

REPLACED SHEETS SG

☒ Description : paged ...1... to paged ...19...
☒ Claim(s) : paged ...20... to paged ...22...
☒ Drawing(s) : paged ... to paged ...
☒ Abstract : paged ...23... to paged ...23...

SWITCH

BACKGROUND OF THE INVENTION

This invention relates to an electrical connection structure for a stationary terminal and a movable piece in a micro switch or the like.

5 One example of a conventional micro switch is as shown in FIGS. 22 and 23.

The micro switch comprises: a stationary terminal 1 which is a common terminal, and a pair of stationary terminals 4 and 5 which are fixedly inserted in a resin casing 9; a switching movable piece 3 having its base end portion engaged with a V-shaped engaging groove formed in one engaging piece 1a of the stationary terminal 1 (hereinafter referred to as "an armature 3", when applicable), and a movable contact 3a provided on its free end portion in such a manner that the movable contact appears on both sides (the upper and lower surfaces) of the free end portion; a movable spring 7 for operating the armature with a snap, the spring 7 having its base end portion engaged with a V-shaped engaging groove 6 formed in the other engaging piece 1b of the stationary terminal 1 and its free end portion engaged with the free end portion of the armature 3; and a push button 8 supported by the casing in such a manner that it is pushed against the middle of the armature 3 when depressed. In the normal state of the micro switch; that is, when the push

10

15

20



button 8 is not depressed yet, as shown in FIGS. 22 and 23 the free end portion of the armature 3 is urged upwardly by the elastic restoring force of the movable spring 7, so that the movable contact 3a is held in contact with the contact of the stationary terminal 4 (which is a normally closed contact). When, under this condition, the push button 8 is depressed, the middle of the armature 3 is displaced below a predetermined position, instantaneously the armature 3 is urged downwardly by the elastic restoring force of the movable spring 8 (snap action), so that the movable contact 3a is tripped over to the contact 5a of the other stationary terminal 5 (which is a normally open contact). Thus, the switching operation has been accomplished.

In the above-described micro switch, the contact resistance of the switch occurs not only in a portion between the contact 3a and either of the contacts 4a and 5a but also in each of engaging portions between the stationary terminal 1 and the armature 3, between the movable spring 7 and the stationary terminal 1 and between the movable spring 7 and the armature 3.

However, the frequent slide motion in the engaging portions makes the contact resistance unstable, as a result of which the switch is liable to become low in contact reliability. Furthermore, sometimes the micro switch suffers from the following difficulty: When the contact resistance increases, heat is generated to increase the temperature of



the micro switch, thus adversely affecting the durability of the latter. Thus, there is much room for improvement in the durability of the conventional micro switch.

In order to improve the contact between the engaging groove 2 and the armature 3 in reliability, there has been proposed a method in which the engaging portions of the engaging groove 2 and the armature 3 are plated with silver. However, the method is not economical because the silver plating will increase the manufacturing cost of the micro switch.

In order to improve the reliability in electrical connection of the stationary terminal 1 and the armature 3, a method has been proposed in which, as shown in FIG. 21, both ends of a lead wire 12 are soldered to the portions of the stationary terminal 1 and the armature 3 which are less displaced from each other. However, the method is also disadvantageous in that the number of components and the number of manufacturing steps are increased as much, and accordingly the manufacturing cost is increased.

SUMMARY OF THE INVENTION

In view of the foregoing, an object of this invention is to provide a switch which can be manufactured relatively readily without increase of the number of components, and is high in the reliability in electrical connection of the stationary terminal and the armature.

The foregoing object of the invention has been achieved by the provision of a first switch in which an armature swingably coupled to a stationary terminal is operated by depression of a push button to trip between contacts, and in which, the stationary terminal and the armature are partially welded to each other. In the first switch, the stationary terminal and the armature coupled to it are stably electrically connected to each other through the welded portions.

In the first switch, it is possible that the armature is swingably engaged with the stationary terminal through their engaging portions, and the armature and the stationary terminal are welded to each other by using portions thereof other than the engaging portions. The armature and the stationary terminal are electrically connected to each other by using their portions which are other than their engaging portions through which the armature and the stationary terminal are mechanically coupled to each other. That is, in the switch, the mechanical connection and the electrical connection of the stationary terminal and the armature are established independently of each other.

In the first switch, it is also possible that an engaging groove is formed in an engaging piece of the stationary terminal, the base end portion of the armature is engaged with the engaging groove, a first tongue piece extended from the armature is laid on a second tongue piece



formed by bending the middle portion of the engaging piece,
and the two tongue pieces are welded together. The welding
portions of the stationary terminal and the armature are
located between the engaging portions through which the
stationary terminal and the armature are mechanically engaged
with each other; that is, the welding portions are located
where the stationary terminal and the armature are less
displaced from each other. Hence, the welding portions will
not interfere the motion of the armature. The first tongue
piece extended from the armature may be bent, and the end
portion of the first tongue piece thus bent may be welded to
the second tongue piece formed by bending the middle portion
of the engaging piece. The tongue piece extended from the
armature is bent, and therefore although the end of the
tongue is welded to the stationary terminal, the armature can
be swung (or tripped) smoothly with the engaging portion as a
fulcrum.

In the first switch, it is also possible that an
engaging groove is formed in an engaging piece of the
stationary terminal, the base end portion of the armature is
engaged with the engaging groove thus formed, an engaging
recess is formed in the outer surface of the middle portion
of the engaging piece, and a tongue piece extended from the
armature is engaged with the engaging recess, and welded to
the stationary terminal. The welding portions of the
stationary terminal and the armature are located where the



stationary terminal and the armature are less displaced from each other, and the welding portions will never interfere with the motion of the armature. In the switch, the engaging piece of the stationary terminal, having no cut, is high rigidity.

Further, the foregoing object of the invention has been also achieved by the provision of a second switch in which an armature swingably coupled to a stationary terminal is operated by depression of a push button to trip between the contacts, and in which a movable spring is laid between the stationary terminal and the armature and supported by and welded to the stationary terminal and the armature. The elastically movable spring is welded to the stationary terminal and the armature, and therefore the welding portions scarcely resist the tripping motion of the armature.

Moreover, the foregoing object of the invention has been also achieved by the provision of a third switch in which an armature swingably coupled to a stationary terminal is operated by depression of a push button to trip between the contacts, and in which an engaging groove is formed in an engaging piece of the stationary terminal, the base end portion of the armature is engaged with the engaging groove thus formed, a tongue piece extended from the armature is placed on a tongue piece protruded from the stationary terminal independently of the engaging piece, and the two tongue piece are welded together. The engaging piece



supporting the base end portion of the armature on the stationary terminal, and the tongue piece onto which the tongue piece of the armature is welded, are formed independently of each other. Therefore, when those tongue
5 pieces are bent which are formed by cutting the stationary terminal, they will not interfere with each other, and therefore they can be formed with high accuracy.

BRIEF DESCRIPTION OF THE DRAWINGS

In the accompanying drawings:

10 FIG. 1 is a vertical sectional view showing a switch, which constitutes a first embodiment of this invention;

FIG. 2 is an exploded perspective view of the switch shown in FIG. 1;

15 FIG. 3 is a perspective view showing essential components of the switch shown in FIG. 1;

FIG. 4 is an exploded perspective view of essential components of the switch shown in FIG. 1;

20 FIG. 5 is a perspective view showing essential components of a switch, which constitutes a second embodiment of the invention;

FIG. 6 is an exploded perspective view of essential components of the switch shown in FIG. 5;

FIG. 7 is a vertical sectional view showing a switch, which constitutes a third embodiment of the invention;

25 FIG. 8 is an exploded perspective view of essential components of the switch shown in FIG. 7;



FIG. 9 is a perspective view of essential components of the switch shown in FIG. 7;

FIG. 10 is a perspective view of essential components of a switch, which constitutes a fourth embodiment of the invention;

FIG. 11 is an exploded perspective view of essential components of the switch shown in FIG. 10;

FIG. 12 is a vertical sectional view showing a switch, which constitutes a fifth embodiment of the invention;

FIG. 13 is an exploded perspective view of essential components of the switch shown in FIG. 12;

FIG. 14 is a vertical sectional view showing a switch, which constitutes a sixth embodiment of the invention;

FIG. 15 is an exploded perspective view of essential components of the switch shown in FIG. 14;

FIG. 16 is a perspective view of essential components of the switch shown in FIG. 14;

FIG. 17 is a vertical sectional view showing a switch, which constitutes a seventh embodiment of the invention;

FIG. 18 is a perspective view of essential components of the switch shown in FIG. 17;

FIG. 19 is a perspective view showing the stationary terminals of the switch shown in FIG. 17;



FIG. 20 is a perspective view showing the stationary terminals assembled in the switch shown in FIG. 17;

FIG. 21 is a perspective view showing essential components of a comparative example of the switch;

FIG. 22 is a vertical sectional view showing a conventional switch; and

FIG. 23 is a perspective view of essential components of the conventional switch shown in FIG. 22.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Preferred embodiments of this invention will be described with reference to the accompanying drawings.

First Embodiment

A switch, which constitutes a first embodiment of the invention, is as shown in FIGS. 1 through 4. The switch is equal in fundamental structure to the above-described conventional switch. That is, the switch comprises: a stationary terminal 1 which is a common terminal with a pair of engaging pieces 1a and 1b; a movable piece 3 having its base end portion engaged with a V-shaped engaging groove 2 formed in the engaging piece 1a of the stationary terminal 1, and a movable contact 3a provided on its free end portion in such a manner that the movable contact appears on both sides (the upper and lower surfaces) of the free end portion (hereinafter referred to as "an armature 3", when applicable); a stationary terminal 4 which is a normally closed terminal with a stationary contact 4a which is



confronted with the movable contact 3a from above; a stationary terminal 5 which is a normally open terminal having a stationary contact 5a which is confronted with the movable contact 3a from below; a movable spring 7 for operating the armature with a snap, the spring 7 having its base end portion engaged with a V-shaped engaging groove 6 formed in the other engaging piece 1b of the stationary terminal 1 and its free end portion engaged with the free end portion of the armature 3; and a push button 8 which is pushed against the middle of the armature 3. Those components 1 through 8 are fixedly held by a resin casing 9 which is made up of a casing body 9a and a cover casing 9b.

In the normal state of the switch; i.e., when the push button 8 is not pushed yet, as shown in FIG. 1 the free end portion of the armature 3 is urged upwardly by the elastic restoring force of the movable spring 7, so that the stationary contact (or normally closed contact) 4a of the stationary terminal 4 is held in contact with the upper surface of the movable contact 3a of the armature 3. When the pushed button 8 is pushed, the middle of the armature 3 is deflected downwardly, so that, when the engaging point of the armature 3 and the spring 7 goes across the prolongation (or dead point) of the straight line connecting the two engaging grooves 2 and 6, instantaneously the armature is displaced downwardly with a snap by the elastic restoring force of the spring 7. As a result, the lower surface of the



movable contact 3a is brought into contact with the stationary contact (or normally open contact) of the stationary terminal 5.

In the stationary terminal 1, a tongue piece 1c is extended from the middle, in the direction of width, of the engaging piece 1a, and bent sideways. The armature 3 has an engaging edge 3b, which is engaged with the engaging piece 1a of the stationary terminal 1. A tongue piece 3c is extended from the engaging edge 3b in such a manner that it is laid on the tongue piece 1c of the stationary terminal 1. The two tongue pieces 1c and 3c are welded together at the ends by soldering, so that the stationary terminal 1 and the armature 3 are positively electrically connected with each other. Those tongue pieces 1c and 3c may be connected by laser welding or spot welding.

Second Embodiment

A second embodiment of the invention is as shown in FIGS. 5 and 6. The second embodiment is also similar in fundamental structure to the above-described first embodiment. In the second embodiment, the tongue piece 3c of the armature 3 is longer than in the first embodiment, and it is curved. The end portion of the tongue piece 3c thus curved is connected to the tongue piece 1c of the stationary terminal 1 by soldering or laser welding or spot welding. The welding of the tongue pieces in this manner scarcely



affects the motion of the armature; that is, the armature 3 can be smoothly tripped with a snap.

Third Embodiment

A third embodiment of the invention is as shown in
5 FIGS. 7 through 9. The third embodiment is also similar in
fundamental structure to the above-described first
embodiment. In the third embodiment, the tongue piece 1c is
extended longer from the middle of the engaging piece 1a of
the stationary terminal 1 than in the first embodiment, and
10 is bent sideways at a level lower than in the first
embodiment. The tongue piece 3c is extended long from the
armature 3, and bent downwardly at the end. The tongue
piece 3c is set above the tongue piece 1c, and under this
condition the free ends of those tongue pieces 3c and 1c are
15 connected together by soldering, laser welding or spot
welding. Hence, the adverse effect of the welding of the
tongues pieces on the motion of the armature can be more
positively eliminated; that is, the armature 3 can be more
smoothly tripped with a snap. In the third embodiment, the
20 push button 8 has a recess 8a to eliminate its interference
with the tongue pieces 1c and 3c.

Fourth Embodiment

A fourth embodiment of the invention is as shown in
FIGS. 10 and 11. The third embodiment is also similar in
25 fundamental structure to the above-described first
embodiment.



In the fourth embodiment, an engaging recess 1d is formed in the outer surface of the engaging piece 1c at the middle by pressing. A tongue piece 3c is extended downwardly from the engaging edge 3b of the armature 3 which is engaged with the engaging piece 1a of the stationary terminal 1. The tongue piece 3c thus extended is inserted into the engaging recess 1d. Under this condition, the tongue piece 3c is connected to the stationary terminal 1 by soldering, laser welding or spot welding.

In each of the above-described first through fourth embodiments of the invention, the stationary terminal 1 and the armature 3 are welded to each other by using their portions which are in direct contact with each other. However, they may be welded by using their portions which are in contact with each other through the movable spring 7.

Fifth Embodiment

A fifth embodiment of the invention is as shown in FIGS. 12 and 13. A switch shown in FIGS. 12 and 13 is different in structure from the above-described switches.

In the switch, its stationary terminal 1 has an engaging hole 10, into which one end portion of an operating metal part 11 is inserted. The other end portion 11a of the operating metal part 11 has an engaging groove 11b, with which one end portion of an armature 3 is engaged. The stationary terminal 1 has an engaging groove 1e, with which one end portion of a movable spring 7 is engaged. The other



end portion of the spring 7 is engaged with the free end portion of the armature 3. When a push button 8 set in a casing 9 is depressed, the other end portion 11a of the operating metal part 11 is moved downwardly thereby. As a result, the armature 3 is tripped with a snap by the elastic restoring force of the spring 7, so that the movable contact 3a of the armature 3 is moved from the contact (or normally closed contact) 4a of an upper stationary terminal 4 over to the contact (or normally open contact) 5a of a lower stationary terminal 5.

The movable spring 7 has tongue pieces 7a and 7b at both ends which are formed by cutting for the stationary terminal 1 and the armature 3, respectively. The ends of those tongue pieces 7a and 7b are connected to the stationary terminal 1 and the armature 3 by soldering, laser welding or spot welding. Thus, the stationary terminal 1 is electrically stably connected to the armature 3 through the movable spring 7.

Sixth Embodiment

A sixth embodiment of the invention is as shown in FIGS. 14 through 16. The sixth embodiment is similar in fundamental structure to the first embodiment. In the sixth embodiment, its stationary terminal 1 has a pair of engaging pieces 1a and 1b which are bent, and a tongue piece 1c between the engaging pieces 1a and 1b. The tongue piece 1c is formed by cutting the body of the stationary terminal 1,



and bent at the end. The armature has an elongated tongue piece 3c. The end portion of the tongue piece 3c is connected to the tongue piece 1c by soldering, laser welding or spot welding.

5 The sixth embodiment is free from the difficulty accompanying the above-described first, second and third embodiments that, since the tongue piece 1c is bent when formed by using the engaging piece 1a, the latter 1a is unavoidably deformed, so that the engaging groove 2 is
10 lowered in positional accuracy.

Seventh Embodiment

A seventh embodiment of the invention is as shown in FIGS. 17 through 20. In a switch shown in those figures, its resin casing 9 is made up of a casing body 9a and a cover 9b
15 which are separable from each other, and its stationary terminals 1, 4 and 5 are held by the casing body 9a in such a manner that they are arranged in a line with their flat base end portions in one plane. The stationary terminal 1 has a pair of engaging pieces 1a and 1b, and a tongue piece 1c at
20 predetermined positions, which are bent independently of one another. The armature 3 has an elongated tongue piece 3c, the end of which is connected to the tongue piece 1c by soldering, laser welding or spot welding.

As is apparent from the above description, the
25 invention has the following merits or effects:



In a switch of a first aspect of the invention, in which an armature swingably coupled to a stationary terminal is operated by depression of a push button to trip between contacts and the stationary terminal is welded to the armature, the electrical connection of the stationary terminal and the armature is greatly improved in reliability; that is, they are high in durability. In welding the stationary terminal and the armature to each other, it is unnecessary to use an additional component such as a lead wire; that is, the stationary terminal is welded directly to the armature. Therefore, they can be relatively readily welded together by soldering, laser welding or spot welding. Hence, the switch can be manufactured at relatively low cost without increase in the number of components or in the number of manufacturing steps; that is, the switch should be highly appreciated in practical use.

When the armature is swingably engaged with the stationary terminal through engaging portions thereof, and the armature and the stationary terminal are welded to each other by using portions thereof other than the engaging portions in the first switch, the stationary terminal is directly welded to the armature; however, the welding scarcely affects the tripping motion of the armature. Hence, the switch is excellent in operating performance, having the same effects as the first switch.



When an engaging groove is formed in an engaging piece of the stationary terminal, the base end portion of the armature is engaged with the engaging groove, a first tongue piece extended from the armature is laid on a second tongue piece formed by bending the middle portion of the engaging piece, and the two tongue pieces are welded together in the first switch, the difficulty is more effectively eliminated that the welding adversely affects the tripping motion of the armature; that is, it is further improved in operating performance. Further, when the first tongue piece extended from the armature is bent, and the end portion of the first tongue piece is welded to the second tongue piece formed by bending the middle portion of the engaging piece, the armature can trip more smoothly, and the difficulty is positively eliminated that the welded portions are for instance cracked when the armature is tripped repeatedly. That is, the switch is high in durability in quality, and in reliability.

When an engaging groove is formed in an engaging piece of the stationary terminal, the base end portion of the armature is engaged with the engaging groove thus formed, an engaging recess is formed in the outer surface of the middle portion of the engaging piece, and a tongue piece extended from the armature is engaged with the engaging recess, and welded to the stationary terminal in the first switch, the engaging piece of the stationary terminal, which is provided



for connecting the latter to the armature, is high in mechanical strength. Hence, the switch has a merit that it is higher in durability, in addition to the merits of the first switch.

5 In a switch of a second aspect of the invention, in which an armature swingably coupled to a stationary terminal is operated by depression of a push button to trip between the contacts, and a flexible movable spring is laid between the stationary terminal and the armature and supported by and
10 welded to the stationary terminal and the armature, the welding will not adversely affect the tripping motion of the armature, and the electrical connection of the stationary terminal and the armature is high in reliability. That is, the switch is excellent in performance.

15 In a switch of a third aspect of the invention, in which an armature swingably coupled to a stationary terminal is operated by depression of a push button to trip between contacts, an engaging groove is formed in an engaging piece of the stationary terminal, the base end portion of the
20 armature is engaged with the engaging groove thus formed, a tongue piece extended from the armature is placed on a tongue piece protruded from the stationary terminal independently of the engaging piece, and the two tongue pieces are welded together, the difficulty that the welding adversely affects
25 the tripping motion of the armature is more positively



eliminated. That is, the switch is much higher in operating performance.

In each of the switches, in order to improve the reliability in electrical connection of the switching elements, namely, the stationary terminal and the armature, they are welded directly to each other. Hence, the switch is smaller in the number of components and in the number of manufacturing steps than the switch which uses lead wires for electrical connecting the switching elements. Accordingly, the switch is lower in manufacturing cost.





WHAT IS CLAIMED IS:

1. A switch in which an armature swingably coupled to a stationary terminal is operated by depression of push button to trip between contacts, said switch comprising an improvement wherein said stationary terminal is welded to
5 said armature.

2. A switch as claimed in claim 1, wherein
said armature is swingably engaged with said stationary terminal through engaging portions thereof, and
10 said armature and said stationary terminal are welded to each other by using portions thereof other than said engaging portions.

3. A switch as claimed in claim 1, wherein
an engaging groove is formed in an engaging
15 piece of said stationary terminal,
the base end portion of said armature is engaged with said engaging groove,

a first tongue piece extended from said armature is laid on a second tongue piece formed by bending
20 the middle portion of said engaging piece, and
said two tongue pieces are welded together.

4. A switch as claimed in claim 3, wherein
said first tongue piece extended from said armature is bent, and





the end portion of said first tongue piece is welded to said second tongue piece formed by bending the middle portion of said engaging piece.

5. A switch as claimed in claim 1, wherein

5 an engaging groove is formed in an engaging piece of said stationary terminal,

the base end portion of said armature is engaged with said engaging groove thus formed,

10 an engaging recess is formed in the outer surface of the middle portion of said engaging piece, and

a tongue piece extended from said armature is engaged with said engaging recess, and welded to said stationary terminal.

6. A switch in which an armature swingably coupled
15 to a stationary terminal is operated by depression of a push button to trip between the contacts, said switch comprising an improvement wherein a movable spring is laid between said stationary terminal and said armature and supported by and welded to said stationary terminal and said armature.

20 7. A switch in which an armature swingably coupled to a stationary terminal is operated by depression of a push button to trip between contacts, comprising an improvement wherein

25 an engaging groove is formed in an engaging piece of said stationary terminal,



the base end portion of said armature is engaged with said engaging groove thus formed, and

a tongue piece extended from said armature is placed on a tongue piece protruded from said stationary terminal independently of said engaging piece, and said two tongue pieces are welded together.

This Sheet Has Been Replaced



ABSTRACT OF THE DISCLOSURE

A switch in which an armature swingably coupled to a stationary terminal is operated by a depression of a push button to trip between the contacts. A movable spring is laid between the stationary terminal and the armature to assist the trip of the armature and the stationary terminal is welded to the armature. The switch can be manufactured relatively readily without increase in the number of components, and is high in the reliability in electrical connection of the stationary terminal and the armature.

This Sheet Has Been Replaced



FIG. 1

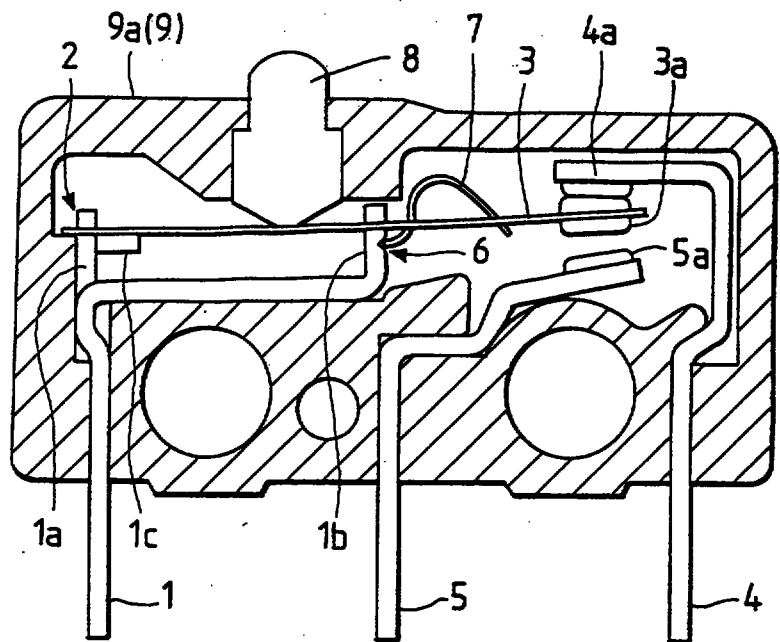
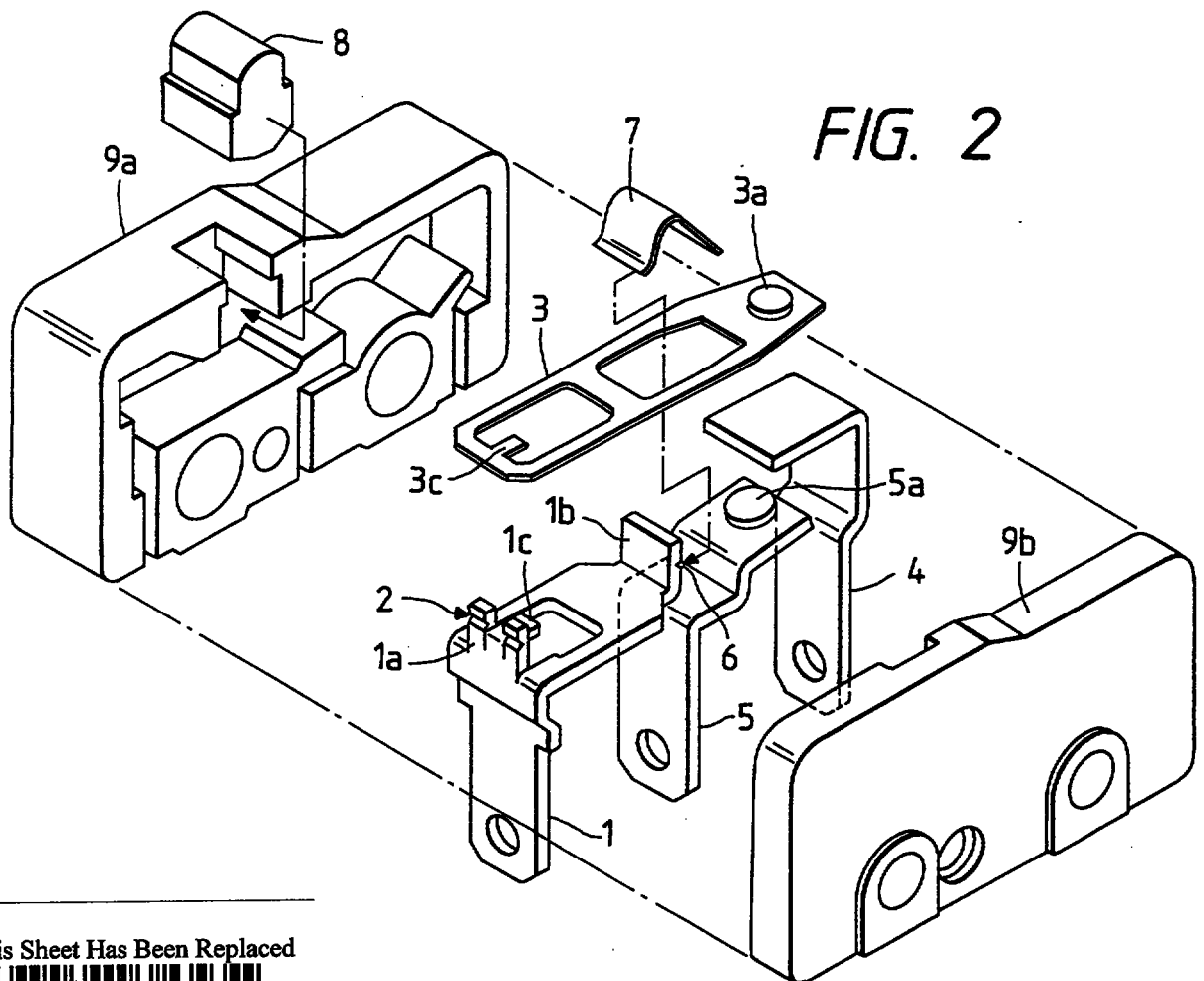


FIG. 2



This Sheet Has Been Replaced



FIG. 3

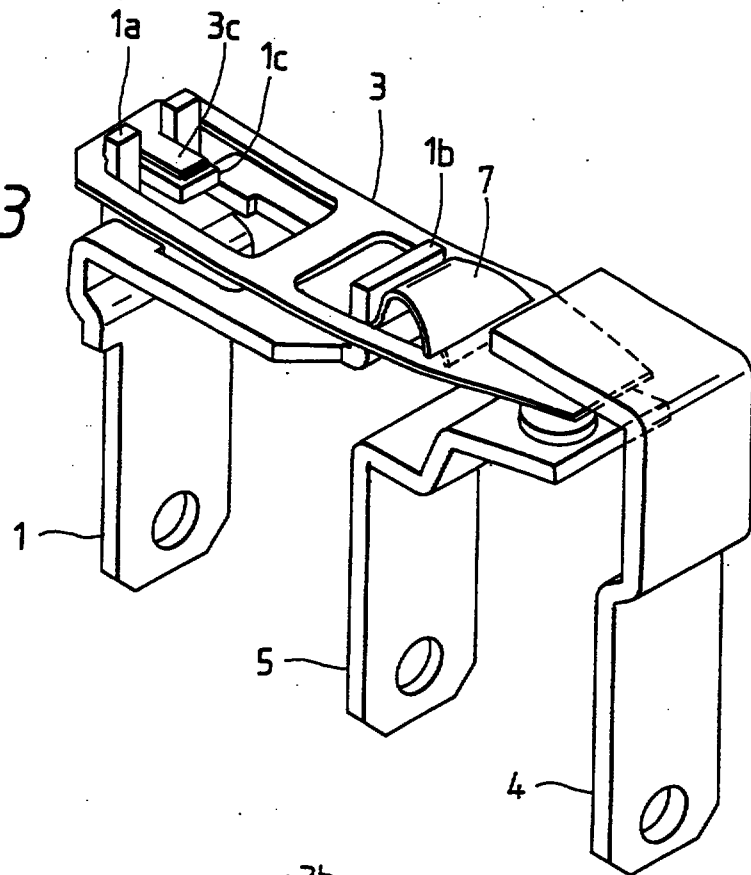
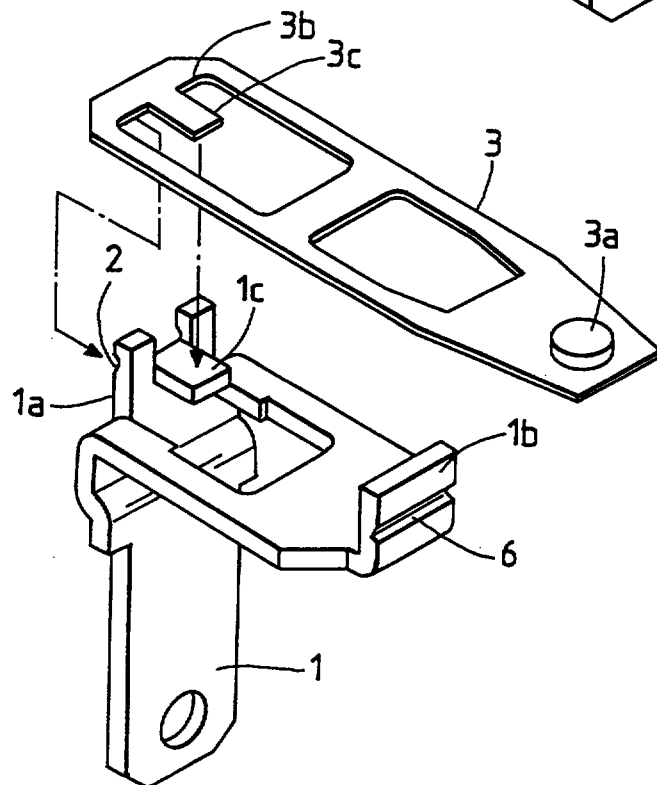


FIG. 4



This Sheet Has Been Replaced



FIG. 5

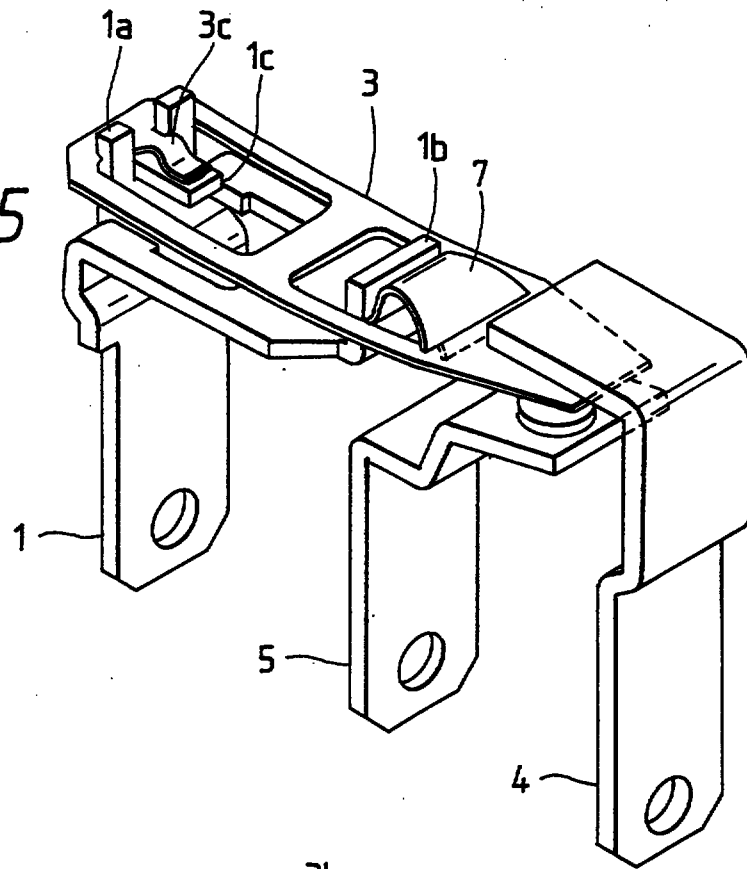
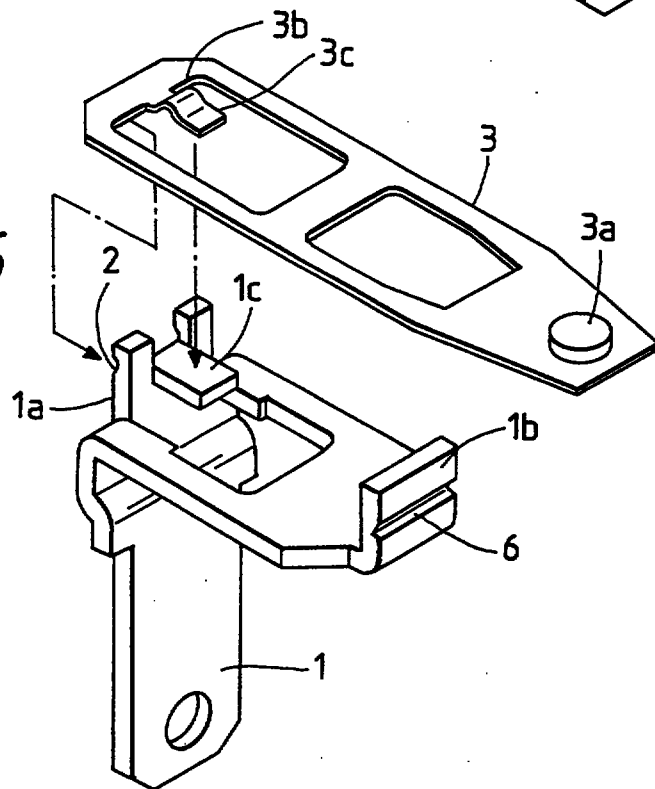


FIG. 6



This Sheet Has Been Replaced



FIG. 7

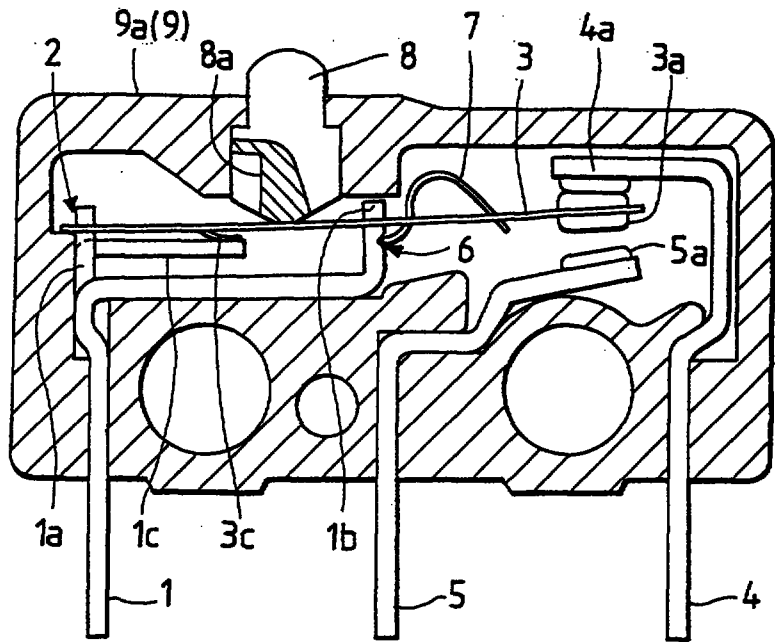
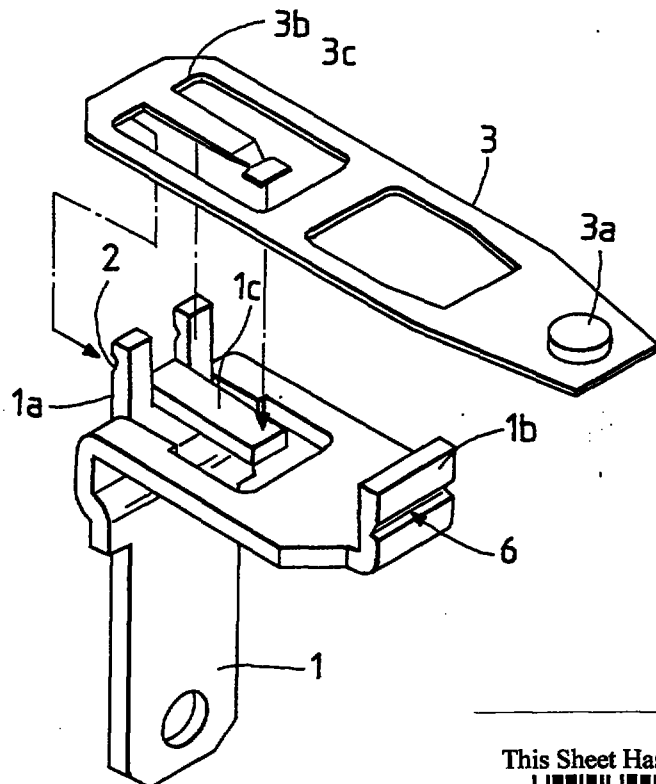


FIG. 8



This Sheet Has Been Replaced



FIG. 9

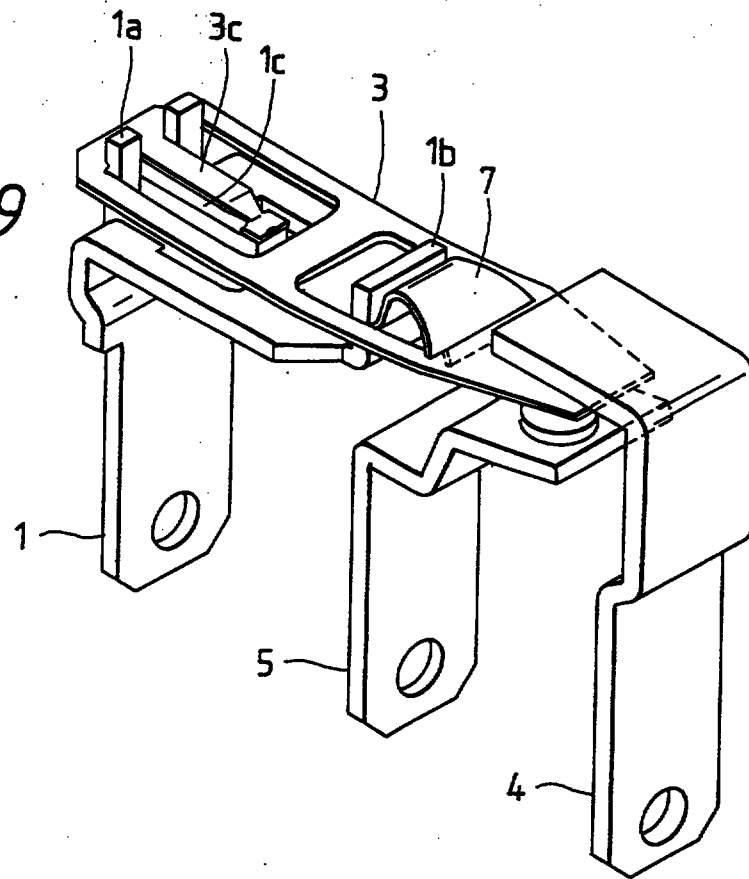
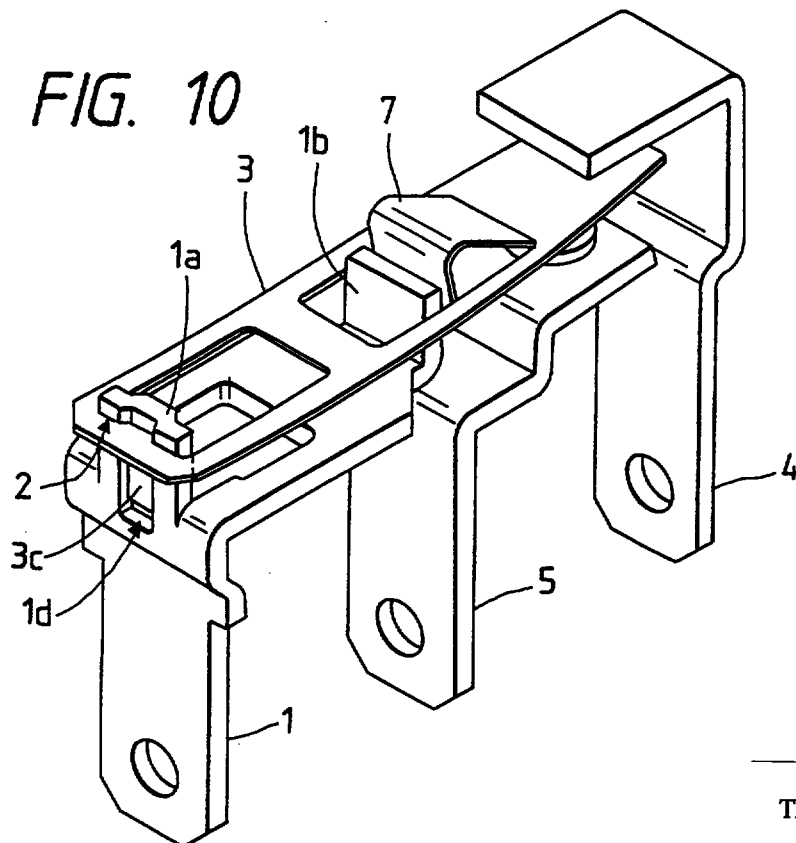


FIG. 10



This Sheet Has Been Replaced



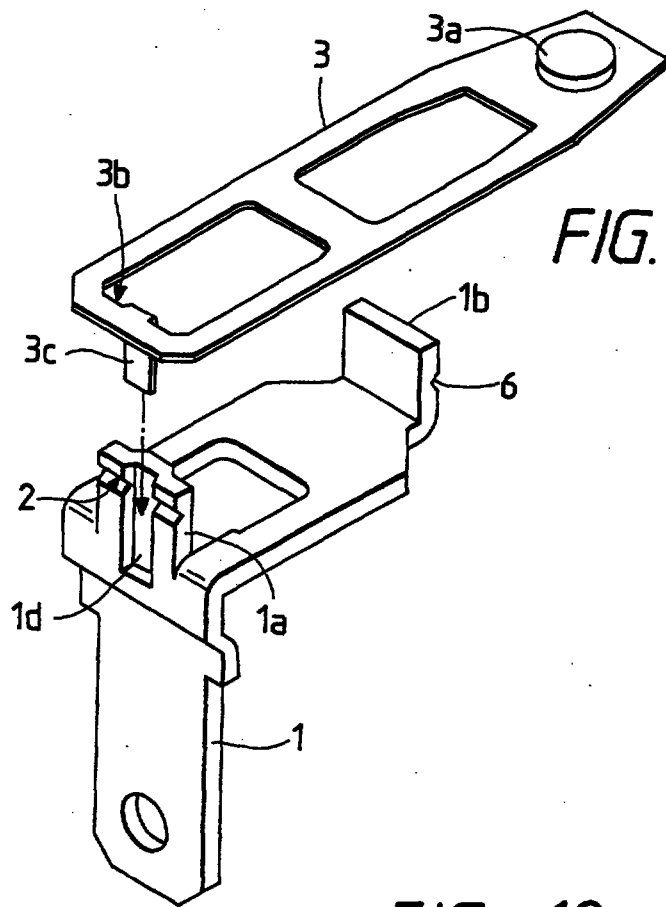


FIG. 11

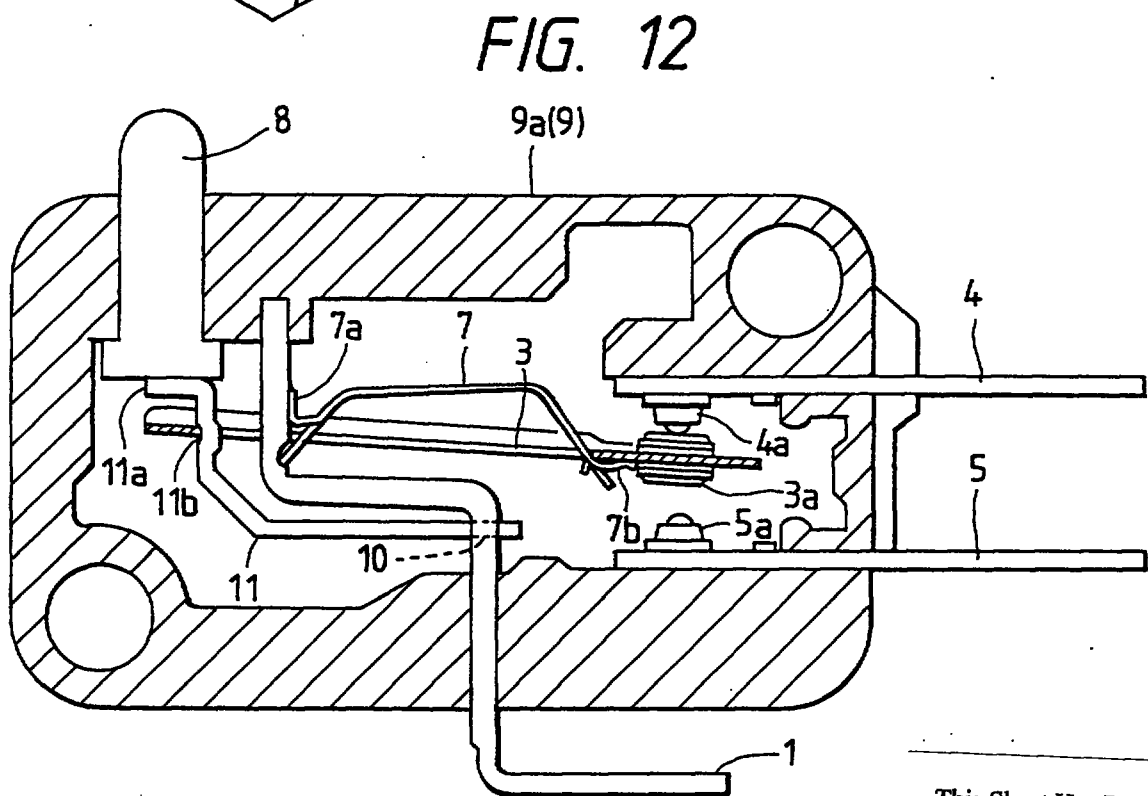


FIG. 12

This Sheet Has Been Replaced



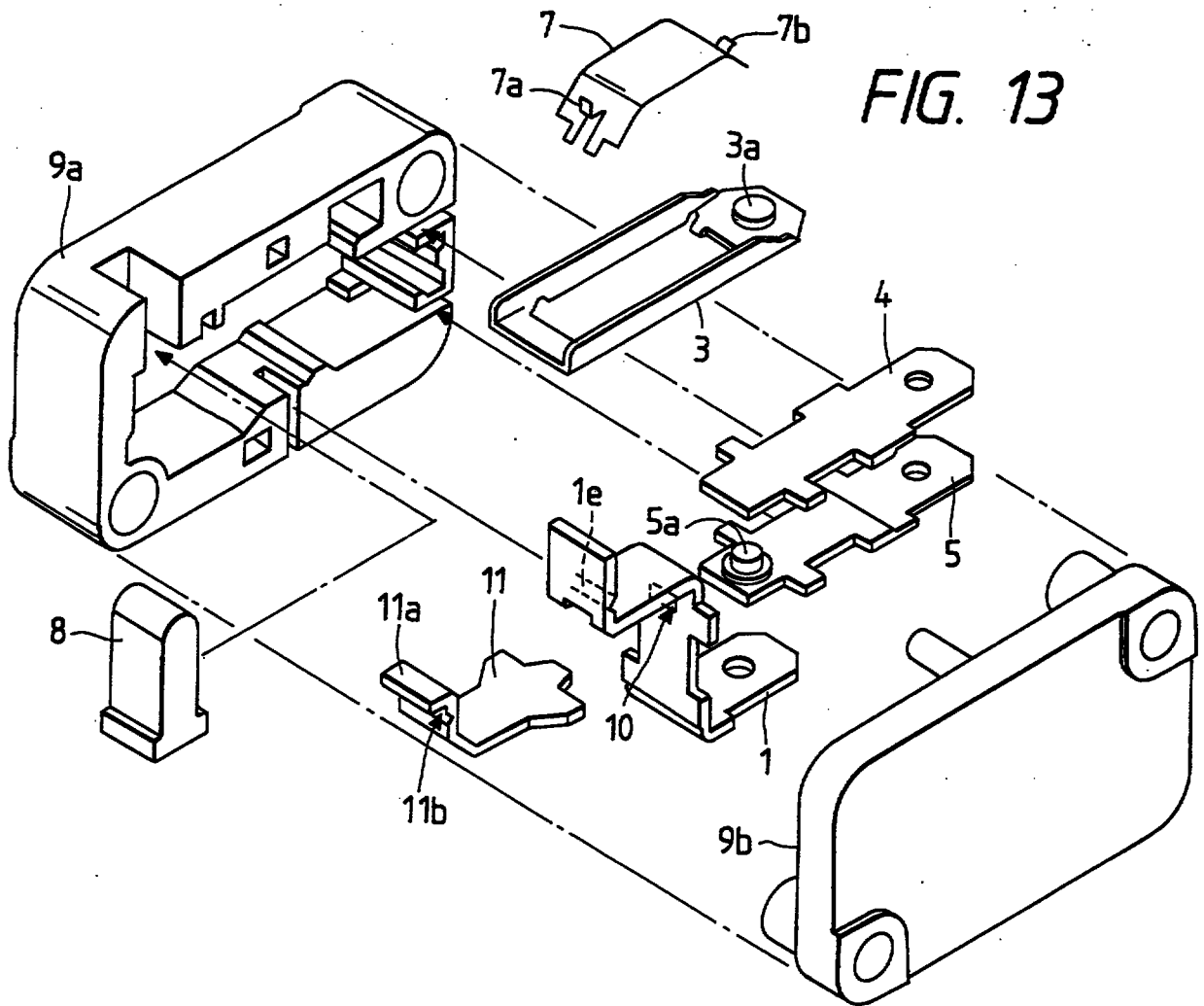
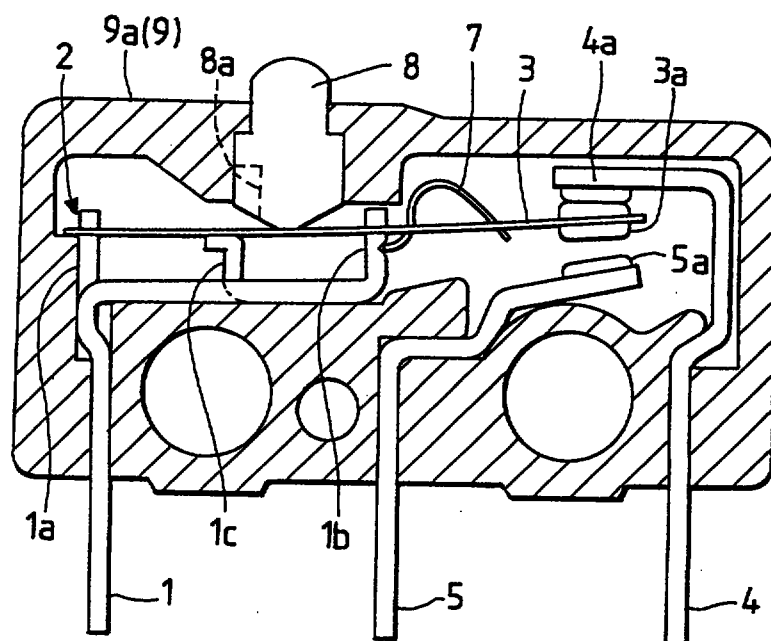


FIG. 14



This Sheet Has Been Replaced



FIG. 15

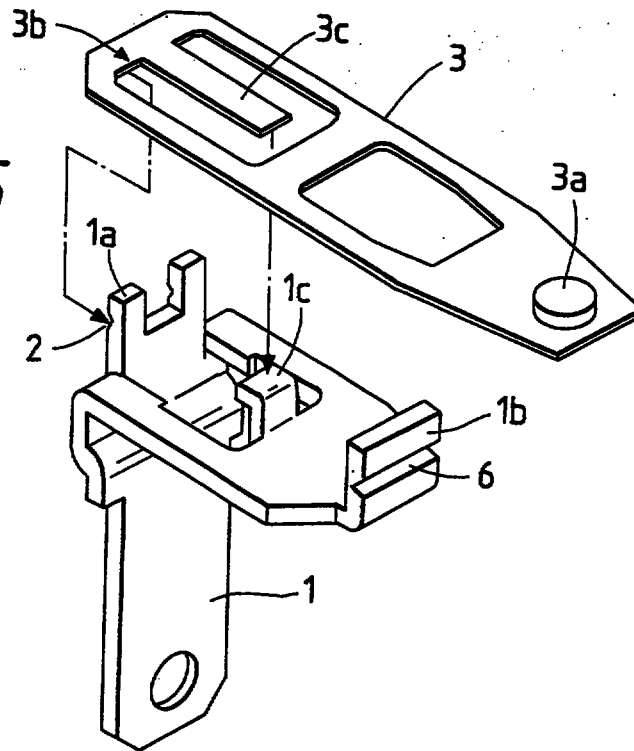
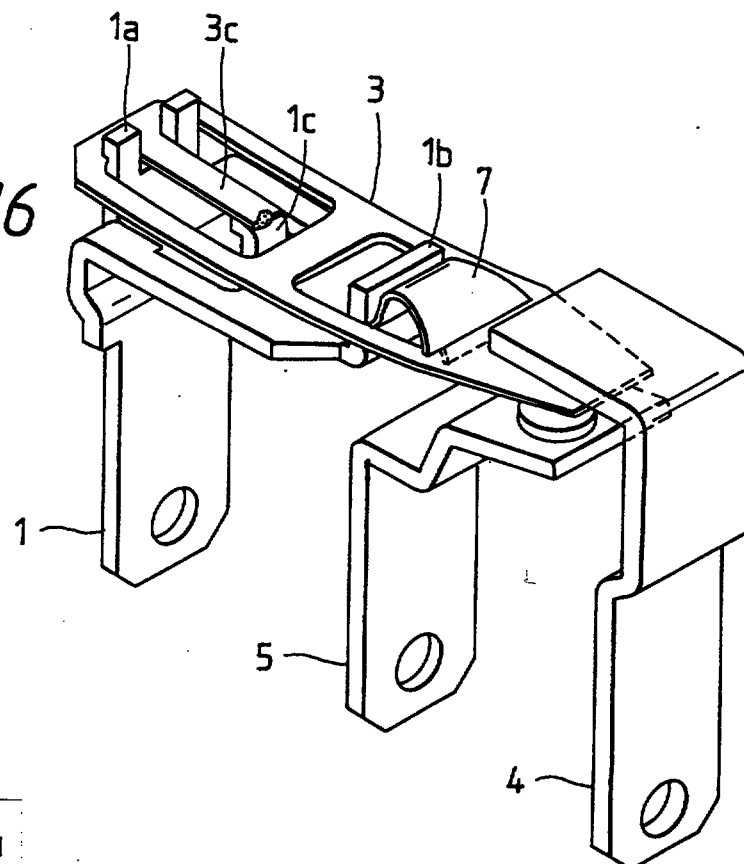


FIG. 16



This Sheet Has Been Replaced



FIG. 17

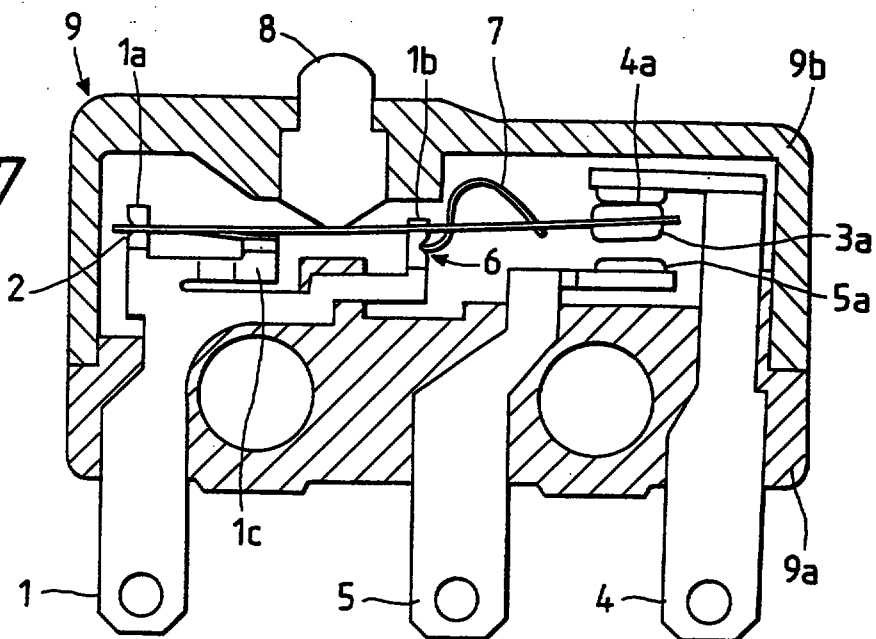
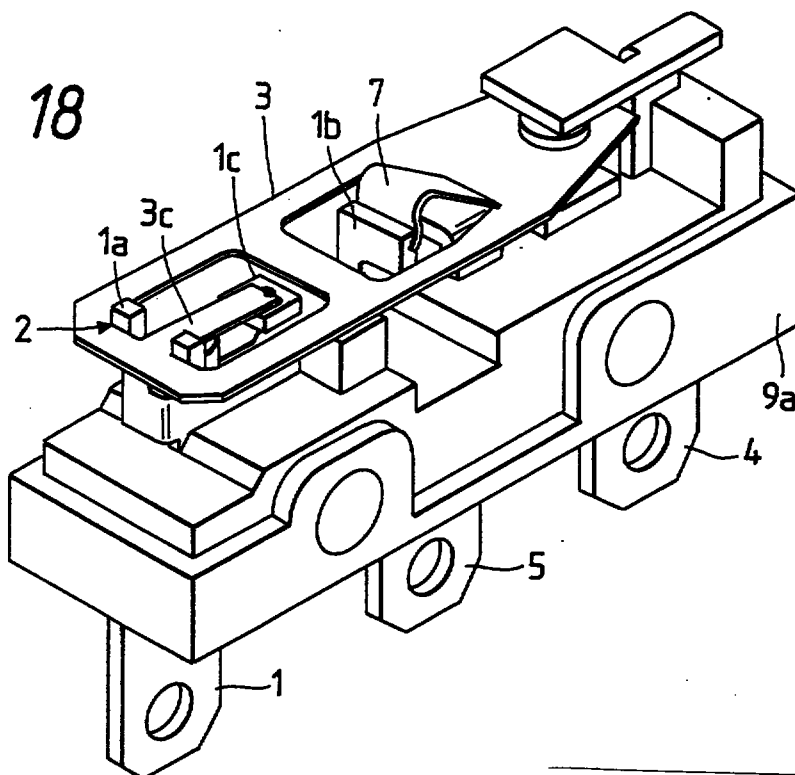


FIG. 18



This Sheet Has Been Replaced



FIG. 19

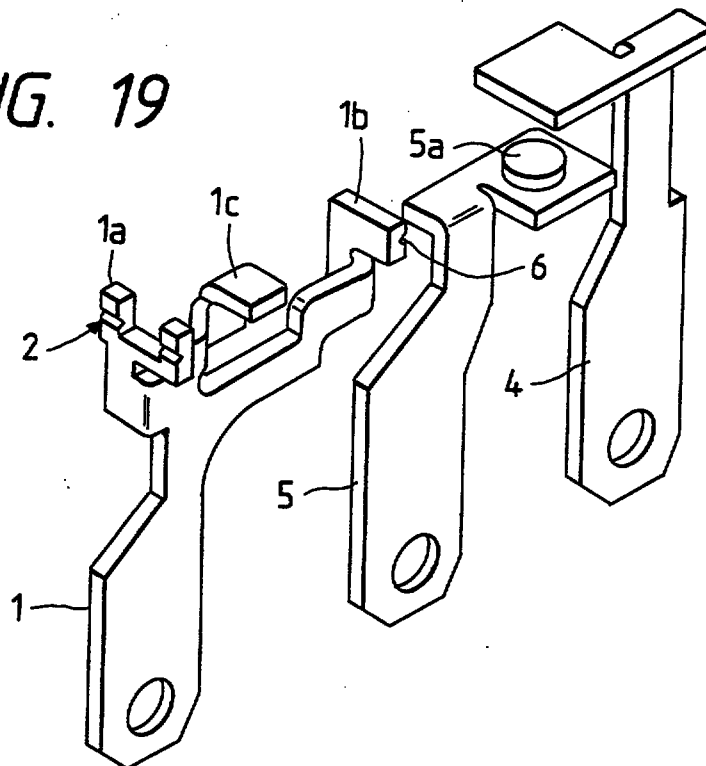
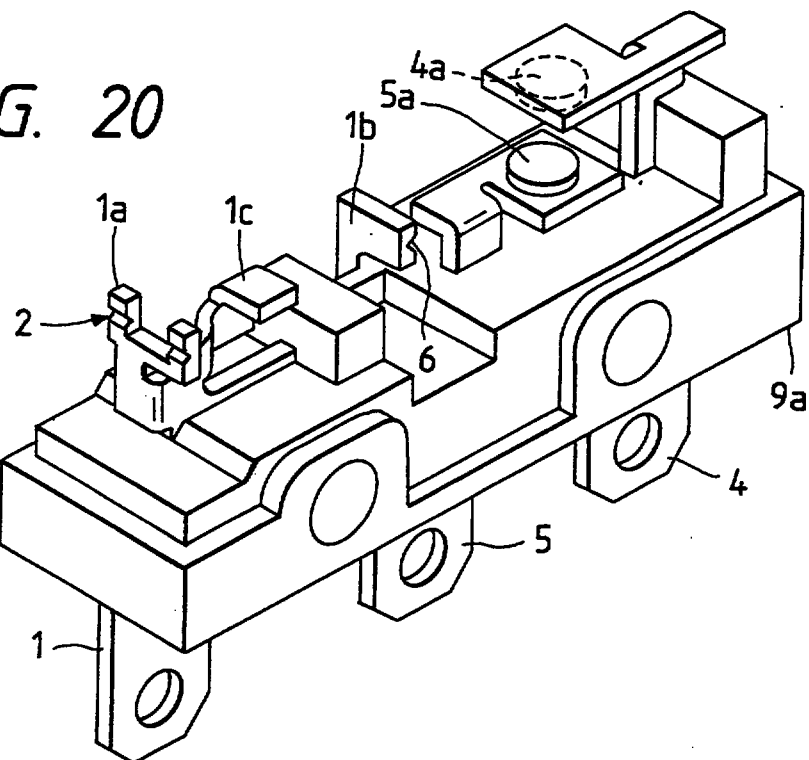


FIG. 20



This Sheet Has Been Replaced



FIG. 21

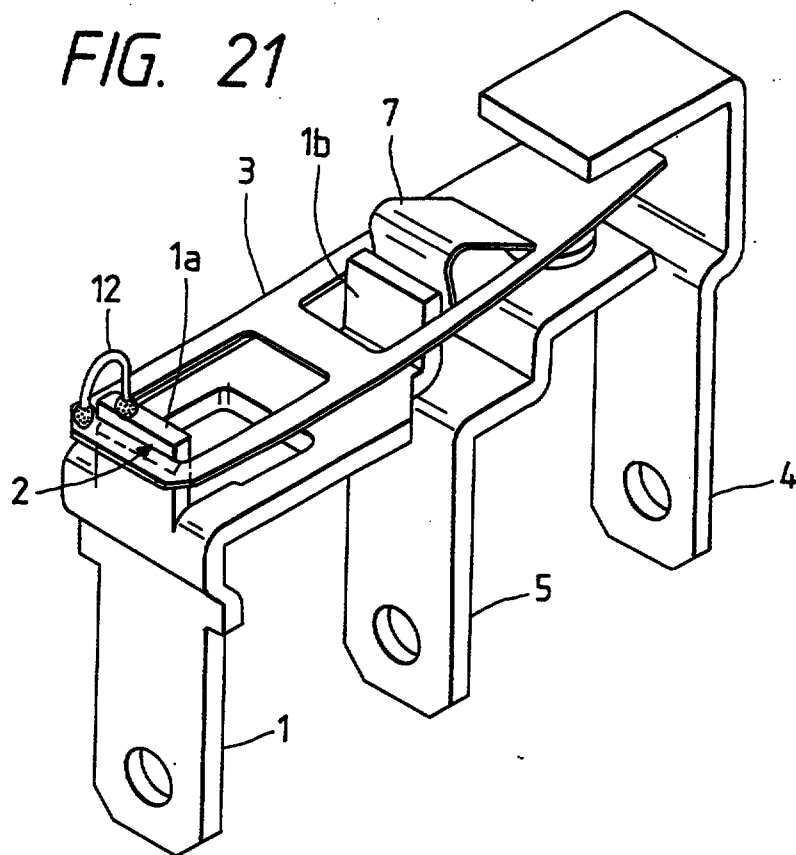
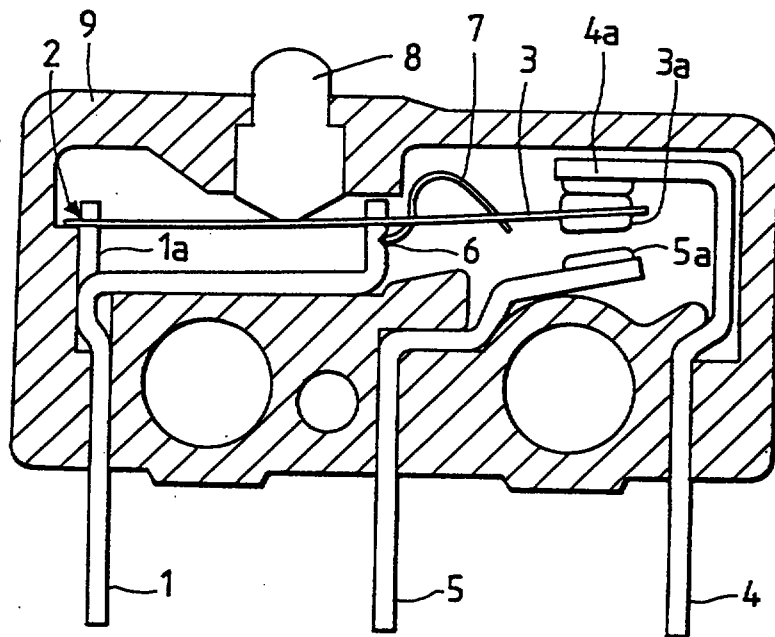


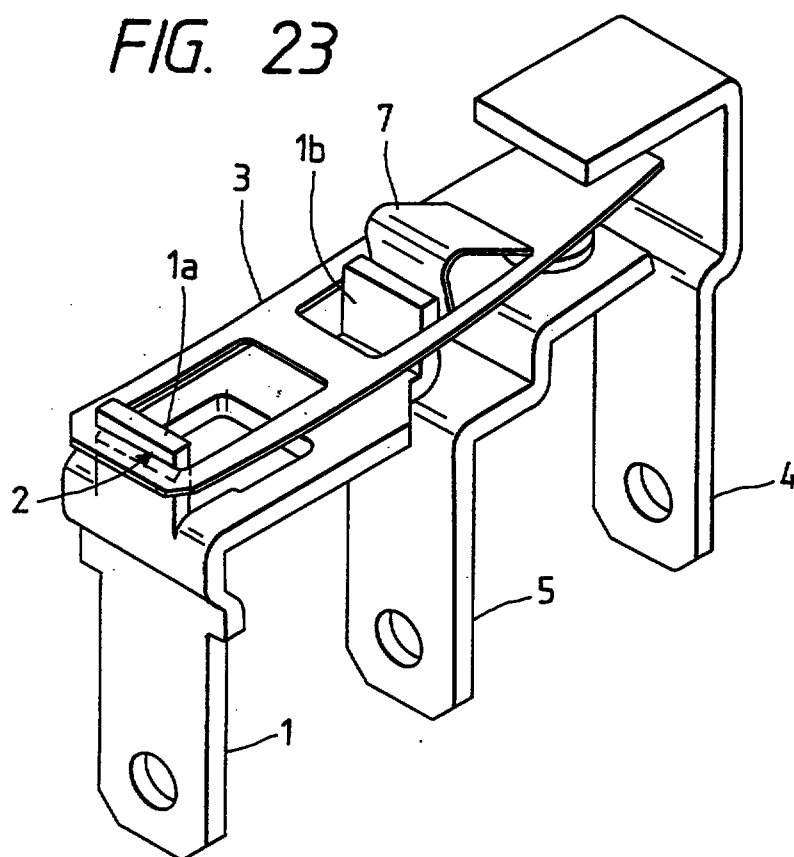
FIG. 22



This Sheet Has Been Replaced



FIG. 23



This Sheet Has Been Replaced



REPLACED SHEETS	SG
☒ Description : paged 1 to paged 19	
☒ Claim(s) : paged 20 to paged 22	
☒ Drawing(s) : paged 1 to paged 12	
☒ Abstract : paged 23 to paged 23	

1

REPLACEMENT SHEETS	SG
☒ Description : paged 1 to paged 19	
☒ Claim(s) : paged 20 to paged 22	
☒ Drawing(s) : paged 1 to paged 12	
☒ Abstract : paged 23 to paged 23	
DATE OF RECEIPT 30 SEP 1996	

SWITCH

BACKGROUND OF THE INVENTION

This invention relates to an electrical connection structure for a stationary terminal and a movable piece in a micro switch or the like.

One example of a conventional micro switch is as shown in FIGS. 22 and 23.

The micro switch comprises: a stationary terminal 1 which is a common terminal, and a pair of stationary terminals 4 and 5 which are fixedly inserted in a resin casing 9; a switching movable piece 3 having its base end portion engaged with a V-shaped engaging groove formed in one engaging piece 1a of the stationary terminal 1 (hereinafter referred to as "an armature 3", when applicable), and a movable contact 3a provided on its free end portion in such a manner that the movable contact appears on both sides (the upper and lower surfaces) of the free end portion; a movable spring 7 for operating the armature with a snap, the spring 7 having its base end portion engaged with a V-shaped engaging groove 6 formed in the other engaging piece 1b of the stationary terminal 1 and its free end portion engaged with the free end portion of the armature 3; and a push button 8 supported by the casing in such a manner that it is pushed against the middle of the armature 3 when depressed. In the normal state of the micro switch; that is, when the push

This Sheet Has Been Replaced



This is the replacement sheet

Date: 30 SEP 1996



button 8 is not depressed yet, as shown in FIGS. 22 and 23 the free end portion of the armature 3 is urged upwardly by the elastic restoring force of the movable spring 7, so that the movable contact 3a is held in contact with the contact of the stationary terminal 4 (which is a normally closed contact). When, under this condition, the push button 8 is depressed, the middle of the armature 3 is displaced below a predetermined position, instantaneously the armature 3 is urged downwardly by the elastic restoring force of the movable spring 8 (snap action), so that the movable contact 3a is tripped over to the contact 5a of the other stationary terminal 5 (which is a normally open contact). Thus, the switching operation has been accomplished.

In the above-described micro switch, the contact resistance of the switch occurs not only in a portion between the contact 3a and either of the contacts 4a and 5a but also in each of engaging portions between the stationary terminal 1 and the armature 3, between the movable spring 7 and the stationary terminal 1 and between the movable spring 7 and the armature 3.

However, the frequent slide motion in the engaging portions makes the contact resistance unstable, as a result of which the switch is liable to become low in contact reliability. Furthermore, sometimes the micro switch suffers from the following difficulty: When the contact resistance increases, heat is generated to increase the temperature of

This is the replacement sheet

Date:

30 SEP 1996



the micro switch, thus adversely affecting the durability of the latter. Thus, there is much room for improvement in the durability of the conventional micro switch.

In order to improve the contact between the engaging groove 2 and the armature 3 in reliability, there has been proposed a method in which the engaging portions of the engaging groove 2 and the armature 3 are plated with silver. However, the method is not economical because the silver plating will increase the manufacturing cost of the micro switch.

In order to improve the reliability in electrical connection of the stationary terminal 1 and the armature 3, a method has been proposed in which, as shown in FIG. 21, both ends of a lead wire 12 are soldered to the portions of the stationary terminal 1 and the armature 3 which are less displaced from each other. However, the method is also disadvantageous in that the number of components and the number of manufacturing steps are increased as much, and accordingly the manufacturing cost is increased.

SUMMARY OF THE INVENTION

In view of the foregoing, an object of this invention is to provide a switch which can be manufactured relatively readily without increase of the number of components, and is high in the reliability in electrical connection of the stationary terminal and the armature.

This is the replacement sheet

Date: 30 SEP 1996



The foregoing object of the invention has been achieved by the provision of a first switch in which an armature swingably coupled to a stationary terminal is operated by depression of a push button to trip between contacts, and in which, the stationary terminal and the armature are partially welded to each other. In the first switch, the stationary terminal and the armature coupled to it are stably electrically connected to each other through the welded portions.

In the first switch, it is possible that the armature is swingably engaged with the stationary terminal through their engaging portions, and the armature and the stationary terminal are welded to each other by using portions thereof other than the engaging portions. The armature and the stationary terminal are electrically connected to each other by using their portions which are other than their engaging portions through which the armature and the stationary terminal are mechanically coupled to each other. That is, in the switch, the mechanical connection and the electrical connection of the stationary terminal and the armature are established independently of each other.

In the first switch, it is also possible that an engaging groove is formed in an engaging piece of the stationary terminal, the base end portion of the armature is engaged with the engaging groove, a first tongue piece extended from the armature is laid on a second tongue piece

This is the replacement sheet

Date: 30 SEP 1996



formed by bending the middle portion of the engaging piece, and the two tongue pieces are welded together. The welding portions of the stationary terminal and the armature are located between the engaging portions through which the stationary terminal and the armature are mechanically engaged with each other; that is, the welding portions are located where the stationary terminal and the armature are less displaced from each other. Hence, the welding portions will not interfere the motion of the armature. The first tongue piece extended from the armature may be bent, and the end portion of the first tongue piece thus bent may be welded to the second tongue piece formed by bending the middle portion of the engaging piece. The tongue piece extended from the armature is bent, and therefore although the end of the tongue is welded to the stationary terminal, the armature can be swung (or tripped) smoothly with the engaging portion as a fulcrum.

In the first switch, it is also possible that an engaging groove is formed in an engaging piece of the stationary terminal, the base end portion of the armature is engaged with the engaging groove thus formed, an engaging recess is formed in the outer surface of the middle portion of the engaging piece, and a tongue piece extended from the armature is engaged with the engaging recess, and welded to the stationary terminal. The welding portions of the stationary terminal and the armature are located where the

This is the replacement sheet

Date: 30 SEP 1996



stationary terminal and the armature are less displaced from each other, and the welding portions will never interfere with the motion of the armature. In the switch, the engaging piece of the stationary terminal, having no cut, is high rigidity.

Further, the foregoing object of the invention has been also achieved by the provision of a second switch in which an armature swingably coupled to a stationary terminal is operated by depression of a push button to trip between the contacts, and in which a movable spring is laid between the stationary terminal and the armature and supported by and welded to the stationary terminal and the armature. The elastically movable spring is welded to the stationary terminal and the armature, and therefore the welding portions scarcely resist the tripping motion of the armature.

Moreover, the foregoing object of the invention has been also achieved by the provision of a third switch in which an armature swingably coupled to a stationary terminal is operated by depression of a push button to trip between the contacts, and in which an engaging groove is formed in an engaging piece of the stationary terminal, the base end portion of the armature is engaged with the engaging groove thus formed, a tongue piece extended from the armature is placed on a tongue piece protruded from the stationary terminal independently of the engaging piece, and the two tongue piece are welded together. The engaging piece

This is the replacement sheet

Date: 30 SEP 1996



supporting the base end portion of the armature on the stationary terminal, and the tongue piece onto which the tongue piece of the armature is welded, are formed independently of each other. Therefore, when those tongue pieces are bent which are formed by cutting the stationary terminal, they will not interfere with each other, and therefore they can be formed with high accuracy.

BRIEF DESCRIPTION OF THE DRAWINGS

In the accompanying drawings:

FIG. 1 is a vertical sectional view showing a switch, which constitutes a first embodiment of this invention;

FIG. 2 is an exploded perspective view of the switch shown in FIG. 1;

FIG. 3 is a perspective view showing essential components of the switch shown in FIG. 1;

FIG. 4 is an exploded perspective view of essential components of the switch shown in FIG. 1;

FIG. 5 is a perspective view showing essential components of a switch, which constitutes a second embodiment of the invention;

FIG. 6 is an exploded perspective view of essential components of the switch shown in FIG. 5;

FIG. 7 is a vertical sectional view showing a switch, which constitutes a third embodiment of the invention;

FIG. 8 is an exploded perspective view of essential components of the switch shown in FIG. 7;

This is the replacement sheet

Date: 30 SEP 1996

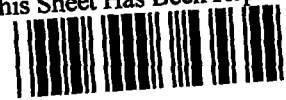


FIG. 9 is a perspective view of essential components of the switch shown in FIG. 7;

FIG. 10 is a perspective view of essential components of a switch, which constitutes a fourth embodiment of the invention;

FIG. 11 is an exploded perspective view of essential components of the switch shown in FIG. 10;

FIG. 12 is a vertical sectional view showing a switch, which constitutes a fifth embodiment of the invention;

FIG. 13 is an exploded perspective view of essential components of the switch shown in FIG. 12;

FIG. 14 is a vertical sectional view showing a switch, which constitutes a sixth embodiment of the invention;

FIG. 15 is an exploded perspective view of essential components of the switch shown in FIG. 14;

FIG. 16 is a perspective view of essential components of the switch shown in FIG. 14;

FIG. 17 is a vertical sectional view showing a switch, which constitutes a seventh embodiment of the invention;

FIG. 18 is a perspective view of essential components of the switch shown in FIG. 17;

FIG. 19 is a perspective view showing the stationary terminals of the switch shown in FIG. 17;

This is the replacement sheet

Date: 30 SEP 1996



FIG. 20 is a perspective view showing the stationary terminals assembled in the switch shown in FIG. 17;

FIG. 21 is a perspective view showing essential components of a comparative example of the switch;

FIG. 22 is a vertical sectional view showing a conventional switch; and

FIG. 23 is a perspective view of essential components of the conventional switch shown in FIG. 22.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Preferred embodiments of this invention will be described with reference to the accompanying drawings.

First Embodiment

A switch, which constitutes a first embodiment of the invention, is as shown in FIGS. 1 through 4. The switch is equal in fundamental structure to the above-described conventional switch. That is, the switch comprises: a stationary terminal 1 which is a common terminal with a pair of engaging pieces 1a and 1b; a movable piece 3 having its base end portion engaged with a V-shaped engaging groove 2 formed in the engaging piece 1a of the stationary terminal 1, and a movable contact 3a provided on its free end portion in such a manner that the movable contact appears on both sides (the upper and lower surfaces) of the free end portion (hereinafter referred to as "an armature 3", when applicable); a stationary terminal 4 which is a normally closed terminal with a stationary contact 4a which is

This is the replacement sheet

Date: 30 SEP 1996



confronted with the movable contact 3a from above; a stationary terminal 5 which is a normally open terminal having a stationary contact 5a which is confronted with the movable contact 3a from below; a movable spring 7 for operating the armature with a snap, the spring 7 having its base end portion engaged with a V-shaped engaging groove 6 formed in the other engaging piece 1b of the stationary terminal 1 and its free end portion engaged with the free end portion of the armature 3; and a push button 8 which is pushed against the middle of the armature 3. Those components 1 through 8 are fixedly held by a resin casing 9 which is made up of a casing body 9a and a cover casing 9b.

In the normal state of the switch; i.e., when the push button 8 is not pushed yet, as shown in FIG. 1 the free end portion of the armature 3 is urged upwardly by the elastic restoring force of the movable spring 7, so that the stationary contact (or normally closed contact) 4a of the stationary terminal 4 is held in contact with the upper surface of the movable contact 3a of the armature 3. When the pushed button 8 is pushed, the middle of the armature 3 is deflected downwardly, so that, when the engaging point of the armature 3 and the spring 7 goes across the prolongation (or dead point) of the straight line connecting the two engaging grooves 2 and 6, instantaneously the armature is displaced downwardly with a snap by the elastic restoring force of the spring 7. As a result, the lower surface of the

This is the replacement sheet

Date:

30 SEP 1996



movable contact 3a is brought into contact with the stationary contact (or normally open contact) of the stationary terminal 5.

In the stationary terminal 1, a tongue piece 1c is extended from the middle, in the direction of width, of the engaging piece 1a, and bent sideways. The armature 3 has an engaging edge 3b, which is engaged with the engaging piece 1a of the stationary terminal 1. A tongue piece 3c is extended from the engaging edge 3b in such a manner that it is laid on the tongue piece 1c of the stationary terminal 1. The two tongue pieces 1c and 3c are welded together at the ends by soldering, so that the stationary terminal 1 and the armature 3 are positively electrically connected with each other. Those tongue pieces 1c and 3c may be connected by laser welding or spot welding.

Second Embodiment

A second embodiment of the invention is as shown in FIGS. 5 and 6. The second embodiment is also similar in fundamental structure to the above-described first embodiment. In the second embodiment, the tongue piece 3c of the armature 3 is longer than in the first embodiment, and it is curved. The end portion of the tongue piece 3c thus curved is connected to the tongue piece 1c of the stationary terminal 1 by soldering or laser welding or spot welding. The welding of the tongue pieces in this manner scarcely

This is the replacement sheet

Date: 30 SEP 1996

affects the motion of the armature; that is, the armature 3 can be smoothly tripped with a snap.

Third Embodiment

A third embodiment of the invention is as shown in FIGS. 7 through 9. The third embodiment is also similar in fundamental structure to the above-described first embodiment. In the third embodiment, the tongue piece 1c is extended longer from the middle of the engaging piece 1a of the stationary terminal 1 than in the first embodiment, and is bent sideways at a level lower than in the first embodiment. The tongue piece 3c is extended long from the armature 3, and bent downwardly at the end. The tongue piece 3c is set above the tongue piece 1c, and under this condition the free ends of those tongue pieces 3c and 1c are connected together by soldering, laser welding or spot welding. Hence, the adverse effect of the welding of the tongues pieces on the motion of the armature can be more positively eliminated; that is, the armature 3 can be more smoothly tripped with a snap. In the third embodiment, the push button 8 has a recess 8a to eliminate its interference with the tongue pieces 1c and 3c.

Fourth Embodiment

A fourth embodiment of the invention is as shown in FIGS. 10 and 11. The third embodiment is also similar in fundamental structure to the above-described first embodiment.

This Sheet Has Been Replaced



This is the replacement sheet

Date: 30 SEP 1996



In the fourth embodiment, an engaging recess 1d is formed in the outer surface of the engaging piece 1c at the middle by pressing. A tongue piece 3c is extended downwardly from the engaging edge 3b of the armature 3 which is engaged with the engaging piece 1a of the stationary terminal 1. The tongue piece 3c thus extended is inserted into the engaging recess 1d. Under this condition, the tongue piece 3c is connected to the stationary terminal 1 by soldering, laser welding or spot welding.

In each of the above-described first through fourth embodiments of the invention, the stationary terminal 1 and the armature 3 are welded to each other by using their portions which are in direct contact with each other. However, they may be welded by using their portions which are in contact with each other through the movable spring 7.

Fifth Embodiment

A fifth embodiment of the invention is as shown in FIGS. 12 and 13. A switch shown in FIGS. 12 and 13 is different in structure from the above-described switches.

In the switch, its stationary terminal 1 has an engaging hole 10, into which one end portion of an operating metal part 11 is inserted. The other end portion 11a of the operating metal part 11 has an engaging groove 11b, with which one end portion of an armature 3 is engaged. The stationary terminal 1 has an engaging groove 1e, with which one end portion of a movable spring 7 is engaged. The other

This is the replacement sheet

Date: 30 SEP 1996

end portion of the spring 7 is engaged with the free end portion of the armature 3. When a push button 8 set in a casing 9 is depressed, the other end portion 11a of the operating metal part 11 is moved downwardly thereby. As a result, the armature 3 is tripped with a snap by the elastic restoring force of the spring 7, so that the movable contact 3a of the armature 3 is moved from the contact (or normally closed contact) 4a of an upper stationary terminal 4 over to the contact (or normally open contact) 5a of a lower stationary terminal 5.

The movable spring 7 has tongue pieces 7a and 7b at both ends which are formed by cutting for the stationary terminal 1 and the armature 3, respectively. The ends of those tongue pieces 7a and 7b are connected to the stationary terminal 1 and the armature 3 by soldering, laser welding or spot welding. Thus, the stationary terminal 1 is electrically stably connected to the armature 3 through the movable spring 7.

Sixth Embodiment

A sixth embodiment of the invention is as shown in FIGS. 14 through 16. The sixth embodiment is similar in fundamental structure to the first embodiment. In the sixth embodiment, its stationary terminal 1 has a pair of engaging pieces 1a and 1b which are bent, and a tongue piece 1c between the engaging pieces 1a and 1b. The tongue piece 1c is formed by cutting the body of the stationary terminal 1,

This Sheet Has Been Replaced



This is the replacement sheet

Date: 30 SEP 1996

and bent at the end. The armature has an elongated tongue piece 3c. The end portion of the tongue piece 3c is connected to the tongue piece 1c by soldering, laser welding or spot welding.

The sixth embodiment is free from the difficulty accompanying the above-described first, second and third embodiments that, since the tongue piece 1c is bent when formed by using the engaging piece 1a, the latter 1a is unavoidably deformed, so that the engaging groove 2 is lowered in positional accuracy.

Seventh Embodiment

A seventh embodiment of the invention is as shown in FIGS. 17 through 20. In a switch shown in those figures, its resin casing 9 is made up of a casing body 9a and a cover 9b which are separable from each other, and its stationary terminals 1, 4 and 5 are held by the casing body 9a in such a manner that they are arranged in a line with their flat base end portions in one plane. The stationary terminal 1 has a pair of engaging pieces 1a and 1b, and a tongue piece 1c at predetermined positions, which are bent independently of one another. The armature 3 has an elongated tongue piece 3c, the end of which is connected to the tongue piece 1c by soldering, laser welding or spot welding.

As is apparent from the above description, the invention has the following merits or effects:

This Sheet Has Been Replaced



This is the replacement sheet

Date:

30 SEP 1996

In a switch of a first aspect of the invention, in which an armature swingably coupled to a stationary terminal is operated by depression of a push button to trip between contacts and the stationary terminal is welded to the armature, the electrical connection of the stationary terminal and the armature is greatly improved in reliability; that is, they are high in durability. In welding the stationary terminal and the armature to each other, it is unnecessary to use an additional component such as a lead wire; that is, the stationary terminal is welded directly to the armature. Therefore, they can be relatively readily welded together by soldering, laser welding or spot welding. Hence, the switch can be manufactured at relatively low cost without increase in the number of components or in the number of manufacturing steps; that is, the switch should be highly appreciated in practical use.

When the armature is swingably engaged with the stationary terminal through engaging portions thereof, and the armature and the stationary terminal are welded to each other by using portions thereof other than the engaging portions in the first switch, the stationary terminal is directly welded to the armature; however, the welding scarcely affects the tripping motion of the armature. Hence, the switch is excellent in operating performance, having the same effects as the first switch.

This Sheet Has Been Replaced



This is the replacement sheet

Date: 30 SEP 1996

When an engaging groove is formed in an engaging piece of the stationary terminal, the base end portion of the armature is engaged with the engaging groove, a first tongue piece extended from the armature is laid on a second tongue piece formed by bending the middle portion of the engaging piece, and the two tongue pieces are welded together in the first switch, the difficulty is more effectively eliminated that the welding adversely affects the tripping motion of the armature; that is, it is further improved in operating performance. Further, when the first tongue piece extended from the armature is bent, and the end portion of the first tongue piece is welded to the second tongue piece formed by bending the middle portion of the engaging piece, the armature can trip more smoothly, and the difficulty is positively eliminated that the welded portions are for instance cracked when the armature is tripped repeatedly. That is, the switch is high in durability in quality, and in reliability.

When an engaging groove is formed in an engaging piece of the stationary terminal, the base end portion of the armature is engaged with the engaging groove thus formed, an engaging recess is formed in the outer surface of the middle portion of the engaging piece, and a tongue piece extended from the armature is engaged with the engaging recess, and welded to the stationary terminal in the first switch, the engaging piece of the stationary terminal, which is provided

This Sheet Has Been Replaced



This is the replacement sheet

Date: 30 SEP 1996

for connecting the latter to the armature, is high in mechanical strength. Hence, the switch has a merit that it is higher in durability, in addition to the merits of the first switch.

In a switch of a second aspect of the invention, in which an armature swingably coupled to a stationary terminal is operated by depression of a push button to trip between the contacts, and a flexible movable spring is laid between the stationary terminal and the armature and supported by and welded to the stationary terminal and the armature, the welding will not adversely affect the tripping motion of the armature, and the electrical connection of the stationary terminal and the armature is high in reliability. That is, the switch is excellent in performance.

In a switch of a third aspect of the invention, in which an armature swingably coupled to a stationary terminal is operated by depression of a push button to trip between contacts, an engaging groove is formed in an engaging piece of the stationary terminal, the base end portion of the armature is engaged with the engaging groove thus formed, a tongue piece extended from the armature is placed on a tongue piece protruded from the stationary terminal independently of the engaging piece, and the two tongue pieces are welded together, the difficulty that the welding adversely affects the tripping motion of the armature is more positively

This Sheet Has Been Replaced



This is the replacement sheet

Date: 30 SEP 1996

eliminated. That is, the switch is much higher in operating performance.

In each of the switches, in order to improve the reliability in electrical connection of the switching elements, namely, the stationary terminal and the armature, they are welded directly to each other. Hence, the switch is smaller in the number of components and in the number of manufacturing steps than the switch which uses lead wires for electrical connecting the switching elements. Accordingly, the switch is lower in manufacturing cost.

This Sheet Has Been Replaced



This is the replacement sheet

Date: 30 SEP 1996

This Sheet Has Been ReplacedWHAT IS CLAIMED IS:

1. A switch in which an armature swingably coupled to a stationary terminal is operated by depression of push button to trip between contacts, said switch comprising an improvement wherein said stationary terminal is welded to said armature.

2. A switch as claimed in claim 1, wherein
said armature is swingably engaged with said stationary terminal through engaging portions thereof, and
said armature and said stationary terminal are welded to each other by using portions thereof other than said engaging portions.

3. A switch as claimed in claim 1, wherein
an engaging groove is formed in an engaging piece of said stationary terminal,
the base end portion of said armature is engaged with said engaging groove,
a first tongue piece extended from said armature is laid on a second tongue piece formed by bending the middle portion of said engaging piece, and
said two tongue pieces are welded together.

4. A switch as claimed in claim 3, wherein
said first tongue piece extended from said armature is bent, and



This is the replacement sheet

Date: 30 SEP 1996



the end portion of said first tongue piece is welded to said second tongue piece formed by bending the middle portion of said engaging piece.

5. A switch as claimed in claim 1, wherein

an engaging groove is formed in an engaging piece of said stationary terminal,

the base end portion of said armature is engaged with said engaging groove thus formed,

an engaging recess is formed in the outer surface of the middle portion of said engaging piece, and

a tongue piece extended from said armature is engaged with said engaging recess, and welded to said stationary terminal.

6. A switch in which an armature swingably coupled to a stationary terminal is operated by depression of a push button to trip between the contacts, said switch comprising an improvement wherein a movable spring is laid between said stationary terminal and said armature and supported by and welded to said stationary terminal and said armature.

7. A switch in which an armature swingably coupled to a stationary terminal is operated by depression of a push button to trip between contacts, comprising an improvement wherein

an engaging groove is formed in an engaging piece of said stationary terminal,



This is the replacement sheet

Date: 30 SEP 1996

the base end portion of said armature is engaged with said engaging groove thus formed, and

a tongue piece extended from said armature is placed on a tongue piece protruded from said stationary terminal independently of said engaging piece, and said two tongue pieces are welded together.

This Sheet Has Been Replaced



* C L M S *

This is the replacement sheet

Date: 30 SEP 1996

ABSTRACT OF THE DISCLOSURE

SWITCH

A switch in which an armature swingably coupled to a stationary terminal is operated by a depression of a push button to trip between the contacts. A movable spring is laid between the stationary terminal and the armature to assist the trip of the armature and the stationary terminal is welded to the armature. The switch can be manufactured relatively readily without increase in the number of components, and is high in the reliability in electrical connection of the stationary terminal and the armature.

FIGURE 12

This Sheet Has Been Replaced

This is the replacement sheet

30 SEP 1996

Date:

FIG. 1

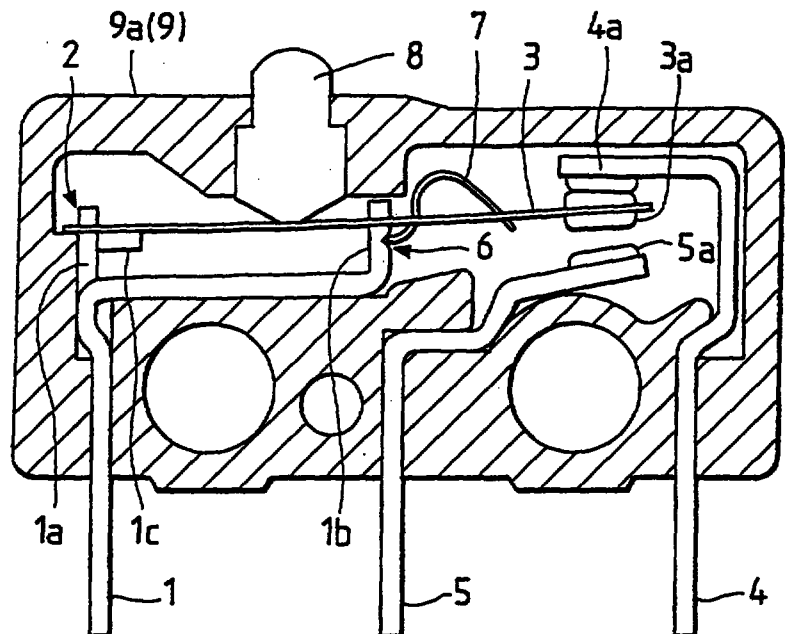
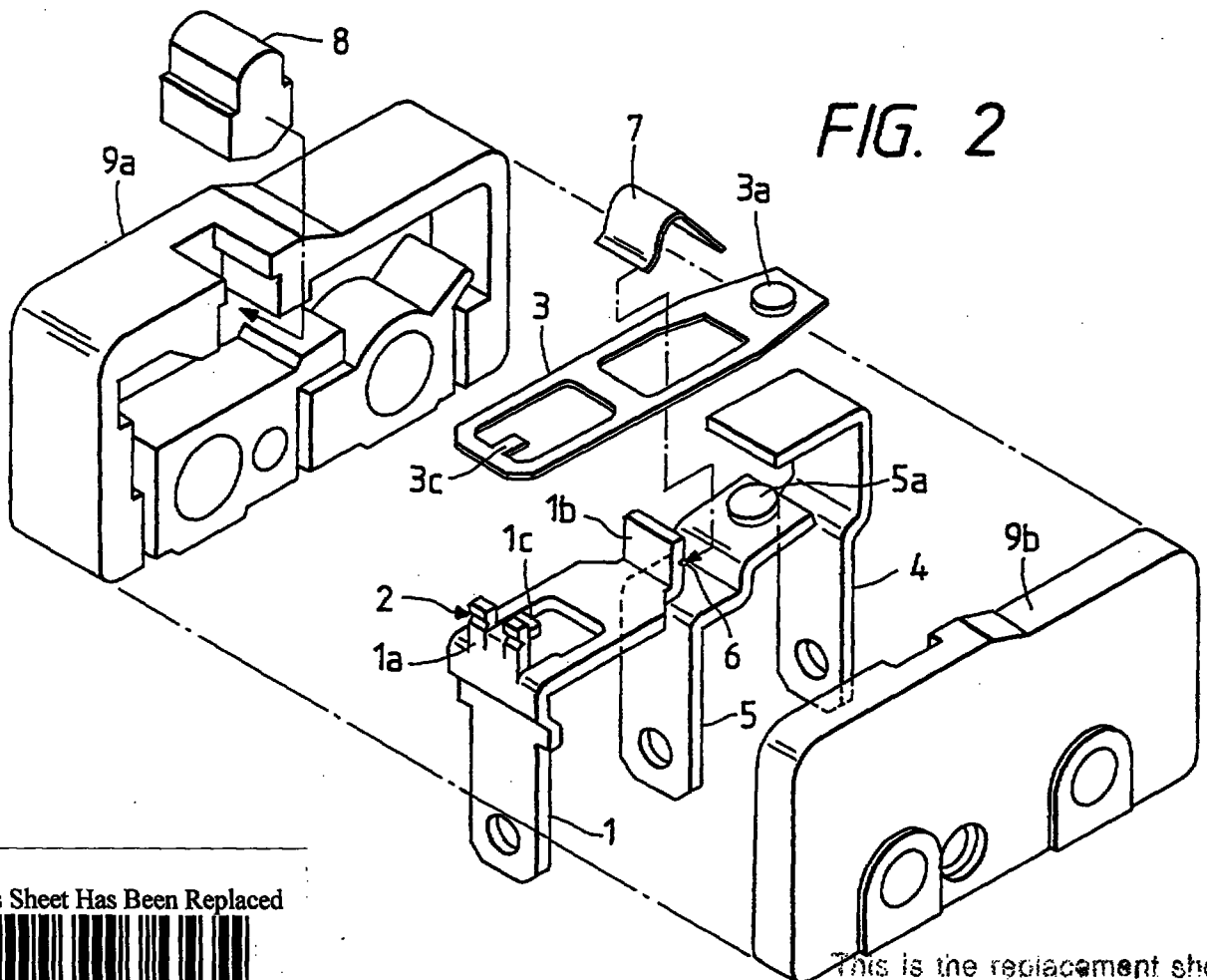


FIG. 2



This Sheet Has Been Replaced



This is the replacement sheet

Date: 30 SEP 1996

FIG. 3

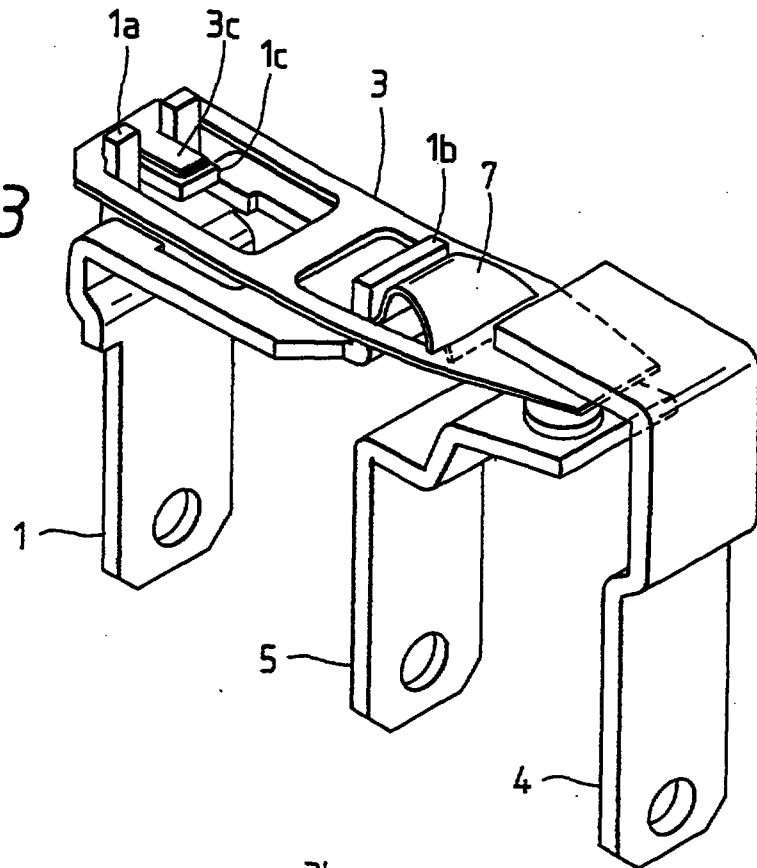
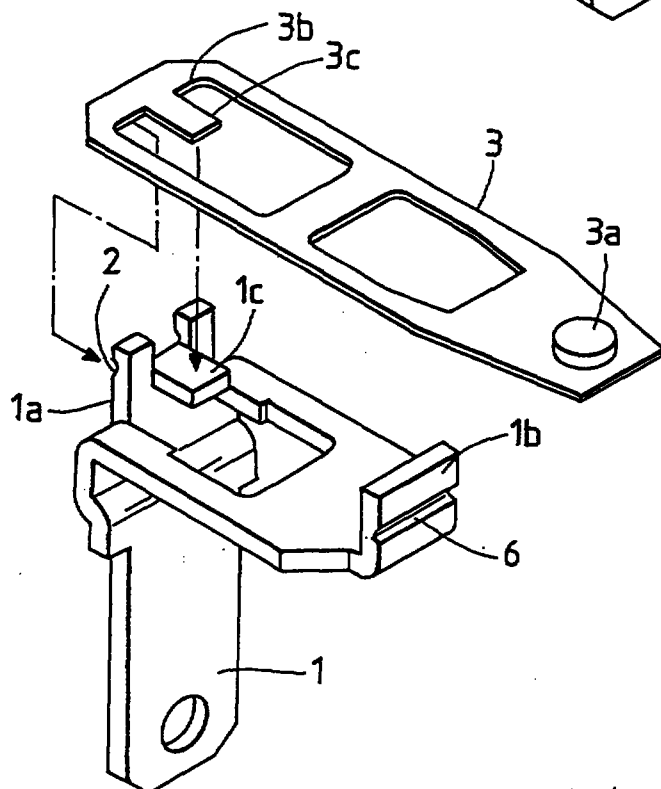


FIG. 4



This Sheet Has Been Replaced



This is the replacement sheet

Date: 30 SEP 1996

FIG. 5

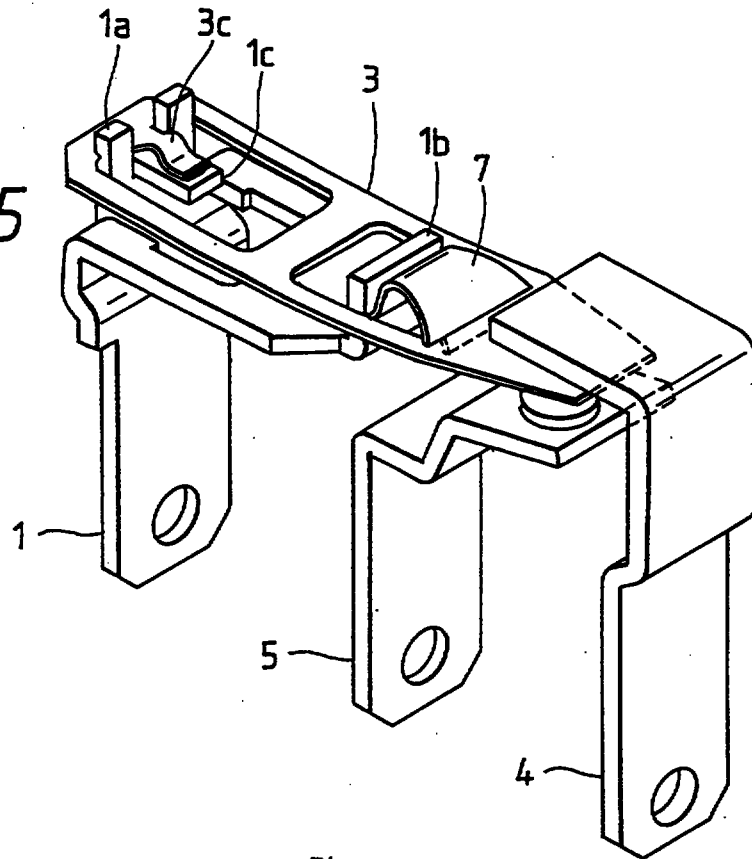
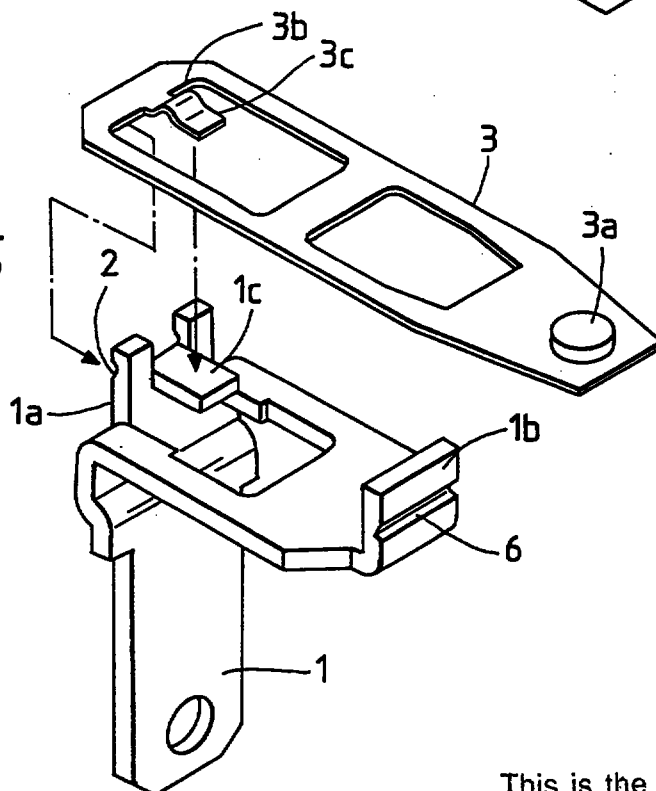


FIG. 6



This Sheet Has Been Replaced



This is the replacement sheet

Date: 30 SEP 1996

4

FIG. 7

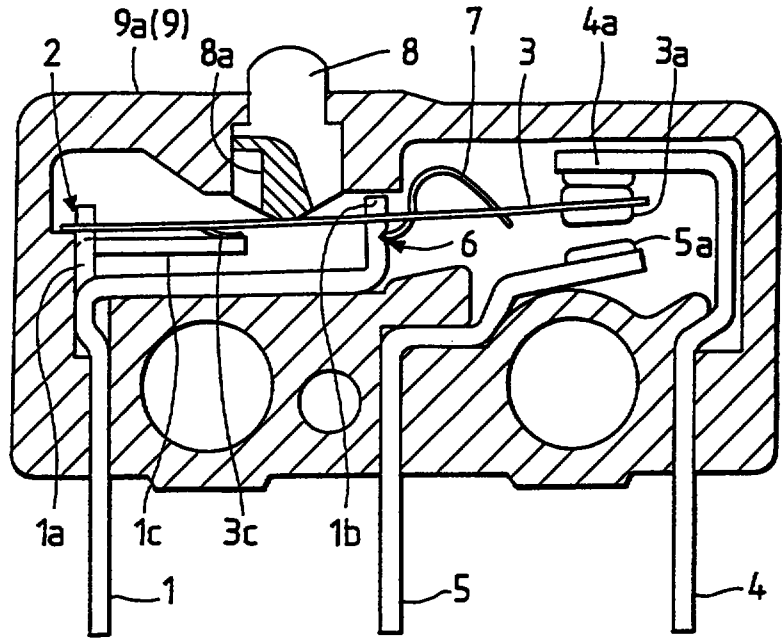
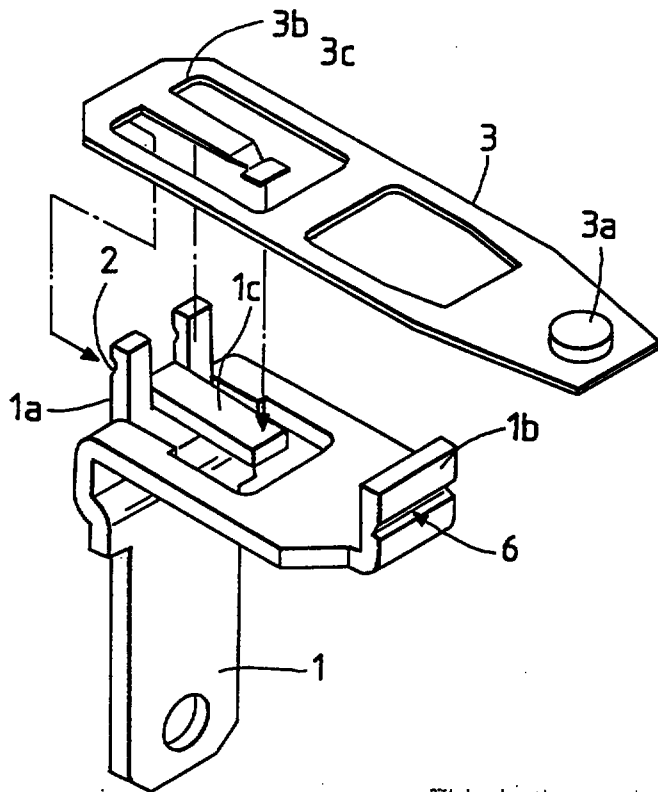


FIG. 8



This Sheet Has Been Replaced



This is the replacement sheet

Date: 30 SEP 1996

FIG. 9

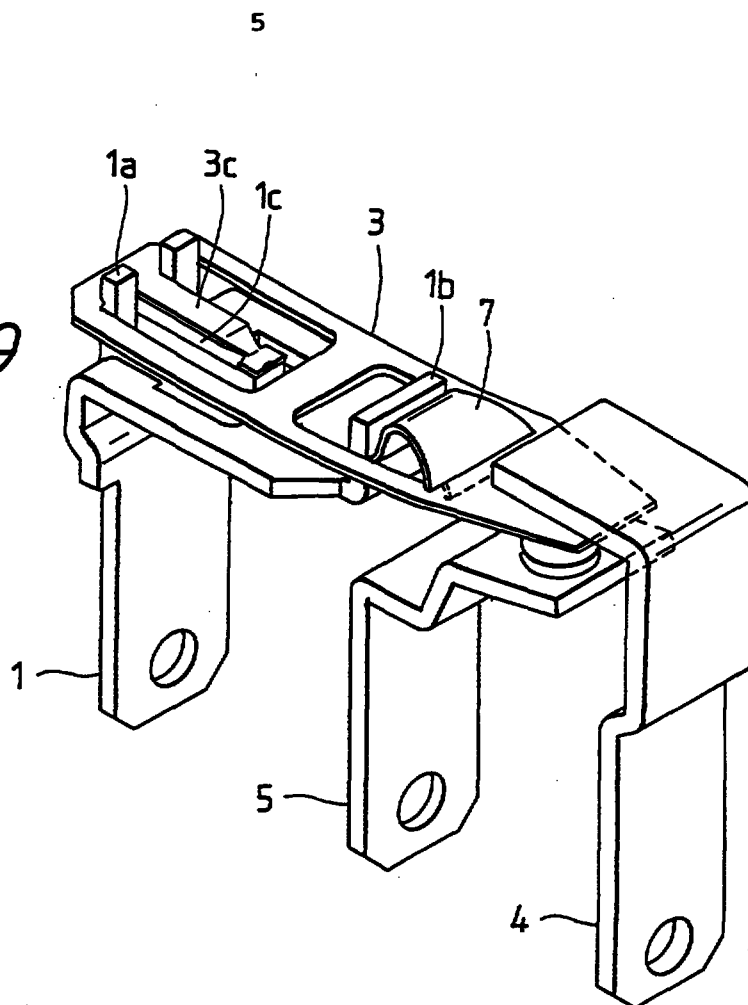
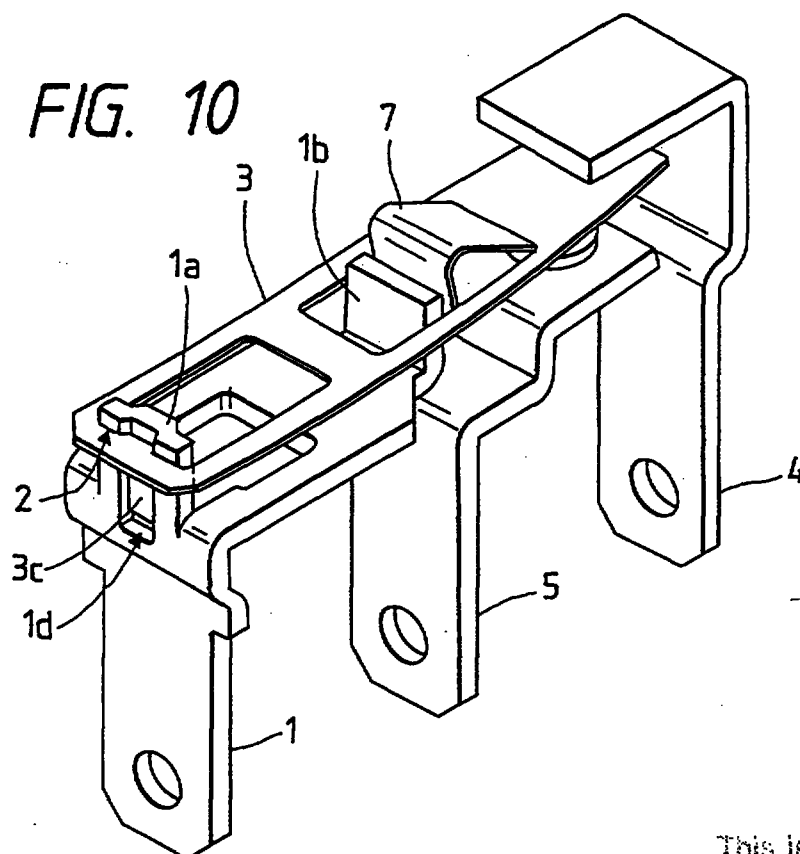


FIG. 10

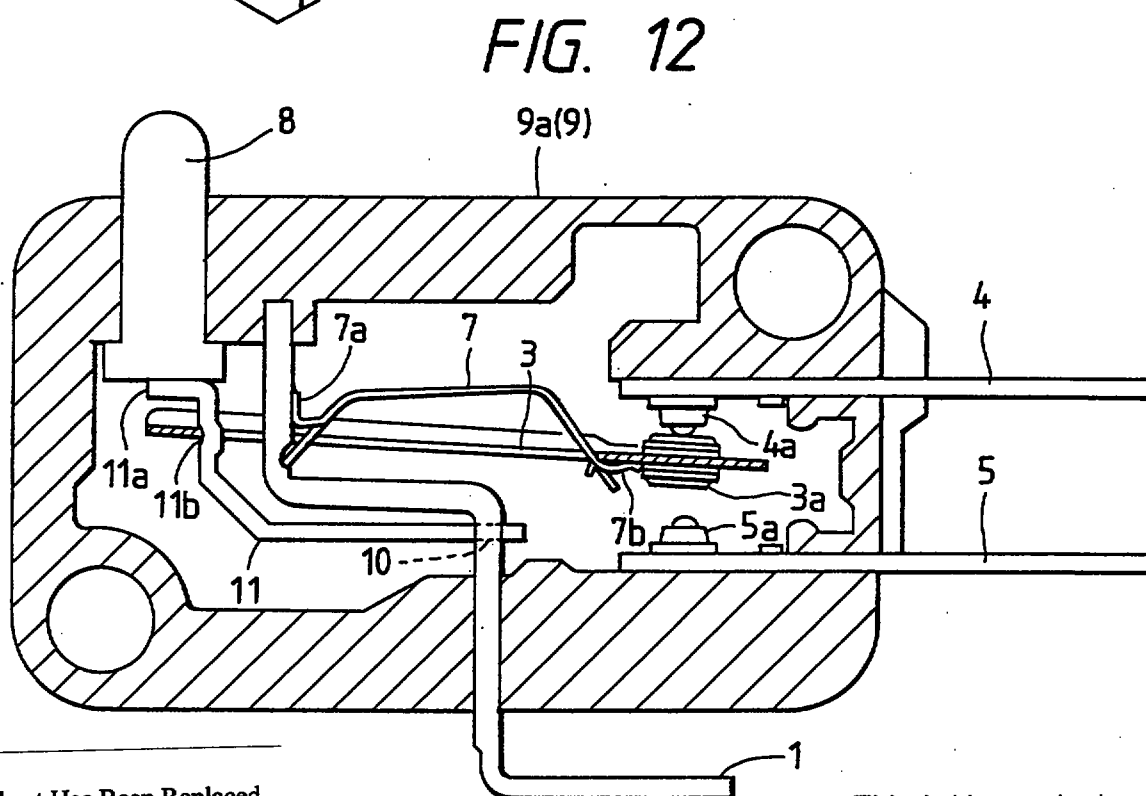
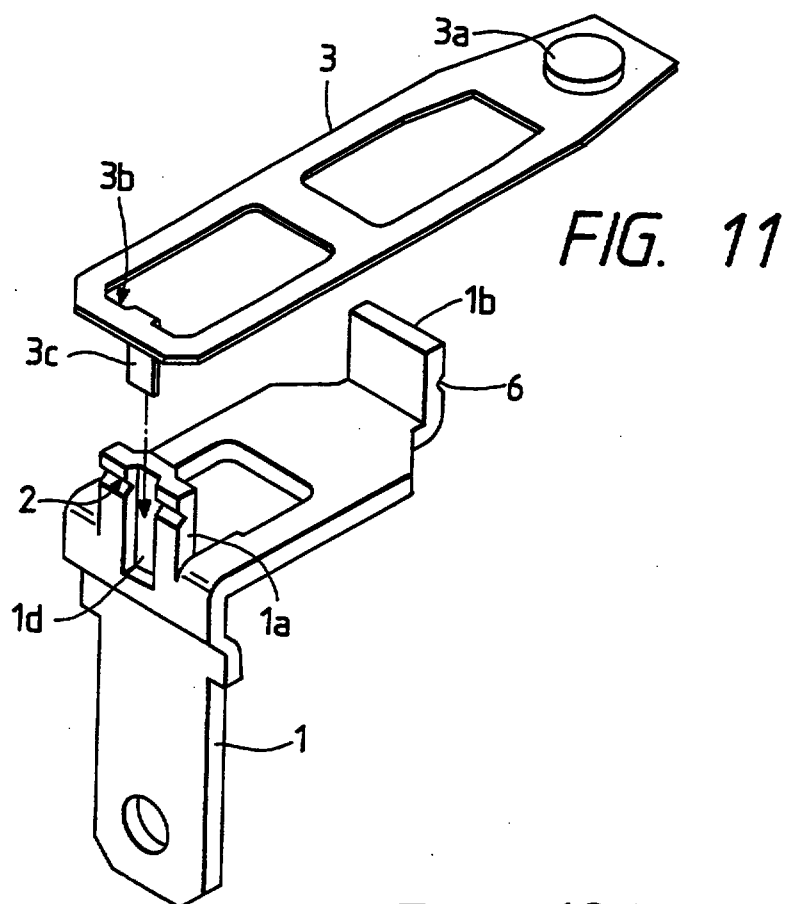


This Sheet Has Been Replaced



This is the replacement sheet

Date: 30 SEP 1996



This Sheet Has Been Replaced



This is the replacement sheet

Date: 30 SEP 1996

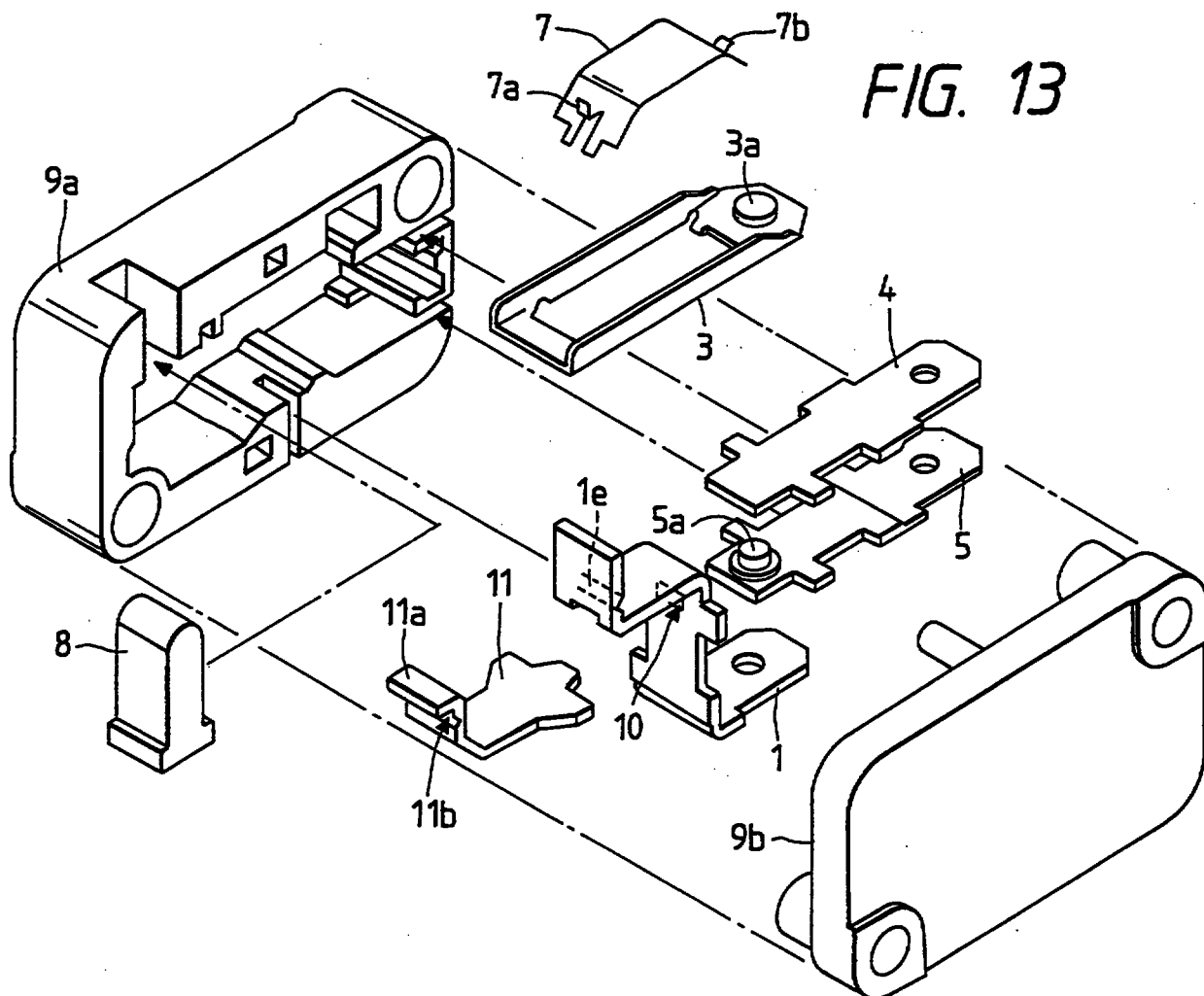
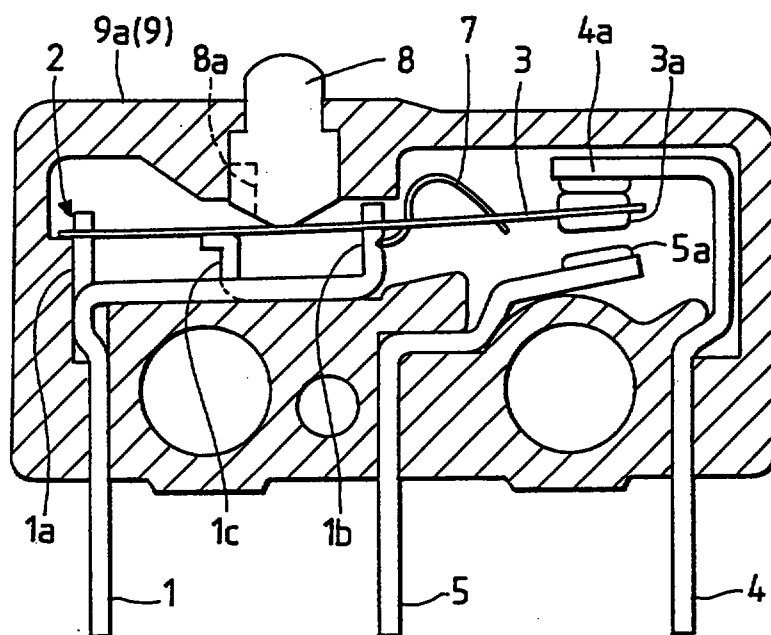


FIG. 14



This Sheet Has Been Replaced



This is the replacement sheet

3 0 SEP 1996

Date:

FIG. 15

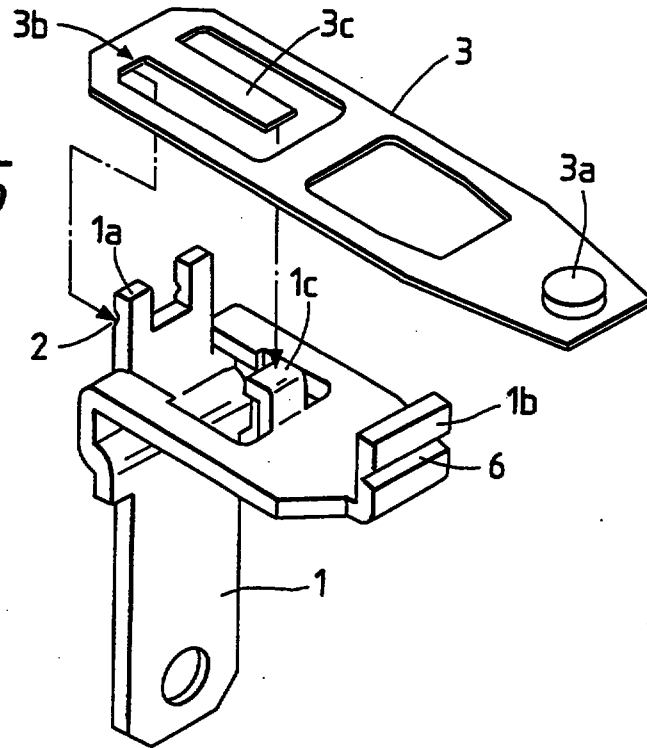
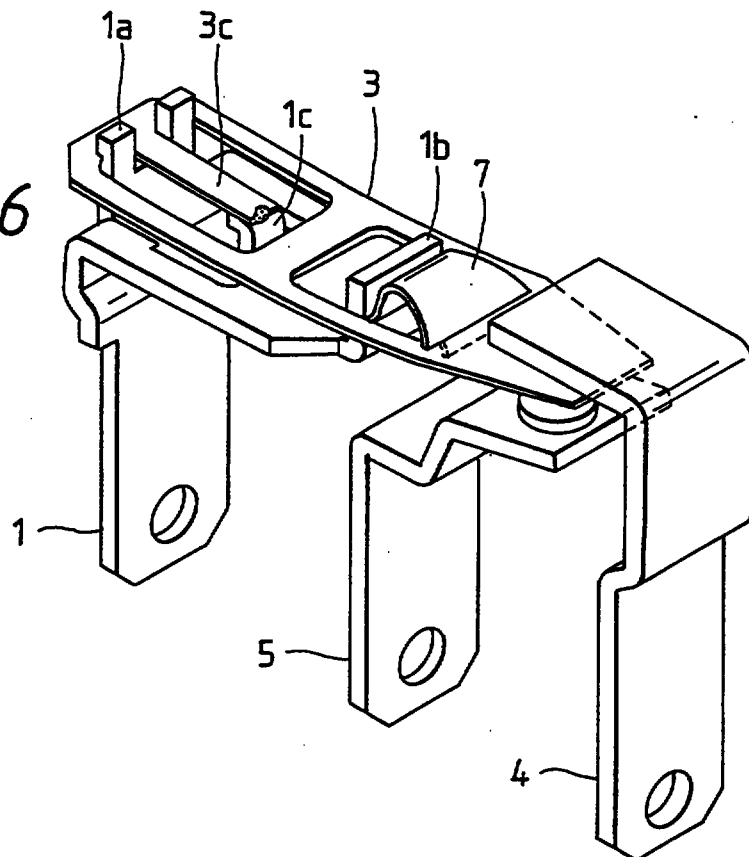


FIG. 16



This Sheet Has Been Replaced



This is the replacement sheet

Date: 30 SEP 1996

FIG. 17

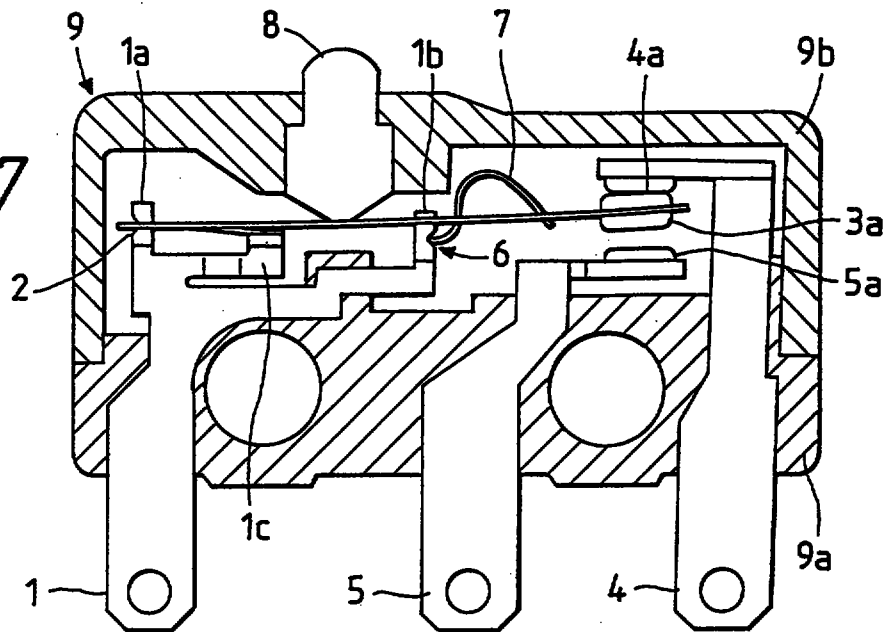
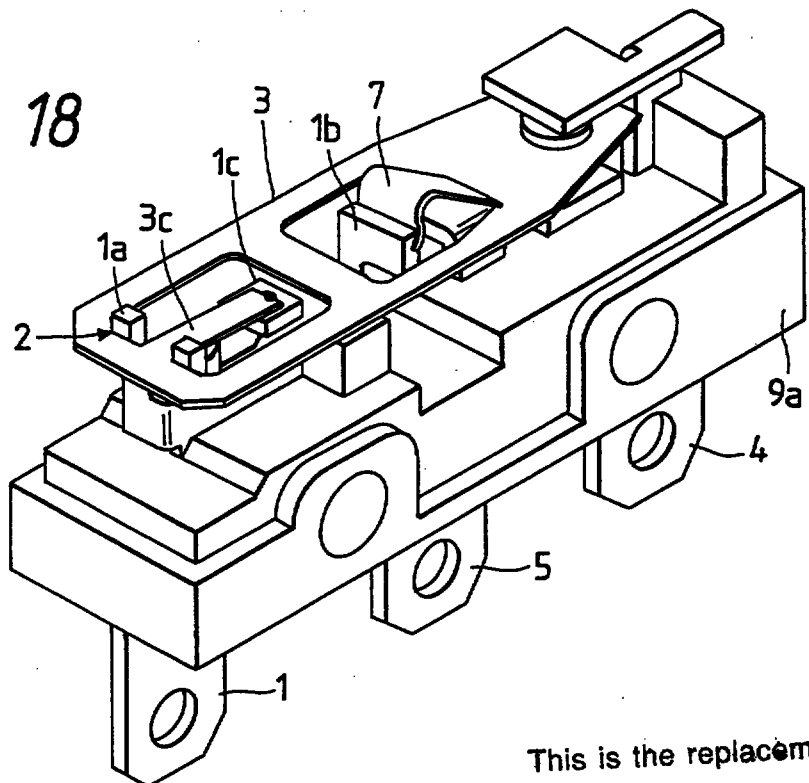


FIG. 18



This Sheet Has Been Replaced



This is the replacement sheet

Date: 30 SEP 1996

FIG. 19

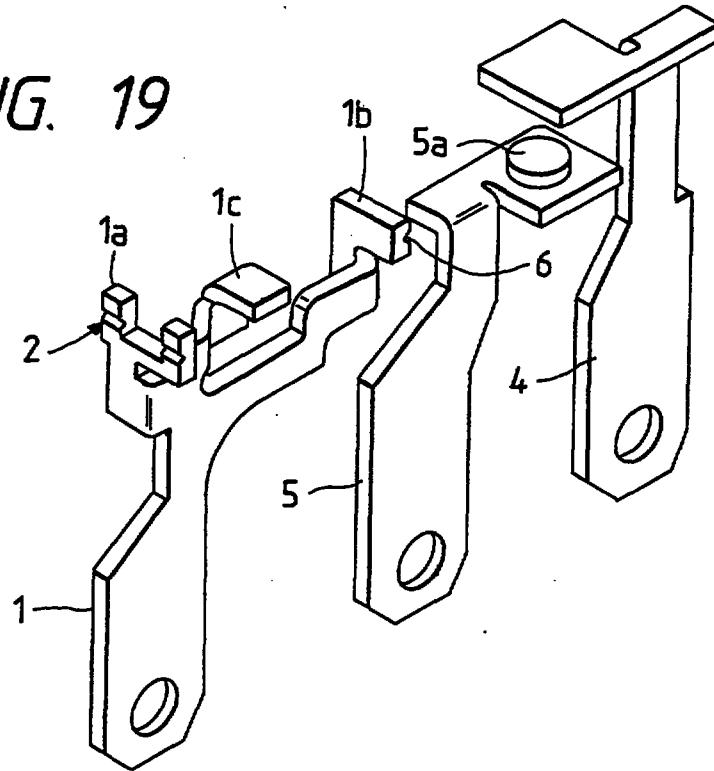
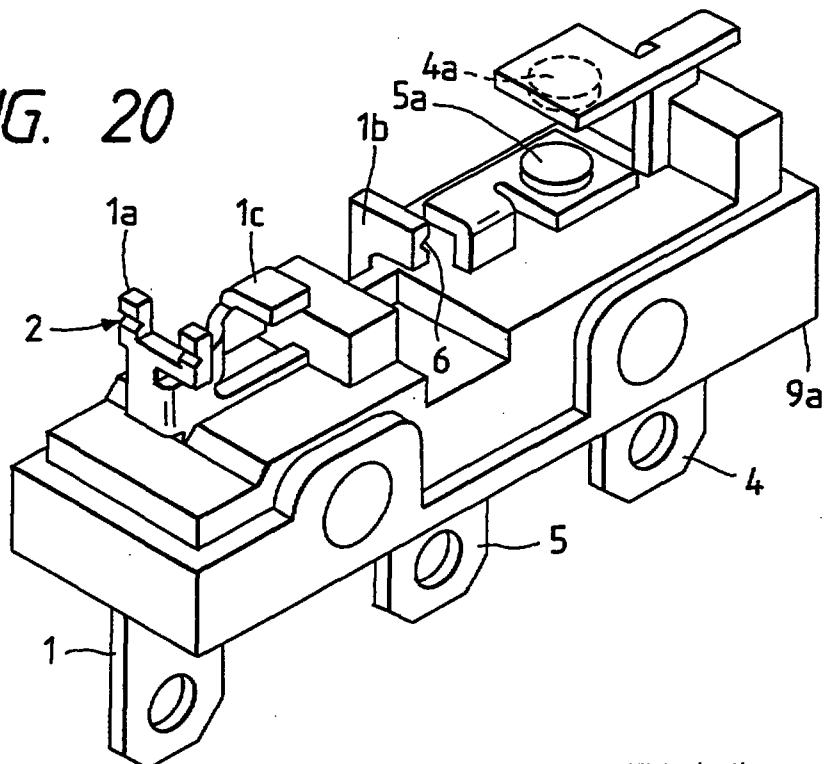


FIG. 20



This Sheet Has Been Replaced



This is the replacement sheet

Date: 30 SEP 1996

FIG. 21

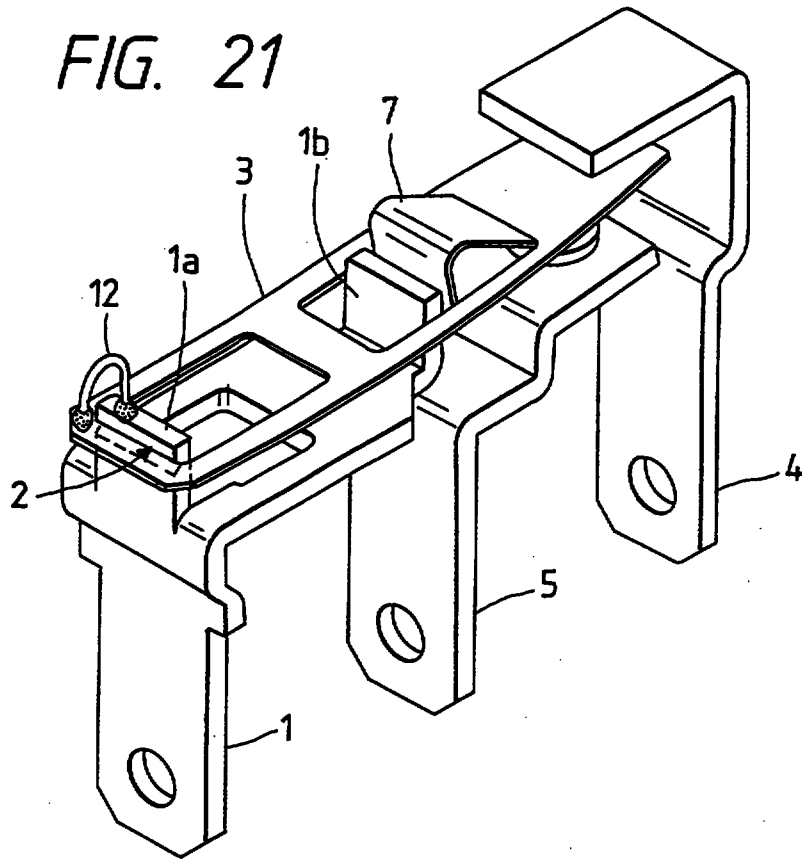
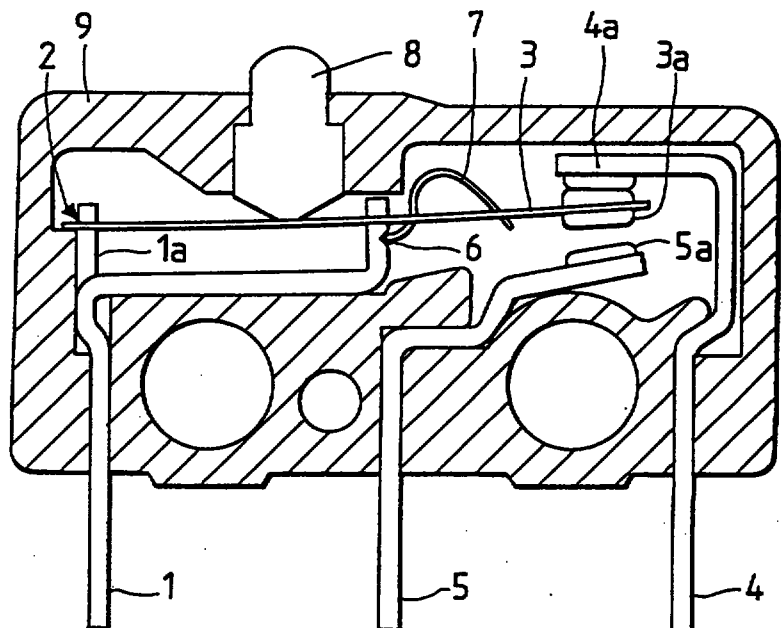


FIG. 22



This Sheet Has Been Replaced

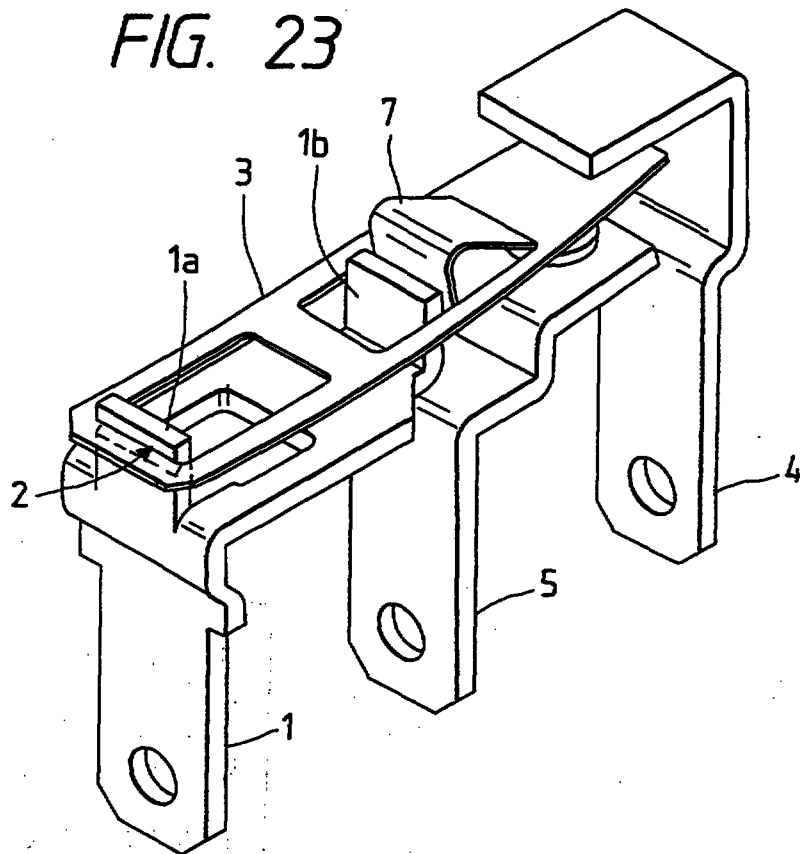


This is the replacement sheet

30 SEP 1996

Date:

FIG. 23



This Sheet Has Been Replaced



This is the replacement sheet

Date: 30 SEP 1996

SWITCH

Description

This invention relates to an electrical connection structure for a stationary terminal and a movable piece in a micro switch or the like.

One example of a conventional micro switch which forms the basis for the preamble of claims 1 and 5 is as shown in FIGS. 22 and 23 (see for instance US-A-5 111 010).

The micro switch comprises: a stationary terminal 1 which is a common terminal, and a pair of stationary terminals 4 and 5 which are fixedly inserted in a resin casing 9; a switching movable piece 3 having its base end portion engaged with a V-shaped engaging groove formed in one engaging piece 1a of the stationary terminal 1 (hereinafter referred to as "an armature 3", when applicable), and a -movable contact 3a provided on its free end portion in such a manner that the movable contact appears on both sides (the upper and lower surfaces) of the free end portion; a movable spring 7 for operating the armature with a snap, the spring 7 having its base end portion engaged with a V-shaped engaging groove 6 formed in the other engaging piece 1b of the stationary terminal 1 and its free end portion engaged with the free end portion of the armature 3; and a push button 8 supported by the casing in such a manner that it is pushed against the middle of the armature 3 when depressed. In the normal state of the micro switch; that is, when the push button 8 is not depressed yet, as shown in FIGS. 22 and 23 the free end portion of the armature 3 is urged upwardly by the elastic restoring force of the movable spring 7, so that the movable contact 3a is held in contact with the contact of the stationary terminal 4 (which is a normally closed contact). When, under this condition, the push button 8 is depressed, the middle of the armature 3 is displaced below a predetermined position, instantaneously the armature 3 is urged downwardly by the elastic restoring force of the movable spring 7 (snap action), so that the movable contact 3a is tripped over to the contact 5a of the other stationary terminal 5 (which is a normally open contact). Thus, the switching operation has been accomplished.

REPLACEMENT SHEETS		SG
☒ Description	: paged 1 to paged 11	
☒ Claim(s)	: paged 12 to paged 13	
☒ Drawing(s)	: paged 1 to paged 14	
☐ Abstract	: paged 1 to paged 1	
DATE OF RECEIPT		14 NOV 1997

This is the replacement sheet
Date: 14 NOV 1997

In the above-described micro switch, the contact resistance of the switch occurs not only in a portion between the contact 3a and either of the contacts 4a and 5a but also in each of engaging portions between the stationary terminal 1 and the armature 3, between the movable spring 7 and the stationary terminal 1 and between the movable spring 7 and the armature 3.

However, the frequent slide motion in the engaging portions makes the contact resistance unstable, as a result of which the switch is liable to become low in contact reliability. Furthermore, sometimes the micro switch suffers from the following difficulty: When the contact resistance increases, heat is generated to increase the temperature of the micro switch, thus adversely affecting the durability of the latter. Thus, there is much room for improvement in the durability of the conventional micro switch.

In order to improve the contact between the engaging groove 2 and the armature 3 in reliability, there has been proposed a method in which the engaging portions of the engaging groove 2 and the armature 3 are plated with sliver. However, the method is not economical because the sliver plating will increase the manufacturing cost of the micro switch.

In order to improve the reliability in electrical connection of the stationary terminal 1 and the armature 3, a method has been proposed in which, as shown in FIG. 21, both ends of a lead wire 12 are soldered to the portions of the stationary terminal 1 and the armature 3 which are less displaced from each other. However, the method is also disadvantageous in that the number of components and the number of manufacturing steps are increased as much, and accordingly the manufacturing cost is increased.

SUMMARY OF THE INVENTION

In view of the foregoing, an object of this invention is to provide a switch which can be manufactured relatively readily without increase of the number of components, and is high in the reliability in electrical connection of the stationary terminal and the armature.

The foregoing object of the invention has been achieved by the provision of a first switch according to claim 1.

This is the replacement sheet

Date: 14 NOV 1997

In the first switch, it is possible that the armature is swingably engaged with the stationary terminal through their engaging portions, and the armature and the stationary terminal are welded to each other by using portions thereof other than the engaging portions. The armature and the stationary terminal are electrically connected to each other by using their portions which are other than their engaging portions through which the armature and the stationary terminal are mechanically coupled to each other. That is, in the switch, the mechanical connection and the electrical connection of the stationary terminal and the armature are established independently of each other.

In the first switch, it is also possible that an engaging groove is formed in an engaging piece of the stationary terminal, the base end portion of the armature is engaged with the engaging groove, a first tongue piece extended from the armature is laid on a second tongue piece formed by bending the middle portion of the engaging piece, and the two tongue pieces are welded together. The welding portions of the stationary terminal and the armature are located between the engaging portions through which the stationary terminal and the armature are mechanically engaged with each other; that is, the welding portions are located where the stationary terminal and the armature are less displaced from each other. Hence, the welding portions will not interfere the motion of the armature. The first tongue piece extended from the armature may be bent, and the end portion of the first tongue piece thus bent may be welded to the second tongue piece formed by bending the middle portion of the engaging piece. The tongue piece extended from the armature is bent, and therefore although the end of the tongue is welded to the stationary terminal, the armature can be swung (or tripped) smoothly with the engaging portion as a fulcrum.

In the first switch, it is also possible that an engaging groove is formed in an engaging piece of the stationary terminal, the base end portion of the armature is engaged with the engaging groove thus formed, an engaging recess is formed in the outer surface of the middle portion of the engaging piece, and a tongue piece extended from the armature is engaged with the engaging

recess, and welded to the stationary terminal. The welding portions of the stationary terminal and the armature are located where the stationary terminal and the armature are less displaced from each other, and the welding portions will never interfere with the motion of the armature. In the switch, the engaging piece of the stationary terminal, having no cut, is high rigidity.

Further, the foregoing object of the invention has been also achieved by the provision of a second switch according to claim 5. The elastically movable spring is welded to the stationary terminal and the armature, and therefore the welding portions scarcely resist the tripping motion of the armature.

BRIEF DESCRIPTION OF THE DRAWINGS

In the accompanying drawings:

FIG. 1 is a vertical sectional view showing a switch, which constitutes a first embodiment of this invention;

FIG. 2 is an exploded perspective view of the switch shown in FIG. 1;

FIG. 3 is a perspective view showing essential components of the switch shown in FIG. 1;

FIG. 4 is an exploded perspective view of essential components of the switch shown in FIG. 1;

FIG. 5 is a perspective view showing essential components of a switch, which constitutes a second embodiment of the invention;

FIG. 6 is an exploded perspective view of essential components of the switch shown in FIG. 5;

FIG. 7 is a vertical sectional view showing a switch, which constitutes a third embodiment of the invention;

FIG. 8 is an exploded perspective view of essential components of the switch shown in FIG. 7;

FIG. 9 is a perspective view of essential components of the switch shown in FIG. 7;

FIG. 10 is a perspective view of essential components of a switch, which constitutes a fourth embodiment of the invention;

FIG. 11 is an exploded perspective view of essential components of the switch shown in FIG. 10;

This is the replacement sheet

Date: 14 NOV 1997

FIG. 12 is a vertical sectional view showing a switch, which constitutes a fifth embodiment of the invention;

FIG. 13 is an exploded perspective view of essential components of the switch shown in FIG. 12;

FIG. 14 is a vertical sectional view showing a switch, which constitutes a sixth embodiment of the invention;

FIG. 15 is an exploded perspective view of essential components of the switch shown in FIG. 14;

FIG. 16 is a perspective view of essential components of the switch shown in FIG. 14;

FIG. 17 is a vertical sectional view showing a switch, which constitutes a seventh embodiment of the invention;

FIG. 18 is a perspective view of essential components of the switch shown in FIG. 17;

FIG. 19 is a perspective view showing the stationary terminals of the switch shown in FIG. 17;

FIG. 20 is a perspective view showing the stationary terminals assembled in the switch shown in FIG. 17;

FIG. 21 is a perspective view showing essential components of a comparative example of the switch;

FIG. 22 is a vertical sectional view showing a conventional switch; and

FIG. 23 is a perspective view of essential components of the conventional switch shown in FIG. 22.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Preferred embodiments of this invention will be described with reference to the accompanying drawings.

First Embodiment

A switch, which constitutes a first embodiment of the invention, is as shown in FIGS. 1 through 4. The switch is equal in fundamental structure to the above-described conventional switch. That is, the switch comprises: a stationary terminal 1 which is a common terminal with a pair of engaging pieces 1a and 1b; a movable piece 3 having its base end portion engaged with a V-shaped engaging groove 2 formed in the engaging piece 1a of the stationary terminal 1, and a movable contact 3a provided on its free end portion in such a manner

This is the replacement sheet

Date: 14 NOV 1997

that the movable contact appears on both sides (the upper and lower surfaces) of the free end portion (hereinafter referred to as "an armature 3", when applicable); a stationary terminal 4 which is a normally closed terminal with a stationary contact 4a which is confronted with the movable contact 3a from above; a stationary terminal 5 which is a normally open terminal having a stationary contact 5a which is confronted with the movable contact 3a from below; a movable spring 7 for operating the armature with a snap, the spring 7 having its base end portion engaged with a V-shaped engaging groove 6 formed in the other engaging piece 1b of the stationary terminal 1 and its free end portion engaged with the free end portion of the armature 3; and a push button 8 which is pushed against the middle of the armature 3. Those components 1 through 8 are fixedly held by a resin casing 9 which is made up of a casing body 9a and a cover casing 9b.

In the normal state of the switch; i.e., when the push button 8 is not pushed yet, as shown in FIG. 1 the free end portion of the armature 3 is urged upwardly by the elastic restoring force of the movable spring 7, so that the stationary contact (or normally closed contact) 4a of the stationary terminal 4 is held in contact with the upper surface of the movable contact 3a of the armature 3. When the pushed button 8 is pushed, the middle of the armature 3 is deflected downwardly, so that, when the engaging point of the armature 3 and the spring 7 goes across the prolongation (or dead point) of the straight line connecting the two engaging grooves 2 and 6, instantaneously the armature is displaced downwardly with a snap by the elastic restoring force of the spring 7. As a result, the lower surface of the movable contact 3a is brought into contact with the stationary contact (or normally open contact) of the stationary terminal 5.

In the stationary terminal 1, a tongue piece 1c is extended from the middle, in the direction of width, of the engaging piece 1a, and bent sideways. The armature 3 has an engaging edge 3b, which is engaged with the engaging piece 1a of the stationary terminal 1. A tongue piece 3c is extended from the engaging edge 3b in such a manner that it is laid on the tongue piece 1c of the stationary terminal 1. The two tongue pieces 1c and 3c are bonded together at the ends by soldering, so that the stationary terminal 1 and the armature 3 are positively electrically connected with each other. Those tongue pieces 1c and 3c may be connected by laser welding or spot welding.

This is the replacement sheet

14 NOV 1997

Date:

Second Embodiment

A second embodiment of the invention is as shown in FIGS. 5 and 6. The second embodiment is also similar in fundamental structure to the above-described first embodiment. In the second embodiment, the tongue piece 3c of the armature 3 is longer than in the first embodiment, and it is curved. The end portion of the tongue piece 3c thus curved is connected to the tongue piece 1c of the stationary terminal 1 by soldering or laser welding or spot welding. The welding of the tongue pieces in this manner scarcely affects the motion of the armature; that is, the armature 3 can be smoothly tripped with a snap.

Third Embodiment

A third embodiment of the invention is as shown in FIGS. 7 through 9. The third embodiment is also similar in fundamental structure to the above-described first embodiment. In the third embodiment, the tongue piece 1c is extended longer from the middle of the engaging piece 1a of the stationary terminal 1 than in the first embodiment, and is bent sideways at a level lower than in the first embodiment. The tongue piece 3c is extended long from the armature 3, and bent downwardly at the end. The tongue piece 3c is set above the tongue piece 1c, and under this condition the free ends of those tongue pieces 3c and 1c are connected together by soldering, laser welding or spot welding. Hence, the adverse effect of the welding of the tongues pieces on the motion of the armature can be more positively eliminated; that is, the armature 3 can be more smoothly tripped with a snap. In the third embodiment, the push button 8 has a recess 8a to eliminate its interference with the tongue pieces 1c and 3c.

Fourth Embodiment

- A fourth embodiment of the invention is as shown in FIGS. 10 and 11. The third embodiment is also similar in fundamental structure to the above-described first embodiment.

In the fourth embodiment, an engaging recess 1d is formed in the outer surface of the engaging piece 1c at the middle by pressing. A tongue piece 3c is extended downwardly from the engaging edge 3b of the armature 3 which is engaged with the engaging piece 1a of the

This is the replacement sheet

14 NOV 1997

Date:

stationary terminal 1. The tongue piece 3c thus extended is inserted into the engaging recess 1d. Under this condition, the tongue piece 3c is connected to the stationary terminal 1 by soldering, laser welding or spot welding.

In each of the above-described first through fourth embodiments of the invention, the stationary terminal 1 and the armature 3 are welded to each other by using their portions which are in direct contact with each other. However, they may be welded by using their portions which are in contact with each other through the movable spring 7, as shown in the following embodiment.

Fifth Embodiment

A fifth embodiment of the invention is as shown in FIGS. 12 and 13. A switch shown in FIGS. 12 and 13 is different in structure from the above-described switches.

In the switch, its stationary terminal 1 has an engaging hole 10, into which one end portion of an operating metal part 11 is inserted. The other end portion 11a of the operating metal part 11 has an engaging groove 11b, with which one end portion of an armature 3 is engaged. The stationary terminal 1 has an engaging groove 1e, with which one end portion of a movable spring 7 is engaged. The other end portion of the spring 7 is engaged with the free end portion of the armature 3. When a push button 8 set in a casing 9 is depressed, the other end portion 11a of the operating metal part 11 is moved downwardly thereby. As a result, the armature 3 is tripped with a snap by the elastic restoring force of the spring 7, so that the movable contact 3a of the armature 3 is moved from the contact (or normally closed contact) 4a of an upper stationary terminal 4 over to the contact (or normally open contact) 5a of a lower stationary terminal 5.

The movable spring 7 has tongue pieces 7a and 7b at both ends which are formed by cutting for the stationary terminal 1 and the armature 3, respectively. The ends of those tongue pieces 7a and 7b are connected to the stationary terminal 1 and the armature 3 by soldering, laser welding or spot welding. Thus, the stationary terminal 1 is electrically stably connected to the armature 3 through the movable spring 7.

This is the replacement sheet

Date: 14 NOV 1997

Sixth Embodiment

A sixth embodiment of the invention is as shown in FIGS. 14 through 16. The sixth embodiment is similar in fundamental structure to the first embodiment. In the sixth embodiment, its stationary terminal 1 has a pair of engaging pieces 1a and 1b which are bent, and a tongue piece 1c between the engaging pieces 1a and 1b. The tongue piece 1c is formed by cutting the body of the stationary terminal 1, and bent at the end. The armature has an elongated tongue piece 3c. The end portion of the tongue piece 3c is connected to the tongue piece 1c by soldering, laser welding or spot welding.

The sixth embodiment is free from the difficulty accompanying the above-described first, second and third embodiments that, since the tongue piece 1c is bent when formed by using the engaging piece 1a, the latter 1a is unavoidably deformed, so that the engaging groove 2 is lowered in positional accuracy.

Seventh Embodiment

A seventh embodiment of the invention is as shown in FIGS. 17 through 20. In a switch shown in those figures, its resin casing 9 is made up of a casing body 9a and a cover 9b which are separable from each other, and its stationary terminals 1, 4 and 5 are held by the casing body 9a in such a manner that they are arranged in a line with their flat base end portions in one plane. The stationary terminal 1 has a pair of engaging pieces 1a and 1b, and a tongue piece 1c at predetermined positions, which are bent independently of one another. The armature 3 has an elongated tongue piece 3c, the end of which is connected to the tongue piece 1c by soldering, laser welding or spot welding.

As is apparent from the above description, the invention has the following merits or effects:

In a switch of a first aspect of the invention, in which an armature swingably coupled to a stationary terminal is operated by depression of a push button to trip between contacts and the stationary terminal is welded to the armature, the electrical connection of the stationary terminal and the armature is greatly improved in reliability; that is, they are high in durability. In welding the stationary terminal and the armature to each other, it is unnecessary to use an additional component such as a lead wire; that is, the stationary terminal is welded di-

This is the replacement sheet

Date: 14 NOV 1997

rectly to the armature. Therefore, they can be relatively readily welded together by soldering, laser welding or spot welding. Hence, the switch can be manufactured at relatively low cost without increase in the number of components or in the number of manufacturing steps; that is, the switch should be highly appreciated in practical use.

When the armature is swingably engaged with the stationary terminal through engaging portions thereof, and the armature and the stationary terminal are welded to each other by using portions thereof other than the engaging portions in the first switch, the stationary terminal is directly welded to the armature; however, the welding scarcely affects the tripping motion of the armature. Hence, the switch is excellent in operating performance, having the same effects as the first switch.

When an engaging groove is formed in an engaging piece of the stationary terminal, the base end portion of the armature is engaged with the engaging groove, a first tongue piece extended from the armature is laid on a second tongue piece formed by bending the middle portion of the engaging piece, and the two tongue pieces are welded together in the first switch, the difficulty is more effectively eliminated that the welding adversely affects the tripping motion of the armature; that is, it is further improved in operating performance. Further, when the first tongue piece extended from the armature is bent, and the end portion of the first tongue piece is welded to the second tongue piece formed by bending the middle portion of the engaging piece, the armature can trip more smoothly, and the difficulty is positively eliminated that the welded portions are for instance cracked when the armature is tripped repeatedly. That is, the switch is high in durability in quality, and in reliability.

When an engaging groove is formed in an engaging piece of the stationary terminal, the base end portion of the armature is engaged with the engaging groove thus formed, an engaging recess is formed in the outer surface of the middle portion of the engaging piece, and a tongue piece extended from the armature is engaged with the engaging recess, and welded to the stationary terminal in the first switch, the engaging piece of the sta-

This is the replacement sheet

Date: 14 NOV 1997

tionary terminal, which is provided for connecting the latter to the armature, is high in mechanical strength. Hence, the switch has a merit that it is higher in durability, in addition to the merits of the first switch.

In a switch of a second aspect of the invention, in which an armature swingably coupled to a stationary terminal is operated by depression of a push button to trip between the contacts, and a flexible movable spring is laid between the stationary terminal and the armature and supported by and welded to the stationary terminal

and the armature, the welding will not adversely affect the tripping motion of the armature, and the electrical connection of the stationary terminal and the armature is high in reliability. That is, the switch is excellent in performance.

In a switch of a third aspect of the invention, in which an armature swingably coupled to a stationary terminal is operated by depression of a push button to trip between contacts, an engaging groove is formed in an engaging piece of the stationary terminal, the base end portion of the armature is engaged with the engaging groove thus formed, a tongue piece extended from the armature is placed on a tongue piece protruded from the stationary terminal independently of the engaging piece, and the two tongue pieces are welded together, the difficulty that the welding adversely affects the tripping motion of the armature is more positively eliminated. That is, the switch is much higher in operating performance.

In each of the switches, in order to improve the reliability in electrical connection of the switching elements, namely, the stationary terminal and the armature, they are welded directly to each other. Hence, the switch is smaller in the number of components and in the number of manufacturing steps than the switch which uses lead wires for electrical connecting the switching elements. Accordingly, the switch is lower in manufacturing cost.

This is the replacement sheet

Date: 14 NOV 1997

Claims

1. A switch comprising

a stationary terminal (1),
an elongated armature (3) having its base end portion hinged to said stationary terminal and carrying a movable contact (3a) at its free end portion,
a movable spring (7) for operating the armature with a snap, said movable spring having its base end portion hinged to said stationary terminal (1) and having its free end portion engaged with said armature,

characterized in that

said armature (3) comprises a first tongue piece (3c) extending from its base end portion, and said tongue piece (3c) is welded or soldered to said stationary terminal (1).

2. A switch according to claim 1, wherein

an engaging groove (2) is formed in an engaging piece (1a) of said stationary terminal (1),
the base end portion of said armature (3) is engaged with said engaging groove (2),
said first tongue piece (3c) is laid on a second tongue piece (1c) formed by bending the middle portion of said engaging piece (1a), and
said first tongue piece is welded or soldered to said second tongue piece (1c).

3. A switch according to claim 2, wherein

said first tongue piece (3c) extending from said armature (3) is bent, and
the end portion of said first tongue piece (3c) is welded or soldered to said second tongue piece (1c).



This is the replacement sheet

Date: 14 NOV 1997

4. A switch according to claim 1, wherein

an engaging groove (2) is formed in an engaging piece (1a) of said stationary terminal (1), the base end portion of said armature (3) is engaged with said engaging groove (2) thus formed,

an engaging recess (1d) is formed in the middle portion of the outer surface of said engaging piece (1a), and

said first tongue piece (3c) extending from said armature (3) is engaged with said engaging recess (1d), and welded or soldered to said stationary terminal (1).

5. A switch comprising

a stationary terminal (1),
an elongated armature (3) having its base end portion hinged to said stationary terminal and carrying a movable contact (3a) at its free end portion,

a movable spring (7) for operating the armature with a snap, said movable spring having its base end portion hinged to said stationary terminal (1) and having its free end portion engaged with said armature,

characterized in that

said movable spring (7) comprises a first tongue piece (7a) extending from its base end portion and a second tongue piece (7b) extending from its free end portion,

said first and second tongue pieces (7a, 7b) are welded or soldered to said stationary terminal (1) and said armature (3), respectively.



This is the replacement sheet

Date: 14 NOV 1997

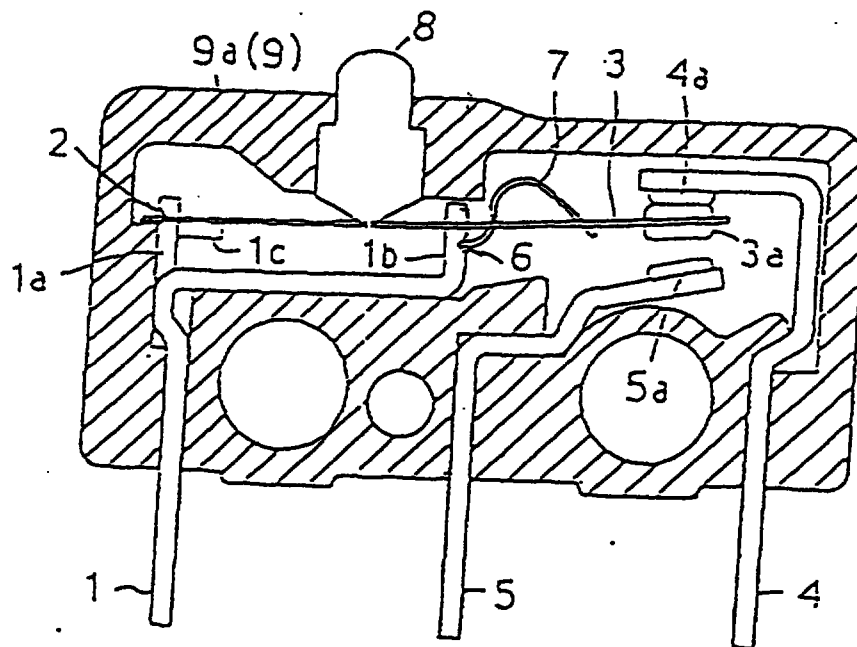


Fig. 1

This is the replacement sheet

Date: 14 NOV 1997

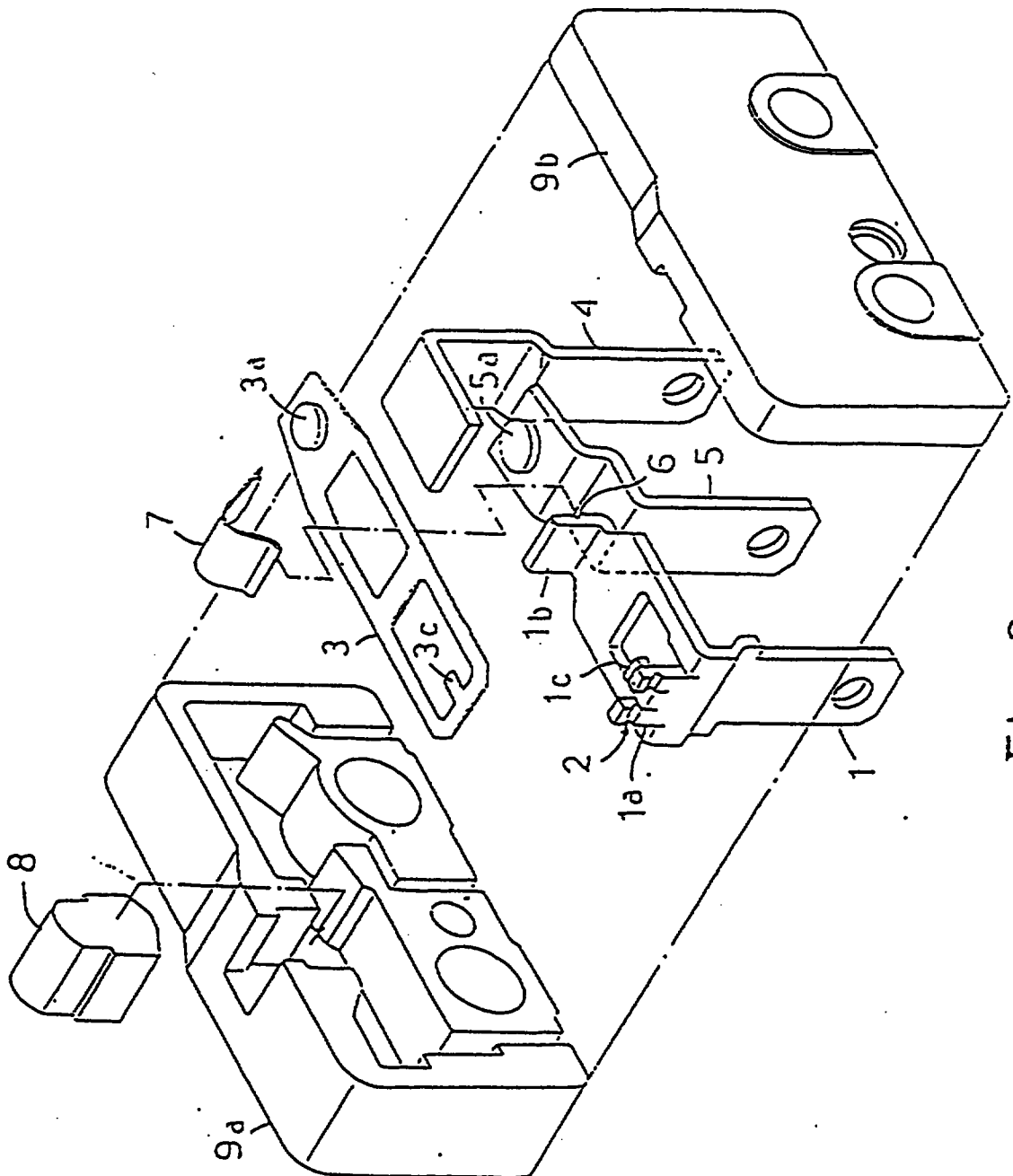


Fig. 2

This is the replacement sheet

Date: 14 NOV 1997

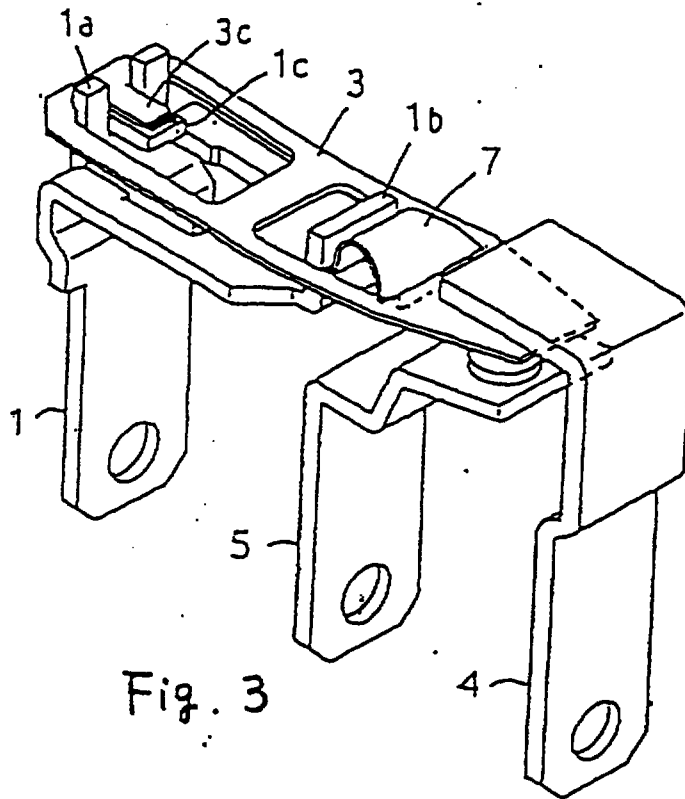


Fig. 3

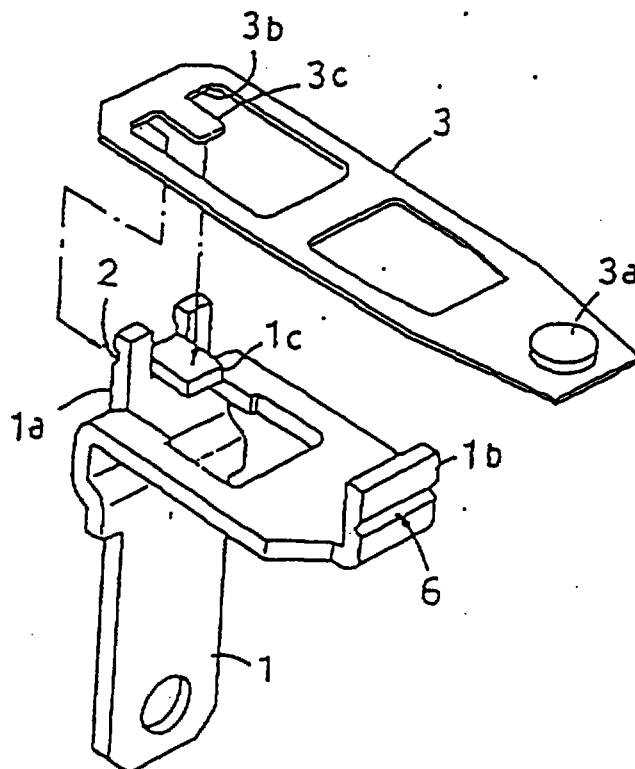


Fig. 4

This is the replacement sheet

Date: 14 NOV 1997

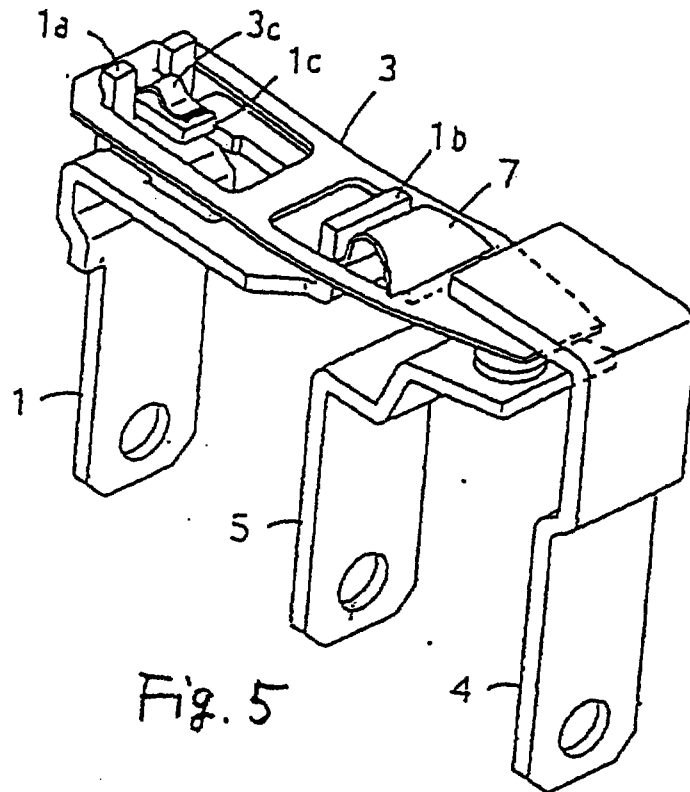


Fig. 5

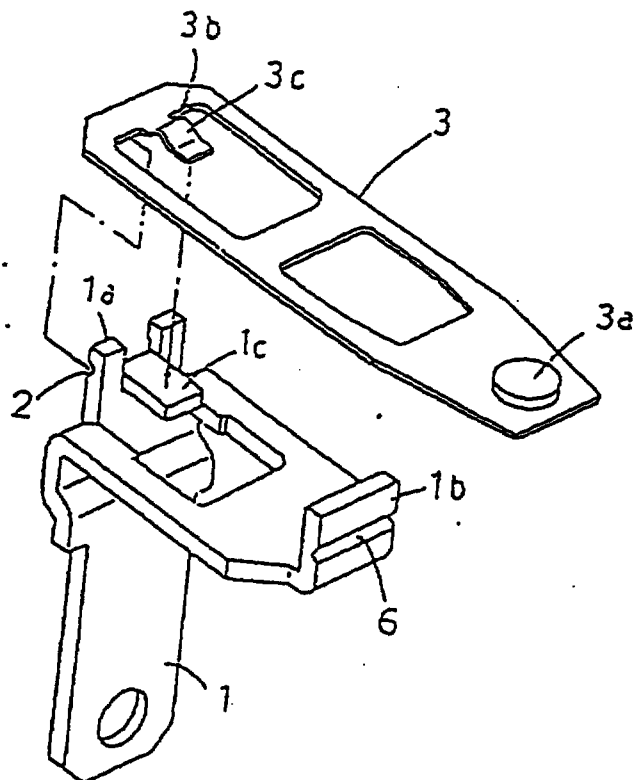


Fig. 6

This is the replacement sheet

Date: 14 NOV 1997

Fig. 7

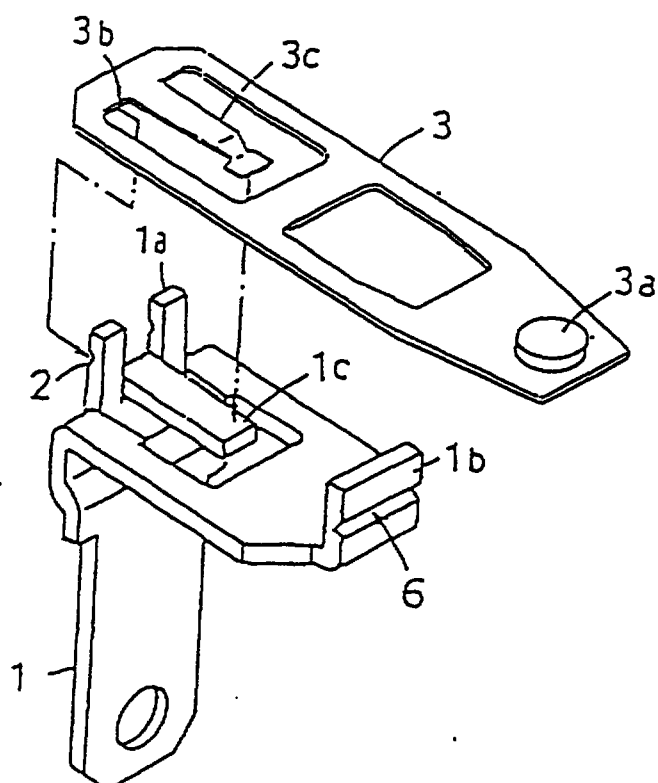


Fig. 8

Date: 14 NOV 1997

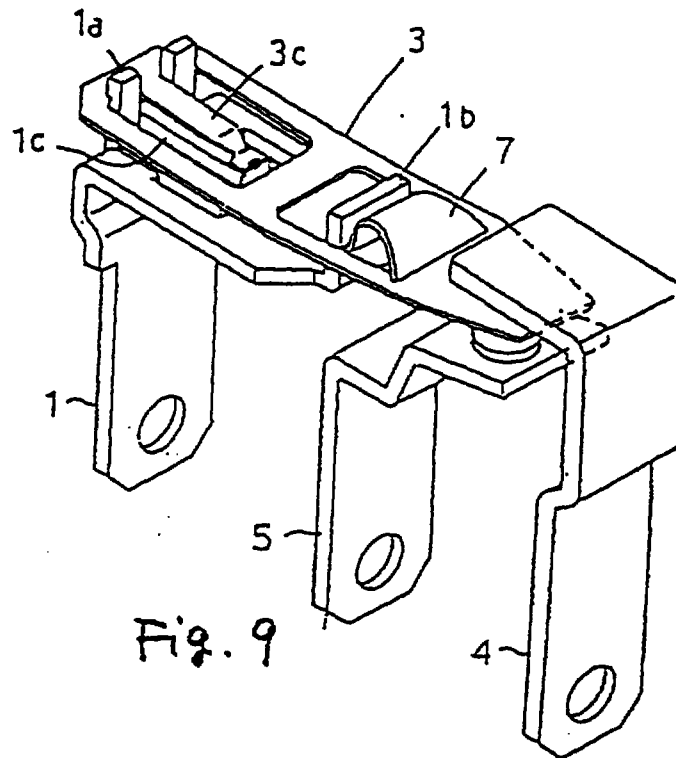


Fig. 9

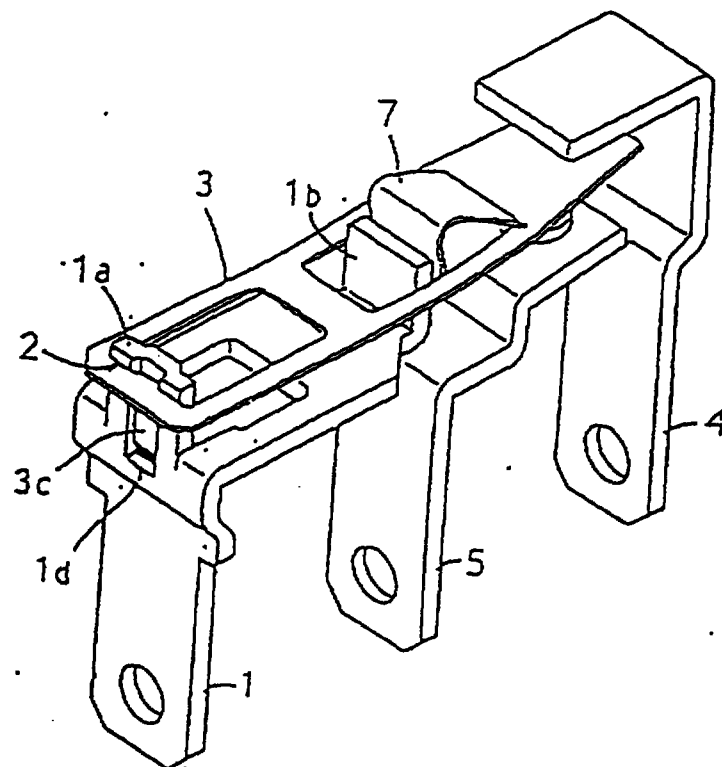


Fig. 10

This is the replacement sheet

Date: 14 NOV 1997

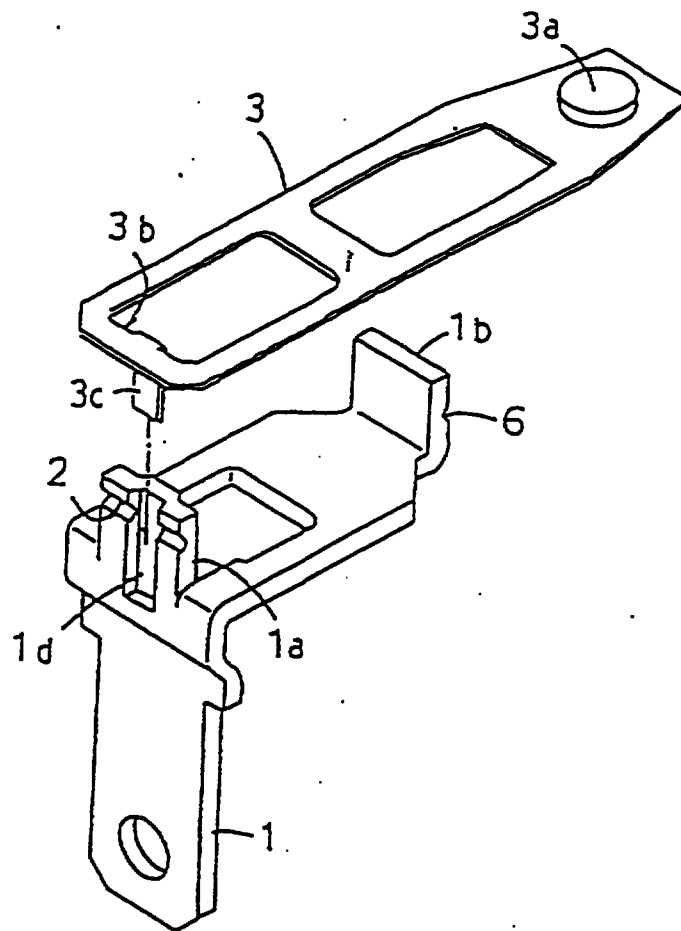


Fig. 11

This is the replacement sheet

Date: 14 NOV 1997

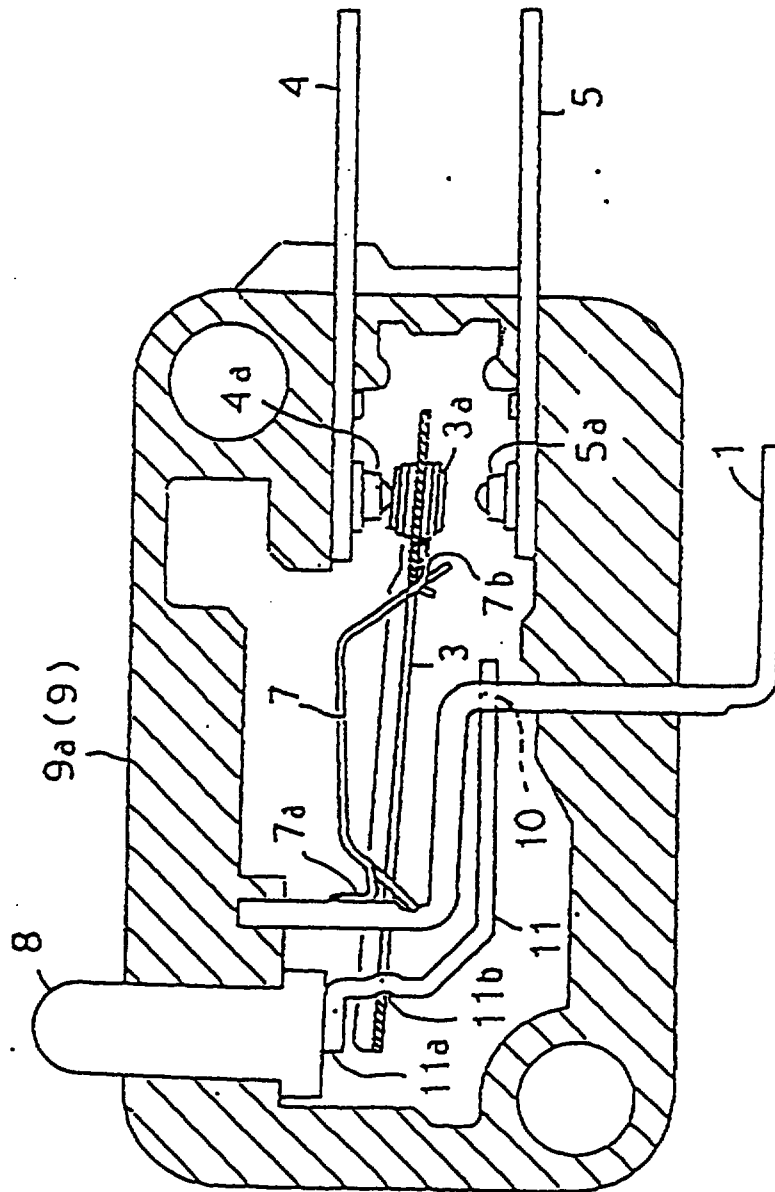


Fig. 12

This is the replacement sheet

Date: 12 4 NOV 1987

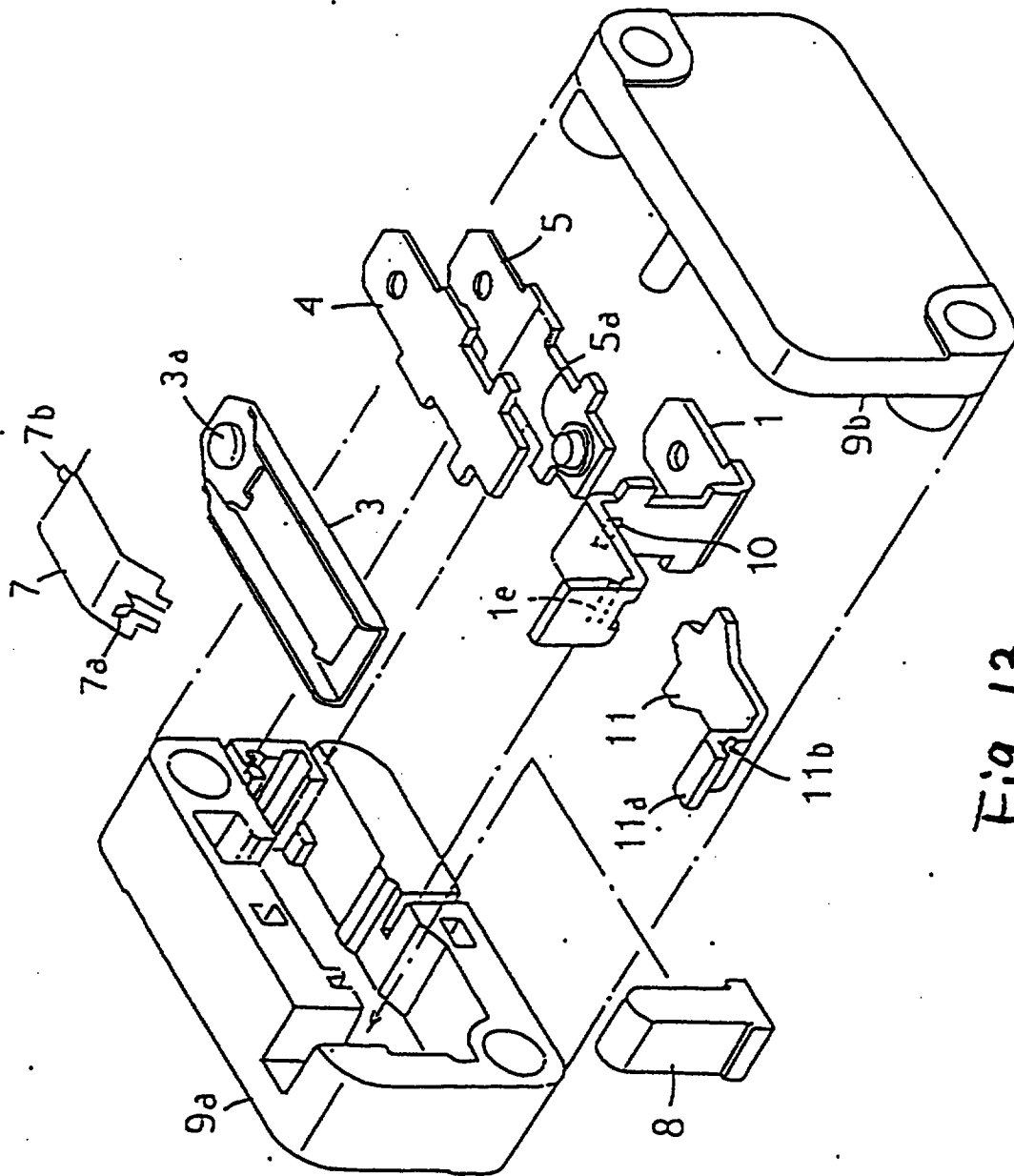


Fig. 13

This is the replacement sheet

Date: 14 NOV 537

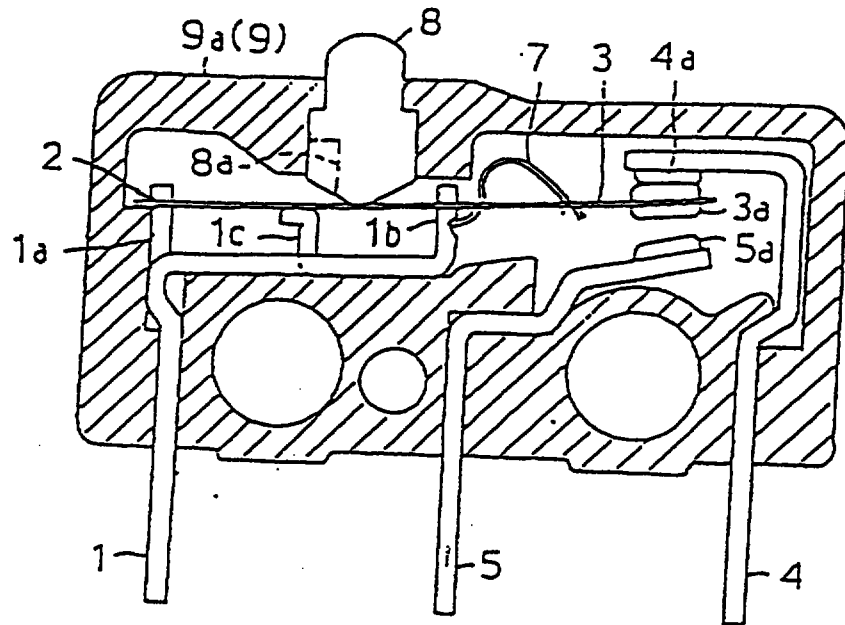


Fig. 14

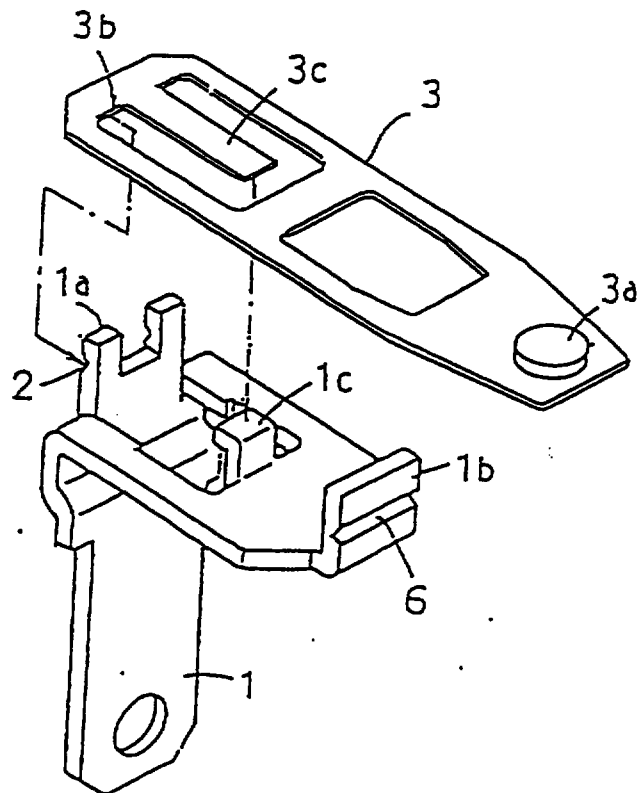


Fig. 15

This is the replacement sheet

Date: 14 NOV 1997

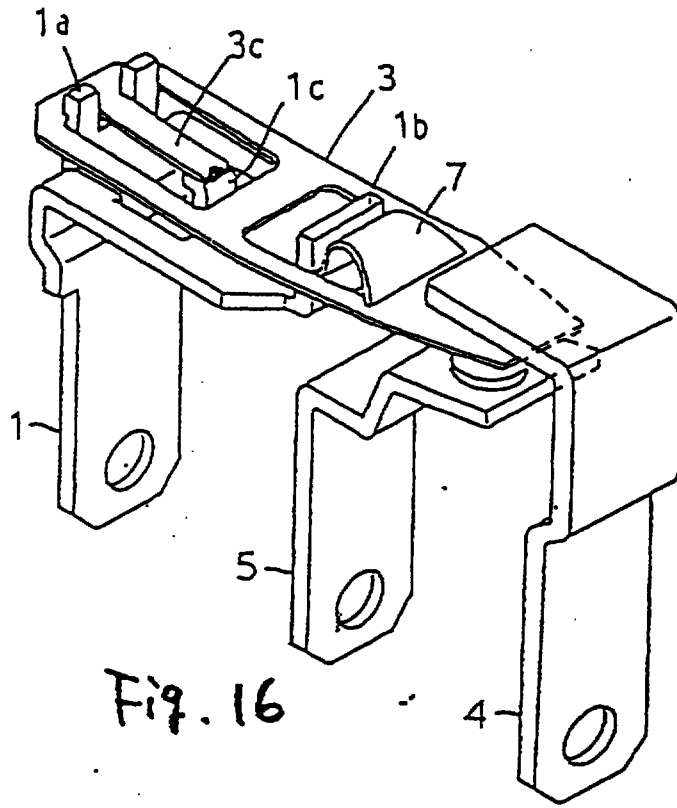


Fig. 16

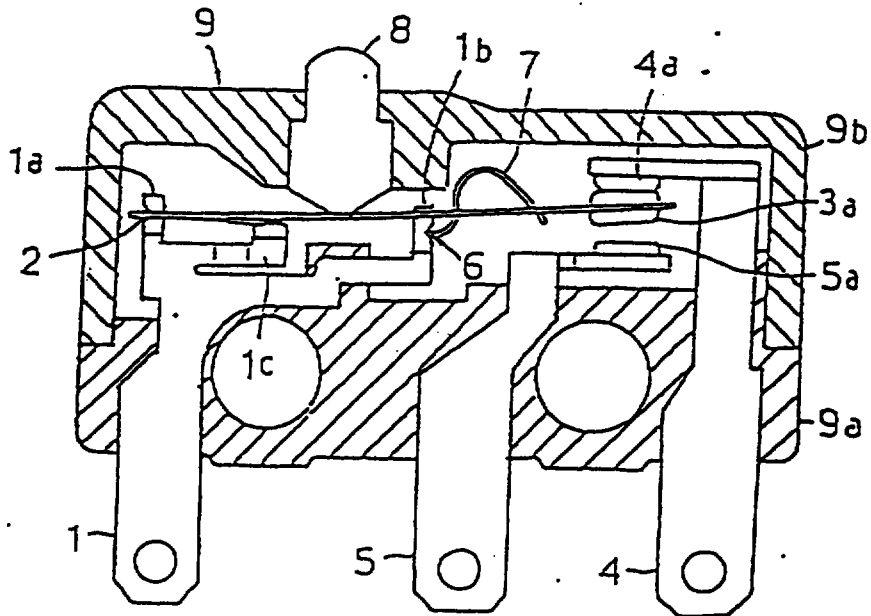


Fig. 17

This is the replacement sheet

Date: 17 4 NOV 1987

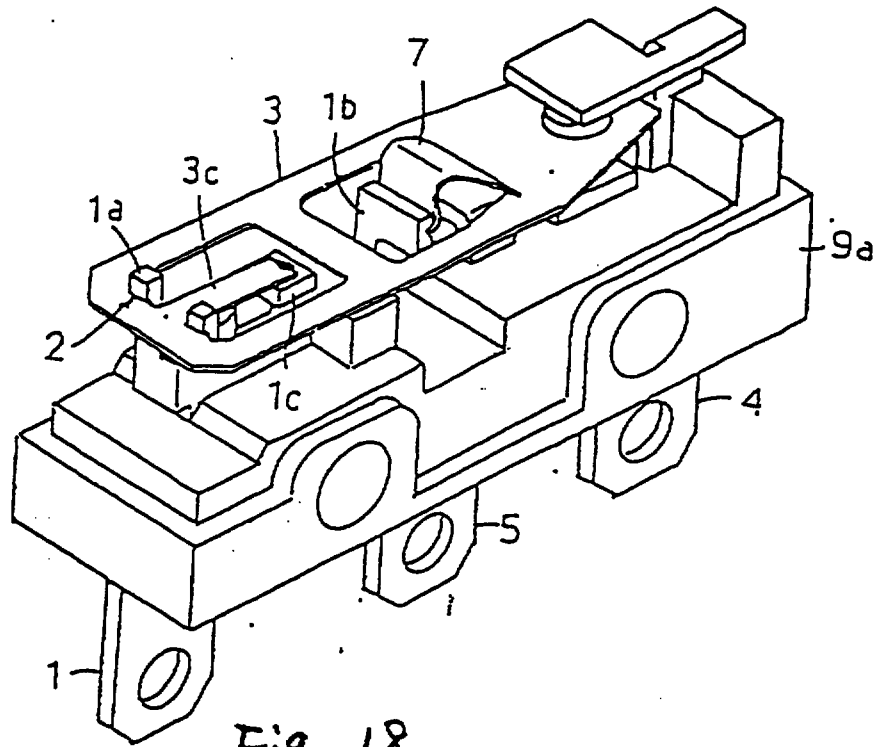


Fig. 18

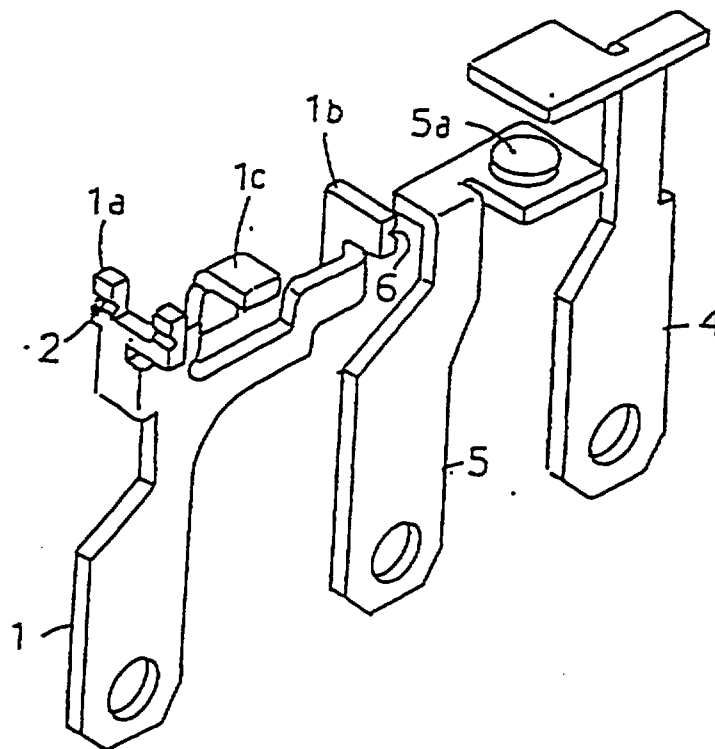
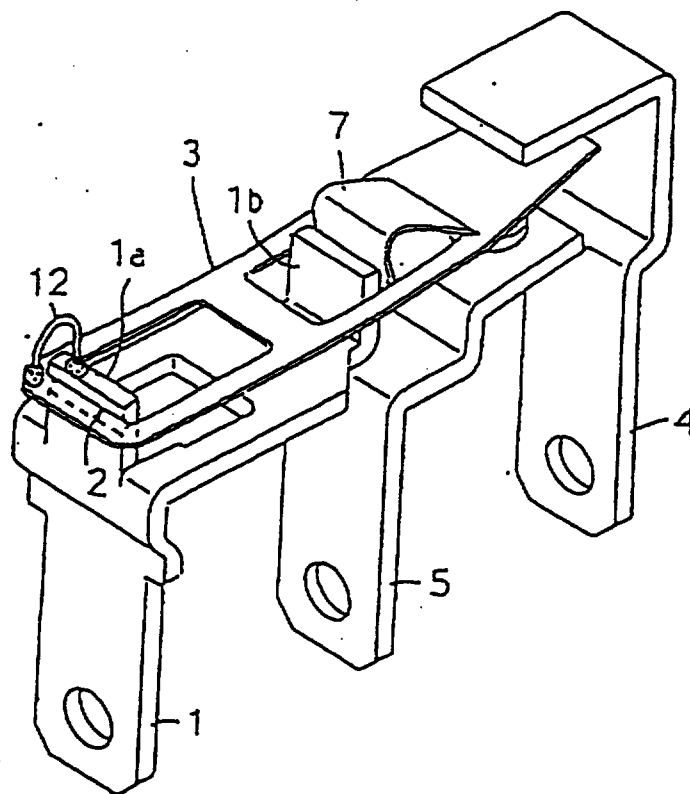
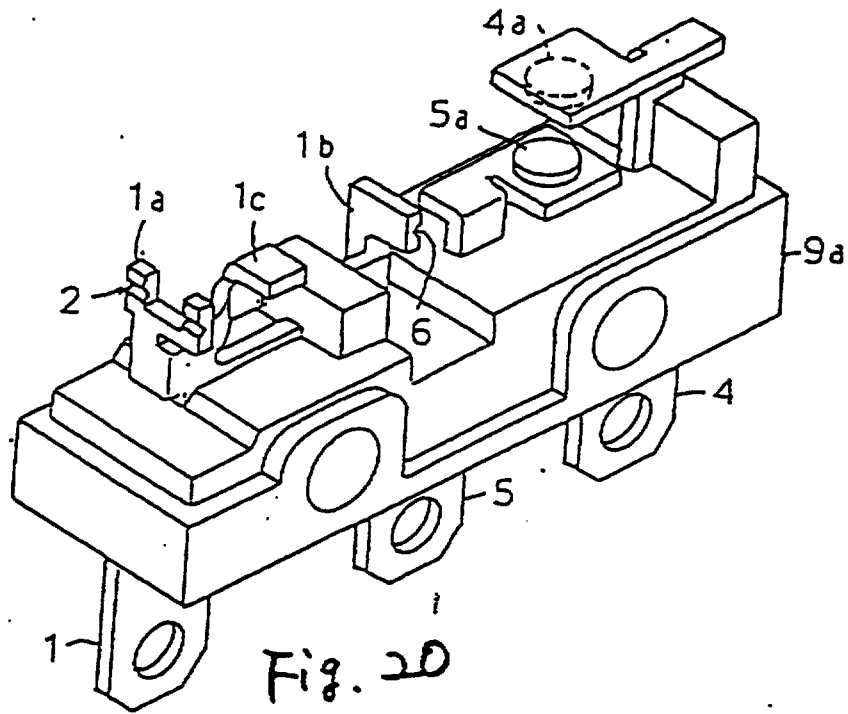


Fig. 19

This is the replacement sheet

Date: 14 NOV 1997



This is the replacement sheet

Date: 14 NOV 1997

Fig. 22

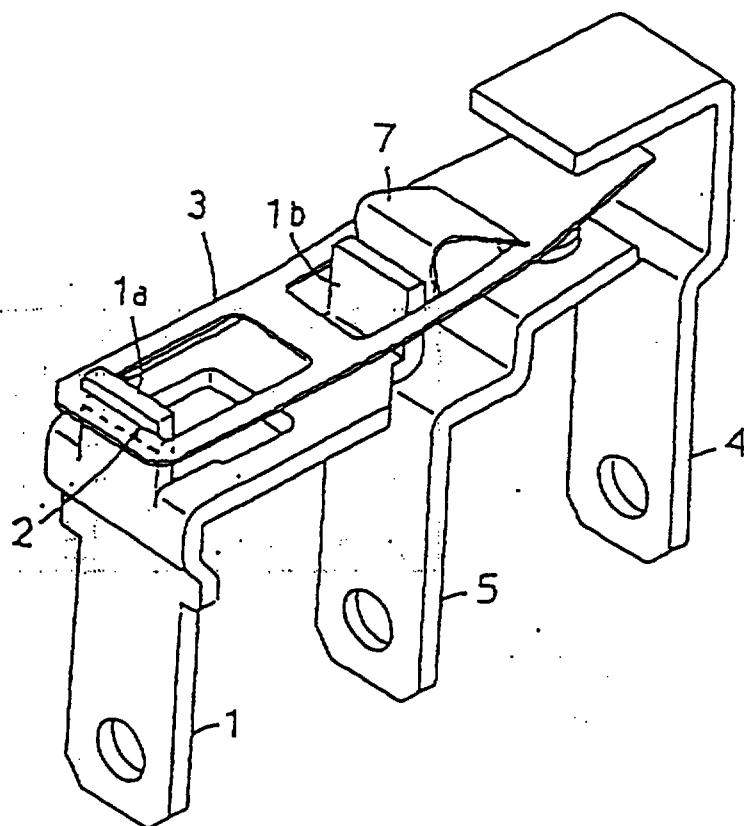


Fig. 23

Date: 14 NOV 1997

- 14 -

ABSTRACT OF THE DISCLOSURE

SWITCH

A switch in which an armature swingably coupled to a stationary terminal is operated by a depression of a push button to trip between the contacts. A movable spring is laid between the stationary terminal and the armature to assist the trip of the armature and the stationary terminal is welded to the armature. The switch can be manufactured relatively readily without increase in the number of components, and is high in the reliability in electrical connection of the stationary terminal and the armature.

FIGURE 12

REPLACEMENT SHEETS		SG
☐	Description : paged to paged	
☐	Claim(s) : paged to paged	
☐	Drawing(s) : paged to paged	
☒	Abstract : paged .14. to paged .14.	
DATE OF RECEIPT		- 6 MAR 1998