(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 048 683 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
**15.04.2009 Bulletin 2009/16**

(51) Int Cl.:
***H01H 37/54** (2006.01)*

(21) Application number: **08016674.7**

(22) Date of filing: **23.09.2008**

(84) Designated Contracting States:
**AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MT NL NO PL PT RO SE SI SK TR**
Designated Extension States:
**AL BA MK RS**

(30) Priority: **12.10.2007 DE 102007050342**

(71) Applicant: **Hofsaess, Marcel P.**
**75175 Pforzheim (DE)**

(72) Inventor: **Hofsaess, Marcel P.**
**75175 Pforzheim (DE)**

(74) Representative: **Otten, Hajo et al**
**Witte, Weller & Partner**
**Patentanwälte**
**Postfach 10 54 62**
**70047 Stuttgart (DE)**

# (54) Switch having a temperature-dependent switching mechanism

(57) A switch (10) has a housing (11) which houses a temperature-dependent switching mechanism (12) and on which a first and a second counter-contact (16, 19) for the switching mechanism (12) are arranged, with the switching mechanism (12) comprising an electrically conductive spring part (31) which carries a movable contact part (32) and a bimetallic snap-action disc (34), which bimetallic snap-action disc (34) is unrestricted below its response temperature, with the spring part (31) making an electrically conductive connection via the contact part (32) between the two countercontacts (16, 19) when the switching mechanism (12) is below the response temperature, with a damping part (35, 37) being arranged between the bimetallic snap-action disc (34) and the spring part (31). (

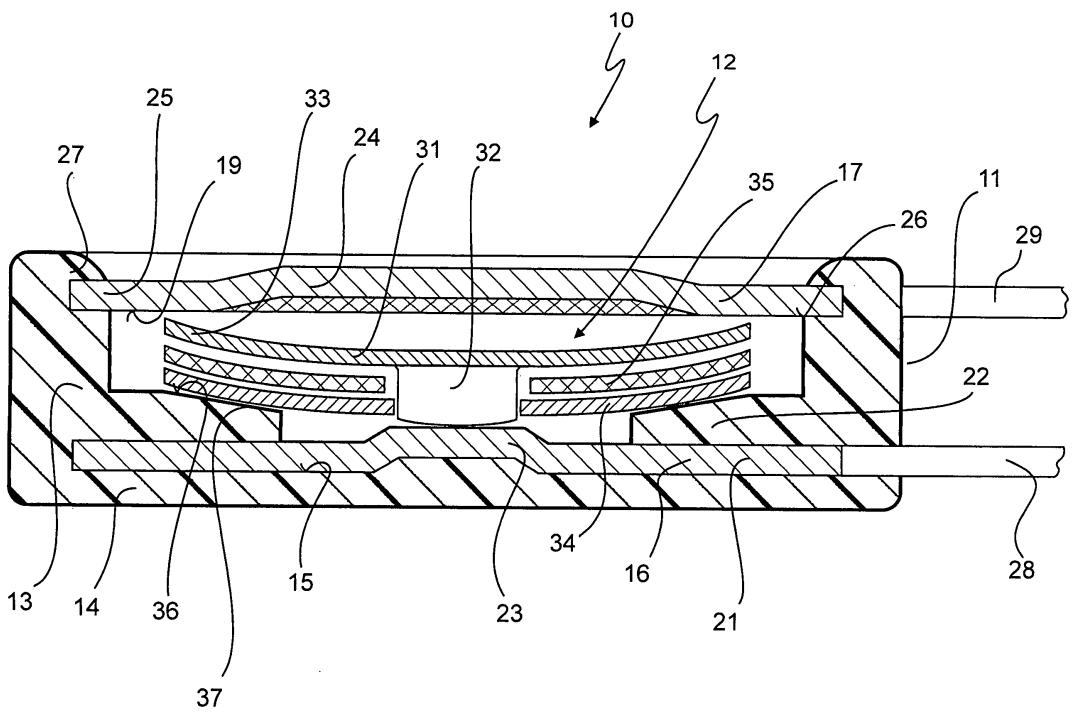


Fig. 1

EP 2 048 683 A1

## Description

**[0001]** The present invention relates to a switch having a housing which houses a temperature-dependent switching mechanism and on which a first and a second counter-contact for the switching mechanism are arranged, with the switching mechanism comprising an electrically conductive spring part which carries a movable contact part and a bimetallic snap-action disc, which bimetallic snap-action disc is unrestricted below its response temperature, with the spring part making an electrically conductive connection via the contact part between the two counter-contacts when the switching mechanism is below the response temperature.

**[0002]** By way of example, a switch such as this is known from DE 37 10 672 A1.

**[0003]** In the known switch, the housing has a lower part, which is manufactured from electrically conductive material, and a cover part, which closes off the lower part and is manufactured from insulating material. The switching mechanism is arranged within this housing and, as a spring part, has a spring disc which is fitted with a movable contact part. The spring disc acts against a bimetallic snap-action disc which is placed over the movable contact part. Below the response or switching temperature, the spring disc which is supported on the base of the lower part, presses the movable contact part against a first counter-contact, which is provided internally on the cover part, and extends upwards in the form of a rivet through the cover. The base of the lower part is used as a second counter-contact for the switching mechanism.

**[0004]** Since the spring disc is itself manufactured from electrically conductive material, it ensures, below the response temperature of the switching mechanism, that there is a low-impedance, electrically conductive connection between the counter-contact on the cover part and the counter-contact on the lower part, with contact being made with the lower part from the outside. If the temperature of the switching mechanism is now increased, then the bimetallic snap-action disc snaps over suddenly and presses the movable contact part away from the counter-contact on the cover, against the force of the spring disc, thus interrupting the electrical connection.

**[0005]** DE 21 21 802 A1 discloses a further switch of this generic type, in whose housing a temperature-dependent switching mechanism as described above is likewise arranged. In this switch, the cover part and lower part are both in the form of pots, and are manufactured from electrically conductive material. An insulating film is arranged between the upper part and the lower part in order to electrically isolate the two housing parts from one another.

**[0006]** The temperature-dependent switching mechanism now on the one hand makes contact with the lower part via the edge of the spring disc and on the other hand makes contact with the cover part via the movable contact part, thus resulting in an electrically conductive connection between the cover part and the lower part as long as the temperature of the switching mechanism is below the response temperature. If the temperature of the switching mechanism increases, then this electrical connection is interrupted in the manner described above.

**[0007]** A switch of this generic type which is known from EP 0 858 090 A2 comprises a two-part housing composed of insulating material, into which a temperature-dependent switching mechanism is inserted. As the spring part, the switching mechanism comprises a spring disc which is fitted approximately centrally with a movable contact on which a bimetallic snap-action disc is arranged. The movable contact part interacts with a fixed first counter-contact, which is provided as a cover electrode internally on the cover part of the housing.

**[0008]** A holding attachment is provided at the side on the spring disc and is mounted by means of a pin on a basis electrode, which is provided on the lower part of the housing and acts as a second counter-contact. The base electrode and the cover electrode in this case each have an external connection into which the stripped end of a connecting wire is inserted.

**[0009]** Depending on the temperature of the spring disc, the movable contact part rests on the fixed first counter-contact such that an electrically conductive connection between the two external connections is made in this case as well via the fixed first counter-contact, the movable contact part, the spring disc, the holding attachment and the second counter-contact.

**[0010]** If the temperature of the bimetallic snap-action disc increases above its response temperature, then it snaps over from its convex shape to a concave shape in which its edge is supported on shoulders and stops provided for this purpose in the upper housing part, and in which case it lifts off the movable contact part from the fixed first counter-contact, against the force of the spring disc. To do this, it is necessary for the bimetallic snap-action disc to force the spring disc to change its convex shape into a concave shape.

**[0011]** When the temperature falls below the response temperature again, then the bimetallic snap-action disc snaps back to its convex shape, thus likewise allowing the spring disc to assume its original shape and to press the movable contact part against the fixed first counter-contact, again.

**[0012]** Finally, DE 197 27 197 discloses a switch of this generic type in which the spring disc is fitted, as the movable contact part, with a contact link which, below the response temperature of the bimetallic snap-action disc, is pressed by the spring disc against the two counter-contacts, which in this case are arranged alongside one another on the cover of the housing. These switches are designed for a high current flow, but otherwise operate in the same way as the switches discussed above.

**[0013]** The temperature-dependent switches and switching mechanisms described so far are used to protect an electrical appliance against excessively high temperature. For this purpose, the supply current for the appliance to be protected is passed through the temperature-dependent switch and the temperature-dependent switching mechanism, with the switch and the switching mechanism being thermally coupled to the appliance to be protected. The respective switching mechanism then opens the circuit at a response temperature which is predetermined by the snap-action temperature of the bimetallic snap-action disc, by the movable contact part being lifted off the fixed counter-contact, or the contact link being lifted off the two counter-contacts.

**[0014]** One initial advantage of all the switching mechanisms described so far is that the current to be disconnected does not flow directly via the bimetallic snap-action disc but is passed via the spring part or the contact link. This reduces the intrinsic heating of the bimetallic snap-action disc, although heat is still created in the interior of the switches as a result of the intrinsic heating of the spring part or of the contact link.

**[0015]** One disadvantage of these switches, and of switches constructed in a similar manner, results from the intrinsically desirable fact that the bimetallic snap-action disc is mechanically unloaded and, so to speak, is inserted freely, loosely or unrestrictedly into the housing, in such a way that mechanical loads over the course of time cannot lead to any shift in the switching temperature, as is the case in switches with a clamped-in bimetallic spring.

**[0016]** When switches such as these with a loosely inserted bimetallic snap-action disc are used in the field of alternating magnetic fields, then the bimetallic snap-action disc can be caused to vibrate below its response temperature, that is to say when it is located freely in the switch without any mechanical loads, since, by virtue of its composition, it can be magnetized by a magnetic field. In other words, the bimetallic snap-action disc is magnetized by the external magnetic field, and may oscillate as a consequence of this.

**[0017]** However, such vibration of the bimetallic snap-action disc is undesirable since the vibration mechanically loads it, and this can lead to a shortening of life and to an uncontrolled shift in the switching temperature.

**[0018]** A further disadvantage is the noise caused by the vibration, which a user often perceives as "chirping", "humming" or "buzzing".

**[0019]** In order to suppress influences such as these, temperature-dependent switches of the type mentioned at the outset are therefore frequently provided with a magnetic protection shield, it being also known to provide for a further, stabilizing spring disc, which keeps the bimetallic snap-action disc free of vibration below its response temperature. However, this further holder for the bimetallic snap-action disc is on the one hand complex in design terms and on the other hand has the undesirable side effect that the bimetallic snap-action disc is nevertheless actually loaded, thus actually not achieving the aim of loose insertion.

**[0020]** In this context, DE 196 36 320 A1 discloses a temperature-dependent switch with a spring tongue which is clamped in at one end and with freely inserted bimetallic strips, wherein a holding or guide part of the spring tongue and/or bimetallic strip is manufactured from magnetic material. In this case, the spring tongue is fitted in a manner known per se with a movable contact which makes contact with the fixed contact, with the spring tongue being connected to an external connection at its clamped-in end, and with the fixed contact also being connected to an external connection. The bimetallic strip, which is admittedly loosely inserted but guided on its narrow faces, lifts the movable contact off the fixed contact in the event of an unacceptable temperature increase.

**[0021]** DE 197 27 383 A1 discloses a switch which in principle is designed in the same way as the switch known from DE 3 710 672 A1 mentioned at the outset. In order to suppress vibration of the bimetallic snap-action disc, the counter-contact on which the edge of the spring disc is supported below the response temperature, is designed to be magnetic.

**[0022]** Although the vibration is considerably reduced in this way, this solution cannot be used for all the designs mentioned above, and, furthermore, its design is frequently complex. Furthermore, the known solutions are costly since special parts must be used.

**[0023]** US 3,755,770 discloses a switch having a temperature-dependent switching mechanism, wherein a bimetallic snap-action disc is provided, which bimetallic snap-action disc is clamped in at its rim by inter-position of a damping disc. As an alternative, this document discloses a switch wherein a damping material is directly glued or otherwise bonded to the bimetallic snap-action disc. By this, vibrations of the bi-metallic snap-action disc shall be damped in order to stabilize the response temperature. With both alternatives, the bimetallic snap-action disc is not unrestricted.

**[0024]** In view of the above, it is an object of the present invention to improve the switch mentioned at the outset such that the effect of vibration on the bimetallic snap-action disc is reduced, with the design of the new switch being simple

**[0025]** According to the invention, in the case of the switch mentioned at the outset this object is achieved in that a first damping part is arranged between the bimetallic snap-action disc and the spring part.

**[0026]** The object underlying the invention is solved completely in this way.

**[0027]** This is because the inventor of the present application has found that it is not necessary to suppress the vibration of the bimetallic snap-action disc per se, but that it is possible to suppress the striking noise of the bimetallic snap-action disc against other parts of the switch by means of a noise-damping intermediate layer.

**[0028]** On the one hand, this reduces or even entirely suppresses the noise that is developed, while on the other hand the bimetallic snap-action disc is not subject to mechanical or magnetic loads and, as before, it is located freely and without any load in the housing, as a result of which the advantages mentioned above are retained.

**[0029]** Furthermore, the first damping part considerably reduces the mechanical loads on the bimetallic snap-action disc on striking against other parts of the switch, thus counteracting shortening of the life and uncontrolled shifting of the switching temperature.

**[0030]** According to the invention, the first damping part is arranged between the bimetallic snap-action disc and the spring part, thus damping impacts between the spring part and the bimetallic snap-action disc. This has nothing to do with the shape of the spring part.

**[0031]** Just the simple insertion of an appropriately placed film between the bimetallic snap-action disc and the spring part leads to a considerable reduction in the impacts, and results in the advantages associated with this.

**[0032]** The bimetallic snap-action disc and spring part are metal parts which, furthermore, are always located very close to one another in the switch. According to the finding of the inventor, even minor vibration of the bimetallic snap-action disc leads to the bimetallic snap-action disc striking the spring part, and the invention now prevents this.

**[0033]** Prior to this invention, it could not be expected that the simple inter-position of a damping part between the bimetallic snap-action disc and the spring part would result in such a reduction of noise and strikes without imparting the mechanical life time of the bimetallic snap-action disc or the long-term stability of the response temperature.

**[0034]** For the purposes of the present application, the expression "bimetallic snap-action discs" means essentially round, oval or rectangular discs which are manufactured from at least two different metals and assume a convex shape or concave shape depending on their temperature.

**[0035]** Additionally, a further damping part can be arranged between the bimetallic snap-action disc and the housing, in such a way that impacts between the edge or the centre of the bimetallic snap-action disc and the housing part, for example a contact shoulder or a cover or base of the housing, are also damped.

**[0036]** Alternatively, the further damping part can also be formed on a part of the housing with which the bimetallic snap-action disc comes into contact. This part may also be a contact shoulder or a cover or base of the housing. In this case, the damping part is formed by corresponding coating or processing of the appropriate housing part.

**[0037]** It is generally preferred if the first and/or further damping part is provided in the form of a disc or ring, preferably a film, and furthermore preferably a film in the form of a disc or ring.

**[0038]** One advantage in this case is that the damping part is in the form of a component which can be produced easily and can furthermore also be inserted without any problems during final assembly of the new switch.

**[0039]** Another advantage is that films which are preferably provided according to the invention can be made thin, in such a way that it is possible to entirely or largely avoid further design adaptations to known switches. In fact, the film can be inserted into free spaces and intermediate spaces which exist in any case by virtue of the design.

**[0040]** In this case, it is preferable for the film to have an enlarged, preferably corrugated, grooved or honeycomb surface, with the first and/or further damping part furthermore preferably being composed of an elastic material, furthermore preferably plastic, synthetic rubber or rubber.

**[0041]** These measures result in the advantage that the effect of impact damping is implemented particularly efficiently by the configuration of the surface, for example by shaping by means of stamping or embossing, and by the choice of the material.

**[0042]** In this case, the expression "enlarged surface" means a surface which is larger than a flat film with the same external dimensions, as can be produced by stamping or embossing on an initially flat film.

**[0043]** Overall, it is important that the damping part is designed, by choice of its material and/or its surface, such that the impacts of the bimetallic snap-action disc during its vibration are braked, that is to say damped.

**[0044]** Further features and advantages result from the description and the attached drawing.

**[0045]** It is self-evident that the features which have been mentioned above and those which are still to be explained in the following text can be used not only in the respectively stated combinations but also in other combinations or on their own without departing from the scope of the present invention.

**[0046]** Embodiments of the invention will be explained in more detail in the following description and are illustrated in the attached drawing, in which:

Figure 1 shows the new switch in the form of an outline embodiment, in the form of a schematic section illustration in a side view, in the closed state; and

Figure 2 shows an illustration as Figure 1, but in the open state.

**[0047]** In Figure 1, 10 denotes a switch in whose housing 11 a temperature-dependent switching mechanism 12 is arranged. Switches such as these are used, for example, for monitoring the temperature of electrically operated appliances, and for this purpose are electrically connected in series with the appliance.

**[0048]** The housing 11 comprises a lower part 11, which has a wall 13 and is composed of electrically insulating material, and on whose inner base 15 a first counter-contact 16 for the switching mechanism 12 is arranged. The lower part 14 is closed off by an electrically conductive cover part 17, whose inner face acts as a second counter-contact 19.

**[0049]** The first counter-contact 16 is in the form of a disc 21. The housing lower part 14 clasps the edge of the disc 21 in an annular shape, thus resulting in an insulating contact area 22 which also provides insulation in the upward direction for the edge of the disc 21.

**[0050]** Approximately centrally, the disc 21 has a contact projection 23, which points into the interior of the housing 11.

**[0051]** The second counter-contact 19 is in the form of a disc 24 whose edge 25 is supported on the inner, circumferential shoulder 26 of the lower part 14. A hot-pressed edge 27 of the lower part 14 clasps the edge 25 of the disc 24, holding the disc 24 captive on the shoulder 26.

**[0052]** The discs 21 and 24 respectively have a connecting part 28 or 29, which is thus formed integrally, extends at the side through the wall 13 out of the switch 10, and is used as the external connection.

**[0053]** The switching mechanism 12 comprises a spring disc 31 which is fitted with a movable contact part 32 which, in the illustrated embodiment, is welded to the spring disc 31. The edge 33 of the spring disc 31 is supported on the disc 24 and, in the lower-temperature position as illustrated in Figure 1, presses the movable contact part 32 against the contact projection 23, thus resulting overall in an electrical connection being produced between the connecting parts 28 and 29 via the electrically conductive spring disc 31.

**[0054]** A bimetallic snap-action disc 34 and a damping film 35, which is arranged between the spring disc 31 and the bimetallic snap-action disc 34, are placed over the movable contact part 32.

**[0055]** If the switching mechanism 12 is heated to such an extent that the bimetallic snap-action disc 34 snaps over to its high-temperature position as shown in Figure 2, the bimetallic snap-action disc is then supported by its edge on the insulating contact area 22, and presses the movable contact part 32 away from the contact projection 23 until, finally, the spring disc 31 finally also snaps open from the illustrated concave shape to a convex shape. The bimetallic snap-action disc 34 is now supported by its edge on the insulating contact area 22, such that any possible contact in the area of the movable contact part 32 on the cover part 17 does not lead to an undesirable short-circuit between the two connecting parts 28 and 29.

**[0056]** If the switch 10, when it is below the response temperature of the bimetallic snap-action disc as shown in Figure 1, is subjected to a magnetic alternating field, then the bimetallic snap-action disc 34 which is located loosely in the switch 10 starts to vibrate which, without the intermediate damping film 35 according to the invention, would lead to it mechanically striking the spring disc 31. These impacts would mechanically load the bimetallic snap-action disc 34 and would furthermore be audible as disturbing noise.

**[0057]** During this vibration, the bimetallic snap-action disc 34 also strikes the surface 36 of the contact area 22. In order to damp these impacts as well, the surface is provided with a damping net 37, which can be produced by coating with an elastic material or by processing the surface 37 itself.

**[0058]** Instead of the damping net 37 a damping film can also be provided on the contact area.

**[0059]** The damping film 35 is in the form of a ring or disc and is manufactured from a plastic, from synthetic rubber or from rubber. The damping film 35 has an enlarged surface which is corrugated, grooved or honeycomb, such that it can elastically damp the impacts of the bimetallic snap-action disc 34.

**[0060]** This results, on the one hand, in the bimetallic snap-action disc 34 being loose in the switch 10 but on the other hand in its impacts against the spring disc 31 and the contact area 22 caused by vibration being damped, without suppressing the vibration itself. Below the response temperature, the bimetallic snap-action disc is completely unrestricted, as it is neither glued to a damping material nor clamped in, neither at its center not at its rim.

**[0061]** The disturbing noise is therefore reduced if not entirely overcome without any disadvantageous effects on the life time of the bimetallic snap-action disc and the long-term stability of the switching temperature. Furthermore, the mechanical loading which is otherwise caused by the vibration is reduced considerably, thus leading to an even better long-term stability of the switching temperature.

## Claims

1. A switch having a housing (11) which houses a temperature-dependent switching mechanism (12) and on which a first and a second counter-contact (16, 19) for the switching mechanism (12) are arranged, with the switching mechanism (12) comprising an electrically conductive spring part (31) which carries a movable contact part (32) and a bimetallic snap-action disc (34), which bimetallic snap-action disc (34) is unrestricted below its response temperature, with the spring part (31) making an electrically conductive connection via the contact part (32) between the two counter-contacts (16, 19) when the switching mechanism (12) is below the response temperature, **characterized in that** a first damping part (35) is arranged between the bimetallic snap-action disc (34) and the spring part (31).

2. The switch of Claim 1, **characterized in that** a further damping part (37) is arranged between the bimetallic snap-action disc (34) and the housing (11).

3. The switch of Claim 1, **characterized in that** the further damping part (37) is formed on a part (36) of the housing (11) with which the bimetallic snap-action disc (34) comes into contact.

4. The switch of anyone of Claims 1 to 3, **characterized**

**in that** the first damping part (35) is in the form of a disc or ring.

5. The switch of anyone of Claims 1 to 4, **characterized in that** the first and/or further damping part (35, 37) comprises a film, preferably a film in the form of a disc or ring.

6. The switch of Claim 5, **characterized in that** the film has an enlarged, preferably corrugated, grooved or honeycomb surface.

7. The switch of anyone of Claims 4 to 6, **characterized in that** the first and/or further damping part (35, 37), preferably the film, is composed of an elastic material, preferably plastic, synthetic rubber or rubber.

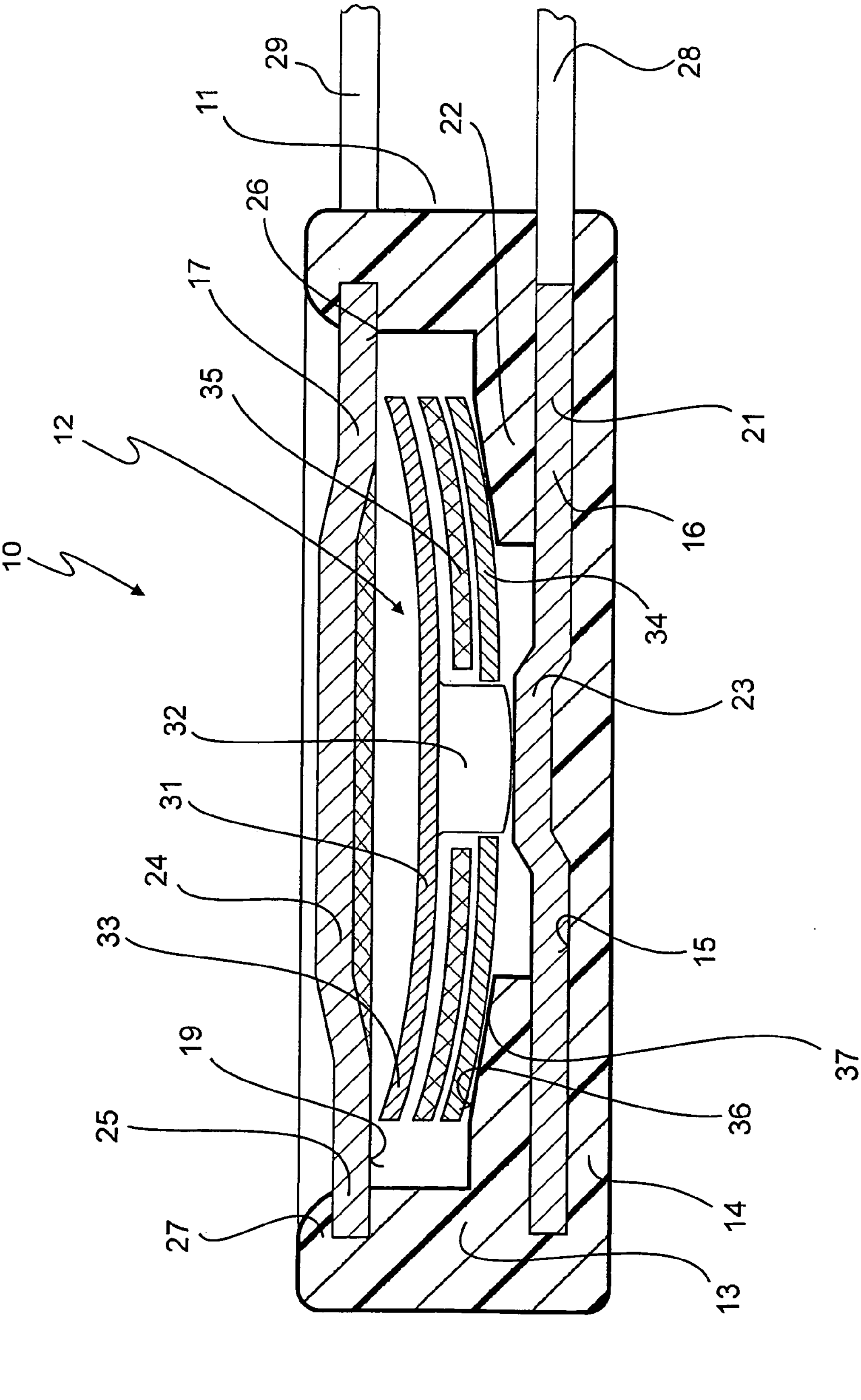
10
11
12
13
14
15
16
17
19
21
22
23
24
25
26
27
28
29
31
32
33
34
35
36
37

Fig. 1

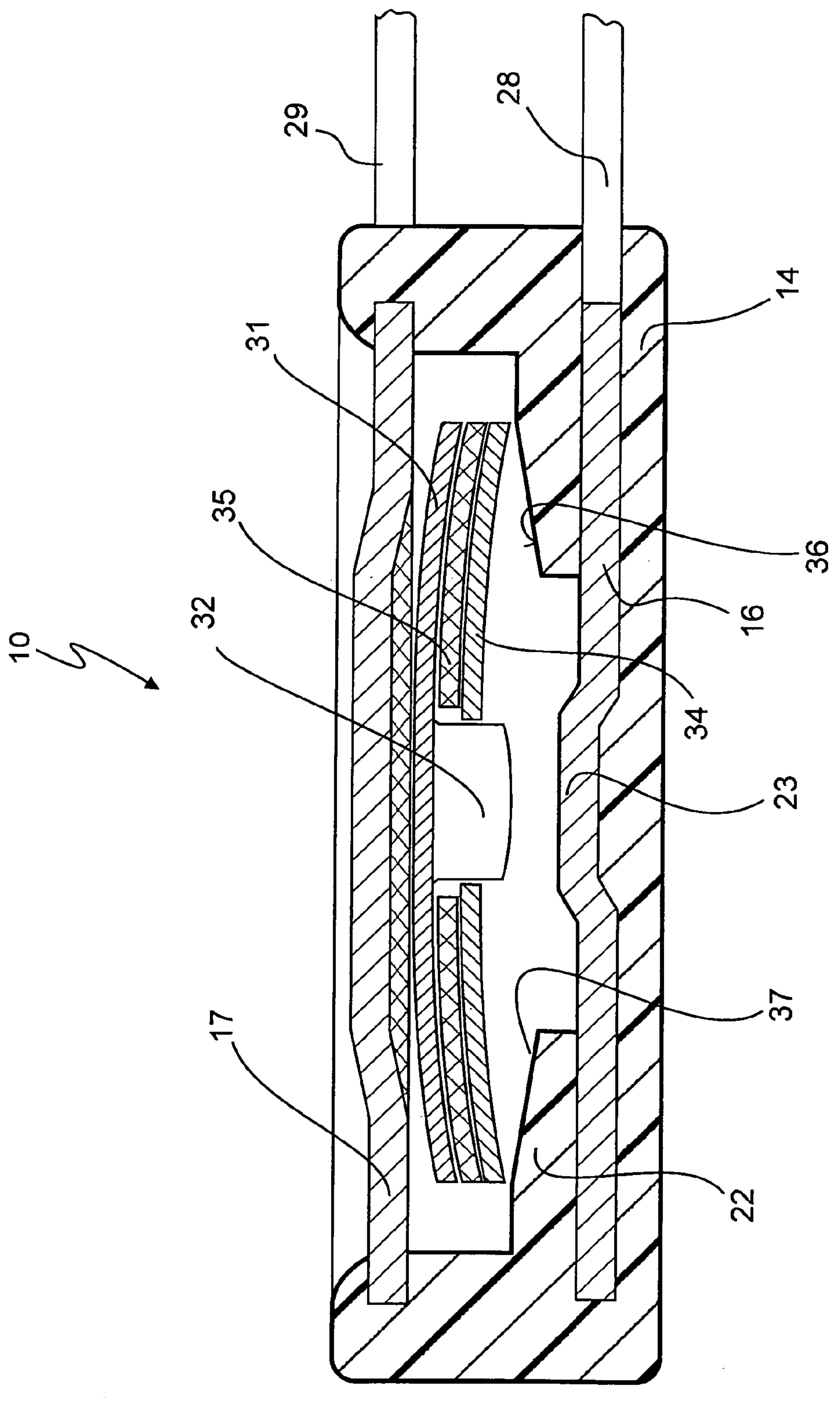


Fig. 2

Europäisches Patentamt
European Patent Office
Office européen des brevets

# EUROPEAN SEARCH REPORT

Application Number
EP 08 01 6674

## DOCUMENTS CONSIDERED TO BE RELEVANT

| Category | Citation of document with indication, where appropriate, of relevant passages | Relevant to claim | CLASSIFICATION OF THE APPLICATION (IPC) |
|---|---|---|---|
| A,D | DE 21 21 802 A1 (THERMIK GERAETEBAU GMBH) 25 January 1973 (1973-01-25)<br>* the whole document *<br>----- | 1-7 | INV.<br>H01H37/54 |
| A | US 4 091 354 A (DEUBEL BERNARD S ET AL) 23 May 1978 (1978-05-23)<br>* column 3, lines 25-43; figure 1 *<br>----- | 1 | |

TECHNICAL FIELDS SEARCHED (IPC)
H01H

The present search report has been drawn up for all claims

1

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| Munich | 26 January 2009 | Simonini, Stefano |

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons
& : member of the same patent family, corresponding document

## ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 08 01 6674

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

26-01-2009

| Patent document cited in search report | Publication date | Patent family member(s) | Publication date |
|---|---|---|---|
| DE 2121802 A1 | 25-01-1973 | DE 7229393 U | 09-11-1972 |
| | | GB 1394612 A | 21-05-1975 |
| US 4091354 A | 23-05-1978 | CA 1065933 A1 | 06-11-1979 |
| | | DE 2718690 A1 | 15-12-1977 |
| | | IT 1080445 B | 16-05-1985 |
| | | JP 52147781 A | 08-12-1977 |



For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

## REFERENCES CITED IN THE DESCRIPTION

*This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.*

### Patent documents cited in the description

- DE 3710672 A1 **[0002] [0021]**
- DE 2121802 A1 **[0005]**
- EP 0858090 A2 **[0007]**
- DE 19727197 **[0012]**
- DE 19636320 A1 **[0020]**
- DE 19727383 A1 **[0021]**
- US 3755770 A **[0023]**