces are required while at the same time effecting high contact pressures. The switch mechanisms are characterized by rapid make and break, and a high ratio of movement between the cooperable contacts and the operating force applied to operate the switch. In conjunction with these advantages there is also had a wiping action of the contacts, together with a simple, inherent spring action for effecting return of the members to their initial positions. Switch mechanisms employing opposed or balanced operating forces and also unbalanced forces are illustrated, and the balanced or opposed-force type of mechanism may be self-locking in one position and may be tripped with the application of a very small operating force, and also maintained in one position by a small operating force.

Variations and modifications may be made within the scope of the claims, and portions of the improvement may be used without others.

What is claimed is:

1. In an electrical switch, a first and a second elongate actuator device, each of said devices comprising: a pair of substantially aligned actuator arms joined together to include an obtuse angle and resiliently biased to increase said angle, said arms having juxtaposed ends operatively connected together; means mounting the remote end of one of said arms of each of said devices to permit at least limited angular movement of said one of said arms and to prevent substantial longitudinal movement of said one of said arms; a pivotal support member pivoted about an axis and having first and second engagement receptacles disposed on opposite sides of said support member and engaging the remote end of the other said arms of said first and second devices, respectively, said axis being between said receptacles but offset from the tangential line of movement of said receptacles, whereby pivoting of said member in one direction produces angular movement of said arms of said first actuator device to reduce the angle between said arms of said first device, thereby laterally shifting in one direction the juxtaposed ends of said arms of said first actuator device, said pivotal movement of said member simultaneously increasing the angle between said arms of said second actuator device and laterally shifting the juxtaposed ends of said arms of said second device in the opposite direction; a first electrical switch contact engageable with one of said arms of said first actuator device to move therewith in the same direction as the juxtaposed ends of the arms of said first actuator device; a second electrical contact engageable with one of said arms of said second actuator device to move therewith in the same direction as the juxtaposed ends of said arms of said second actuator device; and third and fourth switch contacts engageable with said first and second switch contacts, respectively, when said first and second switch contacts are shifted in predetermined directions by rotation of said member.

2. The invention as described in claim 1 comprising, in addition: third and fourth actuator devices, each comprising a pair of substantially aligned actuator arms joined together to include an obtuse angle and resiliently biased to increase said angle, said arms having juxtaposed ends operatively connected together, said pivotal member having third and fourth mounting receptacles symmetrically arranged with respect to said first and second mounting receptacles about said axis, the remote end of one of said arms of each of said third and fourth actuator devices engaging said third and fourth receptacles, respectively, whereby said third and fourth actuator devices operate conversely to said first and second actuator devices, respectively.

3. The invention as described in claim 1 in which said actuator arms are non-conductive and all of said switch contacts are suspended adjacent thereto.

4. The invention as described in claim 1 in which: said arms are substantially rigid and each of said actuator devices comprises a spring attached to one of said arms of each of said devices to bias said arms to increase the angle therebetween, said apparatus comprising, in addition, a substantially rigid member extending from one of said arms of each of said devices, said extension attached to said first device supporting said first electrical switch contact, and said extension attached to said second device supporting said second electrical switch contact.

5. The invention as described in claim 1 in which: each of said arms is resiliently flexible and the pair of arms of each of said actuator devices comprises a single resilient elongated member.

6. The invention as described in claim 5 comprising, in addition: an extension attached to the remote end of one of said arms of each of said actuator devices to pivot therewith, said extensions supporting said first and second electrical switch contact, respectively.

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