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(54) Method of producing a keyboard switch and keyboard switch obtained.

(57) In a process of producing a keyboard switch, a continuous track (10) of a metal foil is machined into two metallic terminal components (13, 14) constituting links between two carrier strips (11, 12). A base housing component (22) is cast from a high temperature resistant material around the terminals (13, 14) and is connected to the carrier strips (11, 12) through two tags (29) protruding outwards from opposite, outer side surfaces (27) of the base housing component (22). In an inner recess (23) of the base housing component (22) a domed metal disc (31) having an acoustically damping coating (32) on the convex side surface thereof, an elastically compressible rubber component (33) and a push button (37) are arranged. On top of the base housing component (22), a top housing component (30) preferably made from the same high temperature resistant plastics material is arranged. Within the recess (23) of the base housing component (22), the terminal (13, 14) define electric contacts (19, 20) with which the domed metal disc (31) co-operates. The terminals (13, 14) are separated from the carrier strips (11, 12) and bent into the configuration of pins of an electronic keyboard switch, and the keyboard switch is still connected through the tags (29) to the carrier strips (11, 12) transferred to a test stand (5), in which the keyboard switch is tested. Provided the keyboard switch is identified as a properly functioning keyboard switch, the tags (29) are separated from the base housing component (22).

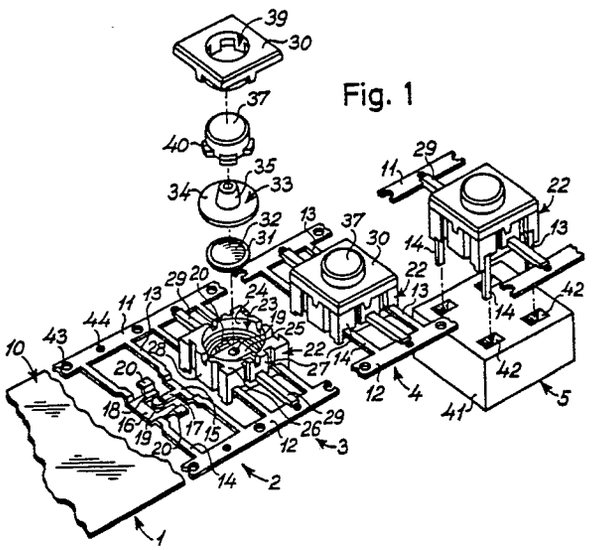

Fig. 1

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A METHOD OF PRODUCING AN ELECTRIC OR ELECTRONIC COMPONENT, A METHOD OF PRODUCING A KEY AND A KEY

The present invention relates to the technical field of production of electric or electronic components, particularly the production of keyboard switches and such keyboard switches.

Within the above technical field, numerous methods of producing electric or electronic components are known as well as numerous keyboard switches. Reference is made to the following patent specifications: EP 0030473, DE 2740746, DE 3542953, DE 3545798, EP 0164799, SE 440836, US 4331851, US 4690484 (corresponding to DE 3542953), US 4659881, US 4352964, and US 4102039.

An object of the present invention is to provide a method rendering it possible to produce a keyboard switch in a few and simple production steps from a few components.

A further object of the present invention is to provide a novel technique of producing a keyboard switch, which may be used in accordance with so-called SMT-technique (SMT: Surface Mounting Technique), i.e. which may stand exposure to solder metal material, such as tin heated to a temperature of e.g. 240° C, for approx. 60 sec.

A still further object of the present invention is to provide a novel technique of producing a keyboard switch, produced in a sequential process and tested prior to its delivery from the production line.

A still further object of the present invention is to provide a keyboard switch and to provide a method of producing such kéybaord switch, which keyboard switch is of a compact, modular structure which allows the keybaord switch to be used in connection with accessory components, such as modular display units, keyboard pads, etc.

The above and other objects and advantages obtained in accordance with the teachings of the present invention will be evident from the description below.

Thus, in accordance with a first aspect of the present invention, a method of producing a keyboard switch, said keyboard switch comprising:
a housing of an insulating material having outer side walls, a switching element enclosed in said housing, and
at least two metallic terminal components, each including:
an outer terminal extending outwards from an outer side wall of said housing and defining an outer terminal end, and an electric contact means being enclosed in said housing and integrally connected to said outer terminal at an end thereof opposite to said outer terminal end;
said switching element being switchable between a first state in which said switching element is out of electrically conductive contact with at least one of said electric contact means of said at least two metallic terminal components, and a second state in which said switching element is establishing electrically conductive contact between said electric contact means of said at least two metallic components;
the method comprising the following sequence of steps:

(a) providing a continuous track of the metal of said metallic terminal components,

(b) processing said continuous track so as to form said metallic terminal components and a carrier strip, said metallic terminal components being integrally connected to said carrier strip through said outer terminal ends,

(c) casting a base housing component of said insulating material around said metallic terminal components, said base housing component defining outer side walls constituting at least part of said outer side walls of said housing through which outer side walls of said base housing component said outer terminals extend, said base housing component comprising at least one tag protruding outwards from an outer side wall of said base housing component and being cast to said carrier strip for establishing mechanical connection between said base housing component and said carrier strip, said base housing component further having a recess in which said electric contact means are exposed,

(d) arranging said switching element in said recess of said base housing component so as to be switchable between said first and second states,

(e) providing a top housing component having an aperture,

(f) providing a stem means,

(g) arranging said stem means in said aperture of said top housing component and arranging said top housing component relative to said base housing component together constituting said housing, said stem means being arranged relative to said switching element so as to switch said switching element between said first and said second states by actuation,

(h) separating said metallic terminal components from said carrier strip by separating said outer terminals from said carrier strip at said outer terminal ends,

(i) testing said keyboard switch produced in steps (a)-(h) in a test stand, while said base housing component is mechanically connected to said carrier strip through said tag, by actuating said

stem means in order to test if said switching element is switchable between said first and second states, and by determining whether said at least two metallic terminal components are electrically insulated relative to one another or not insulated relative to one another when said switching element is in said first state and further determining whether said at least two metallic terminal components are in electrically conductive connection with one another or not when said switch element is in said second state, and

(j) provided said keyboard switch is identified in step (i) as a properly working component, separating said tag from said base housing component.

In accordance with the method according to the present invention, the keyboard switch is manufactured from only five components, viz. the continuous track, the base housing component, the switching element, the stem means, and the top housing component. since the base housing component is mechanically connected to the carrier strip through the tag, the keyboard switch is, during its manufacturing process, advanced through a number of production stations corresponding to the above steps by moving the carrier strip. In accordance with a particular feature of the above method according to the present invention, the keyboard switch is very easily tested in the above step (i) as the keyboard switch produced in the above steps (a)-(h) is simply presented to the test stand integrally connected to the carrier strip through the tag.

In accordance with a preferred embodiment of the method according to the present invention, two carrier strips are processed in the above step (b) from said continuous track, between which carrier strips said metallic components are arranged having their outer terminal ends integrally connected to said carrier strips through said outer terminal ends, and two tags are further cast in the above step (c) to a respective carrier strip. By the provision of two carrier strips and two tags cast to a respective carrier strip, the keyboard switch is to a high degree mechanically supported in its fixation to the two carrier strips when the keyboard switch is advanced through the above steps.

A further increase in the mechanical fixation and support of the keyboard switch when advanced through the above steps, is obtained in accordance with an alternative of the above preferred embodiment of the method according to the present invention in that each metallic terminal component constitutes a link between said two carrier strips, and each of said metallic components has two outer terminals defining outer terminal ends integrally connected to a respective carrier strip.

In accordance with the presently preferred embodiment of the method according to the present invention, said switching element is a domed metal disc, which disc in step (d) is arranged with its dome protruding outwards from said recess, and which disc in its normally domed shape is in said first state and is deformable from said domed shape into a deflected shape constituting said second state, and said stem means provided in step (f) and arranged in said aperture of said top housing component in step (g) is actuatably acting on said metal disc for deforming it from said domed shape to said deflected shape by activation.

In step (g), an elastically compressible body means is preferably arranged in accordance with the method according to the present invention between said stem means and said metal disc in step (f), and, as will be explained below, the elastically compressible body means serves more purposes, viz. to increase the travel or stroke of the metal disc when deformed and optionally to protect the metal disc by sealing along the circumferential edge of the disc and consequently protecting the metal disc and the electric contact means from corrosive gases and exposure to high temperatures in a surface mounting process, when the keyboard switch is soldered to a supporting circuit board, e.g. in a wave soldering machine.

It has been realised that a domed metal disc produces an unpleasant and harsh click, when it is deformed. In accordance with a particular aspect of the present invention, it has further been realised that the click may be damped resulting in a more pleasant sound by providing an acoustically damping material coating or layer on the one side surface of the domed metal disc, which side surface constitutes the outer or convex side surface of the domed metal disc. Consequently, in accordance with a further embodiment of the method according to the present invention, the metal disc is preferably punched from a metal foil, which is provided with a coating of an acoustically damping material on one side surface, which side surface in said domed metal disc constitutes the outer or convex side surface of said domed metal disc.

Furthermore, the keyboard switch produced in accordance with the method according to the present invention is preferably a keyboard switch which may stand exposure to elevated temperatures, such as 240 ° C, during e.g. 60 sec, e.g. in a surface mounting process, e.g. in a wave soldering machine, as the base and top housing components of the keyboard switch are preferably cast from a high-temperature resistant plastics material.

In accordance with a second aspect of the present invention, a keyboard switch is provided, which keyboard switch comprises:

a housing of an insulating material having outer side walls,

a domed metal disc enclosed in said housing, and at least two metallic terminal components, each including:
an outer terminal extending outwards from an outer side wall of said housing and defining an outer terminal end, and an electric contact means being enclosed in said housing and integrally connected to said outer terminal at an end thereof opposite to said outer terminal end;
said domed metal disc being switchable between a first state in which said domed metal disc is in its normally domed shape and is out of electrically conductive contact with at least one of said electric contact means of said at leaśt two metallic terminal components, and a second state in which said domed metal disc is in a deflected shape and establishes electrically conductive contact between said electric contact means of said at least two metallic components by deforming said disc from its normally domed shape to a deflected shape;
said housing comprising:
a base housing component of said insulating material cast around said metallic terminal components, and
a top housing component having an aperture and a stem means,
said base housing component defining outer side walls constituting at least part of said outer side walls of said housing through which outer side walls of said base housing component said outer terminals extend, said base housing component further having a recess in which said electric contact means are exposed, said domed metal disc being arranged in said recess of said base housing component with its dome protruding outwards from said recess so as to be switchable between said first and second states,
said stem means being arranged in said aperture of said top housing component and being arranged relative to said domed metal disc so as to switch said domed metal disc between said first and said second states by actuation, and
said metal disc being made from a metal foil, which is coated with an acoustically damping material on one side surface constituting the outer or convex side surface of said domed metal disc.

As explained above, the keyboard switch according to the present invention preferably further comprises an elastically compressible body means arranged between the stem means and the metal disc, which body means constitutes a means for increasing the stroke of the metal disc to a larger stroke of the stem means.

In the preferred embodiment of the keyboard switch according to the present invention, the keyboard switch is a keyboard switch which may stand exposure to high temperatures, such as 240 ° C, for e.g. 60 sec, as the keyboard switch is exposed to e.g. solder in a surface mounting process. The base and top housing components are made from a high temperature resistant plastics material, such as high-crystal-line copolymers, epoxy resins, olefin-carbon-monoxide copolymers, polycarbonates, polyolefin sulphonates, e.g. polyethylene sulphonate, PES, or polyethylene-terephthalates, e.g. PETP or PET.

In order to seal the domed metal disc and consequently protect the domed metal disc against exposure to gases, such as corrosive gases, and to elevated temperatures, e.g. in the above mentioned surface mounting process, the keyboard switch according to the present invention may further have its stem means, body means and domed metal disc arranged coaxially relative to each other, and the elastically compressible body means may preferably comprise a circular membrane part having a circumferential bead and a central stem part, said stem part of said body means constituting an elastically compressible part for the transmission of the actuation of said stem means to said domed metal disc, which domed metal disc is preferably arranged within the circumferential bead of the membrane part so as to have said bead seal along the circumferential edge of the domed metal disc and consequently seal the domed metal disc relative to the environment.

In the above described preferred embodiment of the keyboard switch according to the invention, the elastically compressible body means is advantageously made from silicon rubber, and the domed metal disc is advantageously made from a CuBe foil of a thickness of e.g. 0.075 mm.

The invention will now be further described with reference to the drawings, in which

Fig. 1 is a schematical and perspective view of a production line in which a keyboard switch is produced in accordance with the methods according to the present invention,

Fig. 2 is a partly vertical sectional view of the keyboard switch shown in Fig. 1,

Fig. 3 is a schematical and perspective view illustrating the production of an accessory component of the keyboard switch shown in Figs. 1 and 2 in accordance with the method of the present invention,

Fig. 4 is a schematical, perspective and partly exploded view of a combination of a keyboard switch according to the present invention, and an accessory component including two light emitting diodes and produced in accordance with the method according to the presént invention, and a manually operable keyboard switch housing component,

Fig. 5 is a schematical, perspective and partly exploded view of the combination shown in Fig. 4, turned upside down, and

Fig. 6 is a schematical and perspective view of a combination of a keyboard switch according to the present invention and a light emitting diode support constituting an accessory top housing component of the key.

In Fig. 1, a method according to the present invention of producing a keyboard switch according to the present invention is illustrated comprising five individual production steps schematically illustrated by positions designated the reference numerals 1-5.

In position 1, a metal plate is provided constituting a continuous track of a metal foil 10.

In position 2, the metal foil track 10 is machined in a punching tool, not shown in Fig. 1, and processed into two carrier strips 11 and 12 between which two terminal assemblies 13 and 14 extend. As will be evident from the description below, each of the terminal assemblies 13 and 14 is in a subsequent production step machined into two terminals. Thus, the terminal assemblies 13 and 14 are integrally connected to the carrier strips 11 and 12 through ends of the terminal assemblies, which ends are intended to constitute the outer terminal ends of the above mentioned terminals. As is evident from Fig. 1, the terminal assembly 13 is machined into a shape defining a centrally indented bar 15, from which a contact bar 17 extends towards the adjacent terminal assembly 14. The outer end of the contact bar 17 remote from the indented bar 15 is further machined into a domed contact pad 19. As is also evident from Fig. 1, the terminal assembly 14 is also machined into a shape defining a centrally indented part 16, from which two connector bars 18 extend towards the adjacent terminal assembly 13. The contact bars 18 are further provided with raised, outer contact parts 20.

In position 3, a base housing component 22 is cast around the above described components 15-20 of the terminal assemblies 13 and 14. The base housing component 22 is cast with a central recess 23 defining a circumferential inner surface 24 and a bottom surface 25, in which the contact pad 19 and the raised, outer contact parts 20 are exposed and protrude upwards. The base housing component 22 further defines a top surface 26, a bottom surface, not shown in Fig. 1, a first outer side surface 27, which faces the carrier strip 12, and a second outer side surface 28. The surfaces 26, 27 and 28 are perpendicular to each other. The base housing component 22 further has a bottom surface, not shown in Fig. 1, parallel with the top surface 26, and two outer side surfaces, not shown in Fig. 1, parallel with the first and a second outer side surfaces 27 and 28, respectively. From the first outer side surface 27 and further from the outer side surface not shown in Fig. 1 parallel therewith carrier tags 29 protrude. The carrier tags 29 are cast integrally with the base housing component 22 and are cast to the respective carrier strips 11 and 12.

As is evident from Fig. 1, the base housing component 22 is further at its top surface 26 and its outer side surfaces 27 and 28 provided with indents mating with a top housing component 30 and accessory components to be described below, respectively.

In the above described base housing component 22, a domed metal disc 31 is arranged, which metal disc has its dome facing upwards, i.e. outwards from the recess 23 of the base housing component 22. The domed metal disc 31 is in its normally domed shape in contact with the contact parts 20, however, out of contact with the central contact pad 19, and does consequently not in its normally domed shape establish electrically conductive connection between the contact pad 19 and the outer contact parts 20 and further between the terminal assemblies 14 and 13. The domed metal disc 31 is at its upper or convex side surface provided with a central coating 32 of an acoustically damping material, e.g. of silicone, serving the purpose of altering the unpleasant and harsh noise generated by an undamped domed metal disc, when the metal disc is deformed from its domed shape to a deformed shape and *vice versa* into a more pleasant, damped noise. On top of the domed metal disc 31, a rubber component 33 is arranged, which comprises two integrally connected parts, a membrane part 34 and a stem part 35. The membrane part 34 has, as is evident from Fig. 1, a larger outer diametre than the domed metal disc 31 and is further at its lower side surface, shown in Fig. 2, provided with a circumferential bead 36. The bead 36 serves the purpose of sealing along the outer circumferential edge of the domed metal disc 31.

The stem part 35 is a hollow part, which is elastically deformable and serves the purpose of transmitting a mechanical force from a button 37 to which said mechanical force is applied to the domed metal disc and further the purpose of increasing the stroke of travel of the botton 37 relative to the stroke of travel of the domed metal disc, as the metal disc is deformed or allowed to revert to its normally domed shape from its deformed shape, by the elastic deformation of the stem part 35.

As is evident from Fig. 2, the membrane part 34 is at its lower side surface provided with a protruding part 38 serving the purpose of contacting the central part of the domed metal disc 31, when the stem part 35 is actuated and forced downwards by the button 37. As the domed metal disc 31 and the rubber component 33 are arranged

in the recess 23 of the base housing component 22, the top housing component 30 is, with the button 37 arranged in a central aperture of the top housing component 30, arranged on top of the base housing component 22 and fixed thereto. The top housing component 30 is, as is evident from fig. 1, provided with a central cylindrical bottom part fitting into the recess 23 in a snap fitting, as is evident from Fig. 2, and further provided with downwards protruding fins for co-operating with the above mentioned indents of the top surface 26 of the base housing component 22. The travel of the button 37 within the aperture 39 of the top housing component 30 is controlled by fins 40 protruding outwards from the circumferential outer side surface of the button 37 at the lower edge thereof, as is evident from Fig. 1, which fins 40 are adapted to co-operate with indents of the inner wall of the aperture 39 of the top housing component 30.

In position 4 of Fig. 1, the above described keyboard switch assembly is assembled from the base housing component 22, the top housing component 30, the button 37, the domed metal disc 31, and the rubber component 33 enclosed in the housing of the keyboard switch assembly. From the first outer side surface 27 and the opposite, parallel side surface, the terminal assemblies 13 and 14 protrude. As the keyboard switch assembly leaves position 4, the terminal assemblies 13 and 14 are separated from the carrier strips 11 and 12 at the outer ends thereof. Consequently, the keyboard switch assembly is connected to the carrier strips 11 and 12 through the tags 29, exclusively. As the keyboard switch assembly leaves position 4, the outer terminals defined by the parts of the terminal assemblies 13 and 14 extending outwards from the base housing component 22 are, furthermore, bent downwards, as is evident from the keyboard switch assembly disclosed in position 5 of Fig. 1. By the separation of the terminal assemblies 13 and 14 from the carrier strips 11 and 12, the short circuiting connection between the terminal assemblies 13 and 14 through the carrier strips 11 and 12 is eliminated.

When still mechanically supported by the carrier strips 11 and 12 through the tags 29 connecting the base housing component 22 to the carrier strips 11 an 12 the keyboard switch assembly may in position 5 be tested in an automatic electric test stand. The test stand is illustrated schematically by a test block 41, which is moved from the position shown in Fig 1 upwards so as to receive the outer ends of the terminals defined by the terminal assemblies 13 and 14 in apertures 42 of the block 41. In the apertures 42, metal contact means are provided for establishing electrically conductive contact to the terminals 13 and 14 and are connected to a test circuit, not shown in Fig. 1, which is capable of determining the presence or absence of a short-circuiting condition. By further actuating the button 37 and consequently deforming the domed metal disc 31 from its normally domed shape into its deformed shape by the interaction of the rubber component 33, and still monitoring the presence or absence of a short-circuiting condition between the terminals 13 and 14, the keyboard switch assembly is easily tested. The object is to determine if the keyboard switch assembly is a properly functional keyboard switch, which in its unactuated state does not establish electrically conductive connection between the terminals 13 and the terminals 14, and which in its actuated state establishes electrically conductive connection between the terminals 13 and 14. Provided the keyboard switch assembly has been identified as a properly working keyboard switch assembly, it is separated from the carrier strips 11 and 12 by cutting or breaking the keyboard switch assembly loose from the tags 29.

In Fig. 1, the carrier strips 11 and 12 are provided with through-going holes 43 and 44. The above described process of producing a keyboard switch assembly according to the present invention is indicated above and carried out by moving the track 10 from position 1 to position 5 by well-known computer controlled mechanical advancing means. The holes 43 and 44 consequently serve the purpose of co-operating with gripping means for advancing the track 10 and further, or alternatively, with e.g. optical or proximity detector means to inform the process controlling computer about the position of the track or the carrier strips 11 and 12 relative to an intended position in one of the positions 1-5 shown in Fig. 1.

In Fig. 2 a vertical sectional view of the keyboard switch assembly described above is shown disclosing the above described components and further in greater detail the sealing of the domed metal disc 31 relative to the environment by the bead 36 of the membrane part 34 of the rubber component 33.

In a production line for the production of the keyboard switch described above with reference to Fig. 1, the metal plate 10 from which the keyboard switch is produced may be advanced through a number of processing stations. Alternatively, the metal plate 10 may be stationary and the production stations may be moved in relation to the metal plate. Furthermore, the production line may constitute any appropriate combination of the above possibilities, viz. the advancing of the metal plate 10 in relation to the stations and the movement of the stations in relation to the metal plate. However, a very important aspect of the present invention is the permanent fixation of the keyboard switch n relation to the metal plate 10 or to the carrier strips 11 and 12 until the keyboard switch has been

tested and positively identified as a properly functioning key. Thus, the keyboard switch is not to be transferred from its production line to a test stand as the keyboard switch is permanently fixed to the carrier strips 11 and 12 and consequently in a fixed position in relation to the tools of the individual stations 2-5, particularly in a fixed position in relation to the block 41 constituting part of a test stand shown in position 5 of Fig. 1.

As mentioned above, the keyboard switch assembly described with reference to Figs. 1 and 2 is adapted to co-operate with accessory components, such as a display assembly 50 shown in Fig. 4. The display assembly 50 is in Fig. 4 mechanically connected to a keyboard switch assembly according to the present invention, which keyboard switch assembly is designated the reference numeral 48 in its entirety, through outwardly protruding dovetail shaped locking means co-operating with the above mentioned indents of the outer side surface 28 shown in Fig. 1. By these interlocking dovetail shaped male and female locking means, the display assembly 50 is connected and mechanically fixed to the keyboard switch assembly 48. The keyboard switch assembly 48 differs from the keyboard switch assembly described with reference to Figs. 1 and 2 in that the button 37 is substituted by a button 47 and in that the top housing component 30 is substituted by a top housing component 60, the top surface of which is at the same level as the button 47.

The display assembly 50 comprises two light emitting diodes 51 and 52, which are received in the housing of the display assembly 50 and connected to terminals thereof,, which terminals are designated the reference numerals 113 and 114 and, like the terminals 13 and 14 of the keyboard switch assembly 48, of a configuration allowing the mounting of the keyboard switch assembly 48 and the display assembly 50 in a surface mounting process, which terminals are known in the art as terminal type "J" SMD. Obviously, the accessory assembly 50 may comprise alternative components. Thus, the two light emitting diodes 51 and 52 only constitute examples of components of the display assembly 50 and may in an alternative embodiment be replaced by e.g. a single light emitting diode, one or more incandescent lamps etc. Furthermore or alternatively, the accessory assembly 50 may comprise one or more active or passive components, such as an integrated circuit, a transistor, a resistor, a capacitor, or a relay. Apart from the accessory component or display assembly 50, the keyboard switch assembly 48 co-operates in Fig. 4 with a push button assembly 54, which comprises two parts, viz. a fixed housing part 55, which is mounted and fixed relative to the assemblies 48 and 50, and a movable or pivotable part 56. The top housing component 60 also differs from the above described top housing component 30 shown in Figs. 1 and 2 in that the top housing component 60 is provided with a further component 61 defining an outer groove 62 for co-operating with an axial part of the pivotable part 56 of the push button assembly 54.

In Fig. 5, the above assemblies 48, 50 and 54 are shown turned upside down. Thus, in Fig. 5 the above mentioned axial part co-operating with the groove 62 is shown designated the reference numerals 63. In Fig. 5, two protruding parts 64 of the fixed housing part 55 of the push button assembly 54 is further shown serving the purpose of co-operating with the indents mentioned above with reference to Fig. 1 of the outer side surface 27 and further of the opposite outer side surface of the base housing component 22. The fixed housing part 55 is further provided with snap-locking means 65 serving the purpose of gripping around the keyboard switch assembly 48 and fixing the housing part 55 thereto. As is evident from Fig. 5, the housing part 55 is further provided with two protruding journalling means 67 co-operating with mating journalling means 68 of the pivotable part 56 of the push button assembly 54, which is further provided with a protruding stem means 66 for transferring a mechanical pressure applied to the pivotable part 56 to the push button 47 and further to the internal contact element of the keyboard switch constituted by the domed metal disc 31, shown in Figs. 1 and 2.

The keyboard switch assembly 48 and the display assembly 50 shown in Fig. 5, however, differ from the keyboard switch assembly 48 and the display assembly 50 shown in Fig. 4 in that the terminals 13, 14 and 113, 114 are of a different configuration, viz. the SMD terminal configuration known in the art as "Gull Wing".

In Fig. 3, three positions 6, 7 and 8 of a sequential process according to the present invention of producing the component or display assembly 50 described above with reference to Figs. 4 and 5 are shown. From a metal track similar to the above described metal track 10 shown in Fig. 1, two carrier strips 111 and 112 are punched and brought to the first position designated 6 in Fig. 3. As is evident from Fig. 3, two terminal assemblies 113 and 114 are further punched from the above mentioned metal track. The terminal assemblies 113 and 114, however, differ from the terminal assemblies 13 and 14 shown in Fig. 1 in that the terminal assemblies 113 and 114 do not constitute links between the carrier strips 111 and 112. Thus, the terminal assembly 113 is connected to the carrier strip 111, exclusively, whereas the terminal assembly 114 is connected to the carrier strip 112, exclusively. In position 7, the terminal assemblies

113 and 114 are further processed and each separated into two individual terminal assemblies. Thus, the terminal assembly 113 is divided into two terminal assemblies 113a and 113b, while the terminal assembly 114 is separated into two terminal assemblies 114a and 114b. The parts of the terminal assemblies 113a,b and 114a,b remote from the carrier strips 111 and 112, respectively, are further indented and bent into the shape shown in Fig. 3. In position 8, a housing part 122 is cast around the terminals 113a,b and 114a,b. After the casting step shown in position 8, the component constituting the housing of the display assembly 50 shown in Figs. 4 and 5 is separated from the carrier strips 111 and 112. As is evident from Fig. 3, the carrier strips 111 and 112 are provided with through-going holes 143 corresponding to the holes 43 and 44 of the carrier strips 11 and 12 shown in Fig. 1.

It is to be realised that the above described keyboard switch or keyboard switch assembly according to the present invention is of a modular configuration, as the keyboard switch assembly may co-operate with an accessory component such as the above described display assembly and the above described push button assembly, which as will be evident to the skilled art worker is translucent or is provided with a translucent part. Thus, the pivotable part 56 of the push button 54 may advantageously be made from a translucent material, which is illuminated by the light emitting diodes 51 and 52 of the display assembly 50. Furthermore, as will be evident from the description of Fig. 4, the push button or the top housing component of the keyboard switch assembly 48 may be modified in order to meet special requirements.

In Fig. 6, a keyboard switch assembly for the present invention is shown, which keyboard switch assembly is modified relative to the above described keyboard switch assembly 48 shown in Figs. 4 and 5, in that a push button extender 70 is arranged on top of the push button 47 shown in Fig. 4, which push-button extender 70 is of a cylindrical configuration. The push button extender 70 defines an inner space 71, in which a light emitting diode 72 is arranged, which diode is mounted in a socket 73 received in the inner space 71. The light emitting diode 72 has its pins extending through slits 75 and 76 of the push button extender 70 and further through apertures of the top housing component 60 of the keyboard switch assembly. In Fig. 6, one of the apertures of the top housing component 60 of the keyboard switch assembly is designated the reference numeral 74. One of the pins of the light emitting diode 72 is also shown in Fig. 6 and designated the reference numeral 77. In Fig. 6, the terminals 13 and 14 of the keyboard switch assembly and further the pin 77 of the light emitting diode 72 are of a configuration different from the terminal configurations shown in Figs. 4 and 5. Thus, it is to be realised that the terminals 13 and 14 and further any pins or terminals of accessory components such as the pin 77 or the terminals 113 and 114 may be of any appropriate configuration.

EXAMPLE 1

In a prototype implementation of the method of producing the keyboard switch assembly shown in Figs. 1 and 2, the carrier strips 11 and 12 and the terminal assemblies 13 and 14 were machined from 0.3 mm silver-plated tin-bronze. The carrier strips 11 and 12 had a width of 3 mm, and the distance between the centre lines of the carrier strips 11 and 12 was 23.96 mm. The distance between the terminal assemblies 13 and 14 was 7.6 mm, the diametre of the holes 44 was 1.2 mm, which holes were arranged at the centre lines of the carrier strips 11 and 12 and further at intermediate positions relative to the terminal assemblies 13 and 14, the diametre of the holes 43 was 1.8 mm. The width of the indented part 16 was 4.4 mm, the raised contact parts 20 were raised 0.5 mm relative to the indented part 16. The raised contact parts 20 and the contact pad 19 were positioned centrally or at the intermediate line of the terminal assemblies 13 and 14. The contact pad 19 was raised 0.45 mm relative to the indented bar 15, and was constituted by a dome with a radius of 1.35 mm defining a circular contact pad of a diametre of 1.224 mm.

The base housing component 22, the top housing component 30 and the button 37 were cast from polycarbonate (or in alternative implementations from PES or PETP). The shrinkage of the components was less than approx. 0.5 per cent. The push button 37 was of a diametre of 6.5 mm and a height of 2.8 mm. The fins 40 had a height of 0.8 mm, and oppositely positioned fins defined a maximum outer diametre of 7.65 mm. The button 37 further had a central, inwardly protruding part shown in Fig. 2, which part defined a height of 0.95 mm from the lower side surface of the bottom.

The assembly comprising the base housing component 22 and the top housing component 30 defined a height of 5 mm, while the maximum height of the keyboard switch assembly from the lower side surface of the base housing component 22 to the top surface of the keyboard switch 37 and 6.4 mm. The outer dimensions of the bottom and top housing parts were 10 mm x 10 mm.

The rubber component 33 was made from silicone rubber of a hardness of 38 Shore +-2. The outer diametre of the membrane part 34 was 8.83

mm, the inner diametre defined within the bead 36 was 6.8 mm, the thickness of the membrane part 34 was 0.3 mm, and the overall thickness of the bead was 0.63 mm. The central protruding part 38 defined a circular surface of a diametre of 1.4 mm protruding 0.4 mm from the lower side surface of the membrane part 34. The stem part 35 was a hollow, cylindrical part of a height of 3.16 mm, which stem part defined an upper outer diametre of 2.8 mm, an angle of taper of the outer cylindrical side surface of the stem part 35 of 7°, an inner recess of a depth of 2.5 mm and of a inner diametre of 1 mm and defining by its inner cylindrical surface an angle of taper of 5°.

The domed metal disc 31 was made from 0.075 mm copper beryllium alloy. The outer diametre of the metal disc 31 was 6.4 mm and the maximum diametre of the acoustically damping coating 32 was 5 mm. The arch or dome radius of the disc wad 39.1 mm, and the height of the dome was 0.25 mm. The domed metal disc was deformed from its normally domed shape by the application of a pressure of 155-165 g and reverted from its deformed shape to its normally domed shaped when the pressure applied to the domed metal disc was less than 115-125 g.

Together the rubber component 33 and the domed metal disc 31 provided an increase of the stroke of the domed metal disc 31 of approximately 0.25 mm-0.3 mm to a total stroke or travel of the push button 37 of approximately 0.8 mm-1 mm.

EXAMPLE 2

The accessory component or display assembly 50 shown in Fig. 4 was in a prototype implementation made from a terminal plate constituted by a silver-plated tin-bronze plate and a housing cast from polycarbonate (or, alternatively, PES or PETP), like the keyboard switch described above in example 1.

Although the invention has been described above with reference to specific embodiments and implementations, it is to be understood that the present invention is not limited to the above embodiments and implementations, thus numerous modifications and amendments are obvious to a person having ordinary skill in the art within the scope of the present invention as defined in the appending claims.

Claims

1. A method of producing a keyboard switch, said keyboard switch comprising:
a housing of an insulating material having outer side walls,
a switching element enclosed in said housing, and
at least two metallic terminal components, each including:
an outer terminal extending outwards from an outer side wall of said housing and defining an outer terminal end, and an electric contact means being enclosed in said housing and integrally connected to said outer terminal at an end thereof opposite to said outer terminal end;
said switching element being switchable between a first state in which said switching element is out of electrically conductive contact with at least one of said electric contact means of said at least two metallic terminal components, and a second state in which said switching element is establishing electrically conductive contact between said electric contact means of said at least two metallic components;
the method comprising the following sequence of steps:

(a) providing a continuous track of the metal of said metallic terminal components,

(b) processing said continuous track so as to form said metallic terminal components and a carrier strip, said metallic terminal components being integrally connected to said carrier strip through said outer terminal ends,

(c) casting a base housing component of said insulating material around said metallic terminal components, said base housing component defining outer side walls constituting at least part of said outer side walls of said housing through which outer side walls of said base housing component said outer terminals extend, said base housing component comprising at least one tag protruding outwards from an outer side wall of said base housing component and being cast to said carrier strip for establishing mechanical connection between said base housing component and said carrier strip, said base housing component further having a recess in which said electric contact means are exposed,

(d) arranging said switching element in said recess of said base housing component so as to be switchable between said first and second states,

(e) providing a top housing component having an aperture,

(f) providing a stem means,

(g) arranging said stem means in said aperture of said top housing component and arranging said top housing component relative to said base housing component together constituting said housing, said stem means being arranged relative to said switching element so as to switch said switching element between said first and said second states by actuation,

(h) separating said metallic terminal components from said carrier strip by separating said outer terminals from said carrier strip at said outer terminal ends,

(i) testing said keyboard switch produced in steps (a)-(h) in a test stand, while said base housing component is mechanically connected to said carrier strip through said tag, by actuating said stem means in order to test if said switching element is switchable between said first and second states, and by determining whether said at least two metallic terminal components are electrically insulated relative to one another or not insulated relative to one another when said switching element is in said first state and further determining whether said at least two metallic terminal components are in electrically conductive connection with one another or not when said switch element is in said second state, and

(j) provided said keyboard switch is identified in step (i) as a properly working component, separating said tag from said base housing component.

2. A method according to claim 1, wherein in step (b) two carrier strips are processed from said continous track, between which carrier strips said metallic components are arranged having their outer terminal ends integrally connected to said carrier strips through said outer terminal ends, and wherein in step (c) two tags are cast to a respective carrier strip.

3. A method according to claim 2, wherein each metallic terminal component constitutes a link between said two carrier strips, and wherein each of said metallic components has two outer terminals defining outer terminal ends integrally connected to a respective carrier strip.

4. A method according to any of the claims 1-3, wherein said switching element is a domed metal disc, which disc in step (d) is arranged with its dome protruding outwards from said recess, and which disc in its normally domed shape is in said first state and is deformable from said domed shape into a deflected shape constituting said second state, and wherein said stem means provided in step (f) and arranged in said aperture of said top housing component in step (g) is actuatably acting on said metal disc for deforming it from said domed shape to said deflected shape by activation.

5. A method according to claim 4, wherein in step (g) an elastically compressible body means is arranged between said stem means and said metal disc.

6. A method according to claim 5, wherein said metal disc is punched from a metal foil, which is provided with a coating of an acoustically damping material on one side surface, which side surface in said domed metal disc constitutes the outer or convex side surface of said domed metal disc.

7. A method according to any of the claims 4-6, wherein in steps (c) and (e) said base and top housing components are cast from a high temperature resistent plastics material.

8. A keyboard switch comprising: a housing of an insulating material having outer side walls,
a domed metal disc enclosed in said housing, and
at least two metallic terminal components, each including:
an outer terminal extending outwards from an outer side wall of said housing and defining an outer terminal end, and an electric contact means being enclosed in said housing and integrally connected to said outer terminal at an end thereof opposite to said outer terminal end;
said domed metal disc being switchable between a first state in which said domed metal disc is in its normally domed shape and is out of electrically conductive contact with at least one of said electric contact means of said at least two metallic terminal components, and a second state in which said domed metal disc is in a deflected shape and establishes electrically conductive contact between said electric contact means of said at least two metallic components by deforming said disc from its normally domed shape to a deflected shape;
said housing comprising:
a base housing component of said insulating material cast around said metallic terminal components, and
a top housing component having an aperture and a stem means,
said base housing component defining outer side walls constituting at least part of said outer side walls of said housing through which outer side walls of said base housing component said outer terminals extend, said base housing component further having a recess in which said electric contact means are exposed, said domed metal disc being arranged in said recess of said base housing component with its dome protruding outwards from said recess so as to be switchable between said first and second states,
said stem means being arranged in said aperture of said top housing component and being arranged relative to said domed metal disc so as to switch said domed metal disc between said first and said second states by actuation, and
said metal disc being made from a metal foil, which is coated with an acoustically damping material on one side surface constituting the outer or convex side surface of said domed metal disc.

9. A keyboard switch according to claim 8, further comprising an elastically compressible body means arranged between said stem means and said metal disc.

10. A keyboard switch according to claim 8 or 9, said base and top housing components being made from a high temperature resistent plastics material, such as high-crystalline copolymers, epoxy resins, olefin-carbon-monoxide copolymers, polycarbonates, polyolefin sulphonates, e.g. polyethylene sulphonate, PES, or polyethylene-terephthalates, e.g. PETP or PET.

11. A keyboard switch according to claim 10, wherein said stem means, said body means and said domed metal disc are arranged coaxially relative to each other, wherein said elastically compressible body means comprises a circular membrane part having a circumferential bead, and a central stem part, wherein said stem part of said body means constitutes an elastically compressible part for the transmission of the actuation of said stem means to said domed metal disc, wherein the diametre of said domed metal disc is smaller than the diametre of said circular membrane part of said body means, and wherein said domed metal disc is arranged within said circumferential bead of said membrane part so as to have said bead seal along the circumferential edge of said domed metal disc.

12. A keyboard switch according to claim 11, said elastically compressible body means being made from silicon rubber, and said domed metal disc being made from a CuBe alloy foil of a thickness of e.g. 0.075 mm.

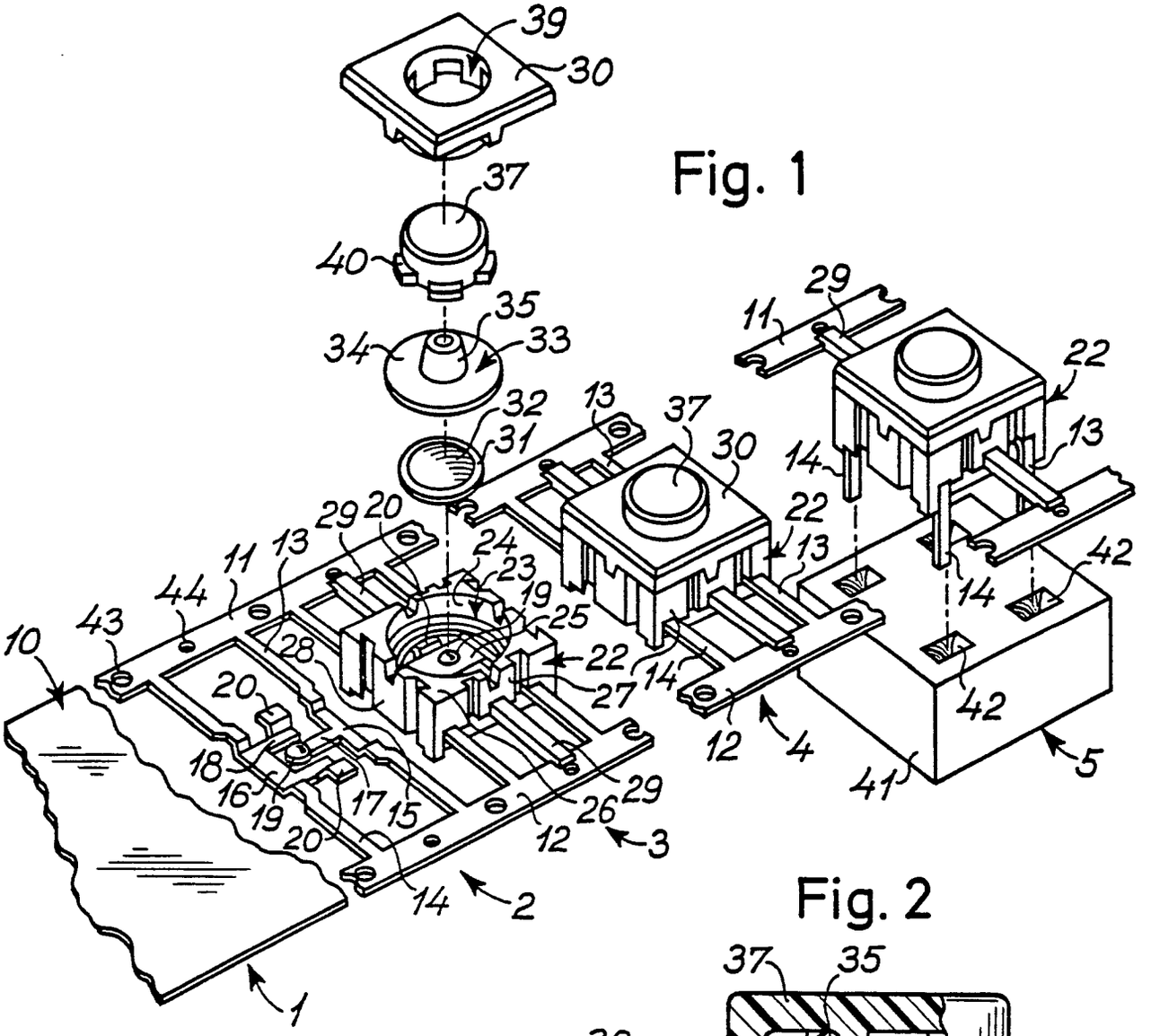


Fig. 1

Fig. 2

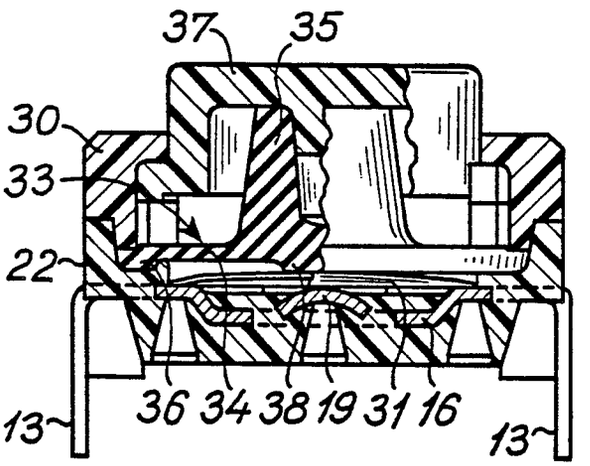
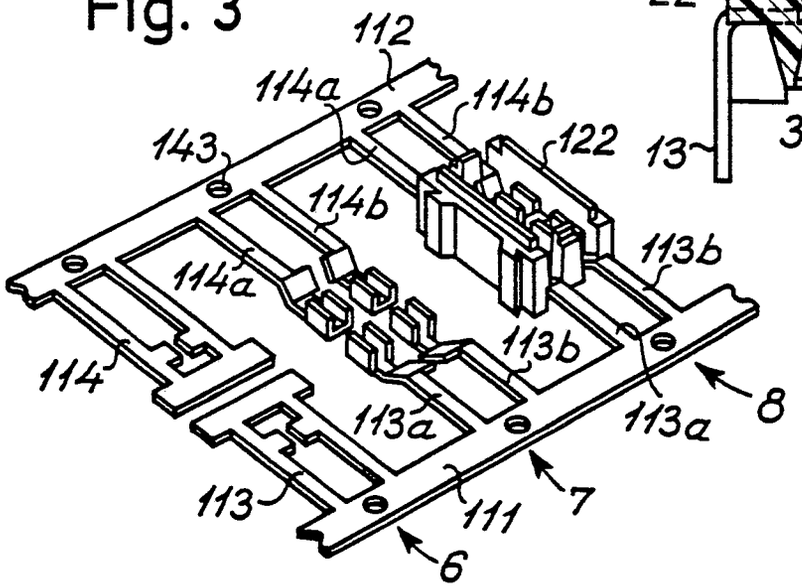


Fig. 3



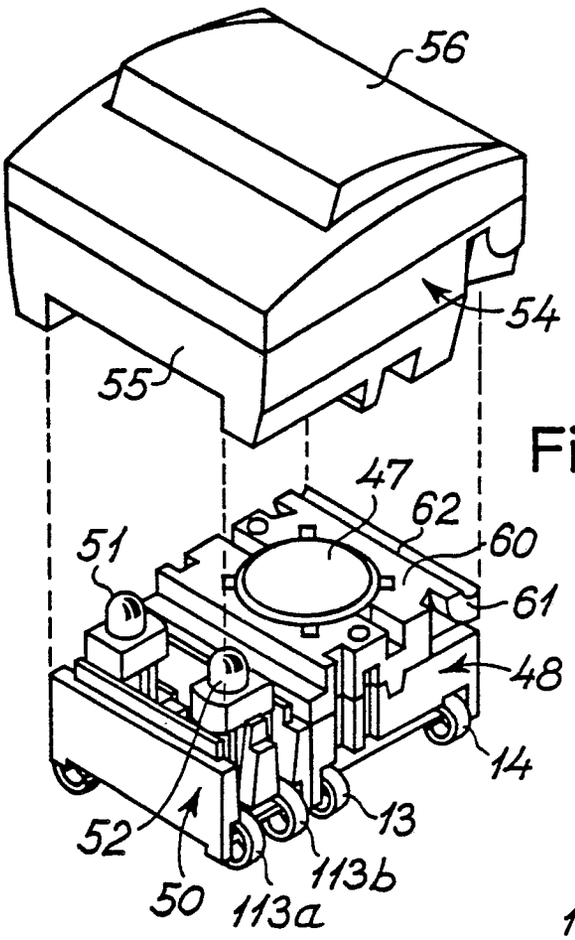


Fig. 4

Fig. 6

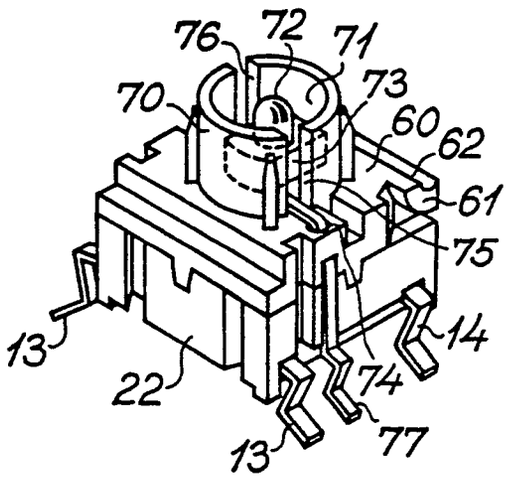
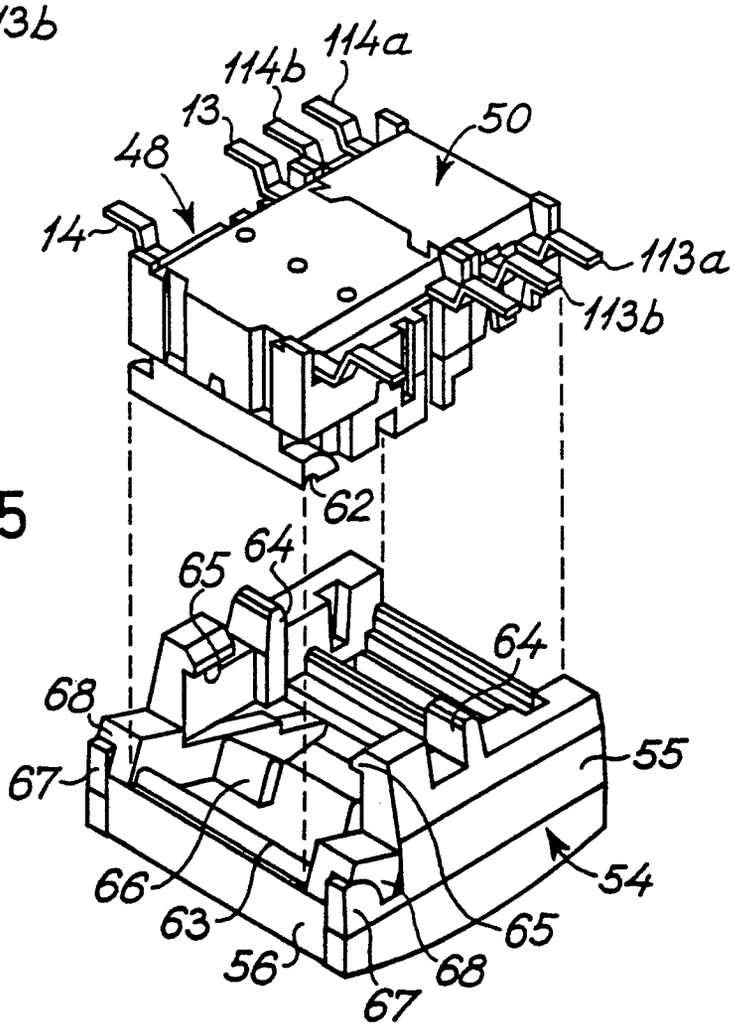


Fig. 5



European Patent Office

EUROPEAN SEARCH REPORT

Application number

EP 89101321.1

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl 4)
A	US-A-4 255 638 (A.F. CONTARINO) *Column 3, lines 16-25*	10	
A,D	US-A-4 659 881 (D.R. DOWE) *Whole document*	11	
A,D	DE-A1-2 740 746 (B/K PATENT DEVELOPMENT INC) *Page 8, lines 22-25*	12	
			TECHNICAL FIELDS SEARCHED (Int. Cl.4)

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner

CATEGORY OF CITED DOCUMENTS

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EUROPEAN SEARCH REPORT

Application number
EP 89101321.1

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl 4)
A,D	EP-A1-0 030 473 (FUJITSU LIMITED) *Whole document*	1-4,8	H 01 H 11/00 H 01 H 13/70
A,D	DE-A1-3 542 953 (ALPS ELECTRIC CO) *Whole document*	1-3	
A,D	DE-A1-3 545 798 (ALPS ELECTRIC CO) *Whole document*	1-3, 8	
A,D	EP-A2-0 164 799 (LITTELFUSE TRACOR B.V.) *Page 20, line 28 - page 21, line 22; figure 8*	1-3	
A	US-A-4 207 448 (A. FURUSAWA ET AL) *Column 6, lines 32-56; figures 9-11*	5,9,11	
A,D	US-A-4 102 039(D.L. HENRICKSON ET AL) *Whole document*	1	TECHNICAL FIELDS SEARCHED (Int. Cl.4)
A	US-A-4 412 113 (I. MITSUGI ET AL) *Column 2, line 49 - column 3, line 15; figures 3,4*	8	H 01 H H 01 R H 02 B H 05 K
A,D	US-A-4 331 851 (L.K. JOHNSON) *Column 4, line 60 - column 5, line 3; figure 8*	8,9	
A	US-A-4 430 531 (A.J. WRIGHT) *Whole document*	5,9,12	
A	EP-A2-0 146 207 (DUBLIER PLC) *Claim 6*	10	

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
STOCKHOLM	20-04-1989	B. NORDENBERG

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X : particularly relevant if taken alone
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