



(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
26.08.2015 Bulletin 2015/35

(51) Int Cl.:
H01H 50/56 (2006.01) **H01H 50/14** (2006.01)
H01H 50/54 (2006.01) **H01H 50/04** (2006.01)
H01H 11/06 (2006.01)

(21) Application number: **14838893.7**

(22) Date of filing: **08.08.2014**

(86) International application number:
PCT/JP2014/071070

(87) International publication number:
WO 2015/098173 (02.07.2015 Gazette 2015/26)

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

(30) Priority: **27.12.2013 JP 2013272863**

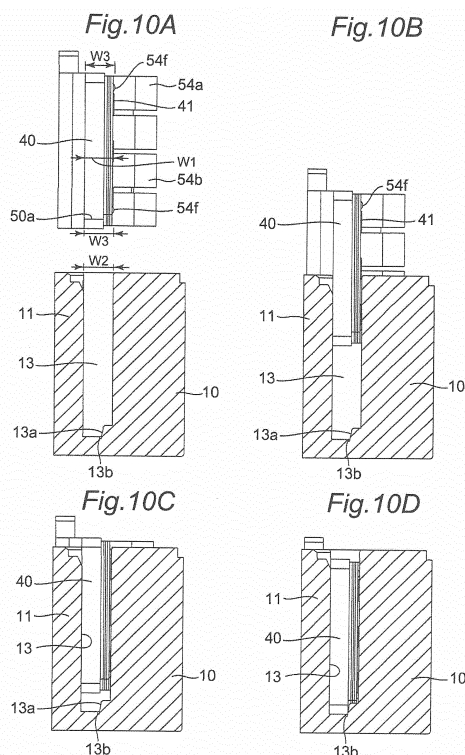
(71) Applicant: **Omron Corporation**
Kyoto-shi, Kyoto 600-8530 (JP)

(72) Inventors:
• **HAYASHIDA, Kaori**
Yamaga-shi
Kumamoto 861-0596 (JP)
• **TANAKA, Hiroyasu**
Yamaga-shi
Kumamoto 861-0596 (JP)
• **KOZAI, Yuji**
Yamaga-shi
Kumamoto 861-0596 (JP)

(74) Representative: **Kilian Kilian & Partner**
Aidenbachstraße 54
81379 München (DE)

(54) **INSTALLATION STRUCTURE FOR CONTACT-POINT TERMINAL AND ELECTROMAGNETIC RELAY PROVIDED WITH SAID INSTALLATION STRUCTURE**

(57) A contact terminal assembling structure free from malfunction or variation in operating characteristic is provided. Movable contact plate assembly 50 is fixed to one end of movable contact terminal 40 by using swaging projection 41. One end of the movable contact terminal is supported by pressing it into groove 13 of base 10. The rear edge of the one end of the movable contact plate assembly 50 has at least one a fitting projection 54f which projects beyond the swaging projection 41 in condition where the contact terminal its inserted in the groove.



Description

TECHNICAL FIELD

[0001] The present invention relates to an assembling structure of a contact terminal and, for example, to an assembling structure of a movable contact terminal to which a movable contact plate incorporated in an electromagnetic relay is securely swaged. The present invention also relates to an electromagnetic relay having the assembling structure.

BACKGROUND

[0002] Conventionally, there has been disclosed an electromagnetic relay including an assembling structure of a movable contact terminal with a movable contact plate fixed thereto, in which for example one end of a first relay terminal 2 having a contact spring 4 swaged thereto is press-fitted in and thereby supported by a press fitting groove of a housing (see Fig. 1 of Patent Document 1).

[0003] Patent Document 1: US Patent No. 6661319

[0004] According to the electromagnetic relay, the one end of the first relay terminal 2 with the contact spring 4 swaged thereto is press-fitted and then assembled in the press fitting groove of the housing as shown in Fig. 1 of the prior art patent document. This results in that the press-fitted portion of the relay terminal may make a scraping contact with the inner surface of the groove to generate debris which may disadvantageously cause contact failures.

[0005] Also, a height of the swaged portion can vary among products, making it difficult to attain a precise positioning of the movable contact, which causes unwanted variation in operating characteristics.

[0006] In view of above, an object of the present invention is to provide an assembling structure of a contact terminal free from contact failure and with minimum variation in operating characteristic.

SUMMARY OF THE INVENTION

[0007] To overcome the above described drawbacks, in an assembling structure of a contact terminal according to the invention, provided is an assembling structure of a contact terminal in which a contact plate is fixed to a contact terminal through a swaging projection mounted on a proximal portion of the contact terminal, and the proximal portion of the contact terminal is supported through an forced insertion thereof in a groove formed in a housing, wherein the contact plate has a rear end portion with respect to a direction of insertion of the contact terminal into the housing, the rear end portion having a rear proximal region, the rear proximal region having at least one fitting projection which is configured to project beyond the swaging projection in condition where the contact terminal is inserted in the groove.

[0008] According to the present invention, the swaging

projection makes a contact with an internal surface of the groove without causing any scraping debris or particles which may otherwise cause contact failure. The fitting projection of the contact plate can be formed more precisely than the swaging projection, ensures a reliable assembling structure free from variation in operating characteristic.

[0009] In another aspect of the invention, at least one fitting projection may be positioned on either side of the swaging projection.

[0010] According to this aspect of the invention, the proximal end of the contact terminal can be supported by the fitting projections on opposite sides of the swaging projection, ensuring a more precise positioning of the contact terminal, which in turn results in an assembling structure having a contact terminal free from variation in operating characteristic.

[0011] In another aspect of the invention, a corner of the front proximal region of the contact plate has a cutout which facilitates the insertion of the contact plate.

[0012] According to this aspect of the invention, the insertion of the contact terminal can easily be made, which ensures an effective mounting of the contact terminal.

[0013] In another aspect of the invention, the contact plate is a movable contact plate and the contact terminal is a movable contact terminal.

[0014] According to this aspect of the invention, the structure is widely used in assembling the contact terminals.

[0015] In another aspect of the invention, the housing has a recess for collecting debris which may be generated by a scraping contact of the contact terminal with the contact portion.

[0016] According to this aspect of the invention, the contact terminal is inserted in the groove in which the front edge of the contact terminal makes a frictional and scraping contact with the contact portion at the final stage of the insertion, enhancing supporting strength of the contact terminal, which ensures that the contact terminal is less likely to drop from the groove.

[0017] In another aspect of the invention, the housing has a recess for collecting debris or particles which may be generated by a frictional and scraping contact of the edge of the contact terminal with the portion.

[0018] According to this aspect of the invention, the scraping debris or particles caused from the contact portion is collected in the collecting recess and therefore provides no harmful affect on the insertion of the contact terminal. The debris in the recess is appropriately retained therein without running out of the recess and therefore no contact failure will be caused by the debris.

[0019] The electromagnetic relay according to the invention employs the above described contact terminal assembling structure in order to solve the above described problems.

[0020] According to the present invention, the swaging projection makes a contact with an internal surface of the

groove without causing any scraping debris or particles which may otherwise cause contact failure in an electromagnetic relay.

[0021] Also, the fitting projection of the contact plate can be formed more precisely than the swaging projection, ensures an electromagnetic relay free from variation in operating characteristic.

BRIEF DESCRIPTION OF THE DRAWINGS

[0022]

Figs. 1A and 1B are a perspective view showing an embodiment of an electromagnetic relay according to the present invention and a perspective view showing a state in which a cover is removed.

Figs. 2A and 2B are plan views showing states brought before/after an operation of the electromagnetic relay illustrated in Fig. 1.

Fig. 3 is an exploded perspective view showing the electromagnetic relay illustrated in Fig. 1A.

Fig. 4 is an exploded perspective view showing the electromagnetic relay illustrated in Fig. 1A as seen at a different angle.

Figs. 5A and 5B are exploded perspective views showing an electromagnetic unit illustrated in Fig. 3.

Figs. 6A and 6B are exploded perspective views showing a movable contact terminal and a movable contact plate assembly illustrated in Fig. 3.

Fig. 7A is a perspective view showing a first movable contact plate illustrated in Fig. 6, and Fig. 7B is a perspective view for explaining a method of assembling a movable contact terminal and a movable contact plate assembly.

Figs. 8A, 8B, 8C and 8D are sectional views for explaining a step of assembling a movable contact terminal and a movable contact plate assembly.

Fig. 9A is a perspective view showing a variant of the first movable contact plate illustrated in Fig. 6 and Fig. 9B is a perspective view for explaining a method of assembling a movable contact terminal and a movable contact plate.

Figs. 10A, 10B, 10C and 10D are sectional views for explaining an assembling step according to a variant of the movable contact terminal and the movable contact plate assembly.

Fig. 11A is a partial front view showing a contact mechanism and Figs. 11B, 11C, and 11D are sectional views for describing an operating process, taken along B - B lines in Fig. 11A.

EMBODIMENTS OF THE INVENTION

[0023] With reference to Figs. 1A-11D, various embodiments of an electromagnetic relay according to the present invention will be described.

[0024] As shown in Figs. 1A to 8D, the electromagnetic relay according to the embodiment of the present inven-

tion generally includes a base 10, an electromagnetic unit 20, a stationary contact terminal 30, a movable contact terminal 40, a movable contact plate assembly 50 securely fixed to the terminal 40, a rotatable actuator 60, an actuator plate 70, a position regulating plate 80, and a cover 90.

[0025] The base 10, which is shaped in the form of rectangular box, has a partition wall 11 protruding from a bottom surface thereof and an engagement recess 11a formed on an upper portion of an inwardly-faced surface of the partition wall 11 as shown in Fig. 3. Also, the base 10 has a pair of terminal slits 12a and 12b formed on peripheral walls partially defining one of internal spaces partitioned by the partition wall 11. A press fitting groove 13 for press fitting one end of the movable contact terminal 40 which will be described below is formed in one of the internal spaces. The base 10 is provided with a positioning projection 14 and a positioning rib 15 (Figs. 2A and 2B) for positioning the electromagnetic unit 20 which will be described below, in the other internal space separated from the one internal space by the partition wall 11. The positioning projection 14 and the positioning rib 15 have positioning holes 14a and 15a provided on upper end surfaces thereof, respectively. In addition, the base 10 has mounting holes 16 provided at diagonally opposing corners thereof and has engaging projections 17 provided on respective outer peripheral surfaces of the base 10.

[0026] As shown in Figs. 5A and 5B, the electromagnetic unit 20 has a spool 21 with flanges 21a and 21b provided on opposite sides thereof, an iron core 23 inserted in a through-hole 21c defined in the spool 21, a coil wound around the spool 21, and substantially L-shaped yokes 24 and 25 fixed to the opposite ends of the iron core 23 protruding from the spool 21. Three coil terminals 26a, 26b, and 26c are press fitted in an edge portion of the flange 21b. As shown in Figs. 2A and 2B, the electromagnetic unit 20 is assembled in the base 10 as it is positioned by the partition wall 11, the positioning projection 14 and the positioning rib 15.

[0027] As shown in Fig. 3, the stationary contact terminal 30 has an opening/closing stationary contact 31 and a conducting stationary contact 32 swagedly fixed to one end thereof. The other end thereof is served as a terminal portion 33. The opening/closing stationary contact 31 is made of a metallic material with a high conductivity such as silver. The opening/closing stationary contact 31 and the conducting stationary contact 32 are configured so that a height of opening/closing stationary contact 31 from the stationary contact terminal 30 is greater than that of the conducting stationary contact 32. Also, the opening/closing stationary contact 31 has a greater diameter than the conducting stationary contact 32. A thickness of a silver material covering a surface of the opening/closing stationary contact 31 is greater than that of the conducting stationary contact 32.

[0028] One end of the movable contact plate assembly 50 is fixed to the movable contact terminal 40 through a

swaging projection 41 provided on one end thereof (Fig. 6B). The other end thereof is served as a terminal portion 42.

[0029] As shown in Figs. 6A and 6B, the movable contact plate assembly 50 has stacked, first, second, third and fourth movable contact plates 51, 52, 53 and 54 of which one ends are swagedly fixed to the swaging projection 41 of the movable contact terminal 40. In the movable contact plate assembly 50, as shown in Fig. 4, an opening/closing movable contact 57 and a conducting movable contact 58 are swagedly fixed to the distal ends of first and second plate portions 55 and 56 divided to extend in parallel in its longitudinal direction, respectively, as shown in Fig. 4.

[0030] The opening/closing movable contact 57 is formed by a metallic material with a high conductivity such as silver. The opening/closing movable contact 57 and the conducting movable contact 58 are configured so that a height of opening/closing movable contact 57 from the movable contact plate assembly 50 is greater than that of the conducting movable contact 58. Also, the opening/closing movable contact 57 has a greater diameter than the conducting movable contact 58. A thickness of a silver material covering a surface of the opening/closing movable contact 57 is greater than that of the conducting movable contact 58. Furthermore, the first and second divided plate portions 55 and 56 have fold portions 55a and 56a formed at proximal portions thereof to have a substantially U-shaped configuration. The movable contact plate assembly 50 has a cutout 50a formed at a corner of the proximal end thereof.

[0031] Although the descriptions have been made to the embodiment in which the opening/closing stationary contact 31 and the opening/closing movable contact 57 have greater heights than the conducting stationary contact 32 and the conducting movable contact 58, respectively, the present invention is not restricted to the above embodiment. For example, at least one of the opening/closing stationary contact 31 and the opening/closing movable contact 57 may have a greater height than the conducting stationary contact 32 and the conducting movable contact 58.

[0032] Of course, the movable contact plate assembly 50 may be formed by at least two movable contact plates.

[0033] As shown in Figs. 6A and 6B, the first movable contact plate 51 has two pieces 51a and 51b divided to extend in parallel in its longitudinal direction. The divided plates 51a and 51b have substantially U-shaped fold portions 51c formed at proximal portions thereof. Also, the first movable contact plate 51 has a plurality of swaging holes 51d arranged in parallel on the proximal end and a cutout 51e formed at the proximal end corner thereof. The divided plates 51a and 51b have a semicircular aperture 51f provided adjacent at distal ends thereof and around a portion in which the opening/closing movable contact 57 and the conducting movable contact 58 are provided. A plate portion outside the aperture 51f is bent to form an elastically deformable bent portion 51g.

[0034] According to this embodiment, the substantially U-shaped aperture 51f is provided to surround the region in which the opening/closing movable contact 57 and the conducting movable contact 58 are disposed, and the plate portion outside of the aperture 51f is bent to form the elastically deformable bent portion 51g. This allows a contact pressure to be controlled by adjusting a shape and size of the aperture 51f and an angle of the bent portion 51g.

[0035] In particular, as shown in Fig. 6B, the bent portion 51g of the divided plate 51b supporting the conducting movable contact 58 in the first movable contact plate 51 is shorter than and has a greater spring constant than that of the divided plate 51a supporting the opening/closing movable contact 57. This ensures that the conducting movable contact 58 and the opening/closing movable contact 57 make substantially the same contact pressure at respective fully closing positions even if the elastic deformation of the divided plate supporting the conducting movable contact 58 after making an electrical contact between the conducting movable and stationary contacts 58 and 32 is smaller than that between the opening/closing movable and stationary contacts 57 and 31.

[0036] As shown in Figs. 6A and 6B, the second movable contact plate 52 has two pieces 52a and 52b divided to extend in parallel in its longitudinal direction. The divided plates 52a and 52b have substantially U-shaped fold portions 52c formed at proximal portions thereof. Also, the second movable contact plate 52 has a plurality of swaging holes 52d arranged in parallel on the proximal end and a cutout 52e formed at the proximal end corner thereof.

[0037] As shown in Figs. 6A and 6B, the third movable contact plate 53 has two pieces 53a and 53b divided to extend in parallel in its longitudinal direction. The divided plates 53a and 53b have substantially U-shaped fold portions 53c formed at proximal portions thereof. Also, the second movable contact plate 53 has a plurality of swaging holes 53d arranged in parallel on the proximal end and a cutout 53e formed at the proximal end corner thereof.

[0038] As shown in Figs. 6A and 6B, the second movable contact plate 54 has two pieces 54a and 54b divided from its distal end by slit extending in its longitudinal direction. The divided plates 54a and 54b have substantially U-shaped fold portions 54c formed at proximal portions thereof. Also, the second movable contact plate 54 has a plurality of swaging holes 54d arranged in parallel on the proximal end and a cutout 54e formed at the proximal end corner thereof. Press-fitting projections 54f are formed by stamping at the proximal end of the plate 54.

[0039] Upper and lower distal end portions of the divided plate 54a are bent in a direction to form a pair of upper and lower positioning tongues 54g and 54g for engagement with an arm 72 of an actuator plate 70 described below.

[0040] Likewise, a distal end of the divided plate 54b is bent in a direction to form a pair of upper and lower

positioning tongues 54h for engagement with the arm 72 of the actuator plate 70 described below. One of the positioning tongue 54h is bent at opposite ends to form positioning ribs 54i for the positioning of the arm 72 in the widthwise direction of the tongue.

[0041] The movable contact terminal 40 with the movable contact plate assembly 50 fixed thereto is press fitted into the press fitting groove 13 of the base 10. In this operation, as shown in Figs. 7A and 7B, the lower end of the movable contact terminal 40 is inserted in the press fitting groove 13 of the base 10 from above. As shown in Figs. 8A and 8B, a thickness W1 of the lower end of the movable contact terminal 40 including the swaging projection 41 is smaller than a width W2 of the press fitting groove 13 ($W1 < W2$), ensuring a smooth assembling without causing any scraping debris. Also, because of the cutout 50a provided at one side corner of the movable contact plate assembly 50, a press fitting can be performed more easily.

[0042] A substantial resistive force is obtained at the insertion of the lower end of the movable contact terminal 40 into the press fitting groove 13 because a thickness W3 of the movable contact terminal 40 including the press fitting projection 54f is greater than or equal to the width W2 of the press fitting groove 13 ($W2 \leq W3$). A further pressing of the movable contact terminal 40 into the groove 13 causes the lower edge of the movable contact terminal to be forcedly engaged with a projectedly-formed, stepped portion 13a formed on the inside surface of the press fitting groove 13 and thereby held immovably. Scraping debris or particles which may be generated by the frictional and scraping contact between the leading lower edge of the movable contact terminal 40 with the stepped portion 13a at the press fitting may be accommodated within in a collecting recess 13b formed on a bottom surface of the press fitting groove 13, which is sealingly covered with the movable contact terminal 40.

[0043] Although the descriptions have been made to the embodiment in which the two press fitting projections 54f are formed on the fourth movable contact plate 54 of the movable contact plate assembly 50, the present invention is not limited thereto. For example, at least one press fitting projection 54f may be sufficient. Alternatively, as shown in Figs. 9A and 9B and Figs. 10A to 10D, two press fitting projections 54f may be provided on upper and lower ends of the fourth movable contact plate 54, namely, four fitting projections may be provided in total.

[0044] Because other structures are substantially the same as the corresponding structures of the first embodiment, like parts are designated by like reference numerals and duplicate descriptions are eliminated.

[0045] As shown in Figs. 3 and 4, the rotatable actuator 60 has first and second iron plates 61 and 62 integrally assembled therewith and holding a permanent magnet therebetween. The actuator 60 further has rotating shafts 63 and 64 protruding coaxially from the upper and lower surfaces and an operation arm 65 protruding from a side surface thereof.

[0046] The actuator 60 is mounted in the base 10 with the rotating shaft 63 inserted in the bearing recess (not shown) formed in the bottom surface of the base 10 so that one ends of the first and second iron plates 61 and 62 move to the magnetic poles 24a and 25a and the other ends of the first and second iron plates 61 and 62 move away from the magnetic poles 24a and 25a, and vice versa, alternately.

[0047] As shown in Figs. 3 and 4, the actuator plate 70 has an engaging hole 71 formed on one end thereof. The rectangular engaging hole 71 is configured to engage with the operation arm 65 of the rotatable actuator 60. The actuator plate 70 further has an upwardly extending engaging arm 72 integrally formed therewith on the other end thereof to define an engaging slot 73 therebetween. The engaging arm 72 has two positioning projections 74 formed at lower side thereof.

[0048] The operation arm 65 of the rotatable actuator 60 is engaged in the engaging hole 71 of the actuator plate 70. The distal end of the movable contact plate assembly 50 is engaged in the engaging slot 73. The engaging arm 72 is engaged with the positioning tongues 54g of the divided plate 54a of the fourth movable contact plate 54 and the positioning tongues 54h and 54h of the divided plate 54b.

[0049] Further, the position regulating rib 54i of the positioning tongue 54h are positioned between the pair of position regulating projections 74 of the engaging arm 72, preventing a displacement of the movable contact plate assembly 50 in a vertical or widthwise direction thereof, which ensures a reliable operating characteristic of the electromagnetic relay.

[0050] As shown in Figs. 3 and 4, the position regulating plate 80 has a planar configuration to extend between the positioning projection 14 and the positioning rib 15. The plate 80 has positioning projections 81 and 82 provided at opposite ends of its lower surface, which are configured so that they can fit in the positioning holes 14a and 15a of the positioning projection 14 and the positioning rib 15, respectively. The plate 80 further has a through hole 83 provided on a central portion thereof so that the rotation shaft 64 of the rotatable actuator 60 can be engaged in the hole.

[0051] As shown in Figs. 3 and 4, a cover 90 takes a planar configuration such that it covers the opening of the base 10 and has at respective diagonally opposing corners thereof cylindrical connecting portions 91 formed with through-holes 91a. The cover 90 has elastic engaging portion 92s formed in respective positions of the outer peripheral edges, corresponding to the engaging projections 17 of the base 10. The cover 90 has a projection 93 formed on a ceiling thereof which engages with the corresponding engagement recess 11a of the partition wall 11 of the base 10.

[0052] The cover 90 is mounted from above on the base 10 supporting the above described components already mounted thereon. The cylinder portions 91 of the cover 90 are engaged in the holes 16 on the base 10,

and the elastic engaging portions 92 of the cover 90 are engaged with the engaging projection 17 of the base 10, which completes the assembling of the base and the cover.

[0053] According to the embodiment, the larger diameter opening/closing movable contact 57 is disposed adjacent the opening of the base 10, which advantageously ensures a reliable inspection and adjustment at the assembling and an enhanced productivity of the relay.

[0054] Next, an operation of the electromagnetic relay according to the present embodiment will be described.

[0055] As shown in Fig. 2A, one end 61a of the first movable iron plate 61 and the other end 62b of the second movable iron plate 62 are magnetically attracted to the magnetic poles 24a and 25a of the yokes 24 and 25 by a magnetic force of the permanent magnet respectively as shown in Fig. 2A. In this condition, the actuator plate 70 engages the operation arm 65 of the rotatable actuator 60 and takes a return position so that the opening/closing movable contact 57 and the conducting movable contacts 58 are disconnected from the opening/closing and conducting stationary contacts 31 and 32. An opposing distance between the opening/closing stationary contact 31 and the opening/closing movable contact 57 is smaller than that between the conducting stationary contact 32 and the conducting movable contact 58 (Fig. 11A).

[0056] When a voltage is applied to the coil 22 in a manner such that it energizes to cancel the magnetic force of the permanent magnet, the rotatable actuator 60 rotates against the magnetic force of the permanent magnet, causing that one end 61a of the first movable iron plate 61 and the other end 62b of the second movable iron plate 62 are disconnected from the magnetic poles 24a and 25a of the yokes 24 and 25 and the other end 61b of the first movable iron plate 61 and one end 62a of the second movable iron plate 62 attract the magnetic poles 25a and 24a of the yokes 25 and 24, respectively. As a result, the operation arm 65 of the rotated rotatable actuator 60 slidably moves the actuator plate 70 so that the inside surface of the engaging slot 73 of the actuator plate 70 simultaneously forces the bent portions 51g of the first movable contact plate 51. This in turn causes that the opening/closing movable contact 57 and the conducting movable contact 58 move around swaging projections 41 where the movable contact plates are swagedly fixed to the movable contact terminal 40. This results in that the opening/closing movable contact 57 makes a contact with the opening/closing stationary contact 31 (Fig. 11C) and then the conducting movable contact 58 comes in contact with the conducting stationary contact 32 (Fig. 11D). Further, the actuator plate 70 forces the bent portions 51g of the movable contact plate assembly 50. It should be noted that, the bent portion 51g of the divided plate 51b with the conducting movable contact 58 is shorter than and has a greater spring constant than the bent portion 51g of the divided plate 51a. This ensures that, even a small amount of movement of the conducting movable contact 58 relative to the open-

ing/closing movable contact 57 eventually allows the opening/closing movable contact 57 and the conducting movable contact 58 to contact the opening/closing stationary contact 31 and the conducting stationary contact 32 with a uniform contact pressure, respectively. The application of the voltage to the coil 22 is halted subsequently, in which the rotatable actuator 60 is held in the same position by the magnetic force of the permanent magnet (Fig. 3).

[0057] Subsequently, when a voltage is applied to the coil 22 in a manner such that it energizes to cancel the magnetic force of the permanent magnet, the rotatable actuator 60 rotates in the opposite direction, causing the operation arm 65 to move the actuator plate 70 and also the engaging arm 72 of the actuator plate 70 to move the distal end of the movable contact plate assembly 50 back into their original positions, respectively (see Fig. 2).

[0058] According to the present embodiment, the relay is unlikely to be damaged by arcing which may occur between the opening/closing movable contact 57 and the opening/closing stationary contact 31. Also, the arcing is less-likely to occur between the conducting movable contact 58 and the conducting stationary contact 32. Advantageously, this prevents shortening of the contact life which would otherwise be caused by the contact wear and ensures a reliable conducting characteristic in the relay.

[0059] The electromagnetic relay according to the invention is not limited to that described above, and the invention can be applied to various electromagnetic relays and electronic devices.

PARTS LIST

[0060]

10	base
11	partition wall
12a, 12b	terminal slit
13	fitting groove
13a	stepped portion
13b	collecting recess
20	electromagnetic unit
21	spool
22	coil
23	iron core
24	yoke
24a	magnetic pole
25	yoke
25a	magnetic pole
30	stationary contact terminal
31	opening/closing stationary contact
32	conducting stationary contact
33	terminal portion
40	opening/closing movable contact
41	swaging projection
42	terminal portion
50	movable contact plate assembly

50a cutout
 51 first movable contact plate
 51f aperture
 51g bent portion
 52 second movable contact plate
 53 third movable contact plate
 54 fourth movable contact plate
 54f press fitting projection
 55a fold portion
 57 opening/closing movable contact
 58 conducting movable contact
 60 rotatable actuator
 61 first movable iron plate
 62 second movable iron plate
 63 rotating shaft
 64 rotating shaft
 65 operating arm
 70 actuator plate
 71 engaging hole
 72 engaging arm
 73 engaging slot
 74 position regulating projection
 80 position regulating plate
 90 cover

cording to any of claims 1 to 3, wherein the contact plate is a movable contact plate and the contact terminal is a movable contact terminal.

- 5 5. The assembling structure of the contact terminal according to any of claims 1 to 4, the housing has a portion which is projected at a bottom corner of the groove, the portion being configured so that an edge of the front portion of the contact terminal makes a contact with the portion.
- 10
6. The assembling structure of the contact terminal according to claim 5, wherein the housing has a recess for collecting debris or particles which may be generated by a frictional and scraping contact of the edge of the contact terminal with the portion.
- 15
7. An electromagnetic relay having the assembling structure of the contact terminal according to any of claims 1 to 6.
- 20

25

Claims

1. An assembling structure of a contact terminal, in which a contact plate is fixed to the contact terminal- by swaging the contact plate around a swaging projection mounted on a proximal portion of the contact terminal, and the proximal portion of the contact terminal is supported by a housing through an forced insertion thereof in a groove formed in the housing, **characterized in that** the contact plate has a proximal portion, the proximal portion has a rear portion which is positioned on a downstream side with respect to a direction of the insertion of the contact terminal, the rear portion has at least one fitting projection which is formed therein so that it projects beyond the swaging projection from the contact plate.
- 30
- 35
- 40
2. The assembling structure of the contact terminal according to claim 1, wherein at least one fitting projection is positioned on either side of the swaging projection.
- 45
3. The assembling structure of the contact terminal according to claim 1 or 2, wherein the proximal portion has a front portion which is positioned on an upstream side with respect to the direction of the insertion, the front portion having a corner formed with a cutout which facilitates the insertion of the contact terminal.
- 50
- 55
4. The assembling structure of the contact terminal ac-

Fig. 1A

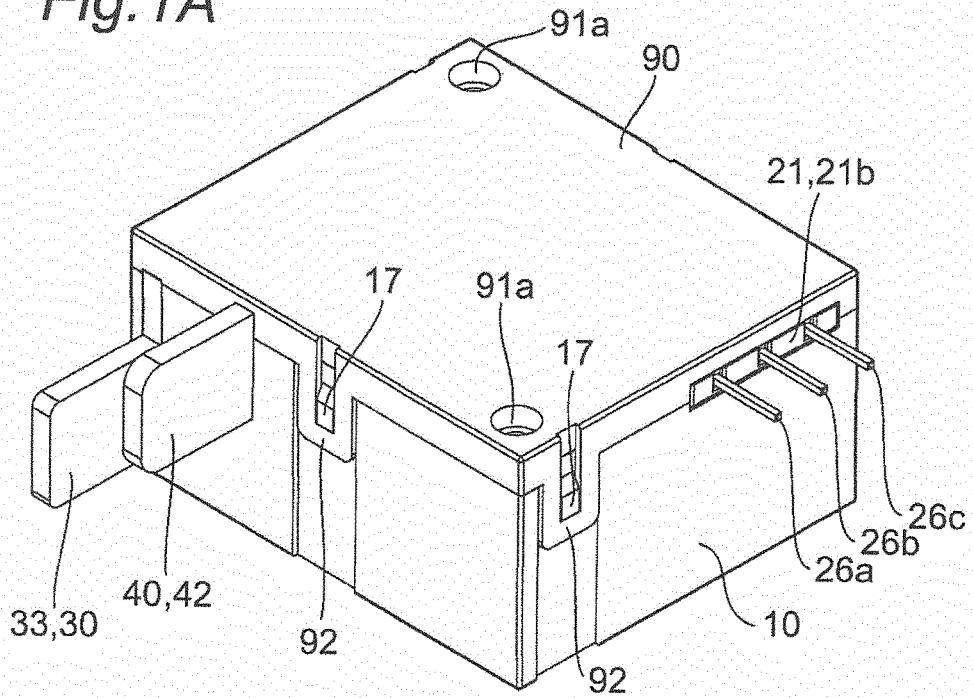


Fig. 1B

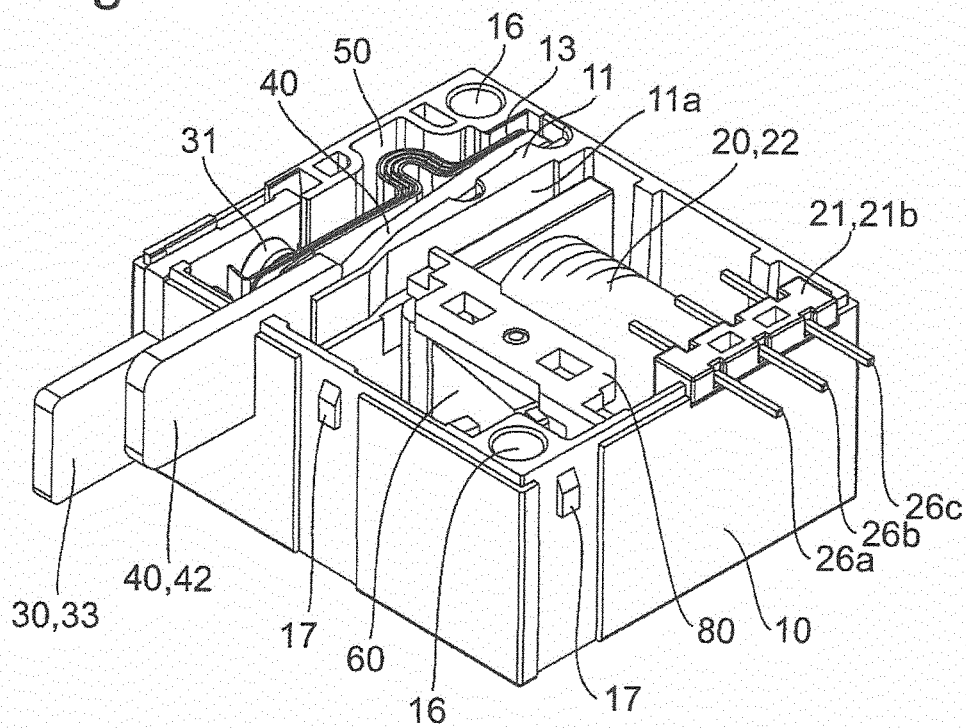


Fig. 2A

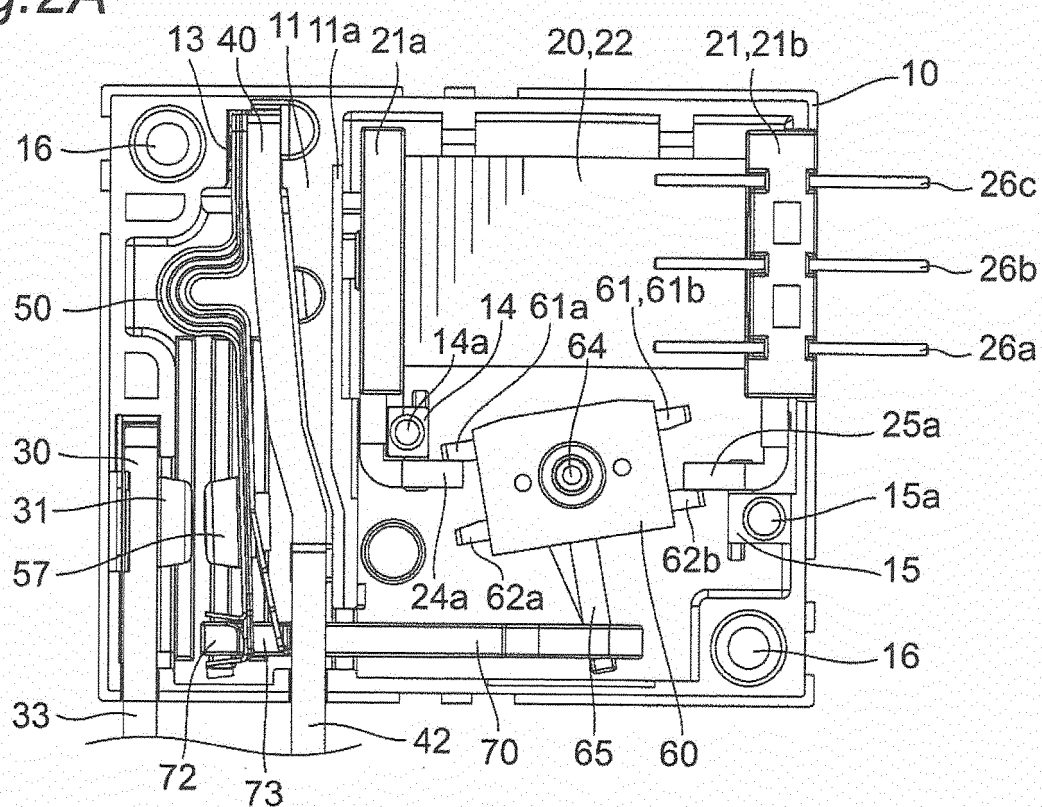


Fig. 2B

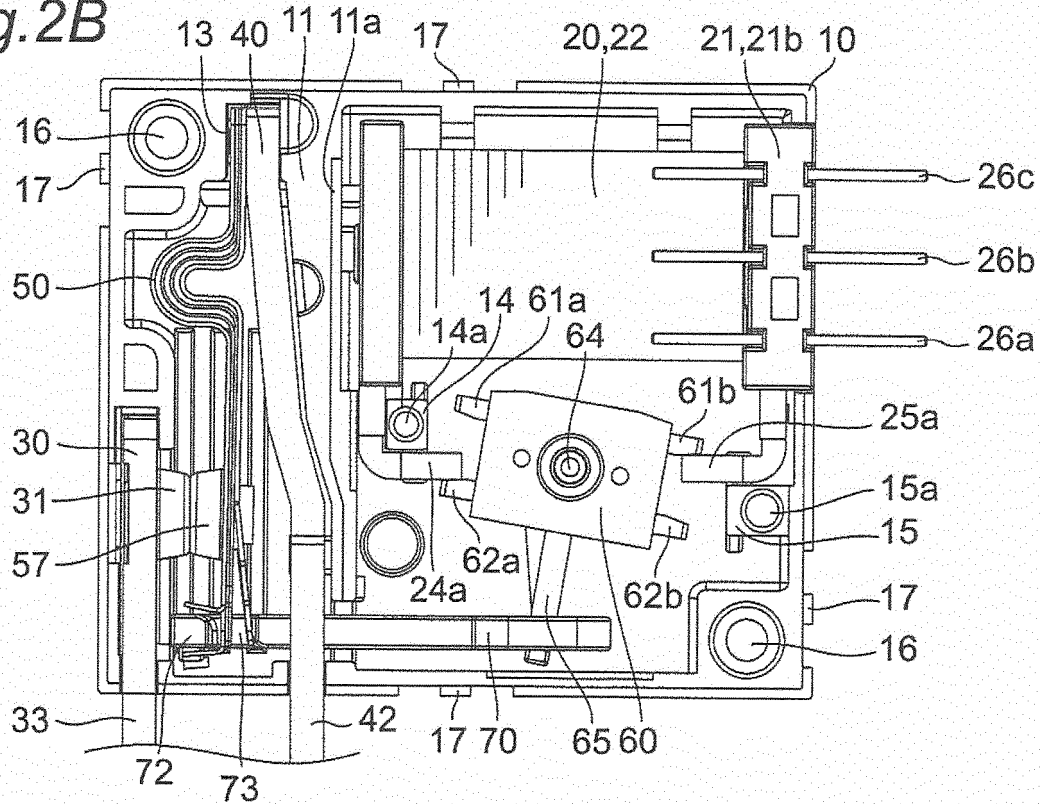


Fig.3

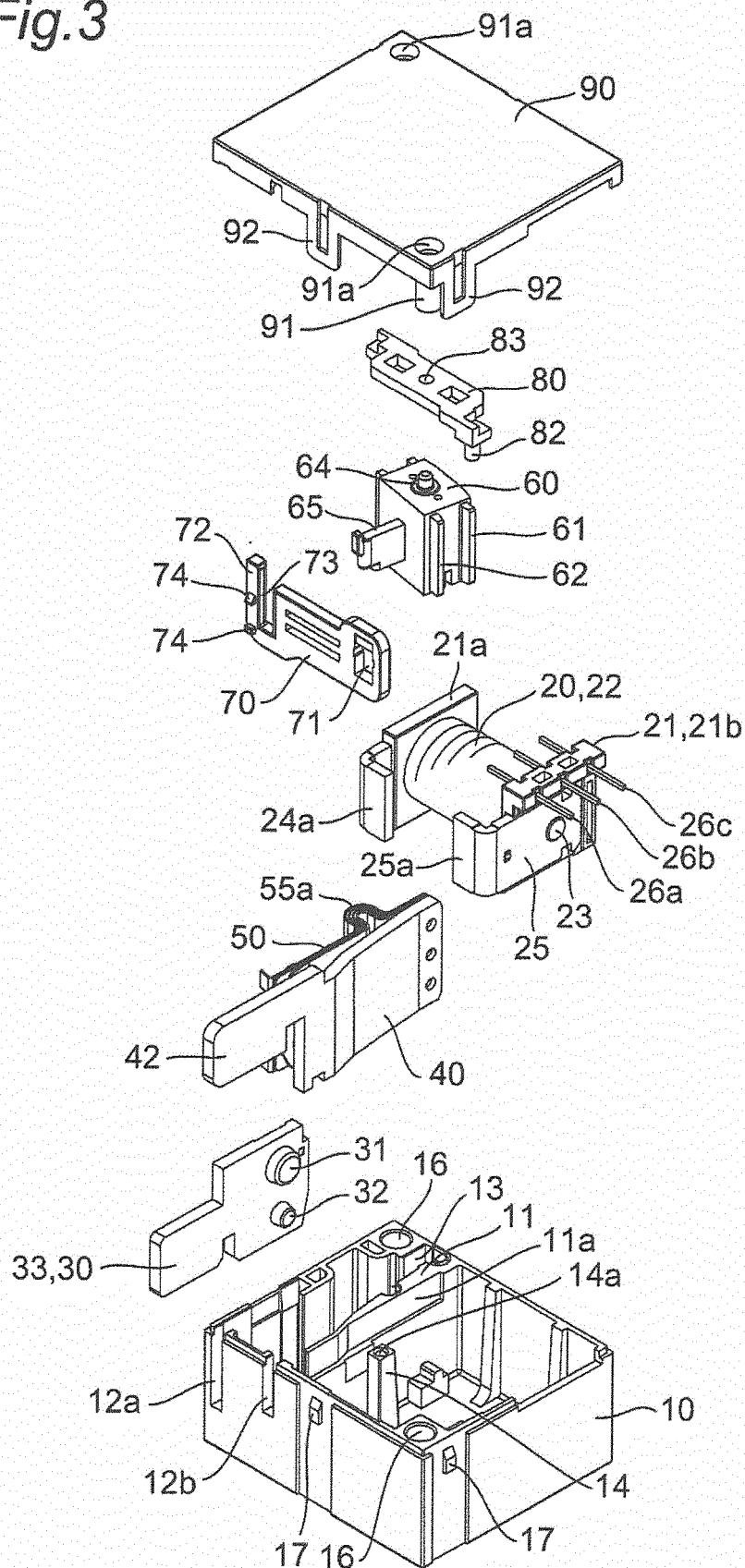


Fig.4

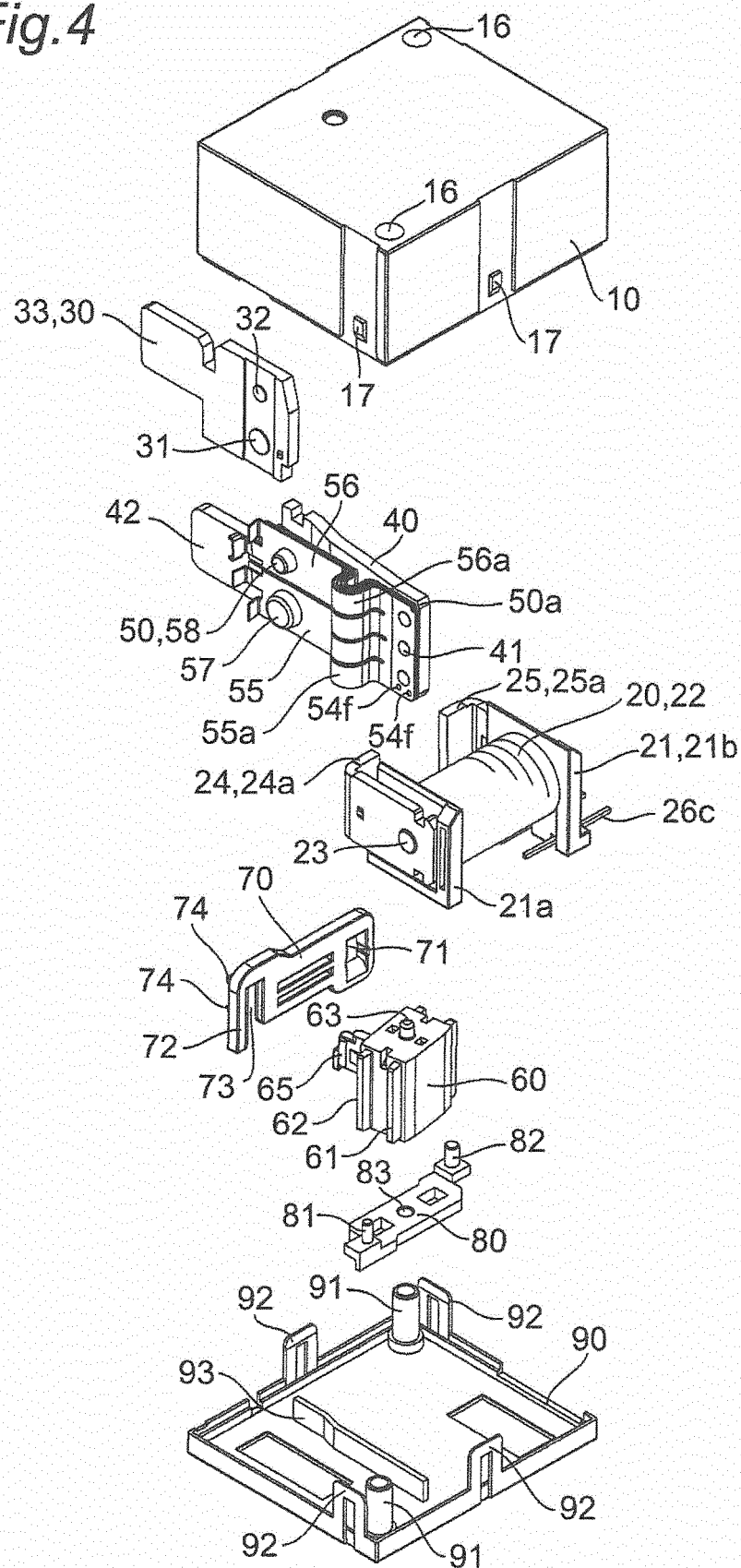


Fig. 5A

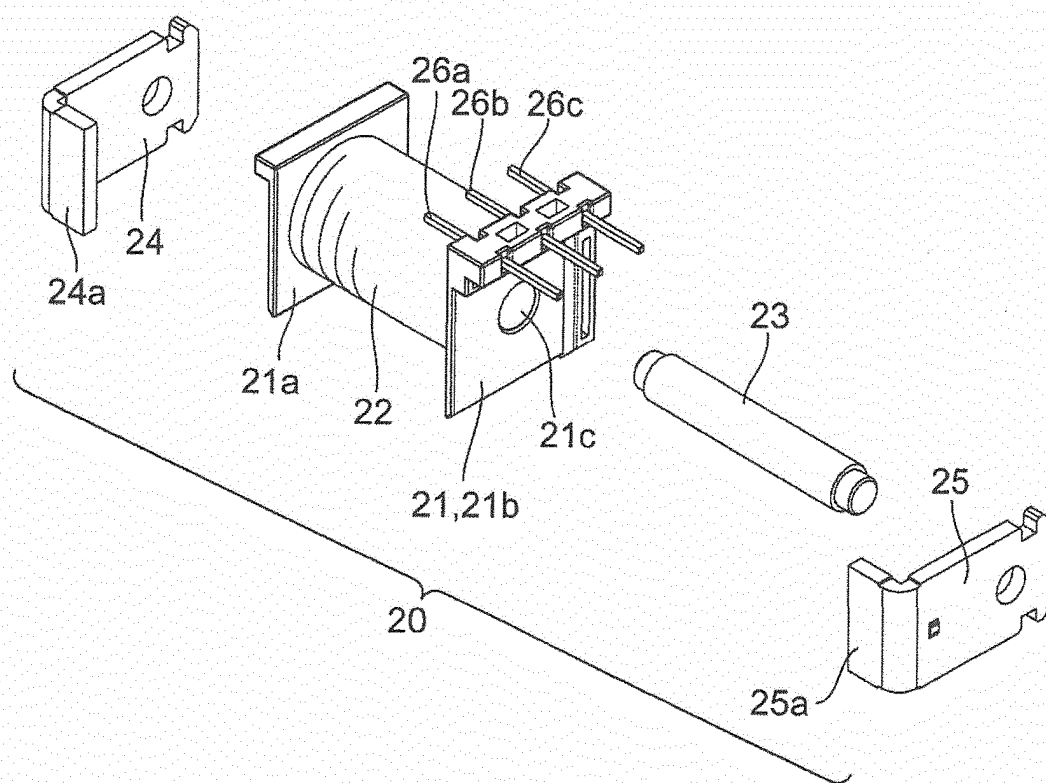


Fig. 5B

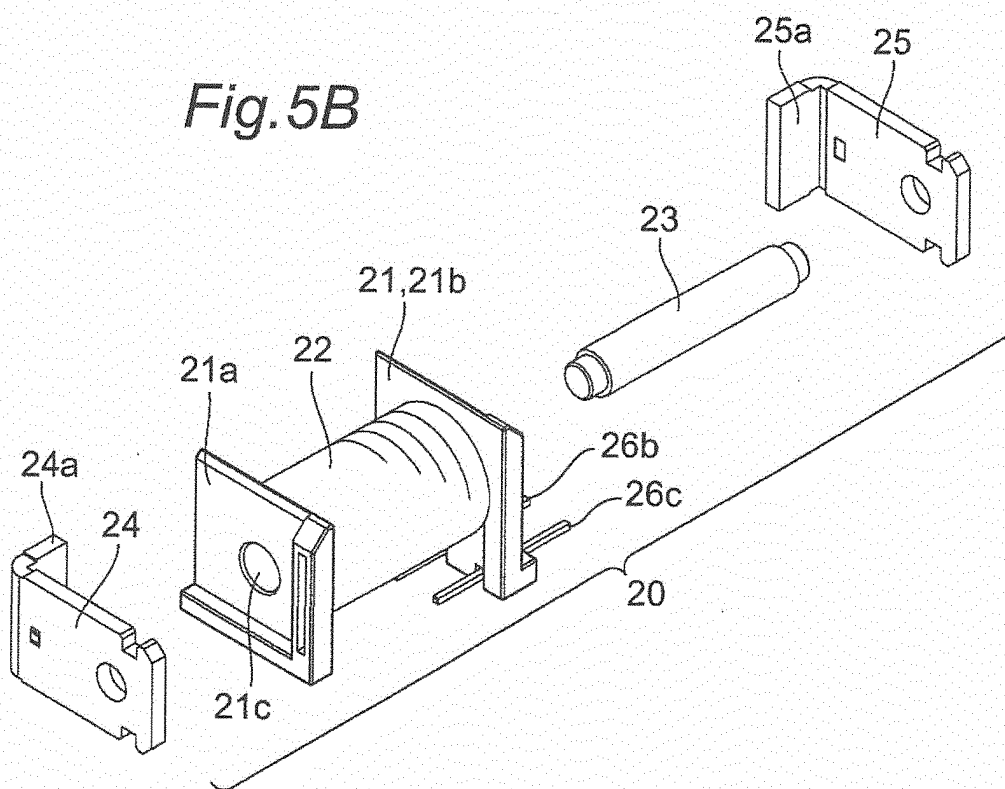


Fig. 6A

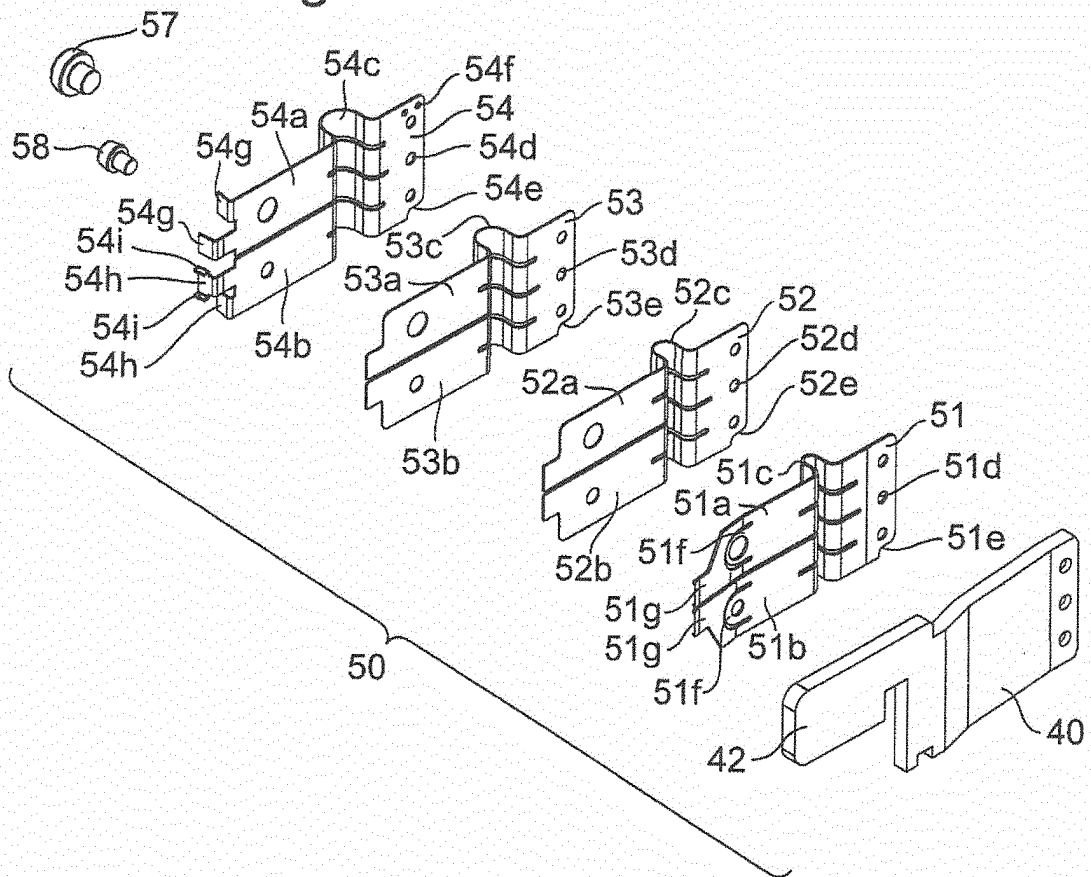


Fig. 6B

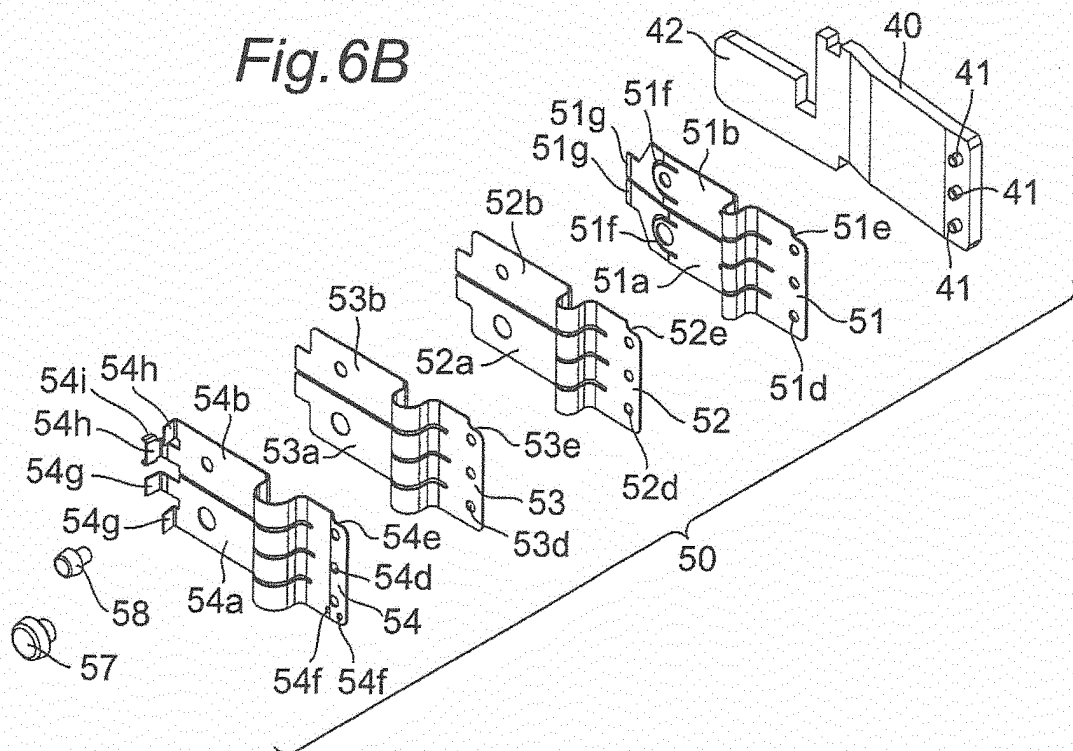


Fig. 7A

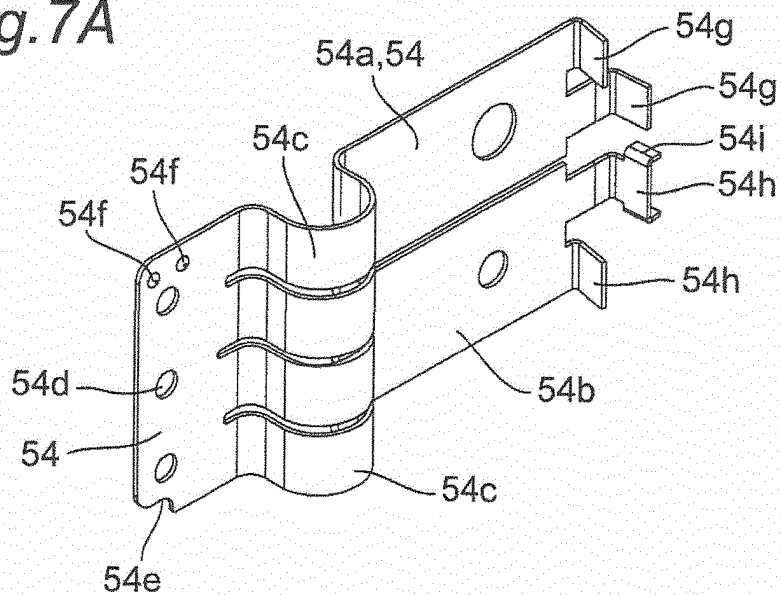


Fig. 7B

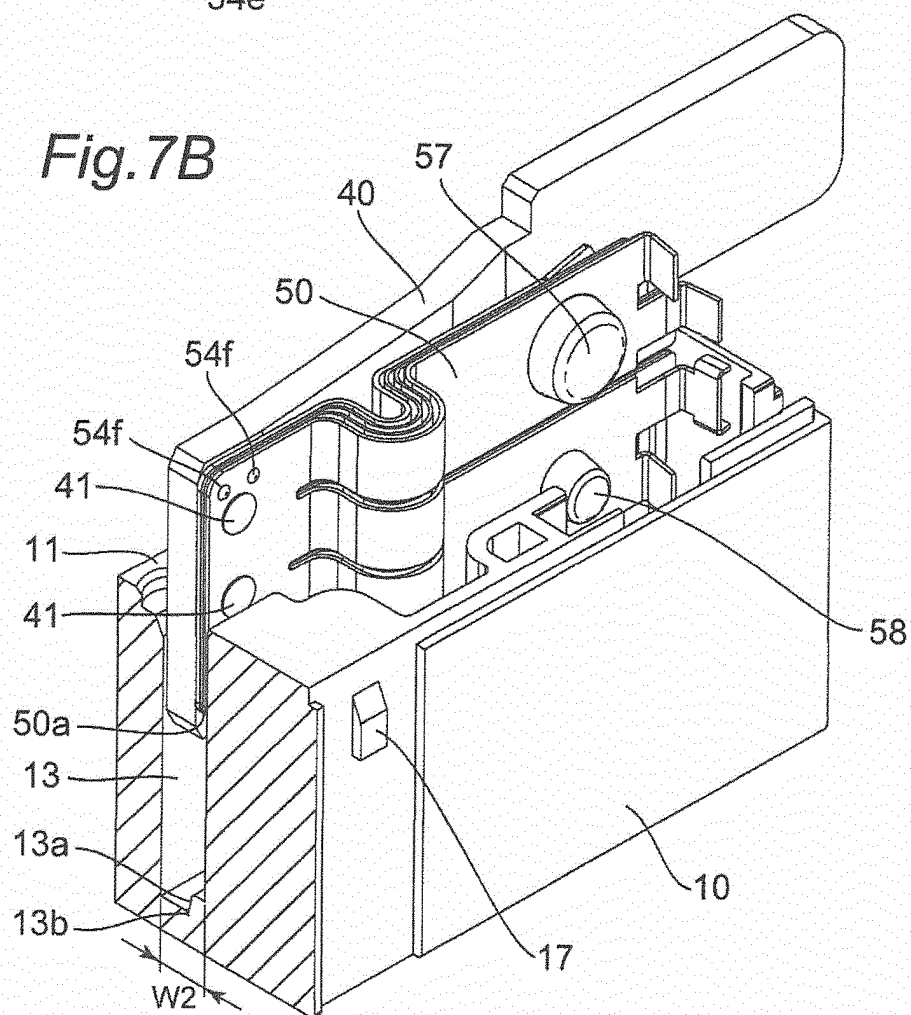


Fig. 8A

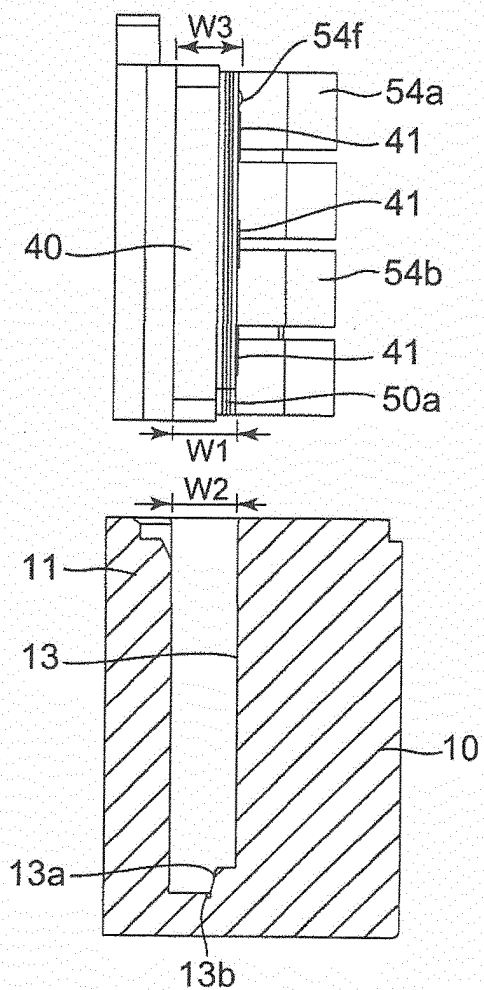


Fig. 8B

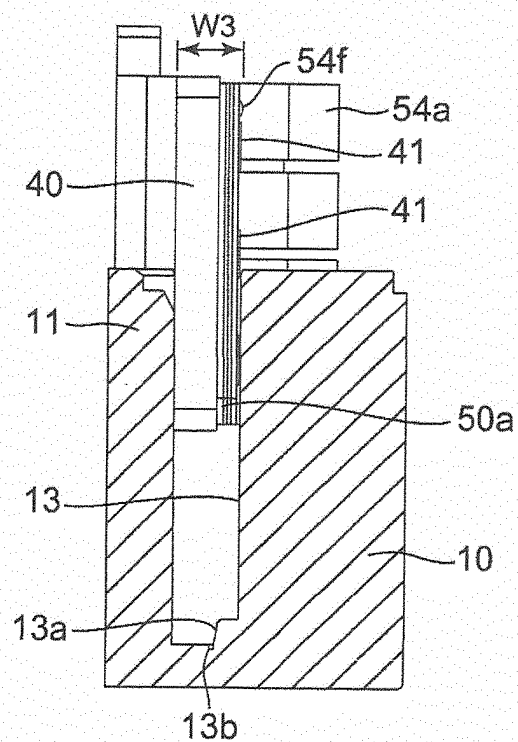


Fig. 8C

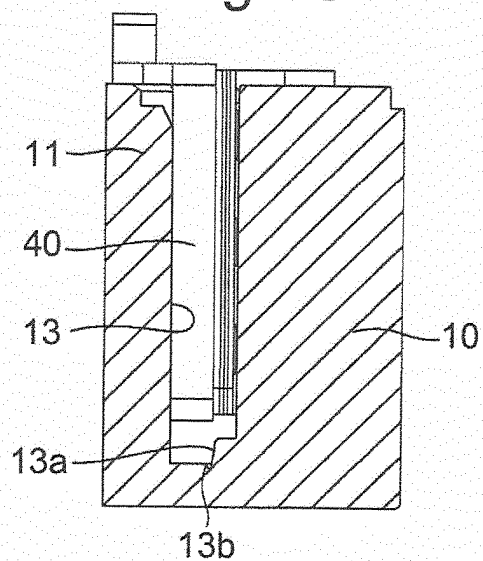


Fig. 8D

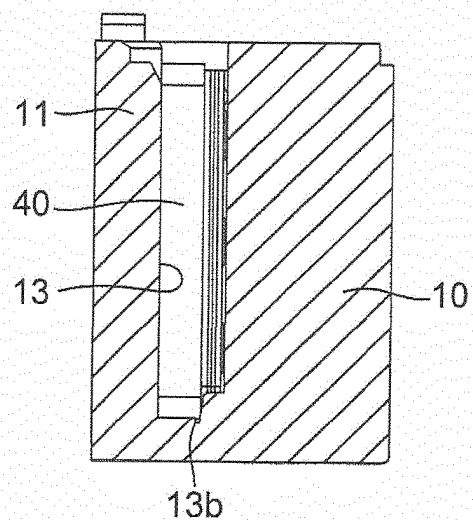


Fig. 9A

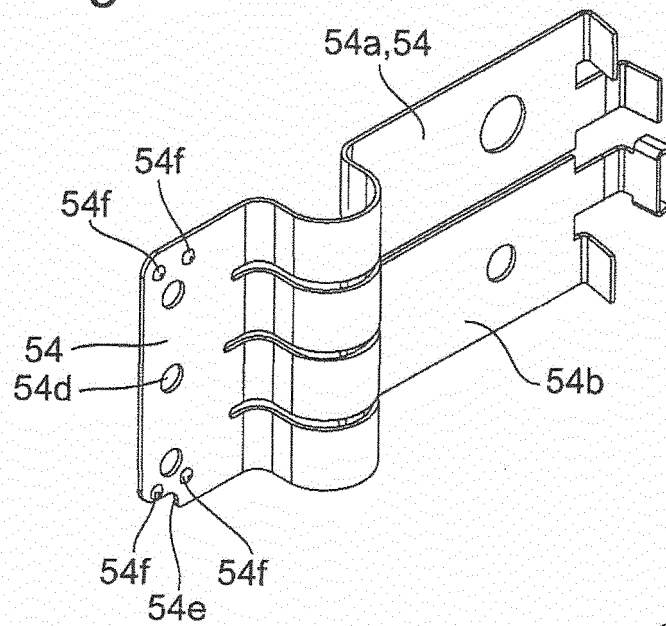


Fig. 9B

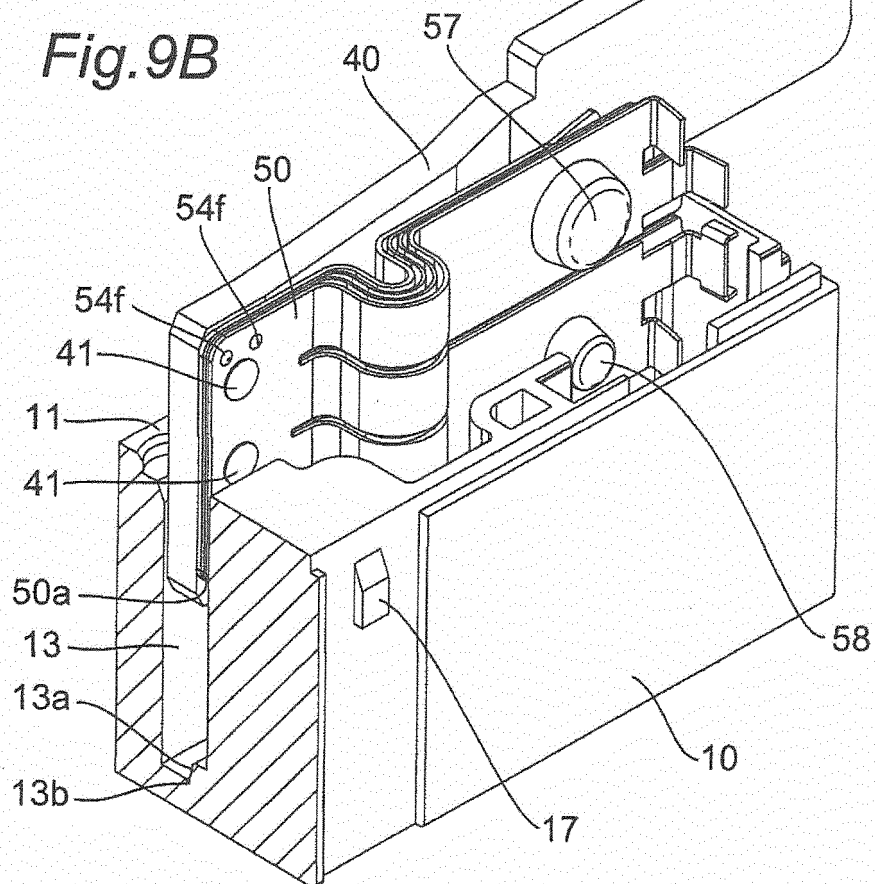


Fig. 10A

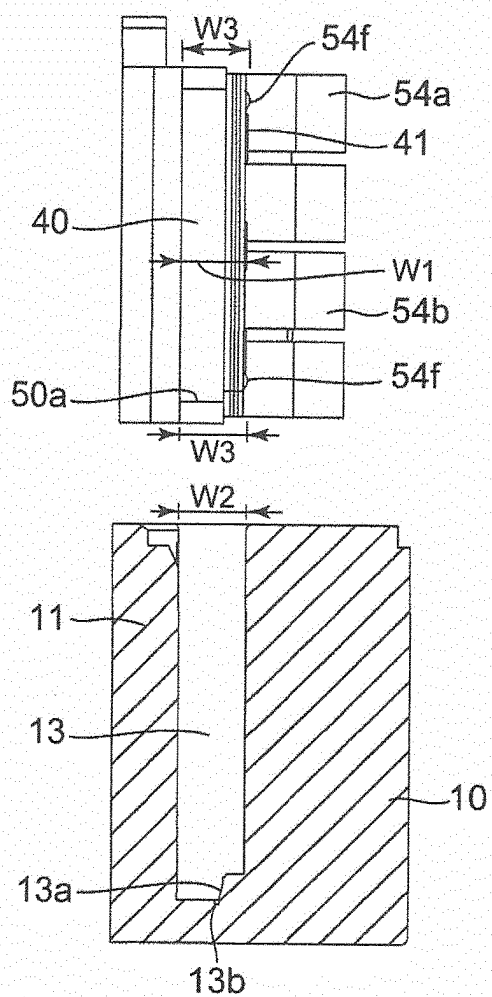


Fig. 10B

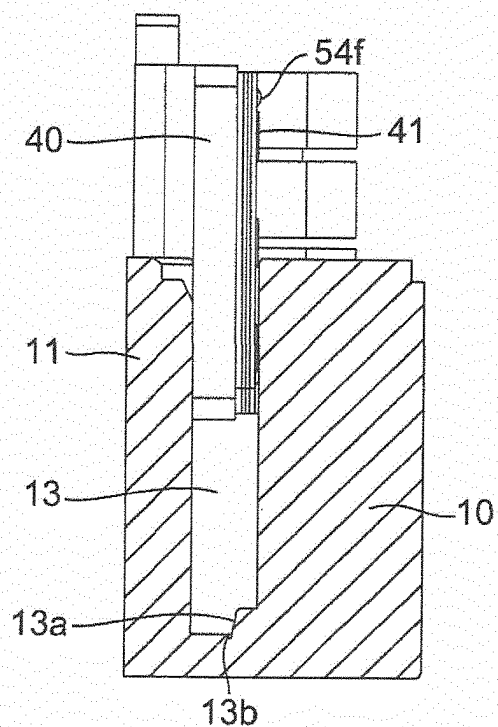


Fig. 10C

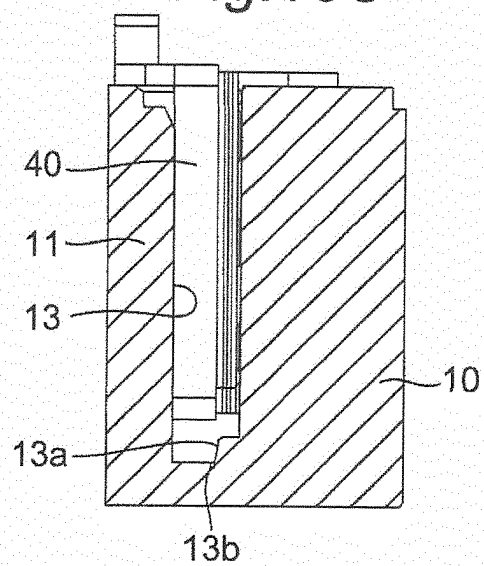


Fig. 10D

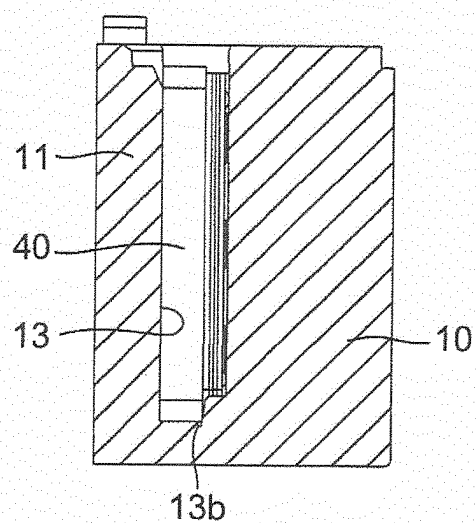


Fig. 11A

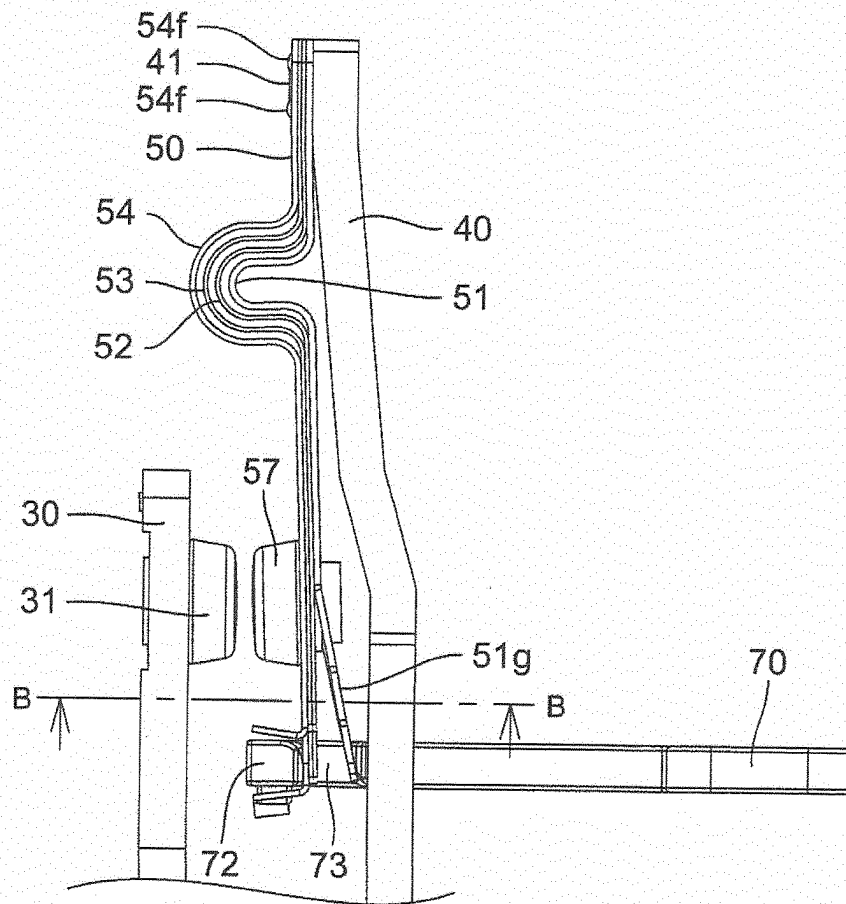


Fig. 11B

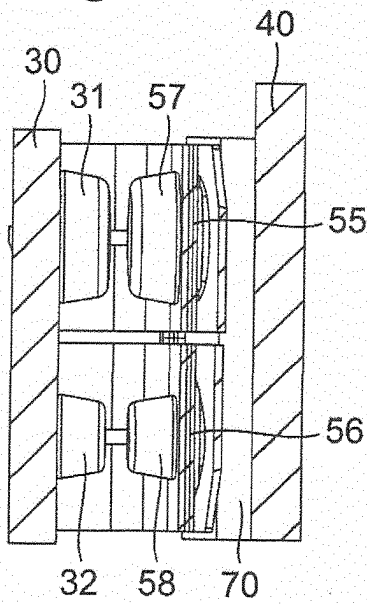


Fig. 11C

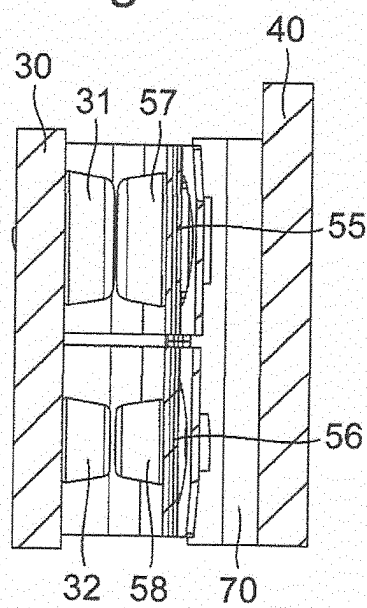
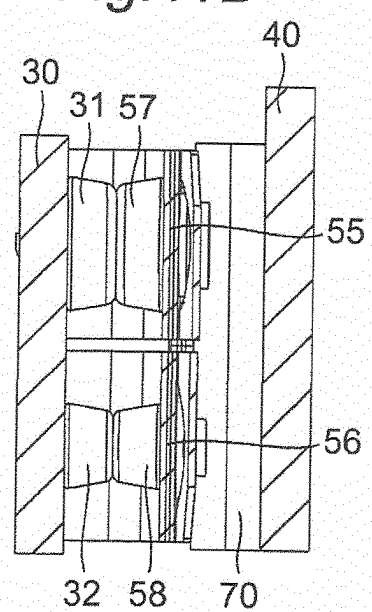


Fig. 11D



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2014/071070

A. CLASSIFICATION OF SUBJECT MATTER

H01H50/56(2006.01)i, H01H50/14(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H01H50/56, H01H50/14, H01H50/54

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2014

Kokai Jitsuyo Shinan Koho 1971-2014 Toroku Jitsuyo Shinan Koho 1994-2014

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	JP 5-234483 A (Omron Corp.), 10 September 1993 (10.09.1993), entire text; fig. 1 to 7 (Family: none)	1, 2, 4, 7 3, 5, 6
A	JP 2007-200579 A (Omron Corp.), 09 August 2007 (09.08.2007), entire text; fig. 1 to 33 (Family: none)	1-7



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T"

later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X"

document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y"

document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&"

document member of the same patent family

Date of the actual completion of the international search

22 August, 2014 (22.08.14)

Date of mailing of the international search report

16 September, 2014 (16.09.14)

Name and mailing address of the ISA/
Japanese Patent Office

Authorized officer

Facsimile No.

Telephone No.

Form PCT/ISA/210 (second sheet) (July 2009)

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

- US 6661319 B [0003]