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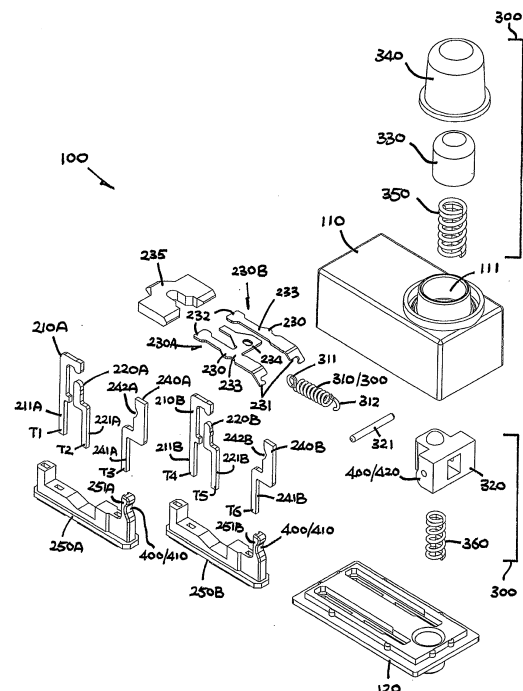
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(54) Electrical Switch

(57) An electrical switch (100) has two switch units (200), each having at least one fixed contact (210A) and a moving contact (230A) supported for pivotal movement during switching operation between an OFF position out of contact with the fixed contact (210A) and an ON position in contact with the fixed contact (210A), and an operating mechanism (300) for moving the two moving contacts (230A & 230B) in tandem between the OFF and ON positions. The operating mechanism (300) has a spring (310) movable between a first position on one side of the two moving contacts (230A & 230B) and resiliently biasing the moving contacts towards the ON positions and a second position on the opposite side of the moving contacts and resiliently biasing the moving contacts towards the OFF positions, and an actuator (320) for moving the spring (310) between the first and second positions past an intermediate position of maximum stress. There is also a detent (400) for adding surmountable resistance against the action of the actuator (320) to move the spring (310) from one of the first and second positions to the other of the first and second positions.

**FIG. 2****EP 2 846 341 A1**

Description

[0001] The present invention relates to an electrical switch suitable for use particularly, but not exclusively, in a vehicle or vessel.

BACKGROUND OF THE INVENTION

[0002] Electrical switches for controlling the operation of precision and/or high-quality electrical equipment or apparatus used in, for example, automobiles are designed with care and precision and must meet a variety of official standards on performance, safety and durability, etc. Particular attention is paid to the design of such electrical switches that incorporate two or more switch units for simultaneous operation, to ensure that the switch units or related circuits will switch on/off at the same time or within a sufficiently short period of time.

[0003] The invention seeks to provide a new or otherwise improved electrical switch that incorporates two or more switch units for simultaneous operation with better performance without compromise on construction.

SUMMARY OF THE INVENTION

[0004] According to the invention, there is provided an electrical switch comprising a first switch unit having at least one first fixed contact and a first moving contact supported for pivotal movement during switching operation between an OFF position out of contact with said at least one first fixed contact and an ON position in contact with said at least one first fixed contact, and a second switch unit having at least one second fixed contact and a second moving contact supported for pivotal movement during switching operation between an OFF position out of contact with said at least one second fixed contact and an ON position in contact with said at least one second fixed contact. Included is an operating mechanism adapted to move the first and second moving contacts in tandem between the OFF and ON positions. The operating mechanism has a first resilient member movable between a first position on one side of the first and second moving contacts and resiliently biasing the first and second moving contacts towards the ON positions and a second position on the opposite side of the first and second moving contacts and resiliently biasing the first and second moving contacts towards the OFF positions, and an actuator arranged to move the first resilient member between the first and second positions past an intermediate position of maximum stress. There is also a detent arranged to add surmountable resistance against the action of the actuator to move the first resilient member from one of the first and second positions to the other of the first and second positions.

[0005] Preferably, the first and second moving contacts are joined by a yoke for operation as a one-piece structure.

[0006] More preferably, the yoke comprises a flat

member, and the first and second moving contacts have respective flat portions connected flat with the yoke.

[0007] Further more preferably, the flat portions of the first and second moving contacts are embedded within the yoke.

[0008] It is preferred that the first resilient member is connected to one of the first and second moving contacts for acting upon the first and second moving contacts combined.

[0009] It is further preferred that said one of the first and second moving contacts has a part which is located centrally between the first and second moving contacts and to which the first resilient member is connected.

[0010] In a preferred construction, at least one of the first and second moving contacts has a one-piece body having opposite first and second ends, with the first end for external connection and the second end for making or breaking contact with the associated said at least one first or second fixed contact.

[0011] More preferably, the first end of the one-piece body is in electrical connection with a support, the support being part of a switch terminal of the electrical switch.

[0012] Further more preferably, the support is a distinct part from the one-piece body, which the first end of the one-piece body bears against and is pivotable about for switching operation.

[0013] Yet further more preferably, the first end of the one-piece body bears against the support under the action of the first resilient member.

[0014] In a preferred embodiment, the detent comprises a snap-action detent which is releasable through a snap action.

[0015] More preferably, the actuator is movable during operation alongside a component, and the detent comprises complementary formations at interface between the actuator and the component for inter-engagement which is releasable by a force equivalent to the surmountable resistance.

[0016] Further more preferably, the complementary formations comprise a protrusion on the actuator and a recess in the component.

[0017] Yet further more preferably, the protrusion is a fixed part of the actuator.

[0018] It is preferred that the actuator is laterally displaceable against the action of the first resilient member to release the inter-engagement.

[0019] It is preferred that the component is part of a locator which locates one or more switch terminals of the electrical switch.

[0020] In a preferred embodiment, the operating mechanism includes a second resilient member and a press member acting upon the actuator via the second resilient member, such that upon pressing the press member will deform the second resilient member and in turn move and operate the actuator.

[0021] More preferably, the press member is protected by a resiliently deformable cover against ingress of water.

[0022] More preferably, the operating mechanism in-

cludes a third resilient member acting upon the actuator in a direction opposite to that of the second resilient member, for returning the actuator upon release of the press member.

[0023] It is preferred that the or each resilient member comprises a coil spring.

[0024] It is preferred that the first and second switch units have generally the same construction.

BRIEF DESCRIPTION OF DRAWINGS

[0025] The invention will now be more particularly described, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 is a perspective view of an embodiment of an electrical switch in accordance with the invention, with a switch housing thereof omitted for clarity;

Figure 2 is an exploded perspective view of the electrical switch of Figure 1, showing all its components including the switch housing;

Figure 3 is another perspective view of the electrical switch corresponding to Figure 1, taken in an opposite direction;

Figure 4 is a top plan view of the electrical switch;

Figures 5A to 5G are sequential cross-sectional side views of the electrical switch of Figure 4, taken along line A-A, illustrating its switching operation; and

Figures 6A to 6G are sequential cross-sectional side views of the electrical switch of Figure 4, taken along line B-B, illustrating its switching operation corresponding to Figures 5A to 5G.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENT

[0026] Referring to the drawings, there is shown an electrical switch 100 embodying the invention, which has a switch housing 110 completed by a base plate 120, a pair of first and second switch units 200A and 200B (or collectively 200) in the switch housing 110, an operating mechanism 300 for simultaneously operating the two switch units 200, and detent 400 arranged to add surmountable resistance against the action of the operating mechanism 300.

[0027] The first switch unit 200A has at least one first fixed contact 210A and a first moving contact 230A supported for pivotal movement during switching operation between an OFF position out of contact with said at least one first fixed contact 210A and an ON position in contact with said at least one first fixed contact 210A. The switch unit 200A includes an additional first fixed contact 220A which is arranged opposite to the original first fixed con-

tact 210A relative to the moving contact 230A for complementary contact making and breaking operation by the moving contact 230A as the moving contact 230A pivots between the two fixed contacts 210A and 220A.

[0028] The two fixed contacts 210A and 220A have respective legs 211A and 221A, and are fixed to the base plate 120 by having their legs 211A and 221A engaging as a tight fit downwardly through an oblong locator 250A that is mounted horizontally on the base plate 120. The two legs 211A and 221A project beyond the base plate 120, where they act as respective switch terminals T1 and T2 for connection of an electrical cable.

[0029] The second switch unit 200B has at least one second fixed contact 210B and a second moving contact 230B supported for pivotal movement during switching operation between an OFF position out of contact with said at least one second fixed contact 210B and an ON position in contact with said at least one second fixed contact 210B. The switch unit 200B includes an additional second fixed contact 220B which is arranged opposite to the original second fixed contact 210B relative to the moving contact 230B for complementary contact making and breaking operation by the moving contact 230B as the moving contact 230B pivots between the two fixed contacts 210B and 220B.

[0030] The two fixed contacts 210B and 220B have respective legs 211B and 221B, and are fixed to the base plate 120 by having their legs 211B and 221B engaging as a tight fit downwardly through another oblong locator 250B that is also mounted horizontally on the base plate 120. The two legs 211B and 221B project beyond the base plate 120, where they act as respective switch terminals T4 and T5 for connection of an electrical cable.

[0031] Although this is not critical but for simplicity, in this particular embodiment, the first and second switch units 200A and 200B have generally or substantially the same or identical construction. They are positioned on the left and right sides, side-by-side on the base plate 120 for simultaneous operation by the operating mechanism 300. The operating mechanism 300 is adapted to move, or pivot, the first and second moving contacts 230A and 230B in tandem between the OFF and ON positions for the first and second fixed contacts 210A and 210B, or between the complementary ON and OFF positions for the additional first and second fixed contacts 220A and 220B.

[0032] In each switch unit 200A/200B, the first/second moving contact 230A/230B has a generally flat and horizontal one-piece contact body 230 having opposite first and second ends 231 and 232, with the first end 231 for external connection and the second end 232 for making and breaking contact with the associated fixed contacts 210A and 220A or 210B and 220B. The first end 231 of the contact body 230 is in electrical connection with a support 240A/240B which is part of a switch terminal of the electrical switch 100 for connection of an electrical cable to the moving contact 230A/230B.

[0033] Each support 240A/240B is a distinct part from

the associated moving contact body 230, which the first end 231 of the contact body 230 bears against and is pivotable about for switching operation. The first end 231 of the contact body 230 bears against a recess 242A/242B at an upper end of the respective support 240A/240B, under the action of a generally horizontal coil spring 310 which pulls both moving contacts 230A and 230B against the respective supports 240A and 240B.

[0034] The supports 240A and 240B have respective legs 241A and 241B, and are fixed to the base plate 120 by having their legs 241A and 241B engaging as a tight fit downwardly through the locators 250A and 250B respectively. The legs 241A and 241B project beyond the base plate 120, where they act as respective switch terminals T3 and T6 for connection of an electrical cable.

[0035] The first and second moving contact 230A and 230B are joined by a yoke 235 for operation as a one-piece structure. The yoke 235 is or comprises a flat member. The two moving contacts 230A and 230B have respective intermediate flat portions 233 which are co-planar and are connected flat with the yoke 235. More specifically, the yoke 235 is molded upon and around the two flat portions 233 such that both flat portions 233 are embedded within the yoke 235.

[0036] One of the flat portions 233, of the first moving contact 230A for example, has a lateral extension part 234 on its inner side facing the second moving contact 230B and located centrally between the two moving contacts 230A and 230B. The extension part 234 has a hole to which a first end 311 of the coil spring 310 is connected (i.e. hooked) such that the coil spring 310 acts upon the first and second moving contacts 230A and 230B combined or together as a whole.

[0037] The operating mechanism 300 is formed by a first resilient member provided by the coil spring 310, which is connected to the moving contacts 230A and 230B integrated by the yoke 235 as described above, an actuator 320 arranged to pivot the coil spring 310 and in turn the moving contacts 230A and 230B, and a press member provided by a press knob 330 vertically above the actuator 320 for operating the same. The actuator 320 has an inserted horizontal pin 321, to which a second end 312 of the spring 310 is connected, whereby upon upward and downward movement the actuator 320 pivots the spring 310. The press knob 330 protrudes vertically upwardly out of the switch housing 110 through an aperture 111 thereof, and is protected by a resiliently deformable cover 340 against ingress of water into the switch housing 110.

[0038] The operating mechanism 300 includes a second resilient member provided by a second coil spring 350 which is compressed vertically between the press knob 330 and the actuator 320, and a third resilient member provided by a third coil spring 360 which is compressed vertically between the actuator 320 and the base plate 120. The third spring 360 is relatively weaker than the second spring 350.

[0039] The press knob 330 acts downwardly upon the actuator 320 via the second spring 350, such that upon pressing the press knob 330 will deform the second spring 350 and in turn, indirectly, move and operate the actuator 320, whilst also compressing the third spring 360. The third spring 360 acts upon the actuator 320 in a direction opposite to that of the second spring 350, i.e. upwardly, for returning the actuator 320 to move back up upon release of the press knob 330. Thus, the press knob 330 stays normally in an upper position.

[0040] Returning to the first coil spring 310, it is movable or pivotable between a first position and a second position. In the first position, the spring 310 is on one side of the first and second moving contacts 230A and 230B, e.g. the upper side as in Figures 5A and 6A, resiliently biasing both moving contacts 230A and 230B towards the ON positions for the first and second fixed contacts 210A and 210B (or the OFF position for the additional first and second fixed contacts 220A and 220B). In the second position, the spring 310 is on the opposite side of the moving contacts 230A and 230B, e.g. the lower side as in Figures 5D and 6D, resiliently biasing both moving contacts 230A and 230B towards the OFF positions for the first and second fixed contacts 210A and 210B (or the ON position for the additional first and second fixed contacts 220A and 220B).

[0041] The actuator 320 is arranged to move or pivot the coil spring 310 between the first and second positions past an intermediate position of maximum stress, in which the spring 310 is subject to maximum stress, such that the intermediate position is unstable. More specifically, the coil spring 310 and combined first and second moving contacts 230A and 230B together constitute a snap-action mechanism, also known as a bi-stable mechanism or toggle, which can be flipped to bend upwards when the spring 310 is pivoted by the actuator 320 towards the upper, first position (Figures 5A and 6A) and to bend downwards when the spring 310 is pivoted towards the lower, second position (Figures 5D and 6D).

[0042] The aforesaid intermediate position represents a threshold or over-centre position for the snap action mechanism and in particular the moving contacts 230A and 230B between their ON and OFF positions. It only takes a relatively small force for both moving contacts 230A and 230B to overcome and flip past the over-centre position in either direction, whereupon the moving contacts 230A and 230B will flick or snap into the opposite ON or OFF position as appropriate under the resilient action of the coil spring 310. Each of the switch units 200A and 200B is, or acts as, a micro switch.

[0043] Although the two switch units 200A and 200B are of the same construction and made of the same materials, due to inevitable variations in physical dimensions, material properties and manufacturing accuracy, etc., the precise time or moment at which the switch units 200A and 200B operate (i.e. switching between the ON and Off states) in practice are not the same and cannot be synchronized within a desirable short time interval e.g.

20ms.

[0044] Because the force required to trigger the moving contacts 230A and 230B is small, the two switch units 200A and 200B will operate inevitably or in the majority of cases at a low speed. Low speed operation makes room for a larger disparity or difference in the time of operation between two switch units 200A and 200B, hence resulting in poor synchronization of their switching actions not taking place within a sufficiently short interval of time as desired. In order to overcome this problem, the detent 400 is incorporated.

[0045] The detent 400 is arranged to add surmountable resistance against the action of the actuator 320 to move the first coil spring 310 from one of the first and second positions, e.g. the upper side of the first and second moving contacts 230A and 230B, to the other of the first and second positions, e.g. the lower side of the first and second moving contacts 230A and 230B.

[0046] The detent 400 is or comprises a snap-action detent which is releasable through a snap action. The detent 400 is provided by a pair of recesses 410 formed on the rear side of a heel-like part 251A/251B of each of the two locators 250A and 250B, and a pair of left and right protrusions 420 fixed on the front side of the actuator 320 in releasable engagement with the recesses 410 respectively. The recesses 410 and protrusions 420 are complementary formations, preferably but not necessarily of complementary cross-sections, at the interface between the actuator 320 and the heel-like parts 251A and 251B (each part being a component).

[0047] While being acted upon by the second spring 350 from above and the third spring 360 from below, the actuator 320 is vertically movable during operation alongside the heel-like parts 251A and 251B (each being a component) of the locators 250A and 250B. The actuator 320 is also subject to horizontal resilient pulling action by the first spring 310 to bear against the heel-like parts 251A and 251B, with its protrusions 420 normally inter-engaged with the respective recesses 410 of the locators 250A and 250B.

[0048] The actuator 320 is allowed room for limited horizontal displacement back-and-forth, that is backward from the locators 250A and 250B against the action of the first spring 310 and then forward towards the locators 250A and 250B under the action of the spring 310. The actuator 320 is laterally displaceable against the action of the spring 310 to release the inter-engagement between the protrusions 420 and the recesses 410. This arrangement makes it possible for the protrusions 420 to disengage from the recesses 410 when the actuator 320 is subject to a relatively large force to move downward, considerably larger than the force required to flip or pivot the two moving contacts 230A and 230B.

[0049] To operate the electrical switch 100, the press knob 330 is pressed (Figures 5A/6A to 5D/6D), and this initially causes compression of the second spring 350 right below the press knob 330 (Figures 5B/6B). Further downward movement of the press knob 330 will result in

an adequate compressive strain built up in the spring 350, whereupon the actuator 320 will suddenly move or snap downward relative to the heel-like parts 251A and 251B, whilst breaking or releasing the inter-engagement between its protrusions 420 and the latter's recesses 410 and also flipping both moving contacts 230A and 230B (and also compressing the third spring 360). The electrical switch 100 thus operates through synchronized switching of its switch units 200A and 200B (Figures 5C/6C).

[0050] As mentioned above, the force needed to release the detent 400 is considerably larger than that required to flip the two moving contacts 230A and 230B. The detent-releasing force is, or is equivalent to, the surmountable resistance mentioned above.

[0051] Upon release of the detent 400 by the force that overcomes the surmountable resistance, the actuator 320 snaps downward at a relatively high speed, resulting in pivoting of the moving contacts 230A and 230B at the same high speed and hence a high speed switching operation that synchronizes the operation of the two switch units 200A and 200B within an acceptably short period of time below, for example, 20ms.

[0052] The operation of the electrical switch 100 continues upon release of the press knob 330, which is then automatically returned to the normal upper position by the third spring 360 (Figures 5E/6E to 5G/6G), whereby the electrical switch 100 performs synchronized reversed switching of its switch units 200A and 200B.

[0053] During such a reversed action, the actuator's protrusions 420 snap back into engagement with the locators' recesses 410, resulting in a reversed snap action with a force upwardly upon the actuator 320 of a magnitude comparable to that overcame the surmountable resistance. This reversed snap action speeds up the actuator 320, which in turn pivots the moving contacts 230A and 230B upwards at the same high speed, thereby performing another high speed switching operation that synchronizes the reversed operation of the two switch units 200A and 200B, likewise within an acceptably short period of time below 20ms.

[0054] The design and construction of the subject electrical switch allows reasonable leeway for imperfections and inherent variability without compromising performance on synchronized operation of its internal switch units.

[0055] It is envisaged that in a different embodiment the detent 400 may be implemented by a spring-loaded ball (in place of the protrusions 420) which protrudes slightly (e.g. about one third of its diameter) on the actuator 320 and is releasably engageable with an adjacent recess. The recess may be formed on the inner surface of the switch housing 110 (rather than the locator 250A/250B). This alternative detent is suitable in case the actuator 320 is not laterally displaceable in a horizontal direction for releasing the detent, i.e. the actuator 320 is confined to a vertical linear path.

[0056] It goes without saying the subject electrical

switch may incorporate more than two switch units for synchronized operation.

[0057] The invention has been given by way of example only, and various other modifications of and/or alterations to the described embodiment may be made by persons skilled in the art without departing from the scope of the invention.

Claims

1. An electrical switch comprising:

a first switch unit comprising at least one first fixed contact and a first moving contact supported for pivotal movement during switching operation between an OFF position out of contact with said at least one first fixed contact and an ON position in contact with said at least one first fixed contact;

a second switch unit comprising at least one second fixed contact and a second moving contact supported for pivotal movement during switching operation between an OFF position out of contact with said at least one second fixed contact and an ON position in contact with said at least one second fixed contact;

an operating mechanism adapted to move the first and second moving contacts in tandem between the OFF and ON positions, comprising a first resilient member movable between a first position on one side of the first and second moving contacts and resiliently biasing the first and second moving contacts towards the ON positions and a second position on the opposite side of the first and second moving contacts and resiliently biasing the first and second moving contacts towards the OFF positions, and an actuator arranged to move the first resilient member between the first and second positions past an intermediate position of maximum stress; and detent arranged to add surmountable resistance against the action of the actuator to move the first resilient member from one of the first and second positions to the other of the first and second positions.

2. The electrical switch as claimed in claim 1, **characterized in that** the first and second moving contacts are joined by a yoke for operation as a one-piece structure.

3. The electrical switch as claimed in claim 2, **characterized in that** the yoke comprises a flat member, and the first and second moving contacts have respective flat portions connected flat with the yoke.

4. The electrical switch as claimed in claim 3, **characterized in that** the flat portions of the first and second moving contacts are embedded within the yoke.

5. The electrical switch as claimed in claim 2, **characterized in that** the first resilient member is connected to one of the first and second moving contacts for acting upon the first and second moving contacts combined.

6. The electrical switch as claimed in claim 5, **characterized in that** said one of the first and second moving contacts has a part which is located centrally between the first and second moving contacts and to which the first resilient member is connected.

7. The electrical switch as claimed in claim 1, **characterized in that** at least one of the first and second moving contacts has a one-piece body having opposite first and second ends, with the first end for external connection and the second end for making or breaking contact with the associated said at least one first or second fixed contact.

8. The electrical switch as claimed in claim 7, **characterized in that** the first end of the one-piece body is in electrical connection with a support, the support being part of a switch terminal of the electrical switch.

9. The electrical switch as claimed in claim 8, **characterized in that** the support is a distinct part from the one-piece body, which the first end of the one-piece body bears against and is pivotable about for switching operation.

10. The electrical switch as claimed in claim 9, **characterized in that** the first end of the one-piece body bears against the support under the action of the first resilient member.

11. The electrical switch as claimed in claim 1, **characterized in that** the detent comprises a snap-action detent which is releasable through a snap action.

12. The electrical switch as claimed in claim 11, **characterized in that** the actuator is movable during operation alongside a component, and the detent comprises complementary formations at interface between the actuator and the component for inter-engagement which is releasable by a force equivalent to the surmountable resistance.

13. The electrical switch as claimed in claim 12, **characterized in that** the complementary formations comprise a protrusion on the actuator and a recess in the component.

14. The electrical switch as claimed in claim 13, **characterized in that** the protrusion is a fixed part of the

actuator.

15. The electrical switch as claimed in any one of claims 12 to 14, **characterized in that** the actuator is laterally displaceable against the action of the first resilient member to release the inter-engagement. 5
16. The electrical switch as claimed in any one of claims 12 to 15, **characterized in that** the component is part of a locator which locates one or more switch terminals of the electrical switch. 10
17. The electrical switch as claimed in any one of claims 1 to 14, **characterized in that** the operating mechanism includes a second resilient member and a press member acting upon the actuator via the second resilient member, such that upon pressing the press member will deform the second resilient member and in turn move and operate the actuator. 15
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18. The electrical switch as claimed in claim 17, **characterized in that** the press member is protected by a resiliently deformable cover against ingress of water. 25
19. The electrical switch as claimed in claim 17, **characterized in that** the operating mechanism includes a third resilient member acting upon the actuator in a direction opposite to that of the second resilient member, for returning the actuator upon release of the press member. 30
20. The electrical switch as claimed in any one of claims 1 to 14, **characterized in that** the or each resilient member comprises an coil spring. 35
21. The electrical switch as claimed in any one of claims 1 to 14, **characterized in that** the first and second switch units have generally the same construction. 40

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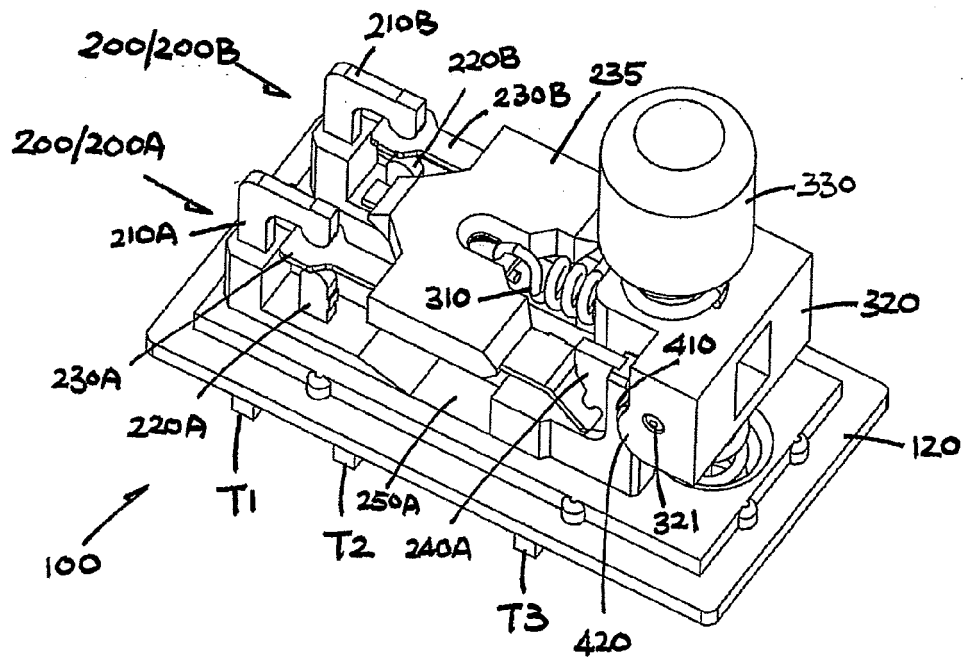


FIG. 1

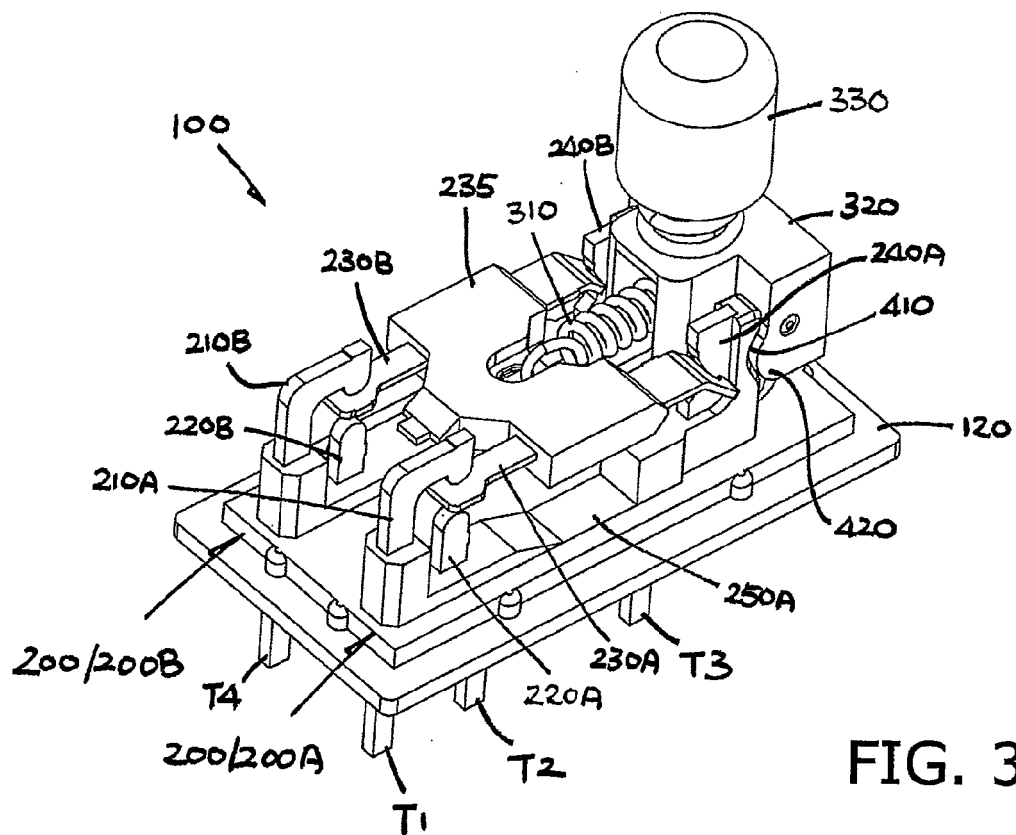


FIG. 3

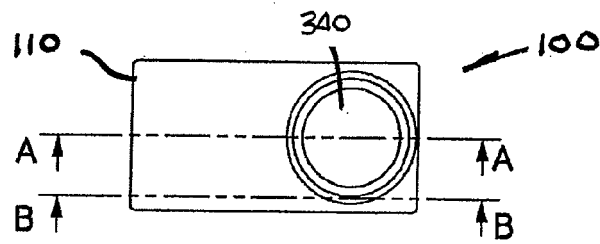


FIG. 4

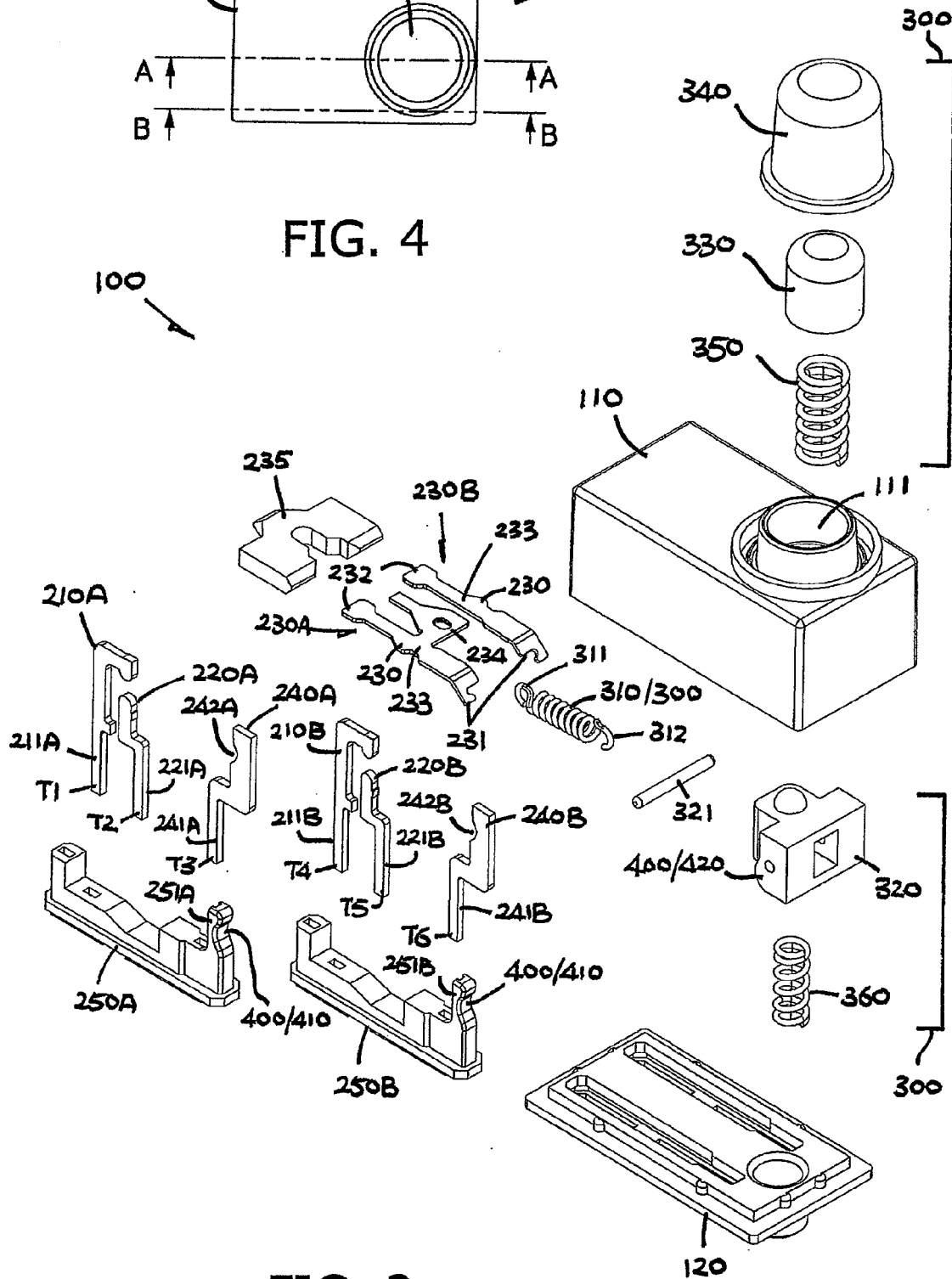


FIG. 2

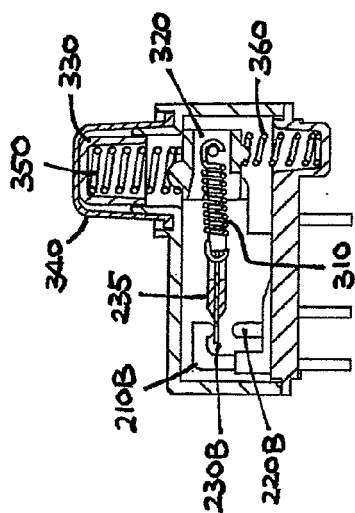


FIG. 5A

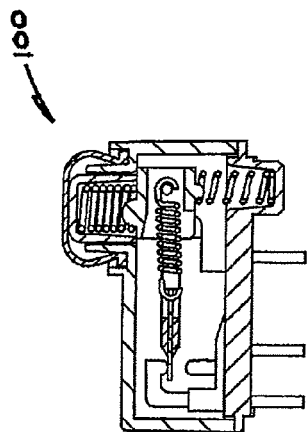


FIG. 5B

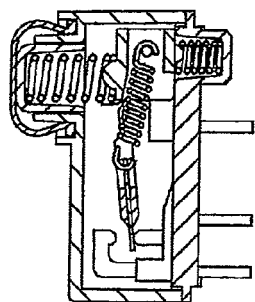


FIG. 5C

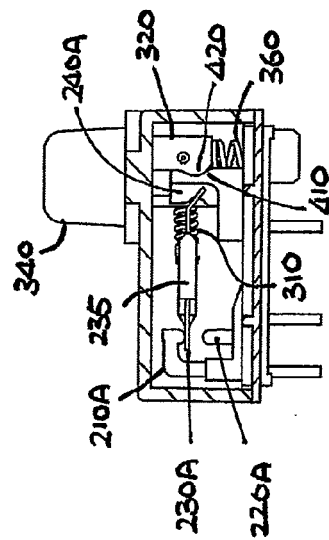


FIG. 6A

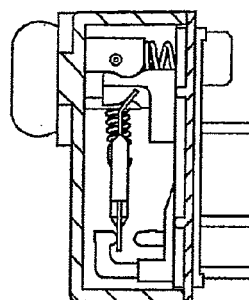


FIG. 6B

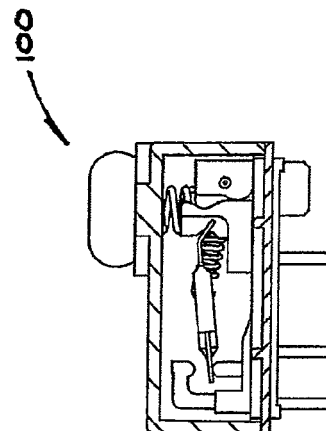


FIG. 6C

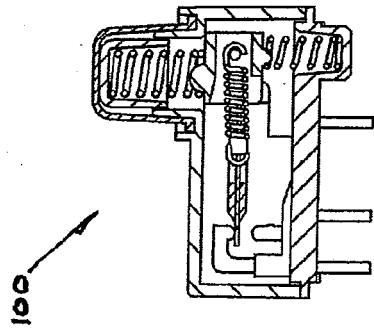


FIG. 5G

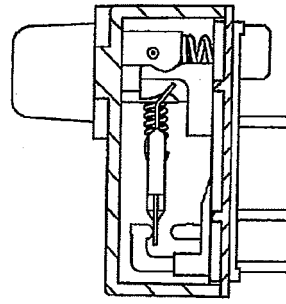


FIG. 6G

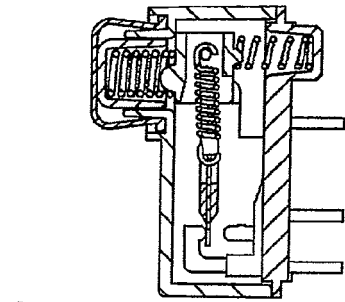


FIG. 5F

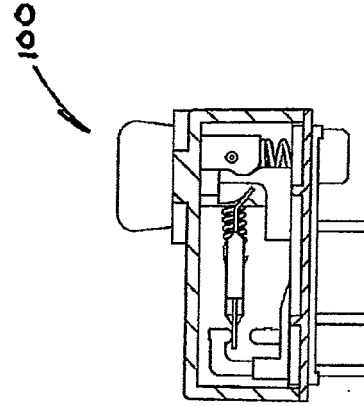


FIG. 6F

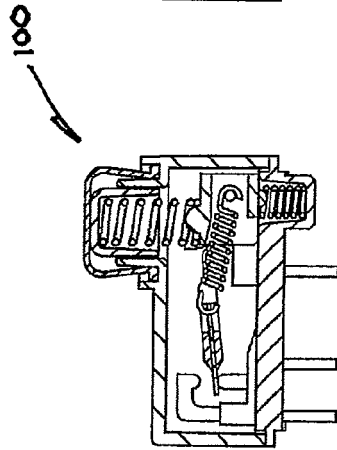


FIG. 5E

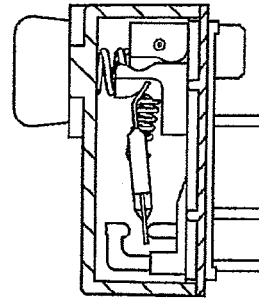


FIG. 6E

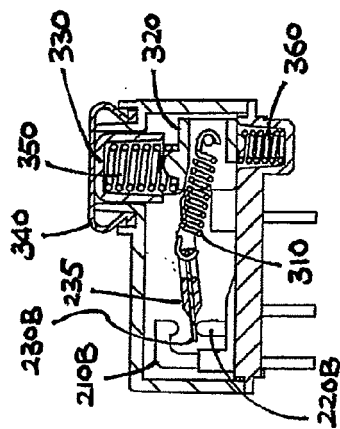


FIG. 5D

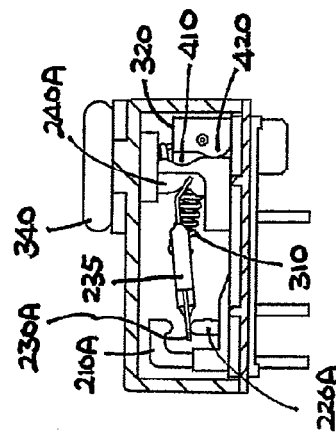


FIG. 6D



EUROPEAN SEARCH REPORT

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