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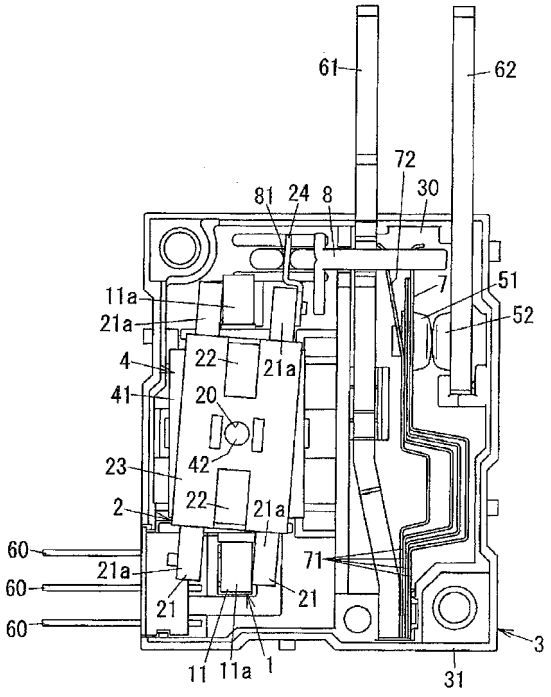
(54) Electromagnetic relay

(57) An electromagnetic relay includes an electromagnet; an armature driven by a magnetic force of the electromagnet and configured to rotate with respect to the electromagnet; a card configured to linearly move when pressed by the armature; a movable contact point moving together with the card; a fixed contact point with which the movable contact point comes into contact or out of contact in response to rotation of the armature; and a housing for storing the electromagnet, the armature, the card, the movable contact point and the fixed contact point, the electromagnet and the fixed contact point being fixed to the housing. The armature includes at least one armature member made of a magnetic material and a connector piece made of a plastically deformable material, the connector piece being arranged between the armature member and the card.

FIG. 1



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Description

Field of the Invention

[0001] The present invention relates to an electromagnetic relay.

Background of the Invention

[0002] Conventionally, there is available an electromagnetic relay that brings a movable contact point into contact with or out of contact with a fixed contact point by rotationally driving an armature connected to the movable contact point through the use of a magnetic force of an electromagnet (see, e.g., Japanese Utility Model Application Publication No. H4-24242).

[0003] As the electromagnetic relay of this kind, there is known, e.g., an electromagnetic relay shown in Fig. 3.

[0004] The electromagnetic relay shown in Fig. 3 will now be described in detail. The electromagnetic relay shown in Fig. 3 includes an electromagnet 1, an armature 2 rotationally driven by the magnetic force of the electromagnet 1 and a housing 3 for storing the electromagnet 1 and the armature 2. The electromagnet 1 is fixed to the housing 3. In the following description, the upper, lower, left and right sides will be defined on the basis of Fig. 3. The front side of the drawing sheet in Fig. 3 will be called "front side". However, these directions are defined just for the sake of convenience in description and may not conform to the directions under an actual use condition.

[0005] The housing 3 includes a body 31 having a storage recess 30 whose front side is opened and a cover (not shown) coupled to the front side of the body 31 to close the storage recess 30.

[0006] A support body 4 for rotatably supporting the armature 2 with respect to the housing 3 is fixed to the housing 3. The support body 4 includes a flat fixing portion 41 whose thickness direction extends in the front-rear direction and whose left-right end portions are fixed to the body 31 and a cylindrical shaft portion 42 protruding frontward from a central area of a front surface of the fixing portion 41. The axial direction of the shaft portion 42 extends in the front-rear direction. As a means for fixing the fixing portion 41 to the body 31, it is possible to use a well-known means such as fitting or the like. The armature 2 has a bearing hole 20 with a circular cross section. The bearing hole 20 extends through the armature 2 in the front-rear direction. The inner diameter of the bearing hole 20 is a little larger than the outer diameter of the shaft portion 42. The shaft portion 42 is inserted into the bearing hole 20, whereby the armature 2 is supported with respect to the housing 3 so as to rotate about the center axis of the shaft portion 42.

[0007] The electromagnet 1 includes a coil (not shown) fixed to the body 31 at the rear side of the fixing portion 41 such that the axial direction thereof extends in the up-down direction and a magnetic pole piece 11 made of a magnetic material and magnetized by the coil. The magnetic pole piece 11 includes a body portion (not shown) extending through the coil in the up-down direction and variable magnetic pole portions 11a protruding frontward from the upper and lower ends of the body portion. Thus, the magnetic pole piece 11 has a generally U-like shape as a whole. More specifically, the variable magnetic pole portions 11a are magnetized into different polarities depending on the flow direction of a current supplied to the coil. The polarities of the variable magnetic pole portions 11a differ from each other. A plurality of (three, in Fig. 3) coil terminals 60 are held in the housing 3. The coil terminals.60 are electrically connected to the coil at one ends thereof. The other ends of the coil terminals 60 protrude toward the left side of the housing 3. An electric current is fed to the coil through the coil terminals 60. More specifically, the electromagnetic relay shown in Fig. 3 is of a so-called two-coil latch type. The coil is provided with a tap. The coil terminals 60 are electrically connected to the opposite ends and the tap of the coil.

[0008] The armature 2 includes two pairs of fixed magnetic pole portions 21a which are respectively provided at the upper and lower end portions thereof. Each of the variable magnetic pole portions 11a is interposed between each pair of the fixed magnetic pole portions 21a. In each pair of the fixed magnetic pole portions 21a, the fixed magnetic pole portion 21a existing at the left side of the variable magnetic pole portions 11a and the fixed magnetic pole portion 21a existing at the right side of the variable magnetic pole portions 11a are magnetized with different polarities. More specifically, the armature 2 includes two permanent magnets 22 whose N-poles are oriented in the same left or right direction, two armature members 21 made of a magnetic material and a synthetic-resin molded body 23 with which the permanent magnets 22 and the armature members 21 are insert-molded. Each of the armature members 21 has a flat rectangular parallelepiped shape. One thickness-direction surface of each of the armature members 21 is magnetically attached to the pole of each of the permanent magnets 22. The opposite end portions of each of the armature members 21 protruding upward and downward beyond each of the permanent magnets 22 serve as the fixed magnetic pole portions 21a. If an electric current is supplied to the coil of the electromagnet 1, one of the fixed magnetic pole portions 21a existing at the left and right sides of the corresponding variable magnetic pole portion 11a is attracted to the corresponding variable magnetic pole portion 11a depending on the direction of the electric current flowing through the coil, whereby the armature 2 is rotated with respect to the housing 3. Once the electric current is supplied to the coil, the position of the armature 2 (and the position of the movable contact point 51 moving together with the armature 2) is maintained (latched) by the magnetic force of the permanent magnets 22 until an electric current flows through the coil in the reverse direction.

[0009] A movable contact point 51 moving together with the rotation of the armature 2 and a fixed contact

point 52 coming into contact with or out of contact with the movable contact point 51 are stored within the housing 3. The movable contact point 51 and the fixed contact point 52 are electrically connected to terminal plates 61 and 62, respectively. In other words, the electric connection between the terminal plates 61 and 62 is switched on and off as the movable contact point 51 comes into contact with or out of contact with the movable contact point 51. Each of the terminal plates 61 and 62 is formed of a metal plate with the thickness direction thereof extending in the left-right direction. Each of the terminal plates 61 and 62 is fixed to the housing 3 in such a fashion that the upper end portion thereof protrudes outside the housing 3. The movable contact point 51 is electrically and mechanically connected to the terminal plate 61 through a contact point retainer 7. The lower end portion of the contact point retainer 7 is fixed to a right surface of the terminal plate 61 and the upper end portion of the contact point retainer 7 is elastically deformable to be displaced in the left-right direction with respect to the lower end portion of the contact point retainer 7. The contact point retainer 7 includes a plurality of contact point retaining springs 71, each of which is formed of a leaf spring extending in the up-down direction. The contact point retaining springs 71 are superimposed in the thickness direction and are bonded to one another in the upper end portions and the lower end portions thereof. The movable contact point 51 is fixed to the upper end portion of the contact point retainer 7, so that the movable contact point 51 can be elastically displaced in the left-right direction with respect to the housing 3 at the left side of the fixed contact point 52.

[0010] The armature 2 and the movable contact point 51 are moved together by a card 8 connected to the contact point retainer 7 and the armature 2. The card 8 has a flat shape as a whole with the thickness direction thereof extending in the up-down direction. The card 8 is guided by the inner surface of the housing 3 so that the card 8 can move in the left-right direction with respect to the housing 3. The terminal plate 61 connected to the movable contact point 51 is shaped not to interfere with the moving path of the card 8 so that the terminal plate 61 should not hinder the displacement of the card 8. The armature 2 and the card 8 are connected to each other by inserting the upper end portion of the right armature member 21 of the armature 2 into an armature recess portion 81 of the card 8 opened upward, downward and frontward. The contact point retainer 7 and the card 8 are connected to each other by inserting the upper end portion of the contact point retainer 7 into a retainer recess portion (not shown) of the card 8 opened upward, downward and rearward. In the upper end portion of the leftmost one of the contact point retaining springs 71, there is provided an elastic card contact portion 72 making contact with the inner surface of the retainer recess portion facing rightward. The elastic card contact portion 72 is inclined so as to extend gradually away from the remaining contact point retaining springs 71.

[0011] In a state that the armature 2 is rotated clockwise to the limit of a moving range with the movable contact point 51 making contact with the fixed contact point 52 (hereinafter referred to as "closed state"), a contact pressure is generated between the movable contact point 51 and the fixed contact point 52 due to the elastic deformation of the elastic card contact portion 72.

[0012] In a state that, as shown in Fig. 3, the armature 2 is rotated counterclockwise to the limit of the moving range with the movable contact point 51 kept out of contact with the fixed contact point 52 (hereinafter referred to as "open state"), the contact point retainer 7 as a whole is elastically deformed so that the upper end portion thereof is displaced leftward with respect to the lower end portion. At this time, the spring force of the contact point retainer 7 acts to bias the movable contact point 51 toward the fixed contact point 52. In other words, the minimum value of an electric current flowing through the coil of the electromagnet 1 required to the transition to the closed state (hereinafter referred to as "minimum on-current") becomes smaller as the elastic deformation amount grows larger.

[0013] In this regard, as a method of adjusting the operation characteristics (e.g., the minimum on-current or the contact pressure in the closed state), it is thinkable to use a method of plastically deforming the portion of the armature 2 connected to the card 8.

[0014] In the example described above, however, the portion of the armature 2 connected to the card 8 is the armature member 21. The armature member 21 is formed relatively thick in order to sufficiently increase the magnetic force. Therefore, it is considerably difficult to adjust the operation characteristics by using the method stated above.

Summary of the Invention

[0015] In view of the above, the present invention provides an electromagnetic relay whose operation characteristics can be adjusted with ease.

[0016] In accordance with one aspect of the present invention, there is provided an electromagnetic relay, including: an electromagnet; an armature driven by a magnetic force of the electromagnet and configured to rotate with respect to the electromagnet; a card configured to linearly move when pressed by the armature; a movable contact point moving together with the card; a fixed contact point with which the movable contact point comes into contact or out of contact in response to rotation of the armature; and a housing for storing the electromagnet, the armature, the card, the movable contact point and the fixed contact point, the electromagnet and the fixed contact point being fixed to the housing, wherein the armature includes at least one armature member made of a magnetic material and a connector piece made of a plastically deformable material, the connector piece being arranged between the armature member and the card.

[0017] Preferably, the connector piece may be bent such that, when seen in a direction parallel to a rotation axis of the armature, the angle formed by a line, which interconnects a contact position of the armature with the card and the rotation axis of the armature, with respect to a displacement direction of the card gets closer to a right angle.

[0018] Preferably, the connector piece may be made of a non-magnetic material.

[0019] With the present embodiment, the operation characteristics can be adjusted by plastically deforming a connector piece which is not required to secure a magnetic property and which is more readily deformed than the armature member. It is therefore easy to adjust the operation characteristics of the electromagnetic relay as compared with a case where the armature member makes direct contact with the card.

Brief Description of the Drawings

[0020]

Fig. 1 is a front view showing an electromagnetic relay according to one embodiment of the present invention, with a cover removed for clarity.

Fig. 2 is a front view showing a comparative example of the electromagnetic relay, with a cover removed for clarity.

Fig. 3 is a front view showing a conventional electromagnetic relay, with a cover removed for clarity.

Detailed Description of the Preferred Embodiments

[0021] One preferred embodiment of the present invention will now be described in detail with reference to the accompanying drawings which form a part hereof.

[0022] The basic configuration of the present embodiment is essentially the same as that of the example shown in Fig. 3. No description will be made on the common components.

[0023] In the present embodiment, as shown in Fig. 1, the armature 2 includes a connector piece 24 connected to the right armature member 21 and protruding upward beyond the right armature member 21. The connector piece 24 is inserted into the armature recess portion 81 of the card 8. The connector piece 24 is made of a plastically deformable material. The connector piece 24 is formed into a flat shape to have a thickness smaller than the thickness of the armature member 21. The thickness direction of the connector piece 24 is orthogonal to the rotation axis of the armature 2.

[0024] As a means for joining the connector piece 24 and the armature member 21 together, it is possible to appropriately use a well-known method such as caulking, fitting or welding. As the material of the connector piece 24, it is preferable to use a non-magnetic material, e.g., aluminum.

[0025] With the configuration stated above, the operation characteristics of the electromagnetic relay can be adjusted by plastically deforming the connector piece 24 which is smaller in thickness than the armature member 21 and which can be more readily deformed than the armature member 21. It is therefore easy to adjust the operation characteristics as compared with a case where the armature member 21 is inserted into the armature recess portion 81 of the card 8.

[0026] For example, if the connector piece 24 is bent to move the card 8 rightward (namely, if the upper end portion of the connector piece 24 is displaced rightward with respect to the lower end portion thereof), the deformation amount of the elastic card contact portion 72 grows larger in the closed state. This makes it possible to obtain an increased contact pressure. On the other hand, the deformation amount of the contact point retainer 7 as a whole grows smaller in the open state. Thus the minimum on-current becomes higher.

[0027] On the contrary, if the connector piece 24 is bent to move the card 8 leftward (namely, if the upper end portion of the connector piece 24 is displaced leftward with respect to the lower end portion thereof), the deformation amount of the elastic card contact portion 72 grows smaller in the closed state. This makes it possible to reduce the contact pressure. On the other hand, the deformation amount of the contact point retainer 7 as a whole grows larger in the open state. Thus the minimum on-current becomes lower.

[0028] When seen from the front side, i.e., in the direction parallel to the rotation axis of the armature 2, if the difference between the right angle (90 degrees) and the angle (hereinafter referred to as "drive angle") formed by a line, which interconnects the contact position of the armature 2 (the connector piece 24) with the card 8 and the rotation axis of the armature 2, with respect to a displacement direction of the card 8 becomes greater, the component force of the rotational force of the armature 2 acting as a push force pressing the card 8 upward or downward grows larger. If the component force grows larger, the frictional force acting between the connector piece 24 and the card 8 or between the card 8 and the inner surface of the housing 3 becomes greater. This increases the drive force (the electric power inputted to the electromagnet 1) which is required to switch the on-off state of the contact points.

[0029] In the example shown in Fig. 1, the connector piece 24 is bent to ensure that the drive angle gets closer to 90 degrees. More specifically, since the rotation axis of the armature 2 (i.e., the center axis of the shaft portion 42) is positioned at the left side of the moving range of the armature recess portion 81, the connector piece 24 is bent into a generally S-like shape so that the end portion thereof existing near the card 8 can be positioned at the left side of the end portion existing near the armature member 21. Accordingly, as compared with a case where the connector piece 24 is not bent as shown in Fig. 2, it is possible to reduce the frictional force acting between the connector piece 24 and the card 8 or between the

card 8 and the inner surface of the housing 3. This makes it possible to reduce the electric power required in opening and closing the contact points.

[0030] Instead of bringing the connector piece 24 into direct contact with the armature member 21 and the card 8 as set forth above, an additional member may be arranged between the connector piece 24 and the card 8 or between the armature member 21 and the connector piece 24.

[0031] While the invention has been shown and described with respect to the embodiments, the present invention is not limited thereto. It will be understood by those skilled in the art that various changes and modifications may be made without departing from the scope of the invention as defined in the following claims.

Claims

1. An electromagnetic relay, comprising:

an electromagnet;
an armature driven by a magnetic force of the electromagnet and configured to rotate with respect to the electromagnet;
a card configured to linearly move when pressed by the armature;
a movable contact point moving together with the card;
a fixed contact point with which the movable contact point comes into contact or out of contact in response to rotation of the armature; and
a housing for storing the electromagnet, the armature, the card, the movable contact point and the fixed contact point, the electromagnet and the fixed contact point being fixed to the housing, wherein the armature includes at least one armature member made of a magnetic material and a connector piece made of a plastically deformable material, the connector piece being arranged between the armature member and the card.

2. The relay of claim 1, wherein the connector piece is bent such that, when seen in a direction parallel to a rotation axis of the armature, the angle formed by a line, which interconnects a contact position of the armature with the card and the rotation axis of the armature, with respect to a displacement direction of the card gets closer to a right angle.

3. The relay of claim 1 or 2, wherein the connector piece is made of a non-magnetic material.

FIG. 1

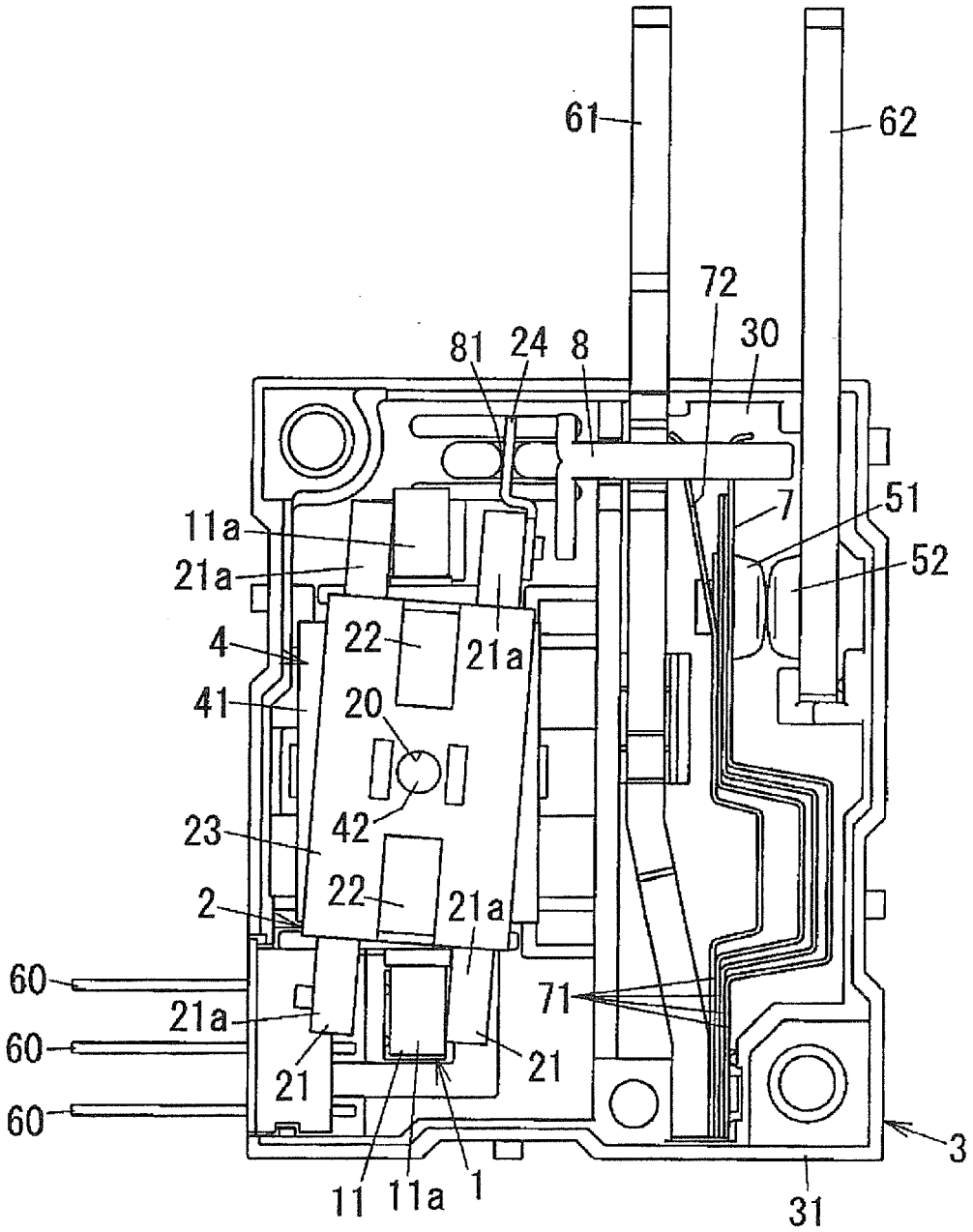
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FIG.2

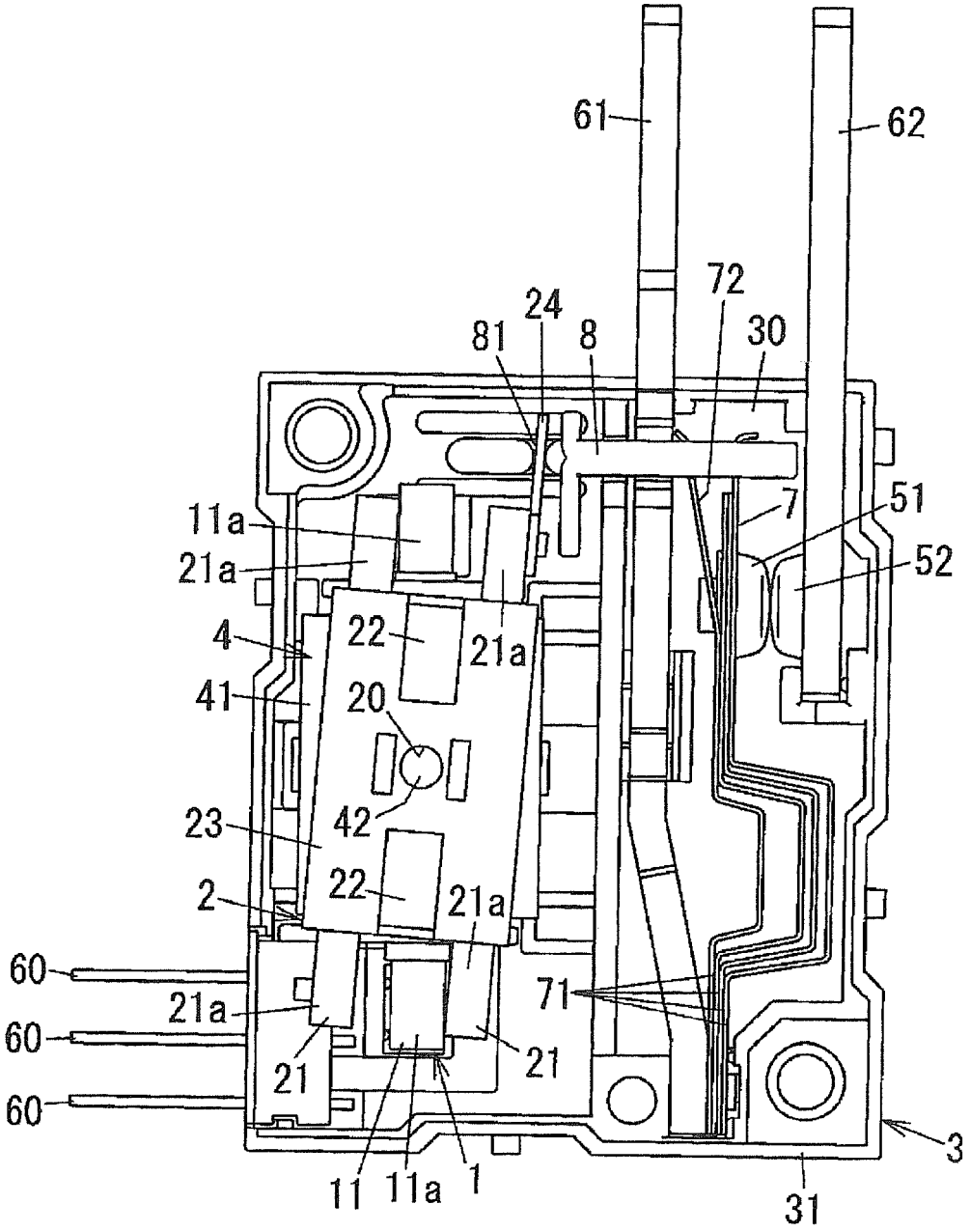
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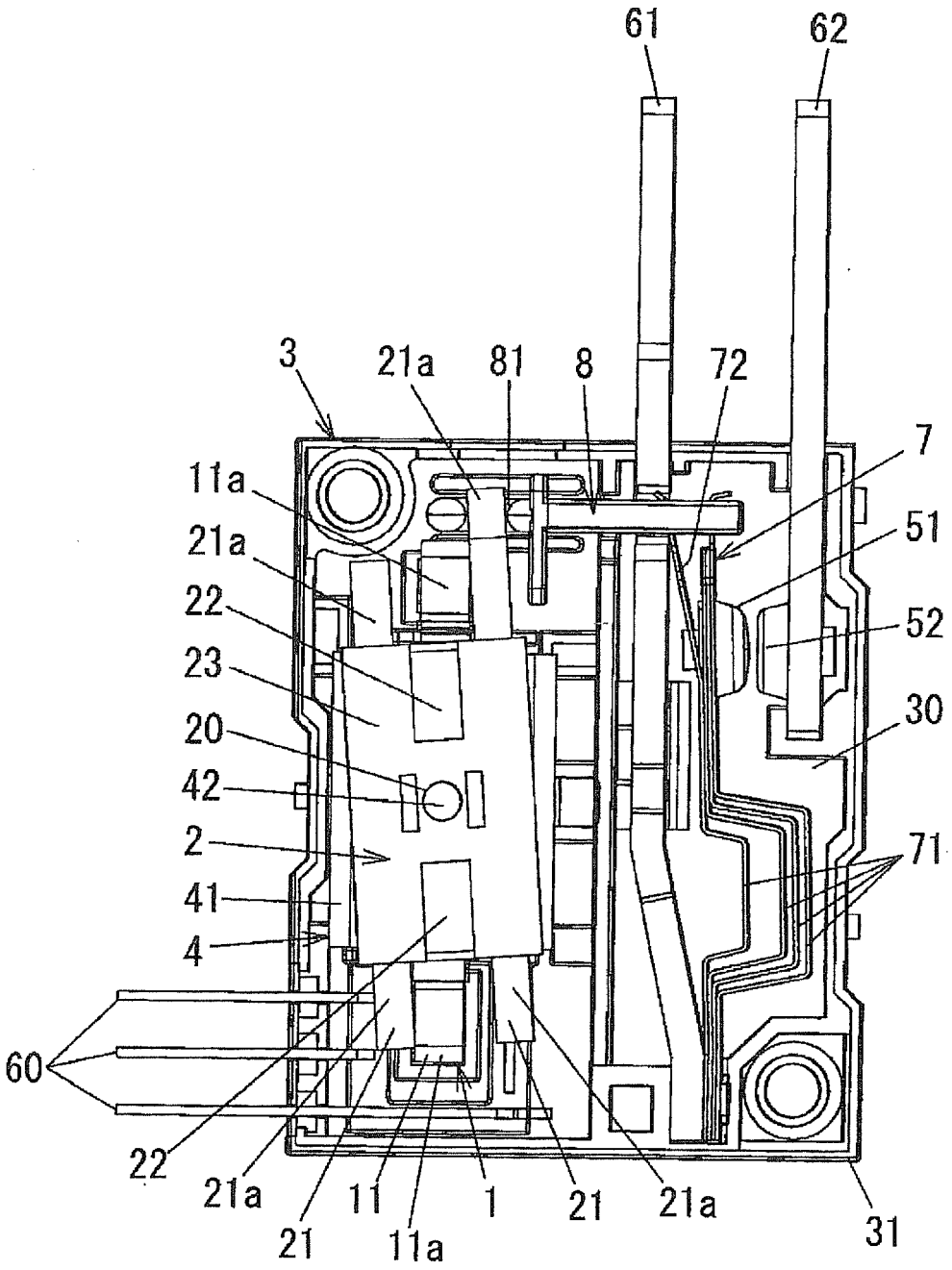
FIG.3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EUROPEAN SEARCH REPORT

Application Number
EP 12 17 5519

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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A	WO 2010/090619 A2 (CLODI L L C [US] CLODI L L C [US]; GRUNER PHILIPP [US]) 12 August 2010 (2010-08-12) * abstract; figures 1-8 * * page 18, paragraph 10 - page 20, paragraph 7 * -----	1	
A	US 2011/048907 A1 (MOELLER MATTHEW LEN [US] ET AL) 3 March 2011 (2011-03-03) * abstract; figures 1-11 * * paragraph [0043] - paragraph [0046] * -----	1	

TECHNICAL FIELDS SEARCHED (IPC)
H01H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	12 December 2012	Serrano Funcia, J

CATEGORY OF CITED DOCUMENTS

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