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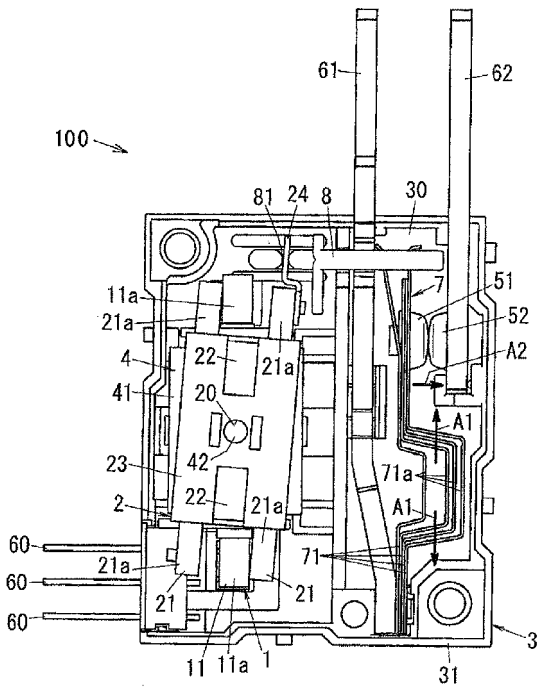
(54) Contact device and electromagnetic relay including same

(57) A contact device includes a contact point retainer configured to hold a movable contact point in one end portion thereof. The contact point retainer includes a plurality of contact point retaining springs superimposed in a thickness direction and formed of leaf springs and a housing configured to fix the other end portion of the contact point retainer and hold a fixed contact point in a position where the movable contact point can come into contact with or out of contact with the fixed contact point in response to elastic deformation of the contact point retainer. Each of the contact point retaining springs includes a bulging portion swelling away in a direction parallel or substantially parallel to a direction from the movable contact point and toward the fixed contact point.

FIG. 1



EP 2 551 868 A1

Description

Field of the Invention

[0001] The present invention relates to a contact device and an electromagnetic relay using the contact device.

Background of the Invention

[0002] Conventionally, there is available a contact device in which, as shown in Fig. 2, a movable contact point 51 is held by a contact point retaining spring 71 formed of a leaf spring and can be displaced with respect to a fixed contact point 52 by the elastic deformation of the contact point retaining spring 71 (see, e.g., Japanese Utility Model Application Publication No. S63-37052). This contact device is used in, e.g., an electromagnetic relay in which the movable contact point 51 is driven by the magnetic force of an electromagnet.

[0003] In this regard, if a large current flows between the movable contact point 51 and the fixed contact point 52, a repulsion force is generated between the movable contact point 51 and the fixed contact point 52. For example, if a large current flows in the direction indicated by arrows A3 in Fig. 2 (namely, from the fixed contact point 52 toward the movable contact point 51), the electromagnetic force generated by the electric current flowing into a contact region 50 of the fixed contact point 52 as indicated by arrows A4 and the electric current flowing out of a contact region 50 of the movable contact point 51 as indicated by arrows A5 acts as a repulsion force by which the movable contact point 51 is moved away from the fixed contact point 52 as indicated by an arrow A6. If the repulsion force is larger than the spring force of the contact point retaining spring 71, there may possibly occur opening of the contact points (namely, separation of the movable contact point 51 from the fixed contact point 52).

[0004] In the event that arc discharge is generated between the movable contact point 51 and the fixed contact point 52 during the opening of the contact points, there is a possibility that the movable contact point 51 and the fixed contact point 52 are welded together by the heat resulting from the arc discharge.

Summary of the Invention

[0005] In view of the above, the present invention provides a contact device capable of restraining opening of contact points which may be caused by a large current and an electromagnetic relay using the contact device.

[0006] In accordance with an aspect of the present invention, there is provided a contact device, including: a contact point retainer configured to hold a movable contact point in one end portion thereof, the contact point retainer including a plurality of contact point retaining springs superimposed in a thickness direction and formed of leaf springs; and a housing configured to fix the other end portion of the contact point retainer and hold a fixed contact point in a position where the movable contact point can come into contact with or out of contact with the fixed contact point in response to elastic deformation of the contact point retainer, wherein each of the contact point retaining springs includes a bulging portion swelling away in a direction parallel or substantially parallel to a direction from the movable contact point and toward the fixed contact point.

[0007] A gap may exist between the bulging portion of at last one of the contact point retaining springs and the bulging portion of the contact point retaining spring adjoining to said at least one of the contact point retaining springs.

[0008] The bulging portion may include a plurality of flat sections connected to one another through angularly bent sections.

[0009] The bulging portion may include upper and lower sections extending parallel to each other.

[0010] The device described above may further include a terminal plate electrically connected to the fixed contact point and held in the housing in such a fashion as to partially protrude outside the housing, the bulging portion positioned near the terminal plate.

[0011] An electromagnetic relay may include the contact device described above; an electromagnet stored and held within the housing; and an armature stored within the housing and driven by a magnetic force of the electromagnet,
wherein the movable contact point is configured to move together with the armature and to come into contact with or out of contact with the fixed contact point.

[0012] With the present embodiment, when a large current flows, the repulsion force generated between one end and the other end of the bulging portion acts to deform the contact point retaining spring in such a direction as to press the movable contact point against the fixed contact point. It is therefore possible to restrain opening of the contact points.

Brief Description of the Drawings

[0013] The objects and features of the present invention will become apparent from the following description of embodiments, given in conjunction with the accompanying drawings, in which:

Fig. 1 is a front view showing an electromagnetic relay according to one embodiment of the present invention, with a cover removed for clarity; and
Fig. 2 is an explanatory view illustrating a problem to be solved by the present invention.

Detailed Description of the Preferred Embodiments

[0014] Hereinafter, one preferred embodiment of the present invention will now be described in detail with ref-

erence to the accompanying drawings which form a part hereof.

[0015] As shown in Fig. 1, an electromagnetic relay 100 according to the present embodiment includes an electromagnet 1, an armature 2 rotationally driven by the magnetic force of the electromagnet 1 and a housing 3 for accommodating the electromagnet 1 and the armature 2. The electromagnet 1 is fixed to the housing 3. In other words, the present embodiment is directed to the electromagnetic relay 100 in which the movable contact point 51 is operated in response to the rotation of the armature 2. In the following description, the upper, lower, left and right sides will be defined on the basis of Fig. 1. The front side of the drawing sheet in Fig. 1 will be called "front" and the back side of the drawing sheet in Fig. 1 will be called "rear". 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.

[0016] 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.

[0017] The electromagnetic relay 100 includes a support body 4 for rotatably supporting the armature 2 with respect 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 columnar 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.

[0018] 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 substantially 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 an electric current supplied to the coil. The polarities of the variable magnetic pole portions 11a differ from each other. A plurality of (three, in Fig. 1) 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 100 according to the present embodiment 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.

[0019] 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 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.

[0020] 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.

[0021] 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 electromagnetic relay 100 according to the present embodiment includes 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. In other words, the movable contact point 51, the fixed contact point 52, the contact point retainer 7 and the housing 3 make up a contact device. 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.

[0022] The electromagnetic relay 100 according to the present embodiment includes a card 8 connected to the contact point retainer 7 and the armature 2 so that the movable contact point 51 can move together with the armature 2. 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 connector piece 24 connected to 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 recess portion (not shown) of the card 8 opened upward, downward and rearward.

[0023] 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 at the upper end portions and the lower end portions thereof. Each of the contact point retaining springs 71 includes a bulging portion 71a swelling rightward (namely, in a parallel or substantially parallel direction to the direction from the movable contact point 51 toward the fixed contact point 52). The bulging portion 71a is formed in a substantially central portion of each of the contact point retaining springs 71 in the up-down direction. The upper and lower end portions of each of the contact point retaining springs 71 existing above and below the bulging portion 71a are flat with the thickness direction thereof extending in the left-right direction. The bulging portion 71a is formed by a bending work. The bulging portion 71a has, e.g., a trapezoidal shape, and includes three flat sections connected to one another through bent sections bent at an obtuse angle. The bulging portions 71a of the contact point retaining springs 71 are formed into a box-like shape so that the bulging portion 71a of the left contact point retaining spring 71 can be received in the left recess of the bulging portion 71a of the right left contact point retaining spring 71. Gaps exist between the adjoining bulging portions 71a of the contact point retaining springs 71. In particular, the gap existing between the bulging portion 71a of the leftmost contact point retaining spring 71 and the bulging portion 71a of the contact point retaining spring 71 adjoining to the leftmost contact point retaining spring 71 is formed into a relatively large size.

[0024] With the configuration described above, upon supplying a large current, electric currents flow through the upper end section and the lower end section of the bulging portion 71a in the substantially opposite directions, whereby a repulsion force is generated between upper end section and the lower end section of the bulging portion 71a as indicated by arrows A1. The repulsion force acts to deform the contact point retainer 7 in such a direction that the upper end portion of the contact point retainer 7 is displaced rightward with respect to the lower end portion thereof as indicated by an arrow A2, namely in such a direction that the movable contact point 51 is pressed against the fixed contact point 52. This makes it possible to restrain disconnection of the contact points.

[0025] Since the gaps exist between the contact point retaining springs 71 (between the bulging portions 71a), the operation characteristics can be adjusted by plastically deforming the respective contact point retaining springs 71 (e.g., the leftmost contact point retaining spring 71) in an appropriate manner.

[0026] It is more preferable to form the bulging portion 71a into a shape (e.g., a rectangular shape) in which the upper and lower sections thereof extend parallel to each other, than to form the bulging portion 71a into the trapezoidal shape described above. In that case, the electric currents flow through the upper and lower sections of bulging portion 71a in the perfectly opposite directions and the repulsion force becomes stronger.

[0027] The bulging portion 71a is positioned near the terminal plate 62. Preferably, the distance between the terminal plate 62 existing at the side of the fixed contact point 52 and the bulging portion 71a is set as small as possible insofar as the insulation can be secured. For example, if the size of the bulging portion 71a is made larger, it becomes possible to make the contact point retaining springs 71 longer. If the position of the terminal plate 62 is set closer to the contact point retainer 7, it becomes possible to reduce the overall size of the electromagnetic relay 100.

[0028] 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. A contact device, comprising:

   a contact point retainer configured to hold a movable contact point in one end portion thereof, the contact point retainer including a plurality of contact point retaining springs superimposed in a thickness direction and formed of leaf springs; and
   a housing configured to fix the other end portion of the contact point retainer and hold a fixed contact point in a position where the movable contact point can come into contact with or out of contact with the fixed contact point in response to elastic deformation of the contact point retainer,
   wherein each of the contact point retaining springs includes a bulging portion swelling away in a direction parallel or substantially parallel to a direction from the movable contact point and toward the fixed contact point.

2. The device of claim 1, wherein a gap exist between the bulging portion of at last one of the contact point retaining springs and the bulging portion of the contact point retaining spring adjoining to said at least one of the contact point retaining springs.

3. The device of claim 1 or 2, wherein the bulging portion includes a plurality of flat sections connected to one another through angularly bent sections.

4. The device of claim 3, wherein the bulging portion includes upper and lower sections extending parallel to each other.

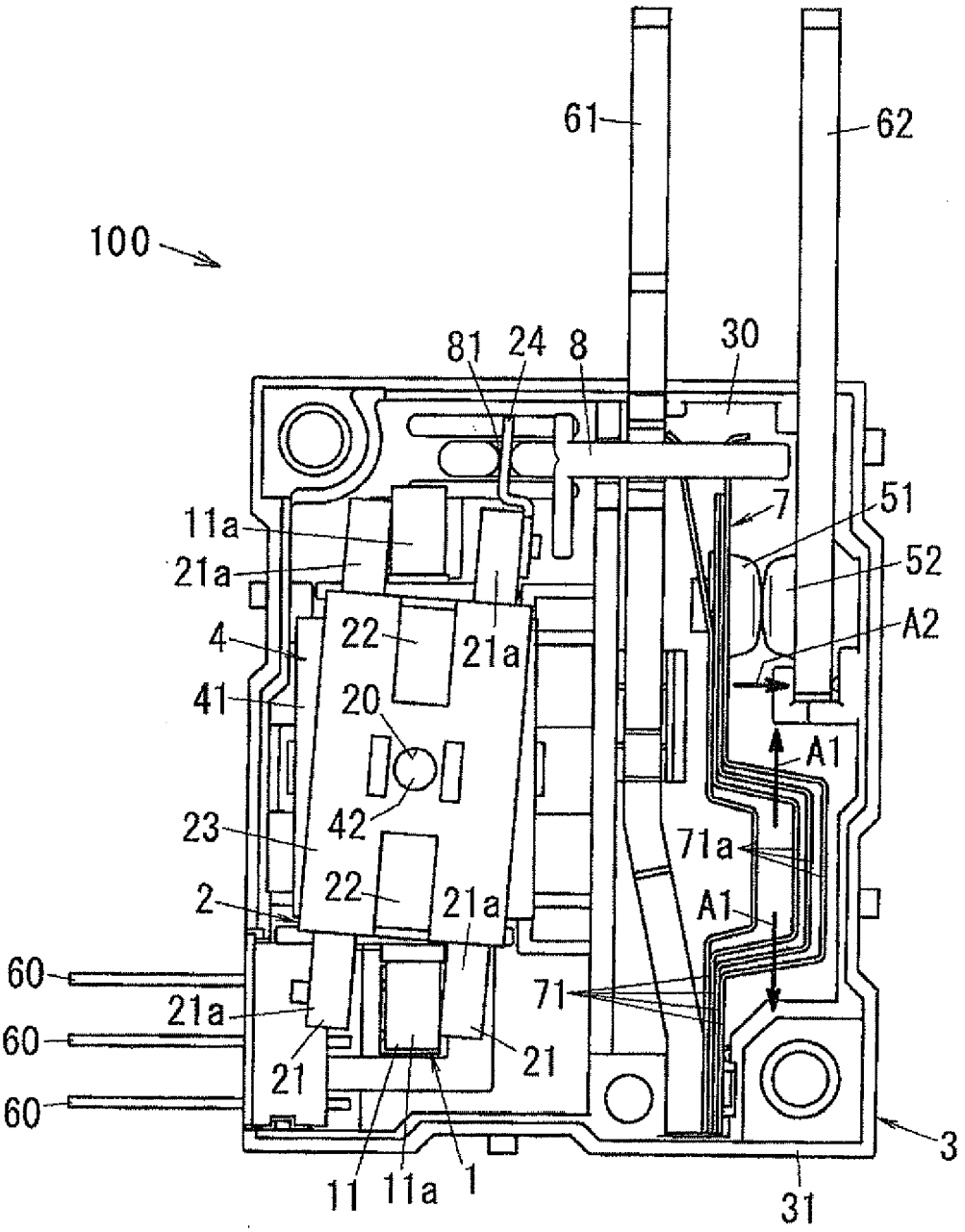
5. The device of any one of claims 1 to 4, further comprising:

   a terminal plate electrically connected to the fixed contact point and held in the housing in such a fashion as to partially protrude outside the housing, the bulging portion positioned near the terminal plate.

6. An electromagnetic relay, comprising:

   the contact device of any one of claims 1 to 5;
   an electromagnet stored and held within the housing; and
   an armature stored within the housing and driven by a magnetic force of the electromagnet,
   wherein the movable contact point is configured to move together with the armature and to come into contact with or out of contact with the fixed contact point.

FIG. 1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A1
42
23
71a
22
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A1
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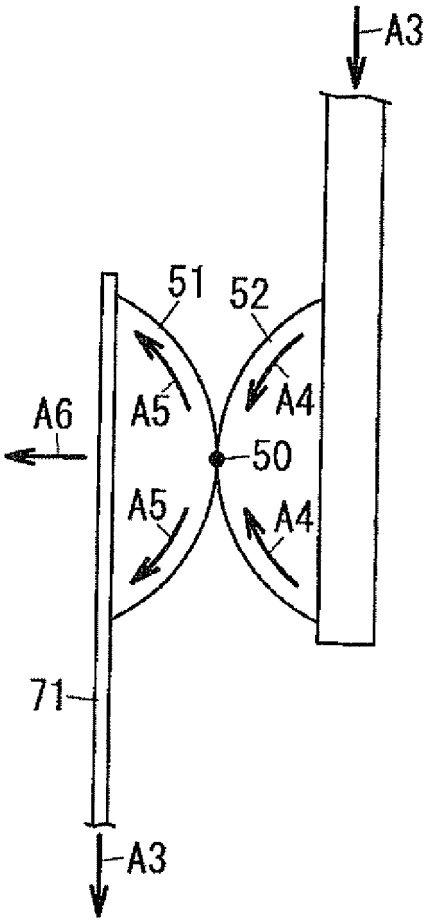
60
71
21a
60
21
21
60
11
11a
1
31
3

FIG. 2



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EUROPEAN SEARCH REPORT

Application Number
EP 12 17 4868

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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	30 November 2012	Serrano Funcia, J

CATEGORY OF CITED DOCUMENTS

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

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