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(54) DEVICE TO DRIVE A SWITCH OF A THERMOSTAT

(57) Device to drive a switch (37) of a thermostat (31), comprising a foil (21), in particular a metal and flexible foil, provided with a flap (19) able to be connected, during use, to an electric contact (32) of the thermostat (31) and a pair of arms (23), able to flex with respect to said flap (19) and to be associated with a first contact part (30) of the switch (37) of the thermostat (31); the first contact part (30) is able to cooperate electrically with a second contact part (36) of the switch; an actuator element (24) of the foil (21) is positioned between the arms (23), able to allow the foil (21) to stably assume at least a first position in which the first contact part (30) cooperates electrically with the second contact part (36) so as to close the switch (37), and at least a second position in which the first contact part (30) is separated from the second contact part (36), so as to open the switch (37); the arms (23) of the foil (21) are reciprocally joined by a bridge element (22) made in a single piece with the arms (23) and able to be associated with the first contact part (30) of the switch (37) of the thermostat (31).

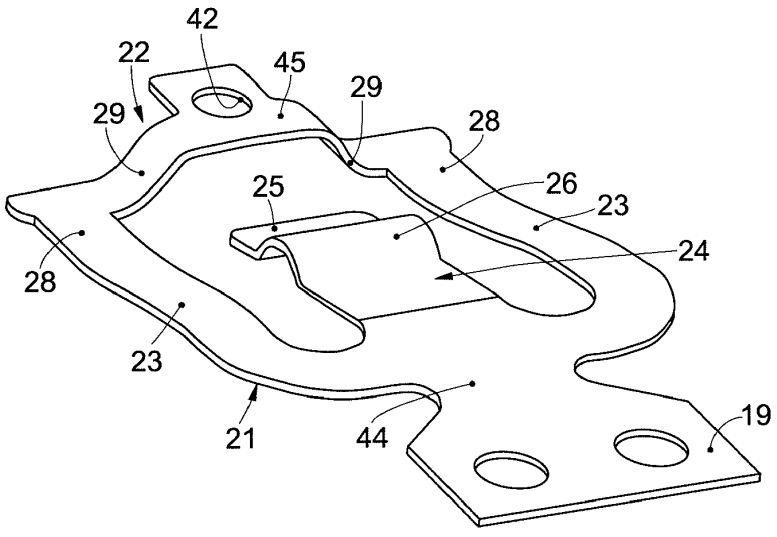

fig. 3

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Description

FIELD OF THE INVENTION

[0001] The present invention concerns a device to drive a switch of a thermostat.

[0002] The present invention also concerns a method to make the drive device and a thermostat comprising the drive device.

[0003] It is understood that the present drive device can be used for any thermostat whatsoever, in particular a mechanical thermostat, usable in any refrigeration or heating apparatus whatsoever.

BACKGROUND OF THE INVENTION

[0004] As is known, a thermostat, in particular a mechanical thermostat, normally comprises an ON/OFF switch that is driven by a temperature-sensitive element, so as to stably assume at least a first position in which it closes the circuit of the thermostat and at least a second position in which it opens the circuit of the thermostat. The temperature-sensitive element can be for example of the fluid expansion type, bimetal foil type or other.

[0005] This switch also comprises, normally, a device to drive the switch cooperating with the element and which is driven in a snap-in manner so as to stably assume at least two positions which correspond to the opening or closing of the switch.

[0006] Figs. 1, 1a and figs. 2, 2a show a device 10 to drive a switch of a thermostat known in the field.

[0007] This drive device 10 comprises a metal and flexible foil 18, provided with a first flap 11 able to be connected, during use, to an electric contact of a thermostat and a pair of arms 13, flexible with respect to said flap 11 and able to be associated with a first contact part of a switch of the thermostat. This first contact part is able to cooperate electrically with a second contact part of the switch of the thermostat, so as to open or close the switch of the thermostat.

[0008] An actuator element 14 of the foil is positioned between the arms 13, able to allow the foil 10, cooperating with a temperature-sensitive element, to stably assume the positions that open and close the switch of the thermostat.

[0009] As can be observed in fig. 1 and fig. 1a, the foil 18 is initially in a flat configuration and the arms 13, in correspondence with their ends 12, are distanced from each other and comprise recesses 15 where the first contact part of the switch will be housed.

[0010] In order to firmly house the first contact part, the arms 13 of the foil 18 are brought closer to each other in correspondence with said recesses 15, see fig. 2 and fig. 2a, so as to form a housing seating 16 for the first contact part and so as to allow the central actuator element 14 to rise, or lower, with respect to the arms 13.

[0011] In order to maintain the arms 13 in the position of fig. 2, as is known, the foil 18 comprises a bridge element 17 which is positioned around the ends 12 of the arms 13 to maintain the desired shape of the seatings 16 and therefore firmly maintain the first electric contact part inside the seating 16.

[0012] Providing this additional bridge element 17 naturally causes the need to have to provide, in addition to the molds necessary to produce the foil 18, also additional molds to produce the bridge element 17.

[0013] Moreover, in the production process of the foil 18, it is necessary to provide other steps in which, manually or automatically, the bridge element 17 is correctly shaped and positioned in the foil 18, so that the arms 13 are correctly enclosed.

[0014] In order to produce the known drive device 10 it is therefore necessary to provide to produce at least two distinct elements, that is to say at least the foil 18 and the bridge element 17, with a consequent increase in costs, workings and the complexity of producing the drive device 10.

[0015] It should also be considered that, since the bridge element 17 is separated from the foil 18, the bridge element 17 could, during use and following repeated uses, typical of thermostats, move from its original position and determine inefficiencies or situations of non-optimal functioning of the thermostat.

[0016] Moreover, the foils of the known drive devices normally have a structural and geometrical configuration that does not allow an effective drive of the switch, see for example the foils described in documents US-A-5159308, GB-A-2280785, GB-2124429 , US-A-3275773 and EP-A-1942389.

[0017] These drive devices are also often equipped with bimetal foils, or are associated with bimetal drive devices, which therefore require at least two distinct metal elements in order to be produced, of which at least one is temperature-sensitive.

[0018] Other limitations and disadvantages of conventional solutions and technologies will be clear to a person of skill after reading the remaining part of the present description with reference to the drawings and the description of the embodiments that follow, although it is clear that the description of the state of the art connected to the present description must not be considered an admission that what is described here is already known from the state of the prior art.

[0019] There is therefore the need to perfect a device to drive a switch of a thermostat and a method to make a foil that can overcome at least one of the disadvantages of the state of the art.

[0020] One purpose of the present invention is to provide a device to drive a switch of a thermostat that is compact, efficient and that allows optimum functioning of the thermostat over time.

[0021] Another purpose of the present invention is to provide a device to drive a switch of a thermostat that does not require, for its production, a series of different components, but in particular is provided with a bridge element already integrated in a flexible foil of the drive

device.

[0022] Another purpose of the present invention is to provide a device to drive a switch of a thermostat that is simple, has a stable configuration and guarantees stable and effective functioning of the thermostat to which it is applied.

[0023] Another purpose of the present invention is to provide a device to drive a thermostat provided with a foil that has a geometric and structural conformation such as to allow an effective and stable drive of the switch with which it will be associated.

[0024] Another purpose of the present invention is a method to make a device to drive a switch of a thermostat that is cheap, simple and does not require the need to provide a series of different production lines.

[0025] The Applicant has devised, tested and embodied the present invention to overcome the shortcomings of the state of the art and to obtain these and other purposes and advantages.

SUMMARY OF THE INVENTION

[0026] The present invention is set forth and characterized in the independent claims, while the dependent claims describe other characteristics of the invention or variants to the main inventive idea.

[0027] In accordance with the above purposes, one purpose of the invention is a device to drive a switch of a thermostat comprising a foil, in particular a metal and flexible foil, provided with a flap able to be connected, during use, to an electric contact of the thermostat and a pair of arms, able to flex with respect to the flap and to be associated with a first contact part of the switch of the thermostat; the first contact part is able to cooperate electrically with a second contact part of the switch; an actuator element of the foil is positioned between the arms, able to allow the foil to stably assume at least a first position in which the first contact part cooperates electrically with the second contact part so as to close the switch, and at least a second position in which the first contact part is separated from the second contact part so as to open the switch.

[0028] According to one aspect of the invention, in the present drive device the arms of the foil are reciprocally joined by a bridge element made in a single piece with the arms and able to be associated with the first contact part of the switch of the thermostat.

[0029] In some embodiments, the arms of the foil converge toward the bridge element, following a plastic deformation of the foil, and the bridge element is situated at a height different from the arms; the foil, comprising the actuator element, is also made of a single flexible metal material.

[0030] Advantageously, therefore, the present drive device comprises a metal and flexible foil in which the bridge element is already integrated, therefore to produce the drive device a single mold will be sufficient in which to make the foil according to the most appropriate shape, at least in the initial extended and not deformed configuration. The ends of the arms are therefore made integral with each other by using the bridge element made in a single piece with the rest of the foil.

[0031] Advantageously, the drive device comprises a foil having a geometric and structural configuration such as to allow its effective and stable use in any type of switches whatsoever in which the drive device will be used.

[0032] Advantageously, moreover, the present foil and therefore the actuator element comprised therein, are made of a single flexible metal material, unlike the normal known devices in which bimetal systems are used.

[0033] The bridge element comprises at least one central portion situated at a height different from the arms and is connected to the arms by means of lateral portions, provided with suitable inclination.

[0034] The bridge element can be positioned in proximity to the ends of the arms situated in an opposite position with respect to the flap, so as to confer on the foil a substantially annular shape.

[0035] A seating for the insertion of at least one segment of the first contact part of the switch can be made in the bridge element.

[0036] The seating can be made in the central portion of the bridge element.

[0037] The actuator element can comprise a rounded part able to cooperate mechanically, during use, with a temperature-sensitive element.

[0038] The temperature-sensitive element can advantageously comprise a capillary tube associated with a bellows.

[0039] A further purpose of the present invention is a method to make a device to drive a switch of a thermostat. The method comprises:

making a foil, in particular a metal and flexible foil, provided with a flap able to be connected, during use, to an electric contact of the thermostat and provided with at least one pair of arms, at least one actuator element positioned between the arms and at least one bridge element to join the arms made in a single piece with the arms; the bridge element is able to house a first contact part of the switch of the thermostat;

the plastic deformation of the foil so as to position the actuator element at a different height, that is, raise it or lower it with respect to the arms of the foil.

[0040] The plastic deformation in particular is performed by applying a compression force of both arms toward the inside of the foil, so that the arms are converging in the direction of respective ends.

[0041] The step of making the foil can be performed by deforming a metal material in a single mold, thus obtaining a foil provided at least with the arms, the actuator element and the bridge element.

[0042] A further purpose of the invention is a thermo-

stat, comprising a support body on which a plurality of electrical contacts are positioned, provided with an on/off switch and comprising a device to drive the switch as defined above.

[0043] These and other aspects, characteristics and advantages of the present disclosure will be better understood with reference to the following description, drawings and attached claims. The drawings, which are integrated and form part of the present description, show some embodiments of the present invention, and together with the description, are intended to describe the principles of the disclosure.

[0044] The various aspects and characteristics described in the present description can be applied individually where possible. These individual aspects, for example aspects and characteristics described in the attached dependent claims, can be the object of divisional applications.

[0045] It is understood that any aspect or characteristic that is discovered, during the patenting process, to be already known, shall not be claimed and shall be the object of a disclaimer.

BRIEF DESCRIPTION OF THE DRAWINGS

[0046] These and other characteristics of the present invention will become apparent from the following description of some embodiments, given as a non-restrictive example with reference to the attached drawings wherein:

- figs. 1 and 1a are respectively a lateral view and a top view of a drive foil of a switch of a thermostat known in the sector and in a configuration before the final assembly;
- figs. 2 and 2a are respectively a lateral view and a top view of the known foil after the assembly of a bridge element to form a known drive device;
- fig. 3 is a three-dimensional view of a device to drive a switch of a thermostat according to the present invention;
- fig. 4 is a three-dimensional view of part of a thermostat that uses the present drive device;
- fig. 5 is a view of a possible wiring diagram of a thermostat that uses the present drive device and is applied, for example, to a refrigerator;
- figs. 6 and 6a are respectively a lateral view and a top view of the present drive device with the foil in a first extended and not deformed configuration;
- figs. 7 and 7a are respectively a lateral view and a top view of the present drive device with the foil in a second folded and deformed configuration.

[0047] To facilitate comprehension, the same reference numbers have been used, where possible, to identify identical common elements in the drawings. It is understood that elements and characteristics of one embodiment can conveniently be incorporated into other embodiments without further clarifications.

DESCRIPTION OF SOME EMBODIMENTS

[0048] We will now refer in detail to the various embodiments of the present invention, of which one or more examples are shown in the attached drawings. Each example is supplied by way of illustration of the invention and shall not be understood as a limitation thereof. For example, the characteristics shown or described insomuch as they are part of one embodiment can be adopted on, or in association with, other embodiments to produce another embodiment. It is understood that the present invention shall include all such modifications and variants.

[0049] Before describing these embodiments, we must also clarify that the present description is not limited in its application to details of the construction and disposition of the components as described in the following description using the attached drawings. The present description can provide other embodiments and can be obtained or executed in various other ways. We must also clarify that the phraseology and terminology used here is for the purposes of description only, and cannot be considered as limitative.

[0050] With reference to the attached drawings and in particular to fig. 3 thereof, a drive device 20 according to the present invention comprises a drive foil 21, in particular a metal and flexible foil, and a bridge element 22 which is made in a single piece with a pair of arms 23 of the foil 21.

[0051] In a substantially central position and between the arms 23, the foil 21 comprises an actuator element 24, which, during use, is located at a height different from the arms 23, therefore it can be raised, or lowered, with respect to the arms 23.

[0052] In particular, in the example and non-limiting case shown, the actuator element 24 comprises a free end 25 which can be raised or lowered with respect to the arms 23.

[0053] Thanks to the conformation of the foil 21, the pressure on the actuator element 24 can determine the snap-in passage of the bridge element 22 and of the arms 23 from a first stable position to a second stable position, and vice versa.

[0054] The arms 23 of the foil 21 converge toward the bridge element 22 following a plastic deformation thereof, and the bridge element 22 is situated at a height different from the arms 23. The foil 21, comprising the actuator element 24, is also made using a single flexible metal material.

[0055] The structural and geometrical conformation of the foil 21 as above, comprising the arms 23 converging toward the bridge element 22 and the bridge element 22 situated at a different height, allows to make a drive device 20 that is effective and stable, for any type whatsoever of switch 37 with which it will be associated.

[0056] The actuator element 24, formed in a single

piece with the foil 21 and made of a single flexible metal material, will be driven by a temperature-sensitive element 27. Advantageously, the temperature-sensitive element 27 can be a capillary tube 38 associated with a bellows 39, see fig. 5.

[0057] The actuator element 24 can also comprise a rounded part 26 on which the temperature-sensitive element 27 can act.

[0058] Returning to fig. 3, the bridge element 22, as can be seen, is made in a single piece in proximity with the ends 28 of the arms 23. Moreover, the bridge element 22 is positioned transversely with respect to the arms 28.

[0059] A seating 42 for the insertion of at least one segment of a first contact part 30 of a switch 37 is made in the bridge element 22, preferably in a central position, see also fig. 4 and fig. 5.

[0060] The seating 42 is made in a central portion 45 of the bridge element 22 which is situated at a height different from the arms 23, for example super-elevated.

[0061] The central portion 45 is connected to the ends 28 of the arms 23 by means of lateral portions 29, provided with a suitable inclination. In this way, the central element assumes a substantially symmetrical shape with respect to the seating 42 where the first contact part 30 of the switch 37 will be inserted. In fact, it is possible to provide that the lateral portions 29 have substantially the same length and the same inclination.

[0062] Fig. 4 shows the present drive device 20 housed inside a thermostat 31, in particular a mechanical thermostat comprising, in a known manner, three electrical contacts 32, 33 and 34 disposed on a support body 35.

[0063] The foil 21 is provided with a flap 19 connected by means of attachment elements 43 to a first electrical contact 32.

[0064] The arms 23 are made in a single piece with the flap 19 and can flex with respect to the flap 19, in particular thanks to a connection part 44 with the flap 19.

[0065] The bridge element 22 is positioned in proximity to the ends 28 of the arms 23, therefore the arms 23 and the bridge element 22 are positioned so as to confer a substantially annular shape on the foil, which confers great compactness and stability on the present drive device 10.

[0066] The first contact part 30 which is positioned in the bridge element 22 is in this case in contact with a second contact part 36 associated with a second contact 33 of the thermostat 31.

[0067] In the situation shown in fig. 4, the foil 21 of the drive device 20 is in the stable position in which the switch 37 and therefore the circuit of the thermostat 31 are closed, contrary to fig. 5 in which the foil 21 is in the stable position in which the switch 37 and therefore the circuit of the thermostat 31 are open. In the stable open position, the first contact part 30 will rest on an abutment element 46 positioned in the thermostat 31, in particular made in the support body 35.

[0068] The passage from said open position to said closed position, and vice versa, occurs by means of a snap-in movement of the arms 23 and of the bridge element 22, so as to move the two contact parts 30 and 36 away from, or toward and in contact with, each other. The snap-in movement is generated by a lowering or raising of the actuator element 24 by means of the temperature-sensitive element 27.

[0069] Fig. 5 shows an application of the present thermostat 31 to a refrigeration apparatus, for example a refrigerator.

[0070] In this case, as mentioned, the switch 37 is in the open position, therefore the refrigerator is at the desired temperature, regulated for example by means of a knob 40.

[0071] The temperature-sensitive element 27 can comprise, as previously mentioned, the capillary tube 38 able to contain a liquid substance which, evaporating following the heating of the refrigerator, evaporates and flows into the bellows 39.

[0072] If the temperature of the refrigerator increases, therefore, the bellows dilates and determines the passage of the switch 37 from the open position to the closed position, schematized in dashed lines and also shown in fig 4, thanks to the foil 21 of the present drive device 20.

[0073] The closing of the switch 37 determines the drive of a compressor 41 to lower the temperature of the refrigerator.

[0074] As stated, and as can be easily understood by observing the drawings, the present drive device 20 can also be applied to a thermostat of other refrigeration or heating apparatuses, or other, in which the temperature-sensitive element 27, preferably comprising the bellows 39, acts on the actuator element 24 as the temperature of the apparatus varies.

[0075] Fig. 6 and fig. 6a show the foil 21 of the present drive device 20 in an extended and flat position. As can be observed, the foil 21 already comprises the bridge element 22 made in a single piece with the arms 23, the actuator element 24 and the flap 19.

[0076] The foil 21, made in particular with a single flexible metal material, can advantageously be obtained by means of a single injection or deformation process of a metal material in a single mold.

[0077] In order to obtain the suitable shaping of the foil 21 and in particular the raising or lowering of the actuator element 24 with respect to the arms 23, the foil 21 is plastically deformed, exerting a compression force P, preferably in correspondence with the ends 28 of the arms 23, until the deformed configuration of fig. 7 and fig. 7a is reached.

[0078] The force P exerted on the arms 23 is therefore directed substantially toward the inside of the foil 21, and at the end of the plastic deformation the arms 23 are converging toward the ends 28.

[0079] In this configuration of fig. 7a, in which the foil 21 is plastically deformed, the actuator element 24 can be driven by a temperature-sensitive element, for example the temperature-sensitive element 27, so as to confer, in a snap-in manner, on the bridge element 22 and on

the arms 23 at least one stable position in which the switch 37 is open and at least one stable position in which the switch 37 is closed.

[0080] Following the plastic deformation of the foil 21, the bridge element 22 is also raised with respect to the arms 23.

[0081] The arms 23 will also be directed converging toward the ends 28 and toward the bridge element 22, following the plastic deformation of the foil 21.

[0082] Following the plastic deformation of the arms 23 and therefore the raising of the actuator element 24, the bridge element 22 can assume a split shape and provided with the central portion 45 and the lateral portions 29 for the connection with the arms 23.

[0083] It is clear that modifications and/or additions of parts may be made to the device to drive a thermostat switch and corresponding production method as described heretofore, without departing from the field and scope of the present invention.

[0084] It is also clear that, although the present invention has been described with reference to some specific examples, a person of skill in the art shall certainly be able to achieve many other equivalent forms of drive device and production method, having the characteristics as set forth in the claims and hence all coming within the field of protection defined thereby.

[0085] In the following claims, the sole purpose of the references in brackets is to facilitate reading: they must not be considered as restrictive factors with regard to the field of protection claimed in the specific claims.

Claims

1. Device to drive a switch (37) of a thermostat (31), comprising a foil (21), in particular a metal and flexible foil, provided with a flap (19) able to be connected, during use, to an electric contact (32) of the thermostat (31) and a pair of arms (23), able to flex with respect to said flap (19) and to be associated with a first contact part (30) of the switch (37) of the thermostat (31), said first contact part (30) being able to cooperate electrically with a second contact part (36) of the switch, an actuator element (24) of the foil (21) being positioned between said arms (23), able to allow said foil (21) to stably assume at least a first position in which said first contact part (30) cooperates electrically with said second contact part (36) so as to close the switch (37), and at least a second position in which said first contact part (30) is separated from said second contact part (36), so as to open the switch (37), said drive device being **characterized in that** said arms (23) of the foil (21) are reciprocally joined by a bridge element (22) made in a single piece with said arms (23) and able to be associated with said first contact part (30) of the switch (37) of the thermostat (31), wherein said arms (23) of said foil (21) converge toward the bridge element (22), following a plastic deformation of the foil (21), and said bridge element (22) is situated at a height different from said arms (23), and wherein said foil (21), comprising said actuator element (24), is in addition made of a single flexible metal material.

2. Drive device as in claim 1, **characterized in that** said bridge element (22) comprises at least one central portion (45) situated at a height different from said arms (23) and is connected to said arms (23) by means of lateral portions (29), provided with a suitable inclination.

3. Drive device as in claim 1, **characterized in that** said bridge element (22) is connected in proximity to the ends (28) of said arms (23) situated in an opposite position with respect to said flap (19), so as to confer on said foil (21) a substantially annular shape.

4. Drive device as in claim 1 or 2, **characterized in that** a seating (42) is made in said bridge element (22) to house said first contact part (30) of the switch (37).

5. Drive device as in claim 3, **characterized in that** said seating (42) is made in said central portion (45) of the bridge element (22).

6. Drive device as in any claim hereinbefore, **characterized in that** said actuator element (24) comprises a rounded part (26) able to cooperate mechanically, during use, with a temperature-sensitive element (27).

7. Drive device as in any claim hereinbefore, **characterized in that** said temperature-sensitive element (27) comprises a capillary tube (38) associated with a bellows (39).

8. Method to make a device to drive a switch (37) of a thermostat (31), **characterized in that** it comprises:

   making a foil (21), in a single flexible metal material, provided with a flap (19) able to be connected, during use, to an electric contact (32) of the thermostat (31) and provided with at least one pair of arms (23), at least one actuator element (24) positioned between said arms (23) and at least one bridge element (22) to join said arms (23) made in a single piece with said arms (23), said bridge element (22) being able to house a first contact part (30) of the switch (37) of the thermostat (31);
   the plastic deformation of said foil (21) so as to position said actuator element (24) at a different height, that is, raise it or lower it with respect to the arms (23) of said foil (21), said plastic defor-

mation is effected by applying a compression force (P) of both the arms (23) toward the inside of the foil (21), so that said arms (23) converge in the direction of respective ends (28) and toward said bridge element (22), which is situated at a height different from said arms (23).

9. Method as in claim 8, **characterized in that** said foil (21) is made by deforming metal material in a single mold, thus obtaining a foil (21) provided at least with said arms (23), said actuator element (24) and said bridge element (22).

10. Thermostat, comprising a support body on which a plurality of electric contacts (32, 33, 34) are positioned and provided with an on/off switch (37), **characterized in that** it comprises a drive device (20) of said switch (37) as defined in any claim from 1 to 7.

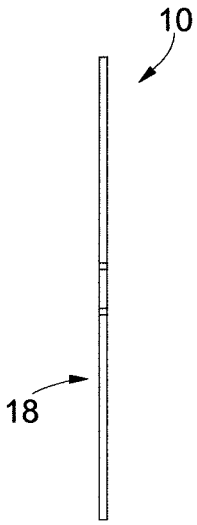

fig. 1
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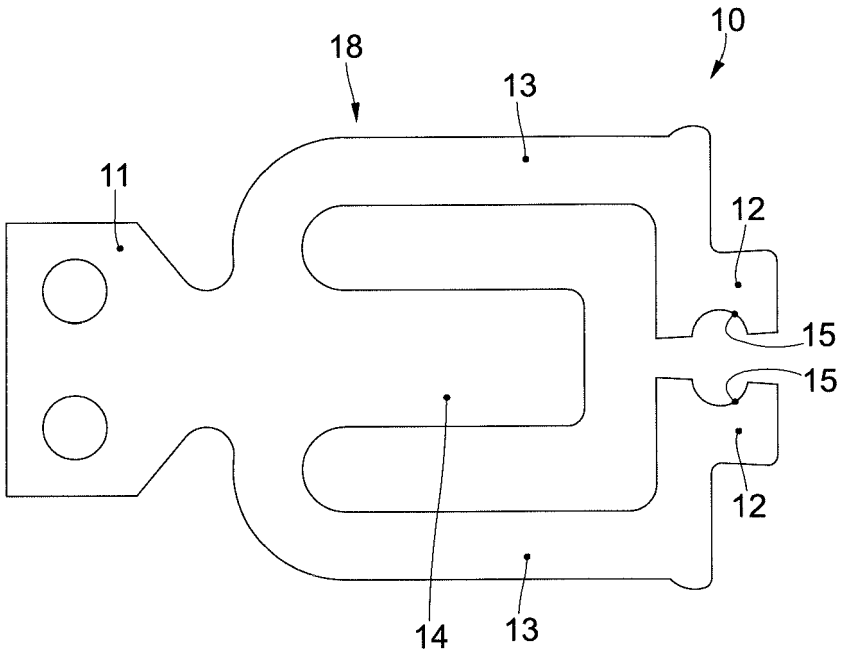

fig. 1a
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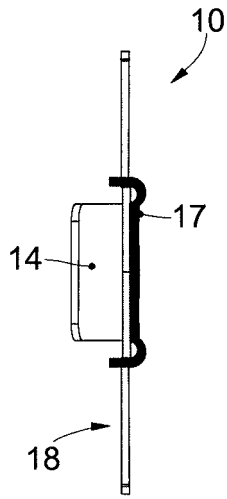

fig. 2
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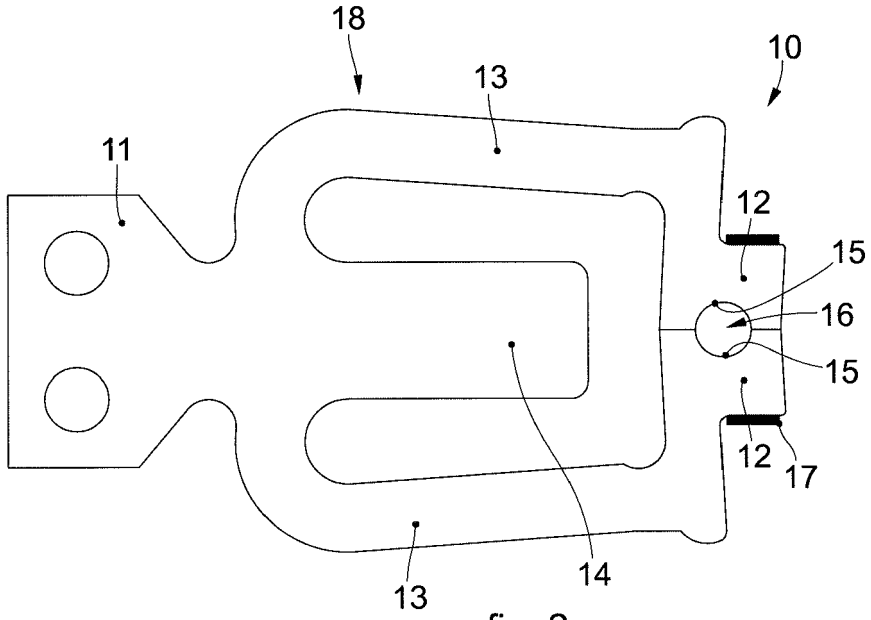

fig. 2a
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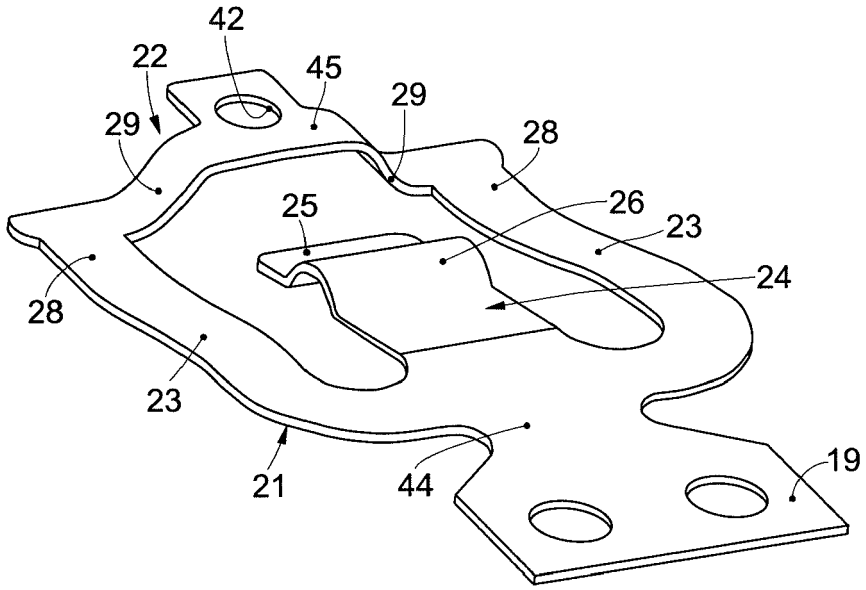
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fig. 3

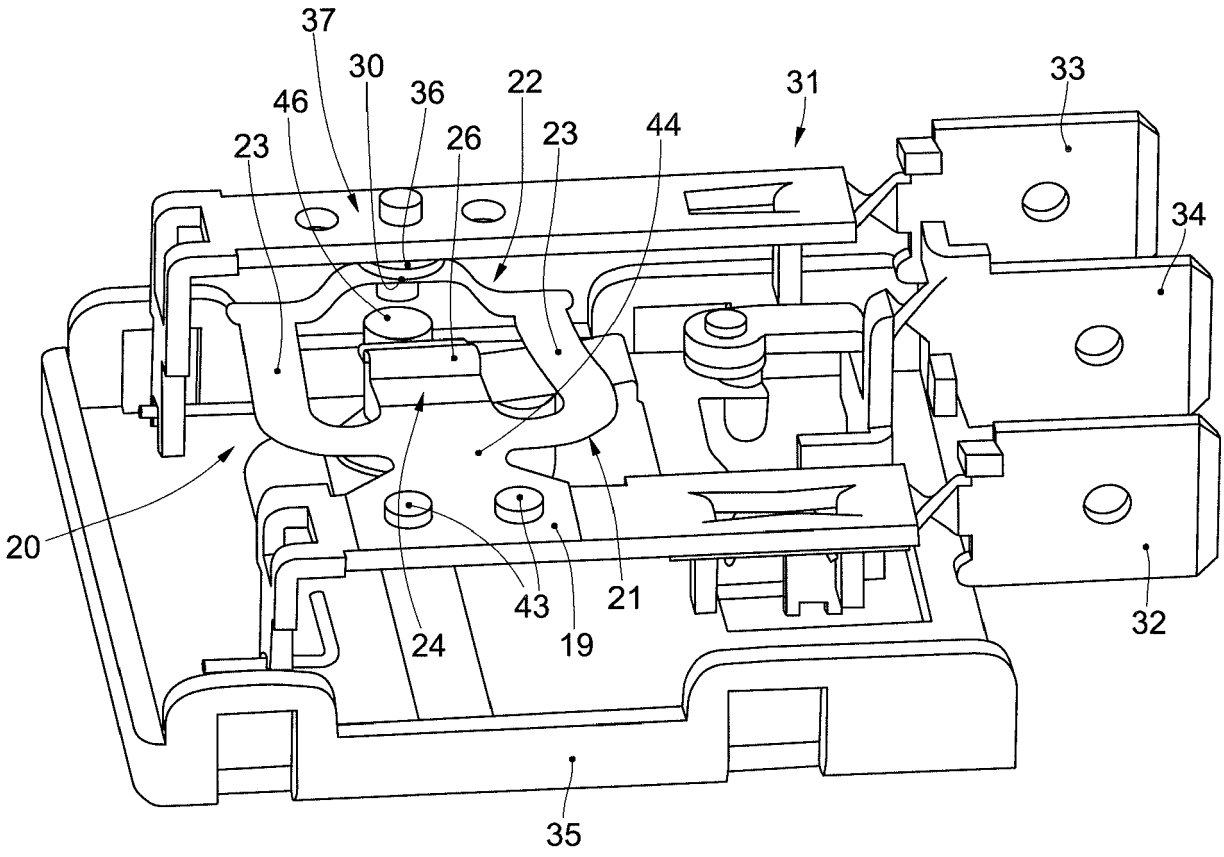
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fig. 4

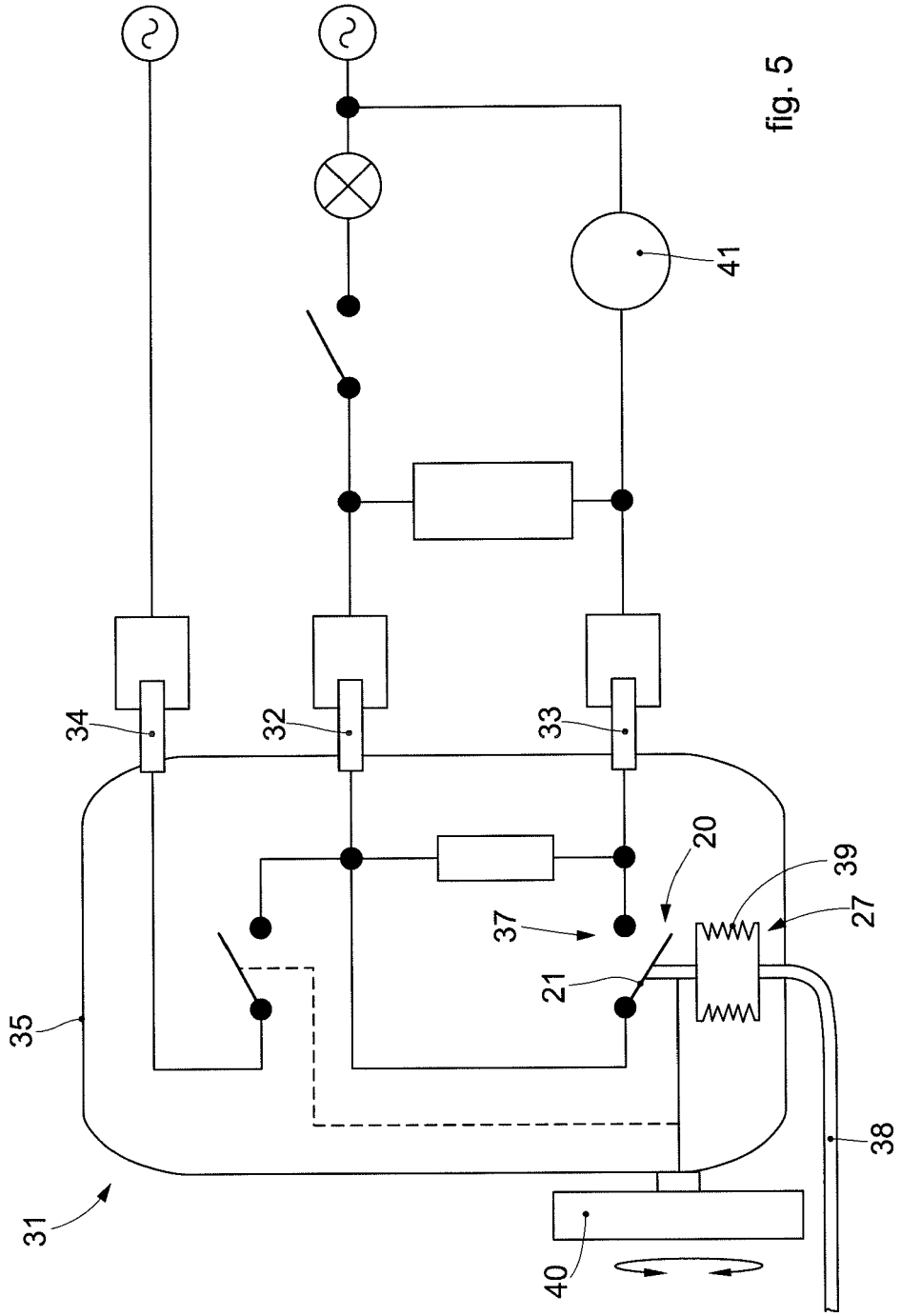

fig. 5

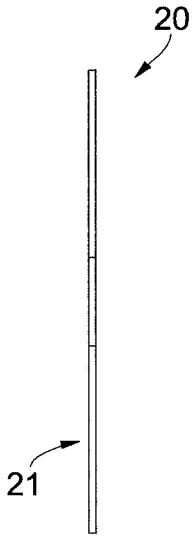

fig. 6

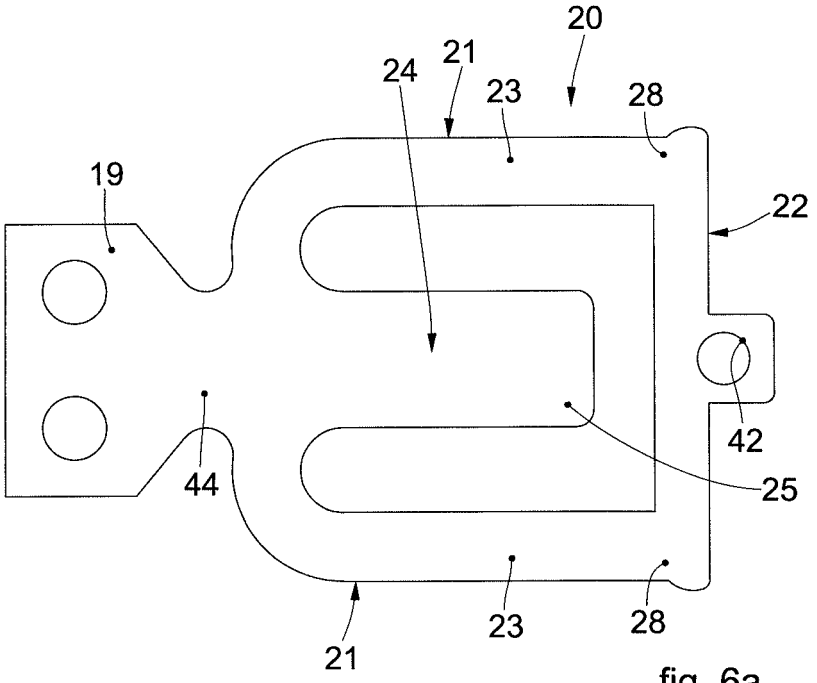

fig. 6a

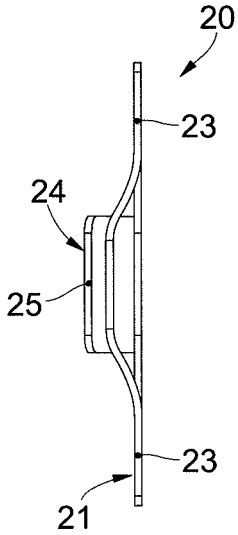

fig. 7

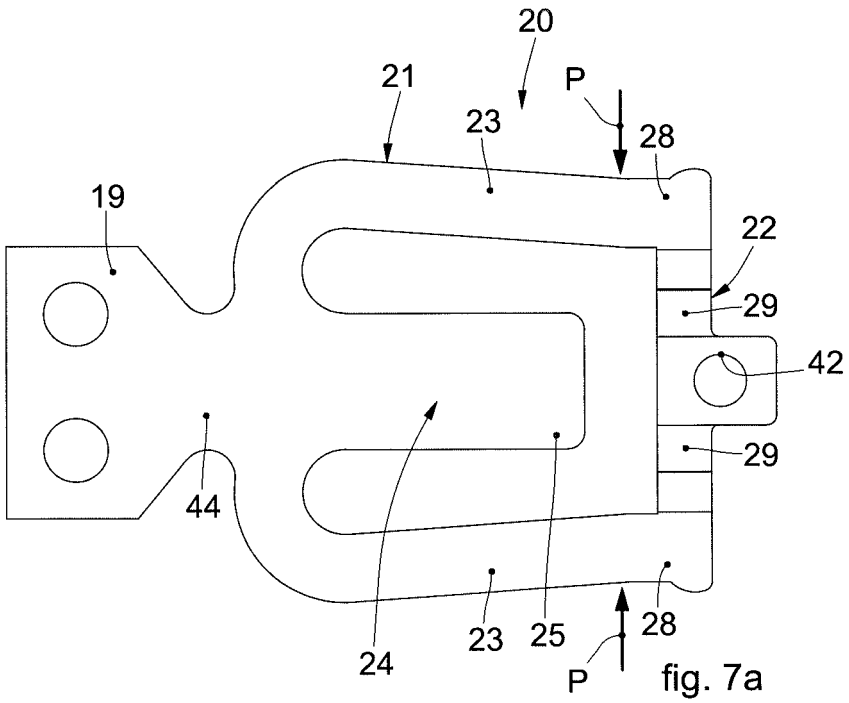

fig. 7a

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EUROPEAN SEARCH REPORT

Application Number
EP 19 20 0755

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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
Munich	10 February 2020	Simonini, Stefano

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