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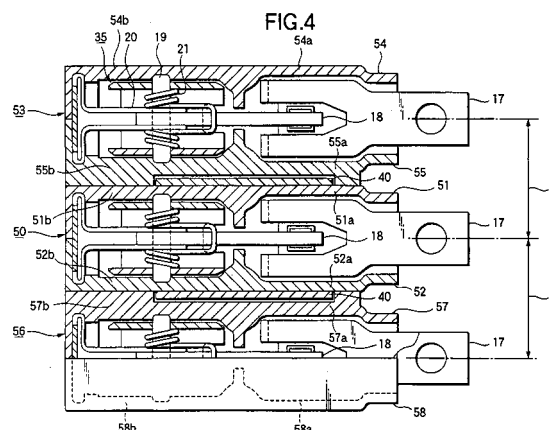
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(54) **CIRCUIT BREAKER**

(57) A circuit breaker is obtained in which it is not required to dispose a phase block between interrupting units, and a case constituting an interrupting unit is hardly broken by flowing of a blast of arc gas which is produced between contacts when a large current such as a short-circuit current flows.

In a circuit breaker having: a contactor mechanism which is configured by a movable contactor 18 and a stationary contactor 17; an opening/closing mechanism 30 for causing the contactor mechanism to perform an opening/closing operation; an arc distinguishing device 59 which attracts an arc in a predetermined direction, the arc being generated when the contactor mechanism is opened; and a housing 10 which is formed so as to accommodate the mechanisms and the device, the contactor mechanism and the arc distinguishing device are accommodated in cases 51 and 52 made of an insulating material to constitute a single-pole interrupting unit 50, 53, or 56, and a plurality of such single-pole interrupting units are closely juxtaposed to constitute a plural-pole interrupting unit.



Description

Technical Field

[0001] The present invention relates to a circuit breaker, and more particularly to a multipole circuit breaker in which a contactor mechanism, an arc distinguishing device, and the like are configured by a single-pole interrupting unit accommodated in a case, and a plurality of such single-pole interrupting units are accommodated in a housing.

Background Art

[0002] Fig. 12 is a partially cutaway section view of a conventional art circuit breaker of the assignee of the present invention and disclosed in, for example, the specification of JP-A-11-221501, and shows a closed state. Fig. 13 is a section view taken along the line a-a of Fig. 12. Fig. 14 shows a state where the circuit breaker shown in Fig. 12 performs an electromagnetic repulsive operation and a movable contactor is separated. Fig. 15 shows a state where the circuit breaker shown in Fig. 12 performs a tripping operation. Fig. 16 is a perspective view of an interrupting unit of the circuit breaker shown in Fig. 12. In the figures, 10 denotes a housing configured by a base 11, a cover 12, and an auxiliary cover 13. These components are formed by a synthetic resin material. The reference numeral 14 denotes a handle formed by a similar material, and 35 denotes a cross bar which is configured by rotor portions 15 that are made of a synthetic resin material, and a coupling pin 16, and in which the rotor portions 15 for plural poles are integrally coupled to one another by the coupling pin 16. The coupling pin 16 is coupled to an opening/closing mechanism 30 which will be described later. The reference numeral 17 denotes a stationary contactor which has a stationary contact 17a, and 18 denotes a movable contactor which has a movable contact 18a, and which is held by the rotor portion 15 so as to be swingable about a shaft 19.

[0003] The movable contactor 18 is urged in the direction of the arrow C by a movable element spring 21. Namely, the movable element spring 21 is a tension spring. One end of the spring is engaged with an outer peripheral portion of the rotor portion 15, and the other end is engaged with the movable contactor 18, thereby urging the movable contactor 18 in the direction of the arrow C. Therefore, the movable contactor 18 can swing in the direction of the arrow D against the movable element spring 21 irrespective of the rotor portion 15. The movable contactor 18 is interlocked with the swinging operation of the cross bar 35. Namely, when the rotor portion 15 of the cross bar 35 is swung by the operation of the opening/closing mechanism 30 which will be described later, the movable contactor 18 is drivenly moved by the swinging. In the above configuration, the stationary contactor 17, the movable contactor 18, the

cross bar 35, and the like constitute a contactor mechanism.

[0004] The reference numeral 20 denotes a movable element holder which is formed so that a pair of connecting conductors 20a (shown in Fig. 13) clamp the both side faces of the movable contactor 18 from both sides and are pressed by the movable element spring 21 to maintain electrical contact. The reference numeral 22 denotes a trip bar which is swung with being interlocked with an operation of an overcurrent tripping device (not shown). When the trip bar 22 is swung in a counterclockwise direction with using the shaft 28 as the fulcrum, the opening/closing mechanism 30 operates. This operation causes the cross bar 35 to swing, whereby the movable contactor 18 is separated from the stationary contactor 17 to perform automatic interruption (trip). As well known in the art, the opening/closing mechanism 30 can be operated by the handle 14.

[0005] The reference numeral 23 denotes an interrupting unit which is configured by the contactor mechanism, an arc distinguishing device, and the like. Namely, as shown in Fig. 13, 23a denotes a first case, and 23b denotes a second case. These cases are formed by a synthetic resin, and accommodate the contactor mechanism which is configured by the stationary contactor 17, the movable contactor 18, the shaft 19, the movable element holder 20, the movable element spring 21, and the cross bar 35, and the arc distinguishing device (not shown). The first case 23a and the second case 23b are coupled into one unit by a plurality of rivets 24 (shown in Fig. 12). As shown in Fig. 13, a first case through hole 23c is opened in a center pole and a side wall of the first case 23a adjacent to the center pole, and a second case through hole 23d is opened in the center pole and a side wall of the second case 23b adjacent to the center pole. A rotor through hole 15a is opened in a pair of side walls of the rotor portions 15 of the cross bar 35.

[0006] The relationships among the rotor through holes 15a and the case through holes 23c and 23d are made so that, when the opening/closing mechanism 30 sets via the cross bar 35 the movable contactor 18 to a closed state, the case through holes 23c and 23d and the rotor through holes 15a communicate with each other to form main portions of an arc gas relief hole. The arc gas relief hole is configured so that, when the opening/closing mechanism 30 sets via the cross bar 35 the movable contactor 18 to an opened state, the rotor portion 15 is swung, and hence the case through holes 23c and 23d are closed by the rotor portion 15, or namely the arc gas relief hole which has been opened is closed.

[0007] The reference numeral 25 denotes phase blocks which are formed inside the base 11 and the cover 12. As shown in Fig. 13, base plates 25a and partition walls 25b which protrude respectively from the base plates 25a in both the sides are formed to set a predetermined dimension L between the center pole and adjacent poles on both the sides. A first air vent channel

25c which communicates with the first case through hole 23c is formed between the partition wall 25b, the center pole of the interrupting unit 23, and an outer wall face 23e of the first case 23a adjacent to the center pole. A second air vent channel 25d which communicates with the second case through hole 23d is formed between the partition wall 25b, the center pole of the interrupting unit 23, and an outer wall face 23f of the second case 23b adjacent to the center pole. The whole of the arc relief hole is formed by the rotor through hole 15a, the first case through hole 23c and the second case through hole 23d, and the first air vent channel 25c and the second air vent channel 25d.

[0008] The reference numeral 26 denotes a tripping actuator. As shown in Fig. 12, an engaging portion 26a which is to be engaged with the trip bar 22 is formed in one end, and a valve portion 26b is formed in the other end. The actuator is rotatably journaled on a shaft 31. The reference numeral 27 denotes a torsion spring which urges the tripping actuator 26 in a counterclockwise direction, an which normally urges in a direction along which the valve portion 26b closes the first air vent channel 25c and the second air vent channel 25d. The reference numeral 40 shown in Fig. 13 denotes a frame for supporting the opening/closing mechanism 30 which is to be incorporated into the center pole.

[0009] In the thus configured circuit breaker, when a large current such as a short-circuit current flows, in the initial state, parallel currents which flow through the stationary contactor 17 and the movable contactor 18 in mutually opposite directions cause the stationary contactor 17 and the movable contactor 18 to perform an electromagnetic repulsive operation, thereby attaining the state shown in Fig. 14. Because of this electromagnetic repulsion, the movable contactor 18 is separated from the stationary contactor 17, and an arc A is generated between the stationary contact 17a and the movable contact 18a. Then, the arc A becomes gaseous to rapidly expand the surrounding gas to produce a blast, and then flows into the whole space in the interrupting unit 23.

[0010] The blast of the arc gas is guided by an arc distinguishing device which is not shown, to be discharged to the outside, and flows also in, for example, a direction indicated by the arrow B in Fig. 13 to be discharged toward the air vent channels 25c and 25d of the phase block 25 with passing through the rotor through holes 15a and the case through holes 23c and 23d. The blast of the arc gas which is discharged toward the air vent channels 25c and 25d presses the valve portion 26b of the tripping actuator 26 to drive the valve portion in the leftward direction. As a result, as shown in Fig. 14, the tripping actuator 26 is swung in a clockwise direction with using the shaft 31 as the fulcrum. This swinging of the tripping actuator 26 causes the engaging portion 26a to be engaged with the trip bar 22 and swing the trip bar 22 in a counterclockwise direction. As a result of this swinging, the engagement with the opening/

closing mechanism 30 by a well-known toggle link mechanism is cancelled, and automatic interruption (trip) is performed at an earlier time after the occurrence of the arc A, thereby attaining the state shown in Fig. 15.

[0011] In order to configure such a multipole circuit breaker, a plurality of single-pole interrupting units 23 are arranged inside the housing 10 having an appropriate width.

[0012] In the above-mentioned circuit breaker of the conventional art, as shown in Fig. 13, three single-pole interrupting units 23 each configured by the contactor mechanism, the arc distinguishing device, and the like are accommodated in parallel inside the housing 10 to configure a three-pole circuit breaker. In the case where a large number of circuit breakers are adjacently arranged on a distribution panel to be connected to feeder bars or the like, the distance between the stationary contactors 17 for the poles serving as connecting terminals must be set to the predetermined distance L, for example, 35 millimeters, and the phase blocks 25 are disposed respectively between the interrupting units 23. Since the interrupting units 23 are positioned via the phase blocks 25, there are problems in that adjustments in longitudinal, laterally, and vertical directions are difficult to do, and that the width of each of the interrupting units 23 is limited.

[0013] The three identical interrupting units 23 are arranged in parallel, and side walls 23h and 23j of the first case 23a, and side walls 23m and 23n of the second case 23b are formed so as to have the same thickness. In the interrupting unit 23 for the center pole, the side walls 23h, 23j, 23m, and 23n are reinforced by the frame 40 for supporting the opening/closing mechanism 30. In the interrupting units 23 for the left and right poles (hereinafter, the upper pole in Fig. 13 is referred to as the left pole, and the lower pole as the right pole) which are adjacent to the center pole, the outer side walls 23h, 23j, 23m, and 23n are reinforced by a base side wall 11a of the housing 10. However, the side walls 23m and 23n, and 23h and 23j, on the side of the center pole, of the case 23b of the interrupting unit 23 for the left pole, and the case 23a of the interrupting unit 23 for the right pole are not reinforced and are thin, thereby producing a further problem in that the side walls are easily broken by a blast of arc gas which is produced at interruption of a large current such as a short-circuit current.

[0014] Since the phase blocks 25 are disposed, the thickness of the cases 23a and 23b of each interrupting unit 23 are naturally limited, and hence it is impossible to provide the cases 23a and 23b of higher strength.

[0015] The invention has been conducted in order to solve the problems. It is an object of the invention to provide a circuit breaker in which it is not required to dispose a phase block between interrupting units, and a case constituting an interrupting unit is hardly broken.

Disclosure of Invention

[0016] The circuit breaker according to the invention is a circuit breaker having: a contactor mechanism which is formed so that, when a short-circuit current flows through a current-flowing circuit, electromagnetic repulsion occurs between a movable contactor and a stationary contactor; an opening/closing mechanism which is coupled via a cross bar to the movable contactor of the contactor mechanism, thereby causing the movable contactor to perform an opening/closing operation; a tripping mechanism which, when a current flowing through the current-flowing circuit exceeds a predetermined value, operates a trip bar to open the contactor mechanism via the opening/closing mechanism; an arc distinguishing device which attracts an arc in a predetermined direction, the arc being generated when the contactor mechanism is opened; and a housing which is formed so as to accommodate the mechanisms and the device, wherein the contactor mechanism, the cross bar, and the arc distinguishing device are accommodated in a case made of an insulating material to constitute a single-pole interrupting unit, and a plurality of single-pole interrupting units are closely juxtaposed to constitute a plural-pole interrupting unit.

[0017] The circuit breaker comprises: an interrupting unit for a center pole; and an interrupting unit for an adjacent pole, the interrupting unit being adjacent to the interrupting unit for the center pole and the housing, and a thickness of a side wall of the case of the interrupting unit for the adjacent pole, on a side adjacent to the center pole is larger than a thickness of a side wall on a side adjacent to the housing.

[0018] A fastening portion is disposed in the interrupting unit for the adjacent pole, and the interrupting unit is fixed in the fastening portion to a base of the housing by a fastening member.

[0019] The circuit breaker comprises a protrusion which is disposed on the case of the interrupting unit for the center pole, and a recess which is disposed in the case of the interrupting unit for the adjacent pole, and which is to be fitted with the protrusion, to integrate plural interrupting units with each other.

[0020] The protrusion has a wedge-like shape, and the recess is a dovetail groove.

[0021] The circuit breaker comprises: an interrupting unit for a center pole; and an interrupting unit for an adjacent pole, the interrupting unit being adjacent to the interrupting unit for the center pole and the housing, and a thickness of a side wall of the case of the interrupting unit for the adjacent pole, on a side adjacent to the housing is larger than a thickness of a side wall on a side adjacent to the center pole.

[0022] The circuit breaker further comprises a recess which is disposed in the case of the interrupting unit, and a stationary contactor having a protrusion which is to be fitted with the recess.

Brief Description of Drawings

[0023]

Fig. 1 is a perspective view of a circuit breaker showing Embodiment 1 of the invention.

Fig. 2 is a plan view of the circuit breaker showing Embodiment 1 of the invention.

Fig. 3 is a section view taken along the line b-b of Fig. 2.

Fig. 4 is a plan section view of main portions of interrupting units of the circuit breaker showing Embodiment 1 of the invention.

Fig. 5 is a plan section view of main portions of interrupting units of a circuit breaker showing Embodiment 2 of the invention.

Fig. 6 is a section view taken along the line c-c of Fig. 5.

Fig. 7 is a plan section view of main portions of interrupting units of a circuit breaker showing Embodiment 3 of the invention.

Fig. 8 is a plan section view of main portions of interrupting units of a circuit breaker showing Embodiment 4 of the invention.

Fig. 9 is a plan section view of main portions of interrupting units of a circuit breaker showing Embodiment 5 of the invention.

Fig. 10 is a view of an interrupting unit of a circuit breaker showing Embodiment 6 of the invention, (A) is a front section view, and (B) is a side view.

Fig. 11 is a trihedral view showing a stationary contactor of Embodiment 6 of the invention.

Fig. 12 is a partially cutaway section view showing a conventional art circuit breaker.

Fig. 13 is a section view taken along the line a-a of Fig. 12.

Fig. 14 is a partially cutaway view showing a state where the circuit breaker shown in Fig. 12 performs an electromagnetic repulsive operation.

Fig. 15 is a partially cutaway view showing a state where the circuit breaker shown in Fig. 12 performs a tripping operation.

Fig. 16 is a perspective view showing an interrupting unit of the conventional art circuit breaker.

Best Mode for Carrying Out the Invention

Embodiment 1.

[0024] In order to describe the invention in more detail, the invention will be described with reference to the accompanying drawings.

[0025] Fig. 1 is a perspective view of a circuit breaker showing Embodiment 1 of the invention. Fig. 2 is a plan view of the circuit breaker of Fig. 1 in which a cover is removed away. Fig. 3 is a section view taken along the line b-b of Fig. 2. Fig. 4 is a plan section view showing main portions of interrupting units of the circuit breaker.

[0026] In the figures, 10 to 22, 24, 28, 30, 35, and 40 are identical with those of the above-described apparatus of the conventional art, and their description is omitted.

[0027] In the circuit breaker shown in Figs. 1 to 3, interrupting units 50, 53, and 56 which will be described later are accommodated in the housing 10 configured by the base 11, the cover 12, and the auxiliary cover 13 that are formed by an insulating material such as a synthetic resin material. Referring to Fig. 4, 50 denotes the interrupting unit for the center pole (hereinafter, referred to as C-pole), 53 denotes the interrupting unit for the left pole (hereinafter, referred to as L-pole) which is adjacent to the center pole, and 56 denotes the interrupting unit for the right pole (hereinafter, referred to as R-pole) which is adjacent to the center pole.

[0028] The reference numeral 51 denotes a first case for the C-pole, 52 denotes a second case for the C-pole, 54 denotes a first case for the L-pole, 55 denotes a second case for the L-pole, 57 denotes a first case for the R-pole, and 58 denotes a second case for the R-pole. These cases are formed by an insulating material such as a synthetic resin, and accommodate a contactor mechanism which is configured by the stationary contactor 17, the movable contactor 18, the shaft 19, the movable element holder 20, the movable element spring 21, and the cross bar 35, and an arc distinguishing device 59 (shown in Fig. 3). Each of the interrupting units 50, 53, and 56 is coupled by a plurality of rivets 24 to be formed as a unit.

[0029] As shown in Fig. 4, a side wall 51a of the first case 51 for the C-pole and a side wall 52a of the second case 52 have the same thickness, and a side wall 51b of the first case 51 and a side wall 52b of the second case 52 have the same thickness. The thicknesses are equal to those of the apparatus of the conventional art. A side wall 54a of the first case 54 for the L-pole and the side wall 51a of the first case 51 for the C-pole have the same thickness, and a side wall 54b of the first case 54 for the L-pole and the side wall 51b of the first case 51 for the C-pole have the same thickness. However, the thickness of a side wall 55a of the second case 55 for the L-pole is formed to be larger than that of the side wall 54a of the first case 54 for the L-pole, and the thickness of a side wall 55b of the second case 55 for the L-pole is formed to be larger than that of the side wall 54b of the first case 54 for the L-pole.

[0030] Furthermore, a side wall 58a of the second case 58 for the R-pole and the side wall 52b of the second case 52 for the C-pole have the same thickness, and a side wall 58b of the second case 58 for the R-pole and the side wall 52b of the second case 52 for the C-pole have the same thickness. The walls are thin in the same manner as those of the apparatus of the conventional art. However, the thickness of a side wall 57a of the first case 57 for the R-pole is formed to be larger than that of the side wall 58a of the second case 58 for the R-pole, and the thickness of a side wall 57b of the

first case 57 for the R-pole is formed to be larger than that of the side wall 58b of the second case 58 for the R-pole.

[0031] In the thus configured circuit breaker, when a large current such as a short-circuit current flows, in the initial state, parallel currents which flow through the stationary contactor 17 and the movable contactor 18 in mutually opposite directions cause the stationary contactor 17 and the movable contactor 18 to electromagnetically repel each other. Because of this electromagnetic repulsion, the movable contactor 18 is separated from the stationary contactor 17, and an arc A (shown in Fig. 3) is generated between the stationary contact 17a and the movable contact 18a. Then, the arc A becomes gaseous to rapidly expand the surrounding gas to produce a blast, and then flows into the whole space in the interrupting unit 50.

[0032] In the following operation, the trip bar 22 is swung with being interlocked with an operation of an overcurrent tripping device (not shown), the engagement with the opening/closing mechanism 30 by a well-known toggle link mechanism is cancelled, and automatic interruption (trip) is performed at an earlier time after the occurrence of the arc A.

[0033] According to the configuration of Embodiment 1, the contactor mechanism, the cross bar 35, and the arc distinguishing device 59 are accommodated in a case made of an insulating material to constitute a single-pole interrupting unit, and a plurality of such single-pole interrupting units are closely juxtaposed to constitute a plural-pole interrupting unit. Therefore, it is possible to obtain a circuit breaker of a high rated interrupting capacity in which, unlike the circuit breaker of the conventional art, the phase blocks 25 that are disposed respectively between the interrupting units in order to ensure the predetermined distances L between the stationary contactors 17 for the poles are not necessary, which is economical, and in which the predetermined distances L can be easily ensured, the interrupting units can be made wider, and, for example, the stationary contactors 17 can be made wider.

[0034] Furthermore, the portions of the interrupting units 53 and 56 for the L- and R-poles on the side of the center pole, i.e., the thicknesses of the side walls 55a and 55b of the second case 55 for the L-pole, and those of the side walls 57a and 57b of the first case 57 for the R-pole are formed to be larger, and the outer end faces of the side walls 55a, 55b, 57a, and 57b abut against the side walls 51a, 51b, 52a, and 52b for the C-pole, so as to ensure the predetermined distances L. Therefore, the side walls are enhanced in strength, so that the cases 55 and 57 are hardly broken by a blast of arc gas which is produced at interruption of a large current such as a short-circuit current.

Embodiment 2.

[0035] Fig. 5 is a plan section view showing main por-

tions of interrupting units of a circuit breaker showing Embodiment 2 of the invention. Fig. 6 is a section view taken along the line c-c of Fig. 5. In the figures, 17 to 21, and 50 to 58 are identical with those of Embodiment 1. The reference numerals 55c and 55e denote a fastening portion and a through hole (which is disposed below the fastening portion 55c and corresponds to a through hole 57c, and which is not shown) formed in the second case 55 for the L-pole, and 57c and 57e denote a fastening portion and a through hole formed in the first case 57 for the R-pole. As shown in Fig. 6, the interrupting units 53 and 56 are fixed to the base 11 of the housing 10 by a fastening member configured by an attachment screw 60, a nut 61, and the like.

[0036] As the fastening member, in place of the attachment screw 60, a self-tapping screw (not shown) may be used to be screwed into cases 55 and 57 in which the through holes 55e and 57e are not opened, so as to fix the interrupting units to the base 11. Alternatively, the interrupting units may be fixed to the base 11 by using rivets (not shown).

[0037] According to the configuration of Embodiment 2, the interrupting units 53 and 56 for the L- and R-poles are fixed to the base 11 by using the fastening member, and hence it is possible to prevent the interrupting units 53 and 56 for the L- and R-poles from being moved in a direction along which the interrupting units are separated from the interrupting unit 50 for the C-pole by the electromagnetic repulsive force generated by the current flowing through a conductor for the C-pole and the currents flowing through the L- and R-poles in the same direction, and the base 11 and the cover 12 constituting the housing 10 from being broken.

Embodiment 3.

[0038] Fig. 7 is a plan section view showing main portions of interrupting units of a circuit breaker showing Embodiment 3 of the invention. In the figure, 17 to 21, and 50 to 58 are identical with those of Embodiment 1. The reference numerals 51d, 51e, 51f, and 51g denote a plurality of protrusions which are formed on the side walls 51a and 51b of the first case 51 for the C-pole, and 52d, 52e, 52f, and 52g denote a plurality of protrusions which are formed on the side walls 52a and 52b of the second case 52. The reference numerals 55d and 55g denote a plurality of recesses which are formed in the side walls 55a and 55b of the second case 55 for the L-pole, and 57d and 57g denote a plurality of recesses which are formed in the side walls 57a and 57b of the first case 57 for the R-pole. The reference numerals 40a and 40b denote a plurality of through holes which are formed in the frame 40.

[0039] According to the configuration of Embodiment 3, when the interrupting units 53 and 56 for the L- and R-poles are to be combined with both the sides of the interrupting unit 50 for the C-pole to configure interrupting units of a three-pole circuit breaker, the plural pro-

trusions 51d and 51g, and 52d and 52g are fitted into the plural recesses 55d and 55g, and 57d and 57g, and the plural protrusions 51e, 51f, 52e, and 52f are fitted into the through holes 40a and 40b of the frame 40.

Therefore, the plural interrupting units 50, 53, and 56 can be surely positioned and integrated with each other, whereby an assembling work is facilitated.

[0040] Furthermore, the interrupting unit 50 for the C-pole, and the interrupting units 53 and 56 for the L- and R-poles are restricted in mutual movement in a plane perpendicular to the shaft 19. Therefore, it is possible to prevent the interrupting unit 50, 53, or 56 for only one pole from being moved at interruption.

[0041] Such a fitting portion configured a protrusion and a recess is required to be disposed in at least one of the interrupting units 50, 53, and 56. As in Embodiment 3, preferably, a plurality of fitting portions may be disposed.

Embodiment 4.

[0042] Fig. 8 is a plan section view showing main portions of interrupting units of a circuit breaker showing Embodiment 4 of the invention. In the figure, 17 to 21, 40, 40a, 40b, 50 to 58, 51e, 51f, 52e, and 52f are identical with those of Embodiment 1.

[0043] The reference numerals 51h and 51j denote a plurality of wedge-like protrusions which are formed on the side walls 51a and 51b of the first case 51 for the C-pole, and 52h and 52j denote a plurality of wedge-like protrusions which are formed on the side walls 52a and 52b of the second case 52. The reference numerals 55h and 55j denote a plurality of dovetail grooves which are formed in the side walls 55a and 55b of the second case 55 for the L-pole, and 57h and 57j denote a plurality of dovetail grooves which are formed in the side walls 57a and 57b of the first case 57 for the R-pole.

[0044] According to the configuration of Embodiment 4, when the interrupting units 53 and 56 for the L- and R-poles are to be combined with both the sides of the interrupting unit 50 for the C-pole to configure interrupting units of a three-pole circuit breaker, the plural wedge-like protrusions 51h and 51j, and 52h and 52j are fitted into the plural dovetail grooves 55h and 55j, and 57h and 57j. Therefore, the plural interrupting units 50, 53, and 56 can be surely positioned and integrated with each other, whereby an assembling work is facilitated. Furthermore, it is possible to prevent the interrupting units 53 and 56 for the L- and R-poles from being moved in a direction along which the interrupting units are separated from the center pole by the electromagnetic repulsive force generated by the current flowing through a conductor for the C-pole and the currents flowing through the L- and R-poles in the same direction, and the base 11 and the cover 12 constituting the housing 10 from being broken.

Embodiment 5.

[0045] Fig. 9 is a plan section view of main portions of interrupting units of a circuit breaker showing Embodiment 5 of the invention. In the figure, 17 to 21, 40, and 50 to 58 are identical with those of Embodiment 1. The side wall 51a of the first case 51 for the C-pole and the side wall 52a of the second case 52 have the same thickness, and the side wall 51b of the first case 51 for the C-pole and the side wall 52b of the second case 52 have the same thickness. The walls are thin in the same manner as those of the apparatus of the conventional art.

[0046] The side wall 55a of the second case 55 for the L-pole and the side wall 52a of the second case 52 for the C-pole have the same thickness, and the side wall 55b of the second case 55 for the L-pole and the side wall 52b of the second case 52 for the C-pole have the same thickness. However, the thickness of the side wall 54a of the first case 54 for the L-pole is formed to be larger than that of the side wall 55a of the second case 55 for the L-pole, and the thickness of the side wall 54b of the first case 54 for the L-pole is formed to be larger than that of the side wall 55b of the second case 55 for the L-pole.

[0047] The side wall 57a of the first case 57 for the R-pole and the side wall 51a of the first case 51 for the C-pole have the same thickness, and the side wall 57b of the first case 57 for the R-pole and the side wall 51b of the first case 51 for the C-pole have the same thickness. The walls are thin in the same manner as those of the apparatus of the conventional art. However, the thickness of the side wall 58a of the second case 58 for the R-pole is formed to be larger than that of the side wall 57a of the first case 57 for the R-pole, and the thickness of the side wall 58b of the second case 58 for the R-pole is formed to be larger than that of the side wall 57b of the first case 57 for the R-pole.

[0048] The reference numerals 51m and 51n denote positioning protrusions which protrude from the side walls 51a and 51b of the first case 51 for the C-pole, and 52m and 52n denote positioning protrusions which protrude from the side walls 52a and 52b of the second case 52 for the C-pole. The protrusions are configured so that their tip end portions abut against the outer walls of the cases 55 and 57 for the adjacent poles to ensure the predetermined distances L, respectively.

[0049] According to the configuration of Embodiment 5, since the side walls 54a and 54b, and 58a and 58b of the outer cases 54 and 58 for the L- and R-poles are formed to be thick, the base side wall 11a (indicated by the two-dot chain line) of the portions which are adjacent to the side walls 54a and 54b, and 58a and 58b can be formed to be thin.

[0050] In the case where an expensive material of excellent strength is used as the material of the base 11 into which the interrupting units are to be accommodated, for example, the material cost of the base 11 is low because the base side wall 11a can be formed to be thin,

with the result that an economical circuit breaker can be obtained.

Embodiment 6.

[0051] Fig. 10 is a view showing an interrupting unit of a circuit breaker showing Embodiment 6 of the invention, (A) is a front section view, and (B) is a side view. Fig. 11 is a view showing a stationary contactor which is to be incorporated into the interrupting unit of Fig. 10, (A) is a plan view, (B) is a front view, and (C) is a side view. In the figures, 15 to 21, 24, and 50 to 52 are identical with those of Embodiment 1, and their description is omitted.

[0052] The reference numeral 17b denotes a protrusion which is disposed on a terminal portion 17c of the stationary contactor 17, 50s denote a terminal take-out port which is disposed in the cases 51 and 52 of the interrupting unit 50, and 50t denotes a case recess which is disposed continuously with the terminal take-out port 50s. When the stationary contactor 17 is incorporated into the terminal take-out port 50s, the protrusion 17b is fitted into the case recess 50t. At this time, gaps G are formed between the end faces of the terminal portion 17c and side walls 51u and 52u of the terminal take-out port 50s.

[0053] According to the configuration of Embodiment 6, the protrusion 17b is disposed on the stationary contactor 17 so as to be fitted into the case recess 50t of the cases 51 and 52 of the interrupting unit 50. In the case where a short-circuit current is interrupted, or where an external wire is to be fastened by a terminal screw (not shown) to the terminal portion 17c, even when the terminal portion 17b is rotated, therefore, the rotating force is received by the case recess 50t via the protrusion 17b, and the rotating force does not act on the side walls of the terminal take-out port 50s because of the gaps G, and acts on the thick portions of high strength between the case recess 50t and the end faces 51v and 52v of the interrupting units 51 and 52. Consequently, the interrupting units 51 and 52 are hardly broken.

[0054] Unlike the circuit breaker of the conventional art, the phase blocks 25 are not disposed, and the interrupting unit can be made wider, and hence the case recess 50t also can be made wider, so that the embodiment can be favorably used.

Industrial Applicability

[0055] As described above, according to the circuit breaker of the invention, a contactor mechanism, a cross bar, and an arc distinguishing device are accommodated in a case made of an insulating material to constitute a single-pole interrupting unit, and a plurality of single-pole interrupting units are closely juxtaposed to constitute a plural-pole interrupting unit. Therefore, it is possible to obtain a circuit breaker of a high rated inter-

rupting capacity in which, unlike a circuit breaker of the conventional art, phase blocks that are disposed respectively between interrupting units in order to ensure predetermined distances between stationary contactors for poles are not necessary, which is economical, and in which the predetermined distances can be easily ensured, and the interrupting units can be made wider.

[0056] Furthermore, the circuit breaker of the invention comprises: an interrupting unit for a center pole; and an interrupting unit for an adjacent pole, the interrupting unit being adjacent to the interrupting unit for the center pole and a housing, and a thickness of a side wall of the case of the interrupting unit for the adjacent pole, on a side adjacent to the center pole is larger than a thickness of a side wall on a side adjacent to the housing. Therefore, side walls are enhanced in strength, so that the cases are hardly broken by a blast of arc gas which is produced at interruption of a large current such as a short-circuit current.

[0057] Furthermore, according to the circuit breaker of the invention, a fastening portion is disposed in the interrupting unit for the adjacent pole, and the interrupting unit is fixed in the fastening portion to a base of the housing by a fastening member. Therefore, the interrupting unit for the adjacent pole is hardly moved by the electromagnetic repulsive force generated by the current flowing through a conductor for the Center-pole and the current flowing through the adjacent pole in the same direction, and the base and the cover constituting the housing can be prevented from being broken.

[0058] Furthermore, according to the circuit breaker of the invention, a protrusion which is disposed on the case of the interrupting unit for the center pole, and a recess which is disposed in the case of the interrupting unit for the adjacent pole, and which is to be fitted with the protrusion are disposed. Therefore, the plural interrupting units can be surely positioned and integrated with each other, and an assembling work is facilitated.

[0059] Furthermore, according to the circuit breaker of the invention, the protrusion has a wedge-like shape and the recess is a dovetail groove. Therefore, the plural interrupting units can be surely positioned and integrated with each other, whereby an assembling work is facilitated. Moreover, the interrupting unit for the adjacent pole is hardly moved by the electromagnetic repulsive force generated by the current flowing through a conductor for the Center-pole and the current flowing through the adjacent pole in the same direction, and the base and the cover constituting the housing can be prevented from being broken.

[0060] Furthermore, the circuit breaker of the invention comprises: an interrupting unit for a center pole; and an interrupting unit for an adjacent pole, the interrupting unit being adjacent to the interrupting unit for the center pole and the housing, and a thickness of a side wall of the case of the interrupting unit for the adjacent pole, on a side adjacent to the housing is larger than a thickness of a side wall on a side adjacent to the center pole. In

the case where an expensive material of excellent strength is used as the material of the base into which the interrupting units are to be accommodated, therefore, the material cost of the base is low because the base side wall can be formed to be thin, with the result that an economical circuit breaker can be obtained.

[0061] Furthermore, according to the circuit breaker of the invention, a recess which is disposed in the case of the interrupting unit, and a stationary contactor having a protrusion which is to be fitted with the recess are disposed. When a short-circuit current is interrupted, or when an external wire is to be fastened to a terminal portion of the stationary contactor, therefore, the interrupting unit is hardly broken.

Claims

1. A circuit breaker having: a contactor mechanism which is formed so that, when a short-circuit current flows through a current-flowing circuit, electromagnetic repulsion occurs between a movable contactor and a stationary contactor; an opening/closing mechanism which is coupled via a cross bar to said movable contactor of said contactor mechanism, thereby causing said movable contactor to perform an opening/closing operation; a tripping mechanism which, when a current flowing through said current-flowing circuit exceeds a predetermined value, operates a trip bar to open said contactor mechanism via said opening/closing mechanism; an arc distinguishing device which attracts an arc in a predetermined direction, the arc being generated when said contactor mechanism is opened; and a housing which is formed so as to accommodate said mechanisms and said device, wherein said contactor mechanism, said cross bar, and said arc distinguishing device are accommodated in a case made of an insulating material to constitute a single-pole interrupting unit, and a plurality of single-pole interrupting units are closely juxtaposed to constitute a plural-pole interrupting unit.
2. A circuit breaker according to claim 1, wherein said circuit breaker comprises: an interrupting unit for a center pole; and an interrupting unit for an adjacent pole, said interrupting unit being adjacent to said interrupting unit for said center pole and said housing, and a thickness of a side wall of said case of said interrupting unit for said adjacent pole, on a side adjacent to the center pole is larger than a thickness of a side wall on a side adjacent to said housing.
3. A circuit breaker according to claim 1 or 2, wherein a fastening portion is disposed in said interrupting unit for the adjacent pole, and said interrupting unit is fixed in said fastening portion to a base of said housing by a fastening member.

4. A circuit breaker according to any one of claims 1 to 3, wherein said circuit breaker comprises a protrusion which is disposed on said case of said interrupting unit for the center pole, and a recess which is disposed in said case of said interrupting unit for the adjacent pole, and which is to be fitted with said protrusion. 5
5. A circuit breaker according to claim 4, wherein said protrusion has a wedge-like shape, and said recess is a dovetail groove. 10
6. A circuit breaker according to claim 1, wherein said circuit breaker comprises: an interrupting unit for a center pole; and an interrupting unit for an adjacent pole, said interrupting unit being adjacent to said interrupting unit for the center pole and said housing, and a thickness of a side wall of said case of said interrupting unit for the adjacent pole, on a side adjacent to said housing is larger than a thickness of a side wall on a side adjacent to the center pole. 15 20
7. A circuit breaker according to any one of claims 1 to 6, wherein said circuit breaker comprises a recess which is disposed in said case of said interrupting unit, and a stationary contactor having a protrusion which is to be fitted with said recess. 25

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FIG.1

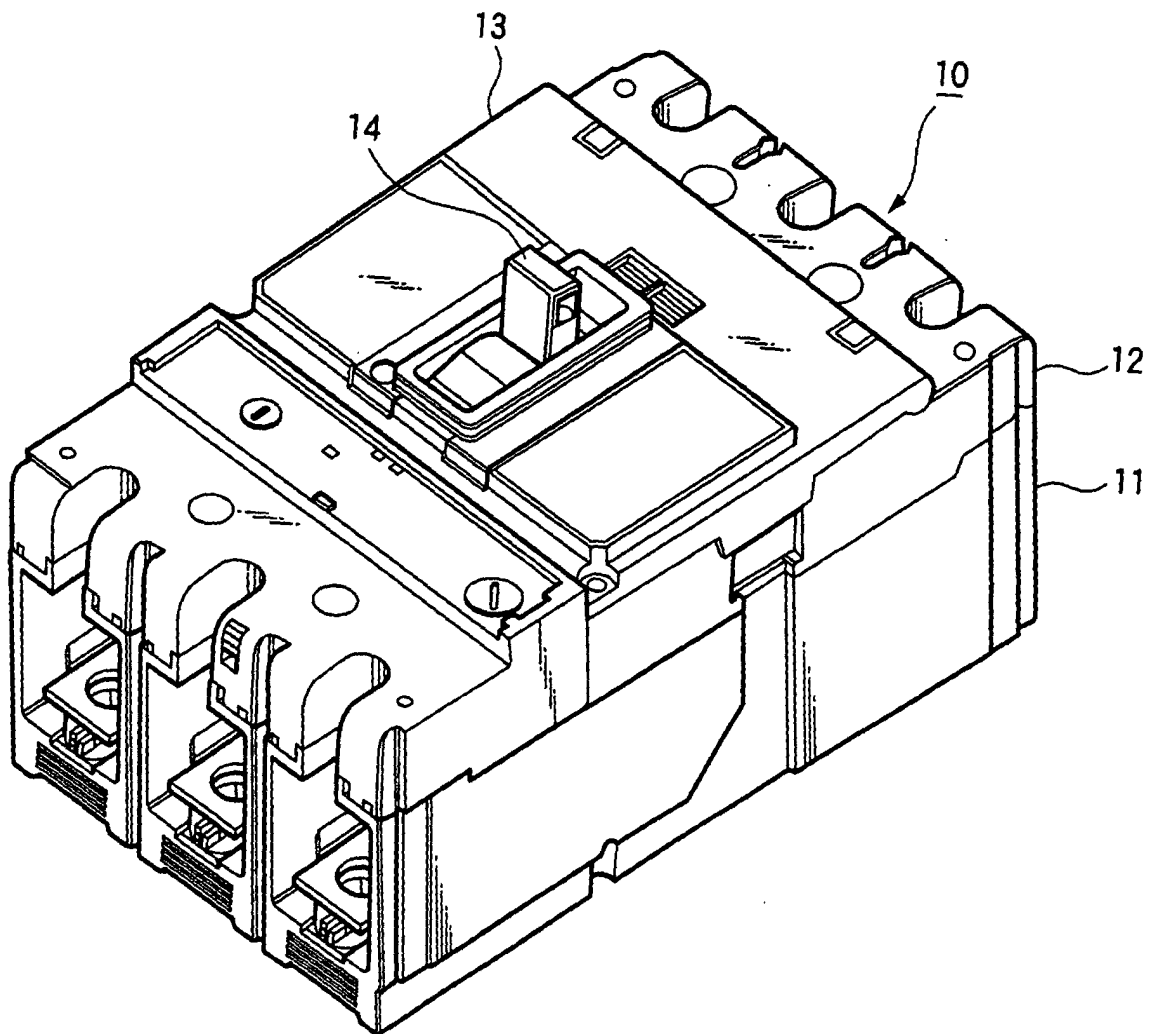


FIG.2

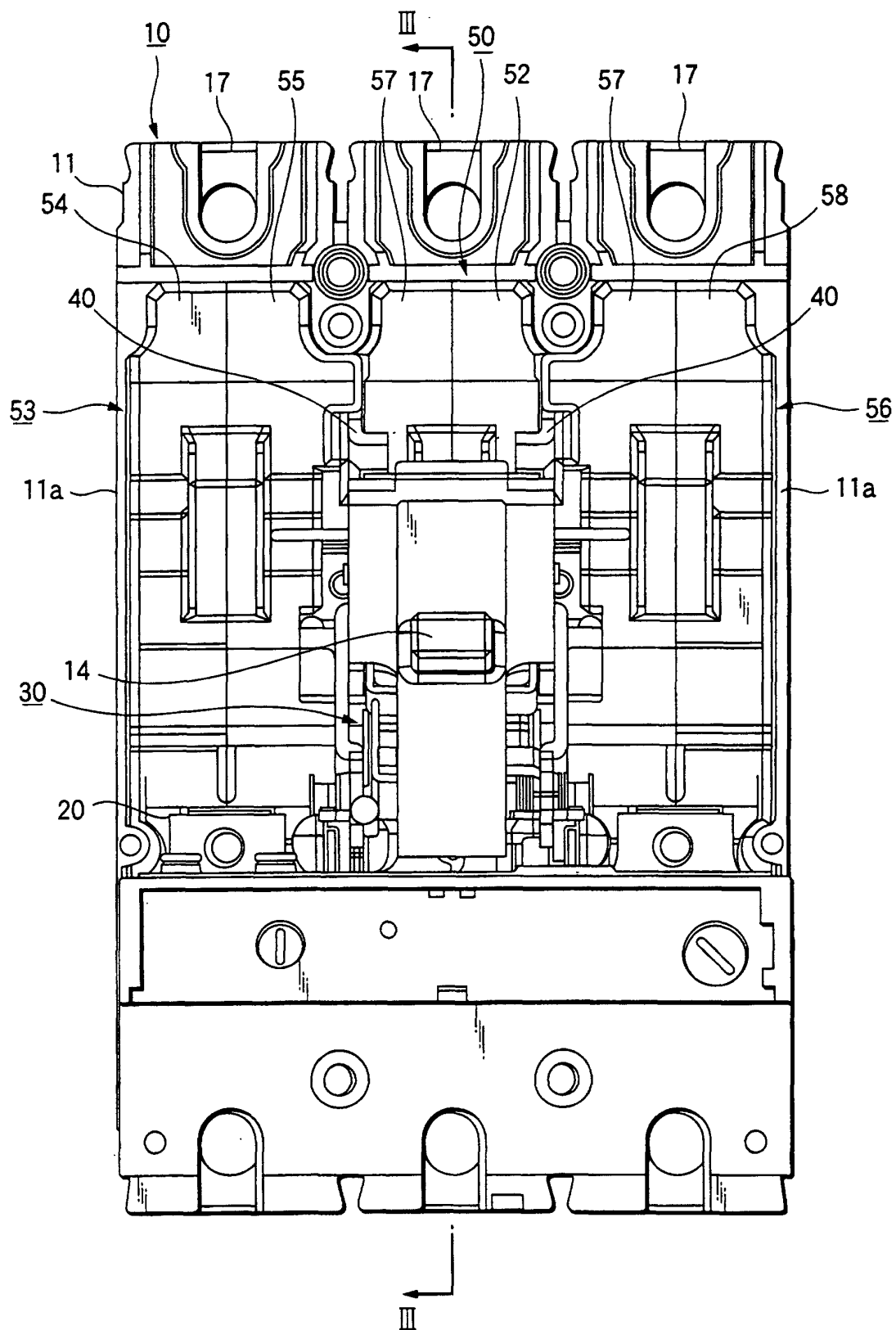
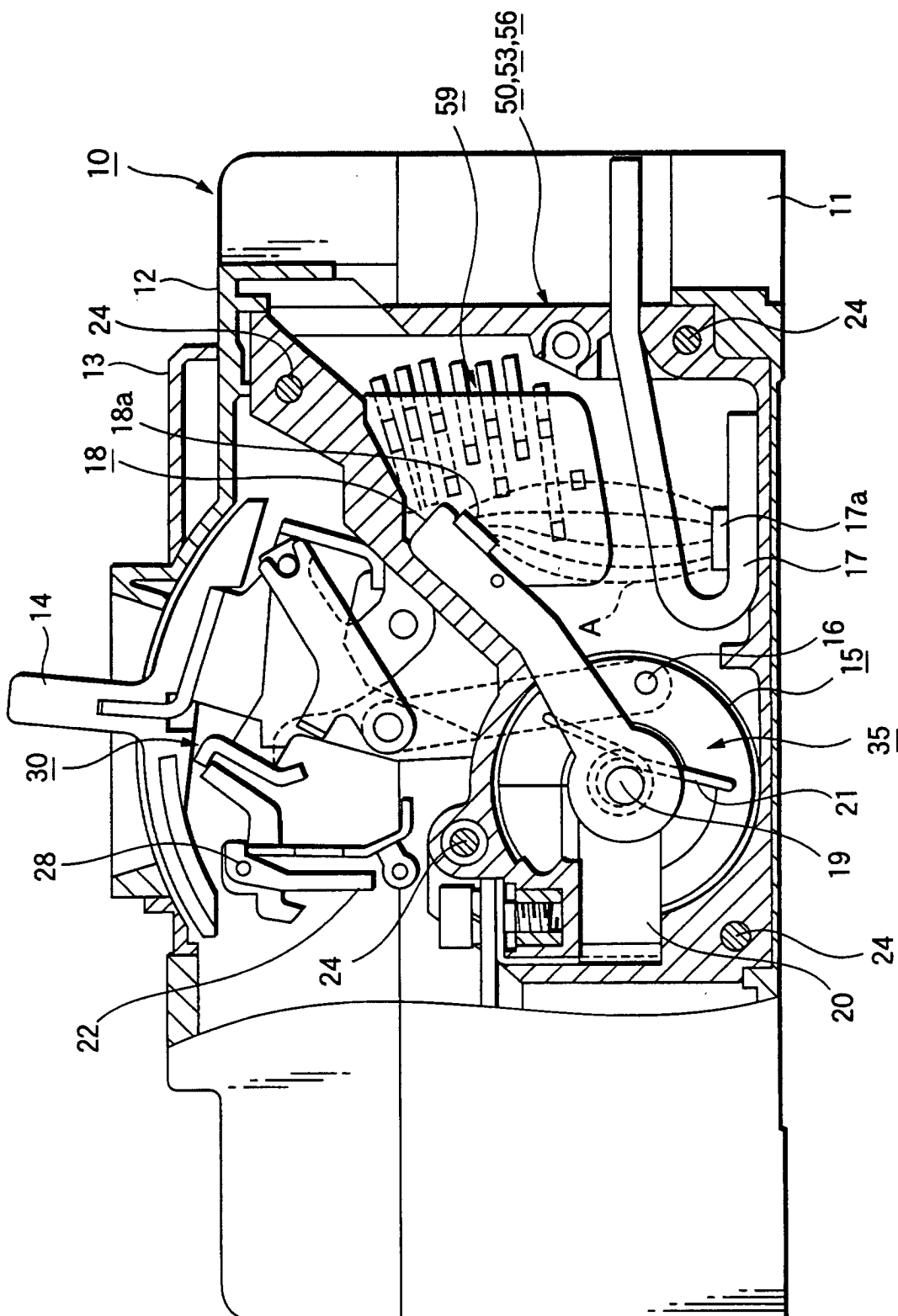
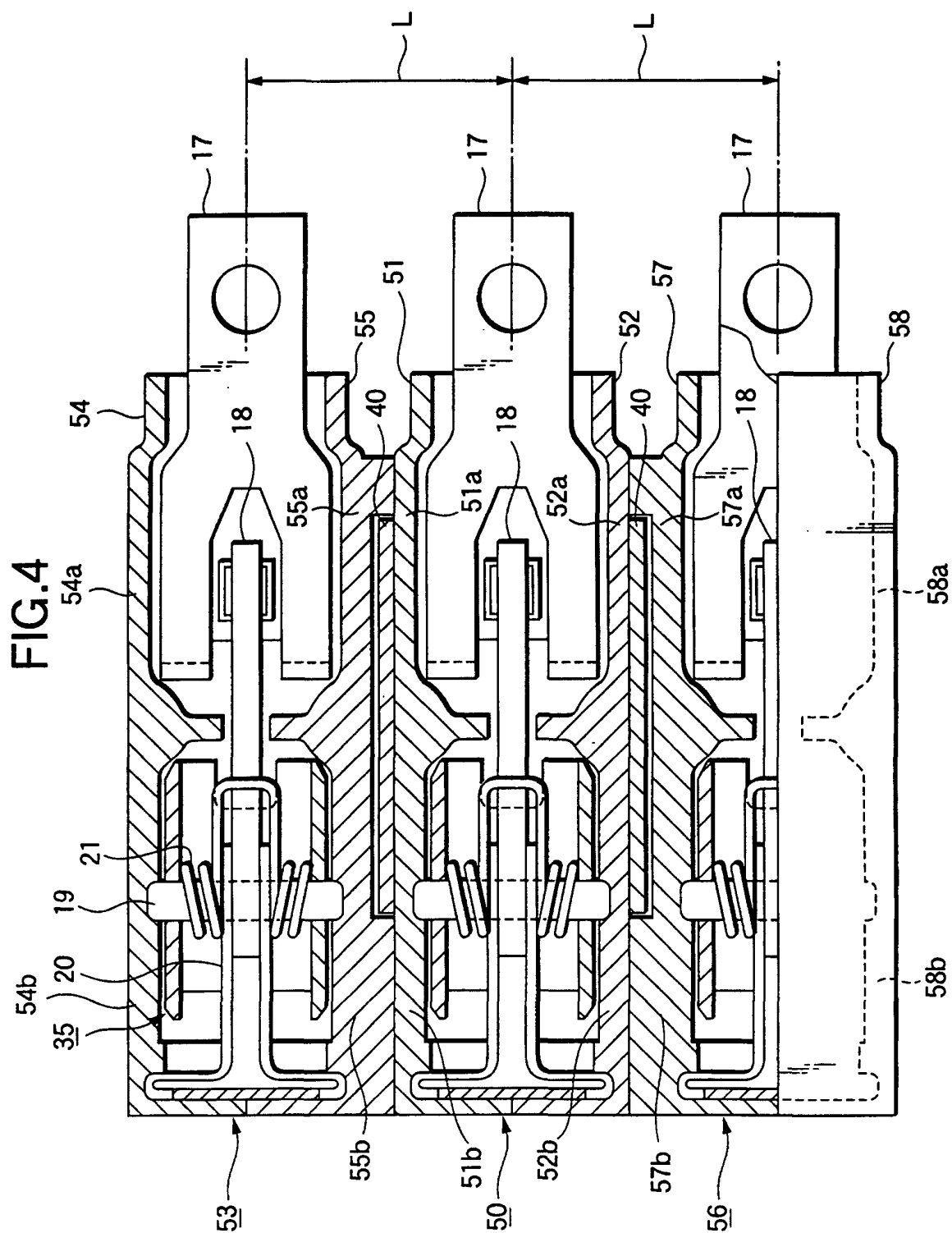


FIG.3





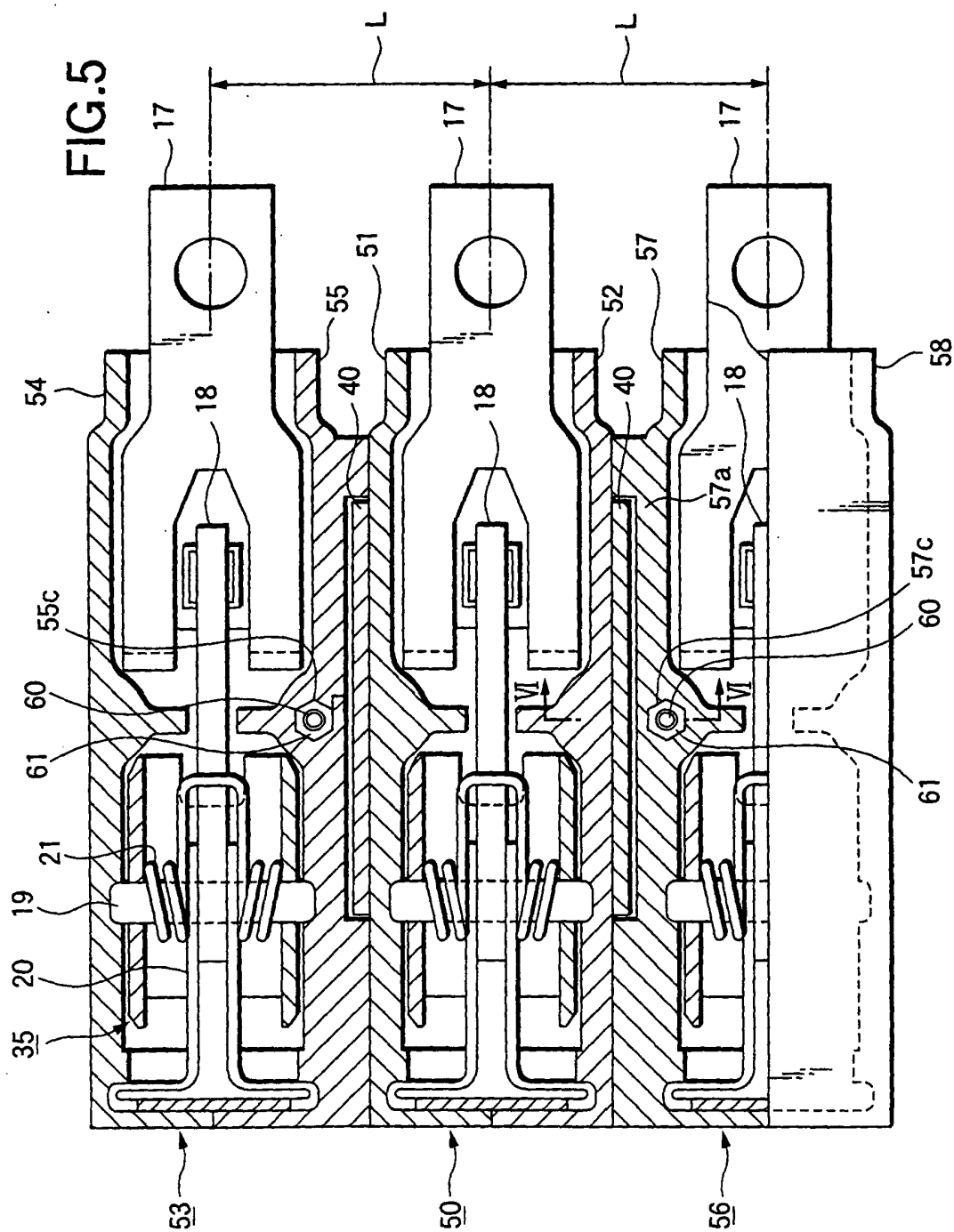


FIG.6

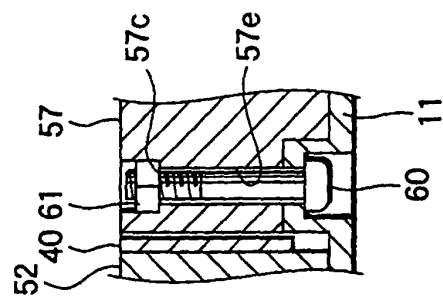


FIG. 7

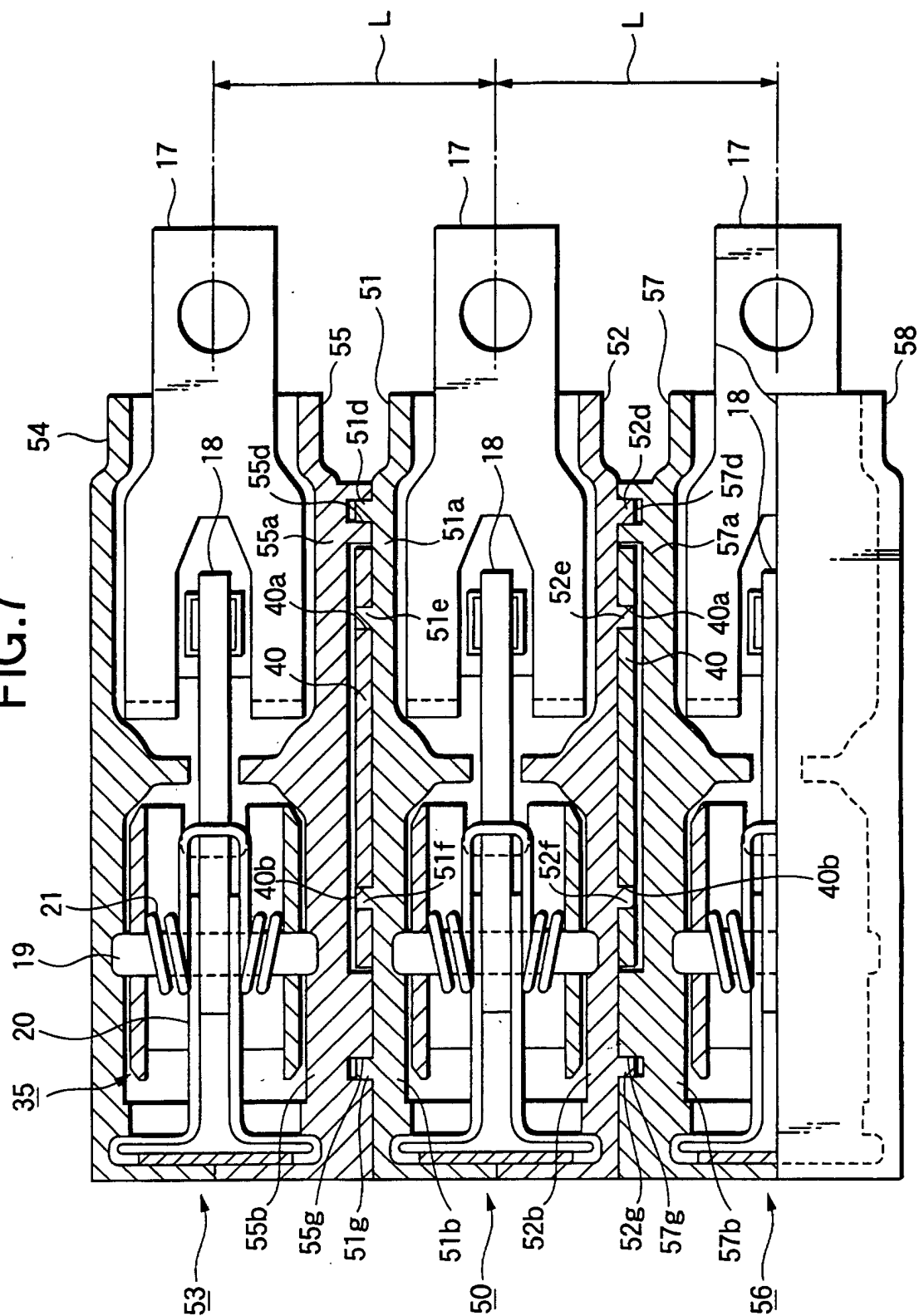
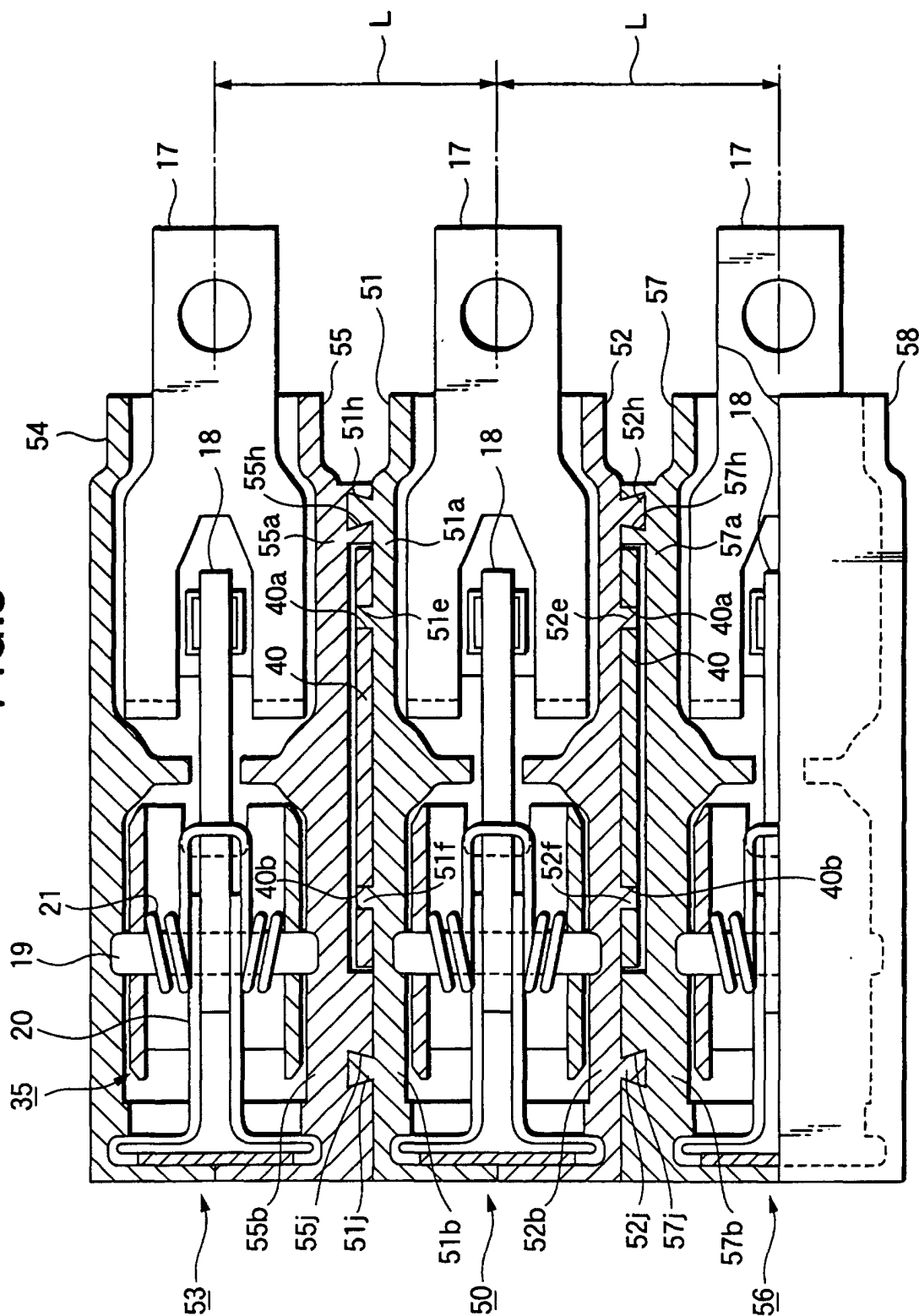
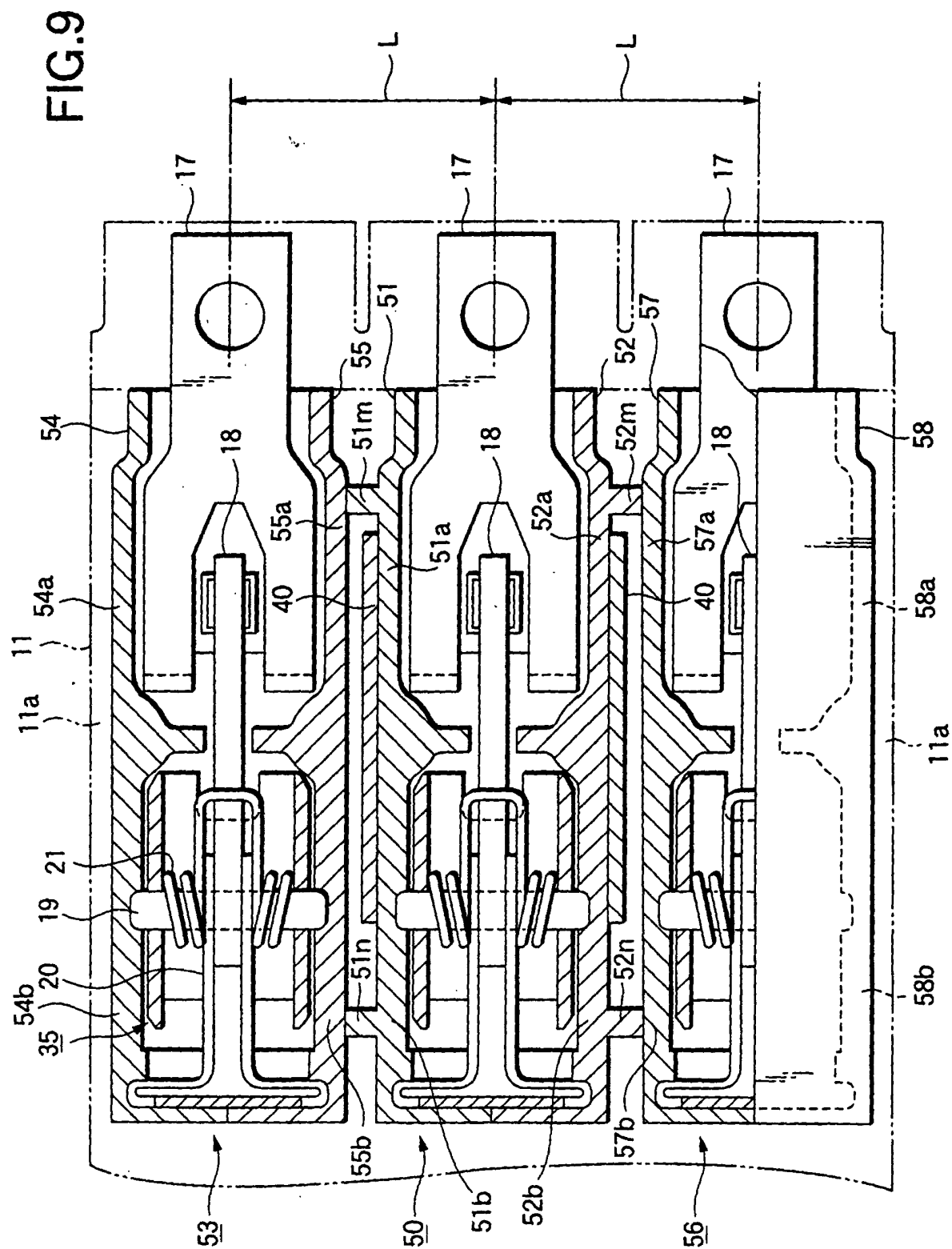


FIG.8





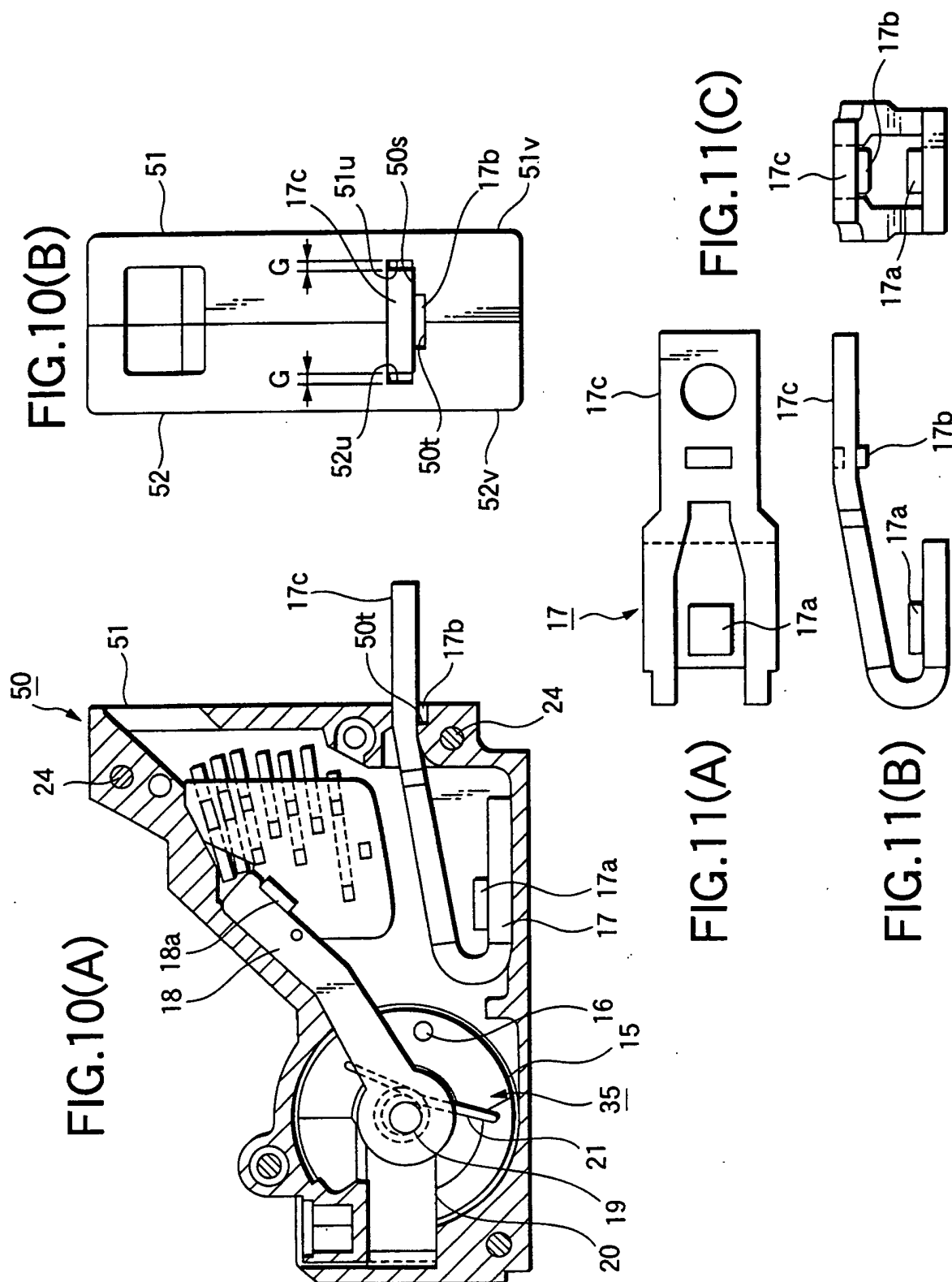
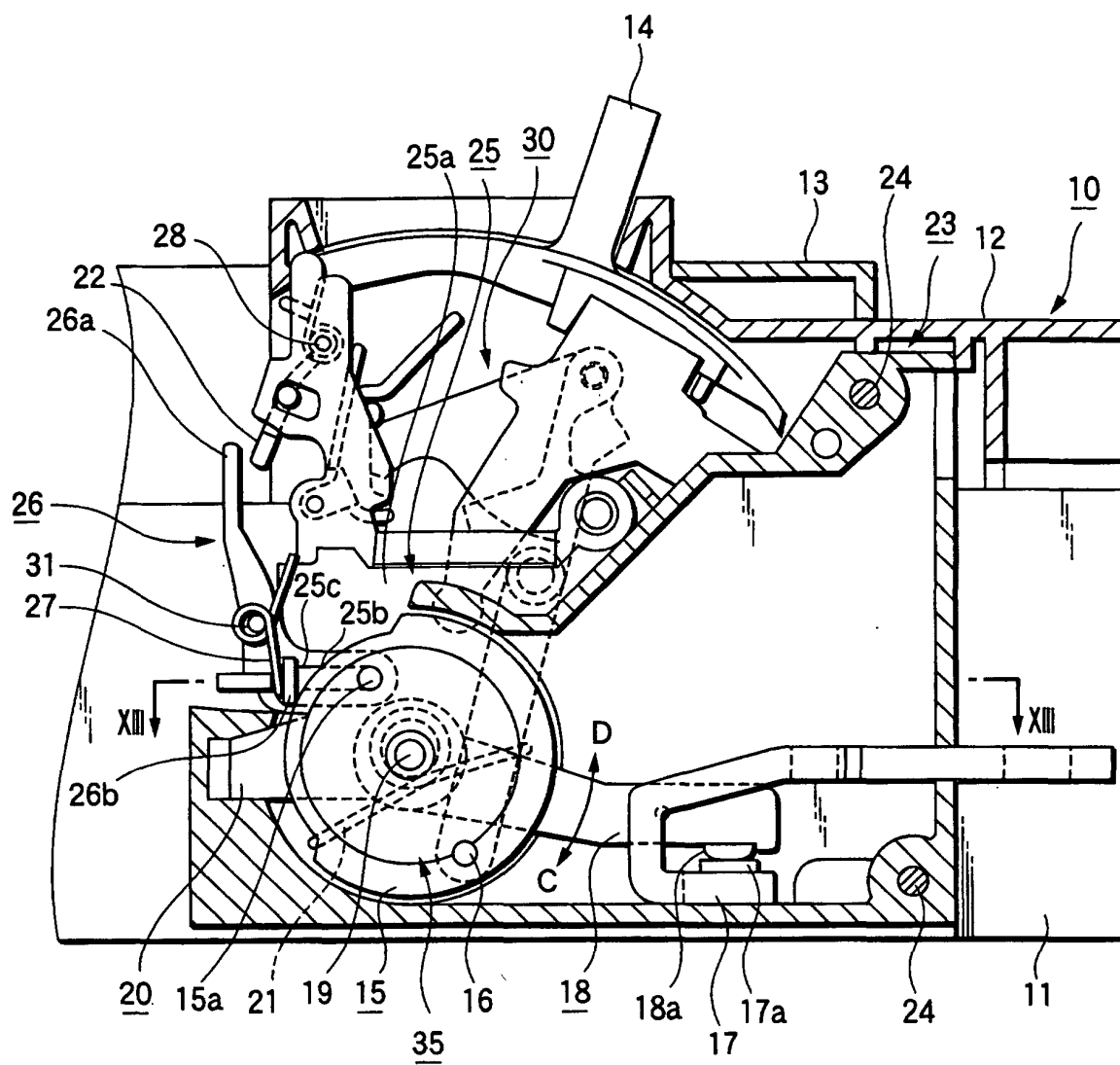


FIG.12



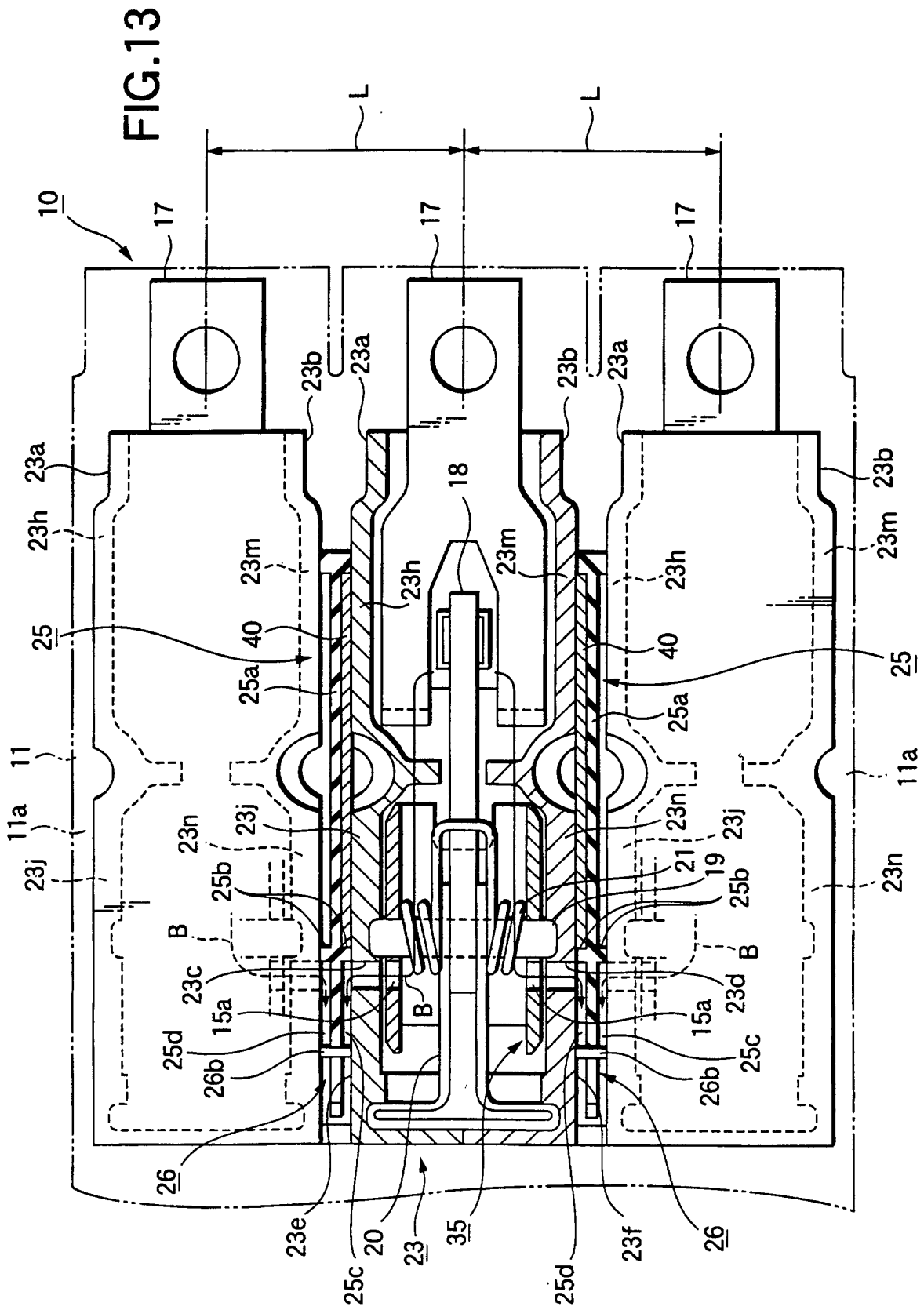


FIG.14

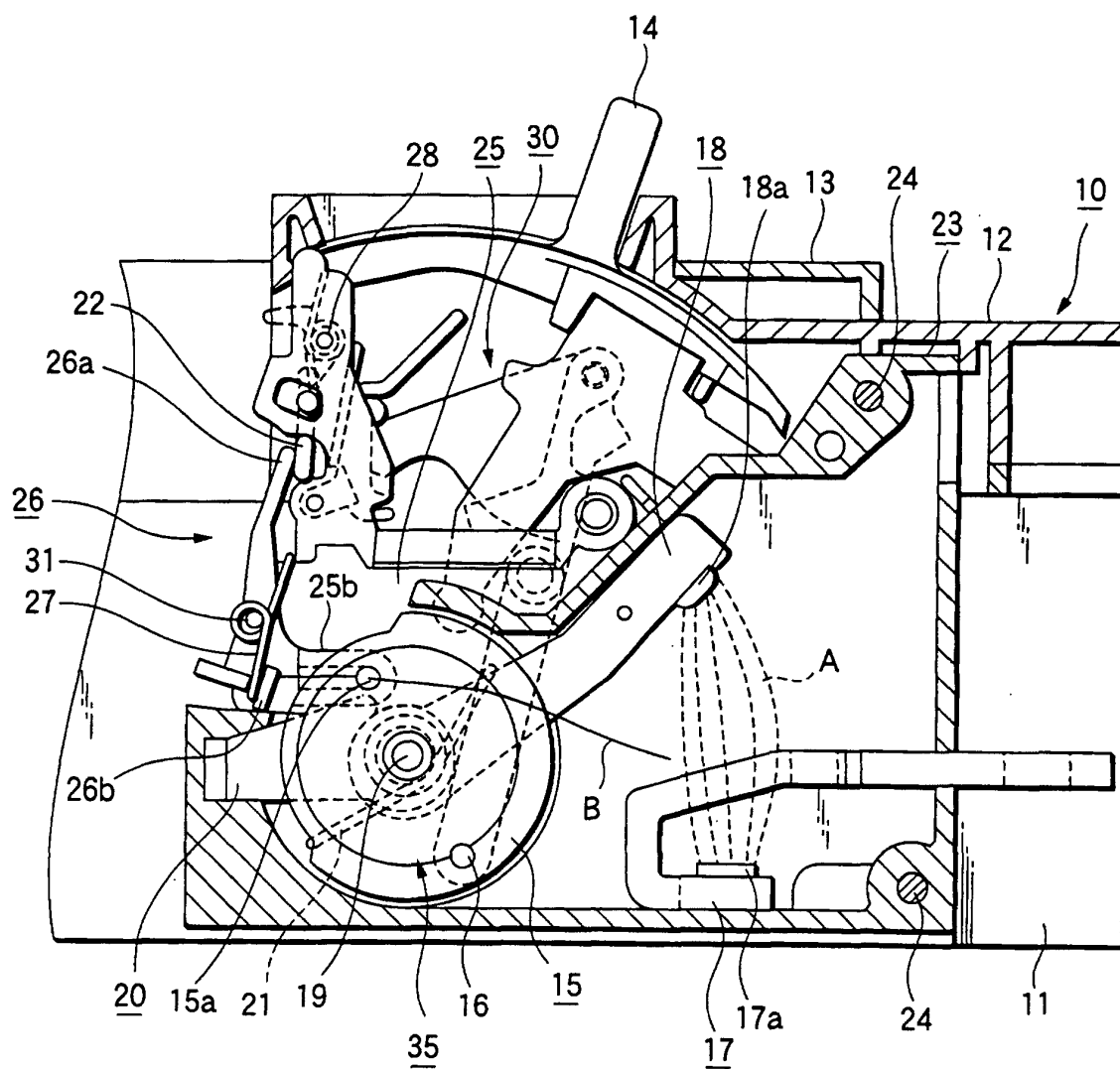


FIG.15

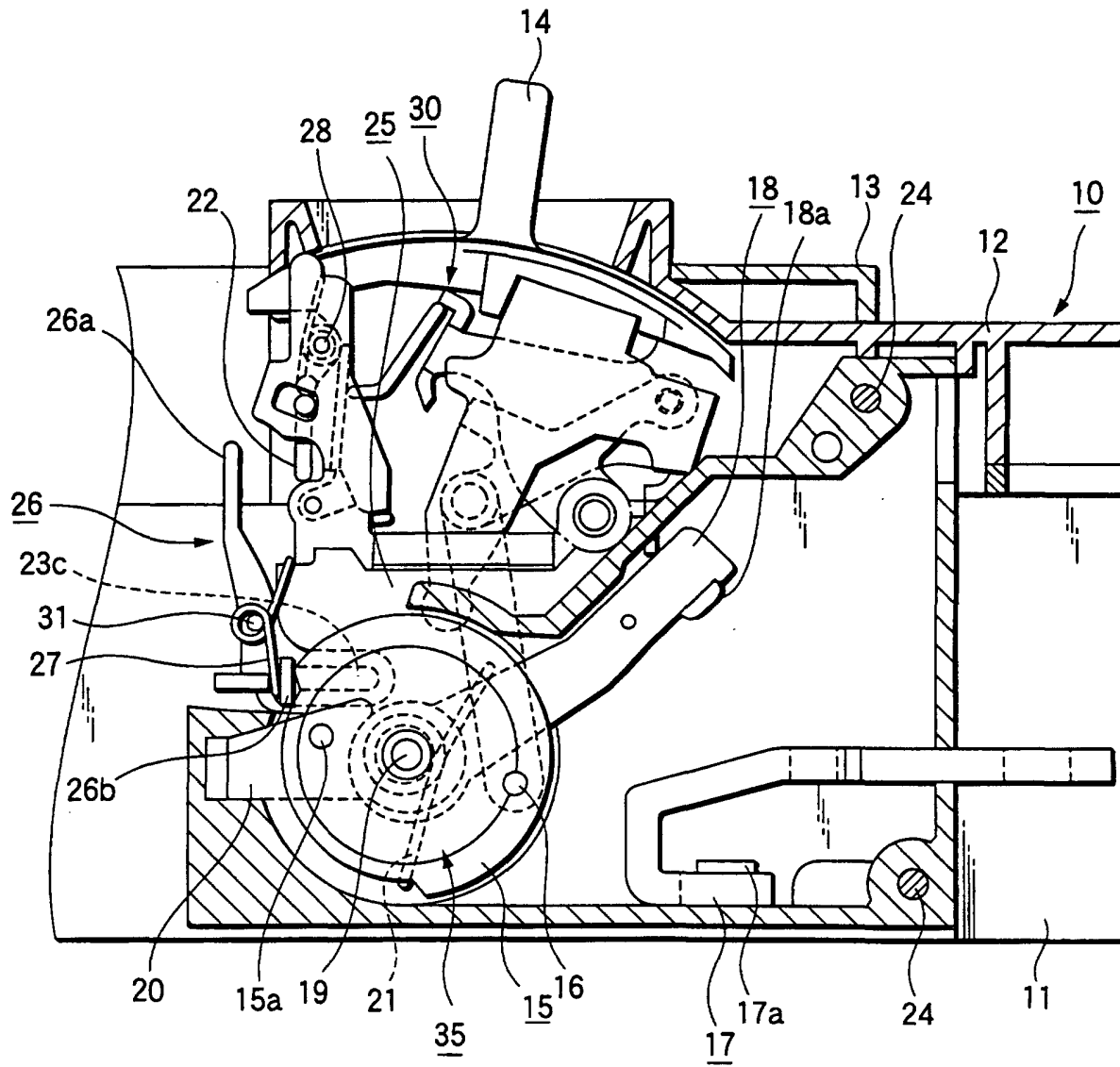
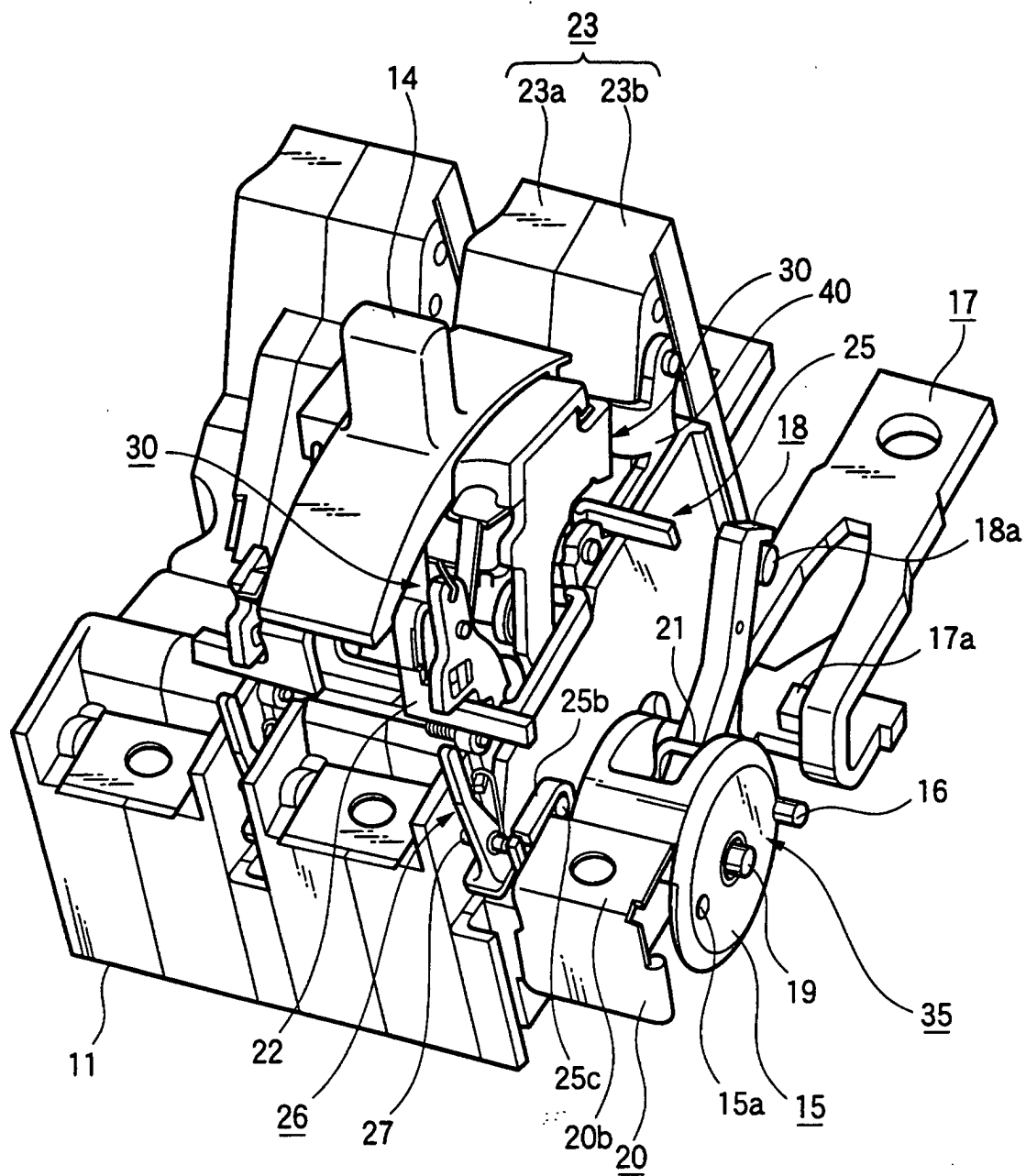


FIG.16



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP00/01673

A. CLASSIFICATION OF SUBJECT MATTER Int.Cl. ⁷ H01H71/12														
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) Int.Cl. ⁷ H01H71/00-83/22														
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Jitsuyo Shinan Koho 1926-1996 Jitsuyo Shinan Toroku Koho 1996-2000 Kokai Jitsuyo Shinan Koho 1971-2000 Toroku Jitsuyo Shinan Koho 1994-2000														
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.												
Y	JP, 7-21897, A (Fuji Electric Co., Ltd.), 24 January, 1995 (24.01.95), Column 2, line 46 to Column 3, line 16; Figs. 1 to 3 (Family: none)	1-7												
Y	JP, 7-53243, Y2 (Fuji Electric Co., Ltd.), 06 December, 1995 (06.12.95), Column 2, line 10 to Column 3, line 9; Fig. 5 (Family: none)	1-7												
Y	JP, 60-250540, A (Matsushita Electric Works, Ltd.), 11 December, 1985 (11.12.85), Figs. 11 to 12 (Family: none)	1-7												
Y A	JP, 6-119866, A (Fuji Electric Co., Ltd.), 28 April, 1994 (28.04.94), Column 2, lines 39 to 43; Figs. 1 to 3 (Family: none)	4, 1-3, 5, 7												
Y	JP, 8-7741, A (Fuji Electric Co., Ltd.), 12 January, 1996 (12.01.96), Column 10, line 46 to Column 11, line 8; Figs. 1 to 3 (Family: none)	5												
☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.														
<table border="0"> <tr> <td>* Special categories of cited documents:</td> <td>"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</td> </tr> <tr> <td>"A" document defining the general state of the art which is not considered to be of particular relevance</td> <td>"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</td> </tr> <tr> <td>"E" earlier document but published on or after the international filing date</td> <td>"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</td> </tr> <tr> <td>"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)</td> <td>"&" document member of the same patent family</td> </tr> <tr> <td>"O" document referring to an oral disclosure, use, exhibition or other means</td> <td></td> </tr> <tr> <td>"P" document published prior to the international filing date but later than the priority date claimed</td> <td></td> </tr> </table>			* Special categories of cited documents:	"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	"A" document defining the general state of the art which is not considered to be of particular relevance	"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	"E" earlier document but published on or after the international filing date	"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	"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)	"&" document member of the same patent family	"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	
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"P" document published prior to the international filing date but later than the priority date claimed														
Date of the actual completion of the international search 14 June, 2000 (14.06.00)		Date of mailing of the international search report 27 June, 2000 (27.06.00)												
Name and mailing address of the ISA/ Japanese Patent Office		Authorized officer												
Facsimile No.		Telephone No.												

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP00/01673

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y A	JP, 7-41946, U (Matsushita Electric Works, Ltd.), 21 July, 1995 (21.07.95), Figs. 2 to 6 (Family: none)	6, 1-5, 7
Y A	JP, 31-1828, Y1 (Bikichi Ishimaru), 08 February, 1956 (08.02.56), Figs. 1 to 2 (Family: none)	6, 1-5, 7
Y	JP, 1-155634, U (Fuji Electric Co., Ltd.), 25 October, 1989 (25.10.89), Figs. 1 to 11 (Family: none)	7
A	EP, 310474, A1 (Merlin, Gerin), 05 April, 1989 (05.04.89) & JP, 1-115025, A & FR, 2621424, A	1-7
A	JP, 58-131625, A (Matsushita Electric Works, Ltd.), 05 August, 1983 (05.08.83) (Family: none)	1-7
A	EP, 177438, A2 (Siemens AG), 09 April, 1986 (09.04.86) & JP, 61-85744, A & US, 4680564, A & CA, 1241987, A & DE, 3578970, C	1-7
A	JP, 48-90127, U (Westinghouse Electric Corporation), 30 October, 1973 (30.10.73) (Family: none)	1-7
A	JP, 50-72964, U (Mitsubishi Electric Corporation), 26 June, 1975 (26.06.75) (Family: none)	1-7

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