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(54) Operating mechanism of a moving contact for an automatic electrical circuit breaker

(57) An operating mechanism of a moving contact (15) for an automatic electrical circuit breaker (10), of novel constructional simplicity, comprises an operating member (28), a system of levers (25) for the engagement of the moving contact (15) with the operating member (25) and for the oscillation of the moving contact (15) from an open position of the circuit breaker, separated from a fixed contact (37), to a closed position of the circuit breaker, with the moving contact (15) in electrical contact with the fixed contact (37), together with elastic means (43) which constantly press the moving contact (15) towards said open position of the circuit breaker, said system of levers (25) interacting with an electrical protection device (34) to release the operating member (28), wherein the levers of said system of levers (25) are made from flat plates.

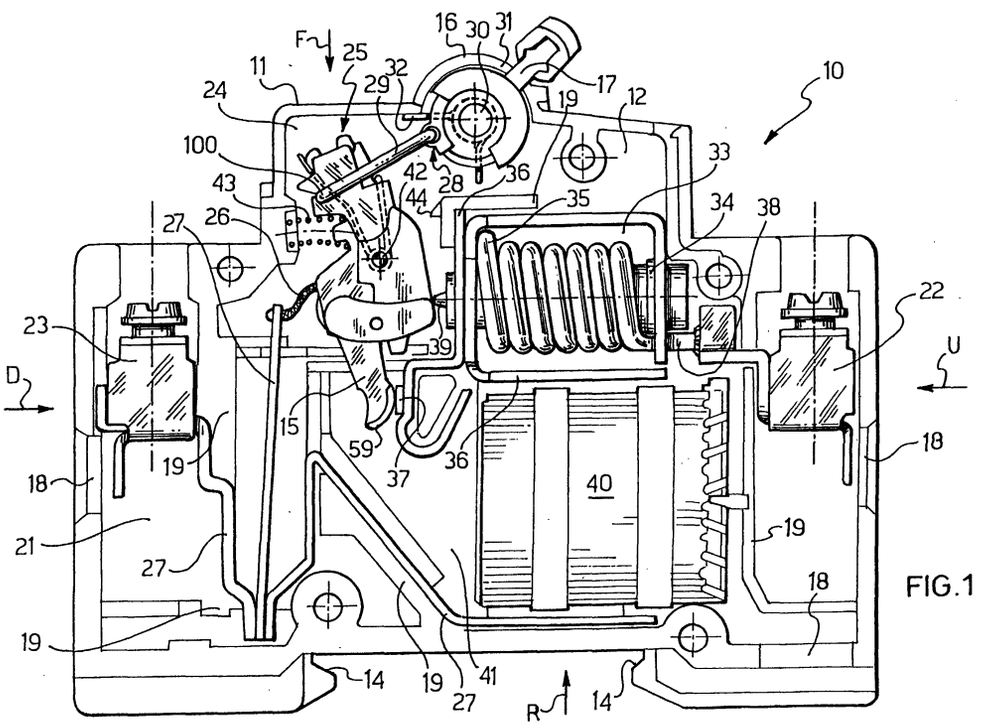

FIG.1

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Description

[0001] The present invention relates to an operating mechanism of a moving contact, particularly designed for use in an automatic electrical circuit breaker.

[0002] More particularly, the invention relates to an operating mechanism of a moving contact, comprising an operating member, a system of levers for engaging the moving contact with the operating member and for the oscillation of the moving contact from an open circuit breaker position where it is separated from a fixed contact to a closed circuit breaker position with the moving contact in electrical contact with the fixed contact, together with elastic means which constantly press the moving contact towards the said open circuit breaker position. Said system of levers interacts with an electrical protection device to release the operating member from the latter and to open the circuit breaker.

[0003] The term "electrical contact" denotes a contact between two metallic bodies which conduct electrical current - for example, the first of said bodies is the moving contact and the second is the fixed contact - in such a way that the current can pass from one conducting body to the other.

[0004] There are known mechanisms of the aforementioned type, in which the aforesaid system of levers comprises an operating lever which supports the moving contact for its oscillation from and towards the fixed contact. Said operating lever interacts with a pawl lever. The pawl lever is supported freely rotatably on a pin-shaped extension of the operating lever and is kept in place by a cap and retaining means. Said pawl lever is pressed by a spring towards a hooked protuberance of the operating lever in such a way as to form an engagement element, designed for the engagement and release of the operating member.

[0005] It can be understood from the above that the known mechanism has numerous disadvantages. The main disadvantage arises from the fact that the aforesaid operating lever, being provided with protuberances, slots, pins and stop surfaces, has such a complex shape that it has to be made by complicated procedures, for example by casting or injection moulding, and consequently must be made from an alloy suitable for the die-casting of highly complex shapes, such as an alloy of zinc, aluminium and copper, known as "zama". Consequently, the known mechanism provided with the aforesaid supporting lever is difficult to make, while its assembly is complicated and its maintenance is time-consuming.

[0006] The problem to which the present invention relates is that of proposing an operating mechanism for an automatic electrical circuit breaker which has structural and functional characteristics such that the aforesaid disadvantages cited with reference to the prior art are overcome.

[0007] This problem is resolved by means of an operating mechanism of a moving contact for an automatic electrical circuit breaker of the type specified above, characterized in that the levers of the system of levers are in the form of flat plates.

[0008] Further characteristics and the advantages of the invention will be made clear by the following description of a preferred embodiment thereof, provided for guidance and without restrictive intent, with reference to the attached figures, in which:

Figure 1 shows a side view, in partial section, of an automatic electrical circuit breaker;
Figure 2 shows, in a side view, a mechanism for the circuit breaker shown in Figure 1;
Figures 3, 4 and 5 show three perspective views, from three different viewpoints, of the mechanism shown in Figure 2;
Figure 6 shows an exploded perspective view of the mechanism shown in Figure 2;
Figures 7, 8 and 9 show, in three side views, a detail of the circuit breaker shown in Figure 1, in three different stages of operation;

[0009] With reference to the aforesaid figures, number 10 indicates as a whole an automatic electrical circuit breaker. For example, the electrical circuit breaker 10 is of the magneto-thermal type or, in other words, an automatic circuit breaker with a magneto-thermal release device.

[0010] Said electrical circuit breaker 10 comprises a box-shaped housing 11, particularly of the type with a flat box-shaped body, consisting of two half-shells 12. In other words, the box-shaped body 11 consists of a half-shell 12 forming a base and a half-shell forming a cover (not shown). Said half-shells are juxtaposed and made integral with each other by fixing means such as rivets or bolts. Said box-shaped housing 11 has in its rear part (as shown by the arrow "R") engagement means 14 designed for coupling to a busbar of omega cross section (not shown), according to DIN standards. The front part (as shown by the arrow "F") of the box-shaped housing 11 has a portion 16 projecting outwards. At the top (as shown by the arrow "U") and at the bottom (as shown by the arrow "D") of said box-shaped housing 11 there are provided slots 18 designed for the electrical connection of the circuit breaker 10 to an electrical mains. For example, the ends of cables or electrical busbars are inserted into the box-shaped housing 11 through said slots 18. The box-shaped housing 11 is of the modular type, and in particular has standard dimensions.

[0011] Ribs 19 are provided inside said box-shaped housing 11 to strengthen the box-shaped housing 11, but also to delimit compartments or chambers. A first and a second compartment 20 and 21 are located near the upper and lower parts (arrows "U" and "D") of the box-shaped housing 11. Said compartments 20 and 21 house a first and a second terminal 22 and 23, designed for the electrical connection of the circuit breaker 10 to

the ends of conductors of the electrical mains received in the slots 18. An operating mechanism of a moving contact 15 is housed in a further compartment 24 of the box-shaped housing 11. The operating mechanism will be described in greater detail in the following text. For the present, it may be noted that said mechanism comprises a system of levers, indicated as a whole by 25, and an operating member, indicated as a whole by 28. Said system of levers 25 is designed for the engagement of the moving contact 15 with the operating member 28 and for the oscillation of the moving contact 15 from an open position of the circuit breaker 10, separated from a fixed contact 37, to a closed position of the circuit breaker 10, with the moving contact 15 in electrical contact with the fixed contact 37. The oscillation of the moving contact 15 and of the system of levers 25 takes place in a plane (indicated by "P" in Figure 6). Said system of levers 25 is connected electrically to one of the terminals, for example the second terminal 23, by means of a flexible conducting cable or braid 26, and by means of busbars 27 (Figure 1). Said operating member 28 comprises a bar with a rod or link 29, designed to interact with the system of levers 25, and an operating lever 17. The link, for example a wire bar bent into a C shape, has one end connected eccentrically to the operating lever in such a way as to form a toggle mechanism. The free end of the link is bent in such a way that it can be engaged by the system of levers 25. For example, the link is a rod whose free end is bent orthogonally to the plane "P" of oscillation of the system of levers 25 in the form of a bearing end 100 of the rod. The operating lever 17 is supported freely rotatably on a pivot 30 which is integral with the box-shaped housing 11 and positioned orthogonally to the plane "P" of oscillation of the system of levers 25. Said operating lever 17 is constantly pressed by elastic means 32 towards a position in which the toggle mechanism is folded back (open circuit breaker position). The operating member 28 is housed in the compartment 24 containing the system of levers 25 in such a way that the operating lever 17 partially projects through an aperture 31 from the projecting portion 16 of the front part "F" of the box-shaped housing 11. Adjacent to the system of levers 25 there is provided a further compartment 33 housing an electrical protection device 34, for example an electromagnet, which is of a known type. One end 35 of said electrical protection device 34 is connected electrically to an armature 36. The fixed contact 37 extends from said armature 36 and is positioned in such a way that it can interact with the moving contact 15 when the circuit breaker is in the closed position. A second end 38 of said protection device is connected electrically to the second terminal 22. The electrical protection device 34 comprises a moving element provided at one of its ends with a striker 39 designed to interact with said system of levers 25. An arc extinguishing cell 40, housed in a de-ionization compartment or chamber 41, is interposed between the fixed contact 37 and the armature 36 on the one hand and the busbars 27 on the other hand (Figure 1).

[0012] The system of levers 25 is supported freely rotatably on a single pivot 42 housed in bearings provided in the half-shells 12 of the box-shaped housing 11 in such a way that its axis X-X is orthogonal to the plane "P" of oscillation of said system of levers 25. Elastic means 43 constantly press the moving contact 15 to bear against a stop 44 provided in one of the ribs 19 of the housing 11 in a suitable position to form the location of the contact separate from the fixed contact 37, in other words the open circuit breaker position. For example, a helical spring 43 is interposed between the wall of the box-shaped housing 11 and the moving contact 15, in such a way as to constantly press the moving contact 15 away from the fixed contact 37 (Figure 7).

[0013] Advantageously, the system of levers 25 comprises flat plate levers. In one embodiment, said flat plate levers are arranged in the plane "P", or parallel to the plane "P" of oscillation of the system of levers 25 (Figure 6).

[0014] In particular, the system of levers 25 comprises an engagement lever 45 consisting of a plate bent into a bracket to form a first and a second arm 46 and 47 connected to each other by an intermediate portion 48.

[0015] Eyes 49 and 50, designed to receive the single pivot 42 in journals 51 and 52, are provided at the free ends of the said arms 46, 47. Around said journal 52, the eye 50 of said second arm 47 has a border or flange 53, capable of forming a pivot coaxial with said journal 52. A hook 54 extends from the side of the first arm 46 opposite the operating lever 17. In one embodiment, the edge of the engagement lever further from the operating lever is shaped in the form of a hook 54. The said hook 54 is designed to engage with the free end of the link 29 and, in particular, has a partial supporting surface 55a inside the hook 54 for the free end of the link or bearing end 100 of the rod. Preferably, the said hook 54 is tapered externally in such a way as to form a lead-in for the engagement of the link 29 or, in other words, a surface 55b provided on the outside of the hook 54 is inclined in such a way as to facilitate the passage of the end 100 of the link 29 into the hook 54. The connecting portion 48 of the arms 46 and 47 of the engagement lever is delimited by a first edge facing the operating lever 17, forming a stop surface 56, and by a second edge, opposite the first, forming a striking piece 57 (Figures 2, 3, 4, 5 and 6).

[0016] The said bracket-shaped engagement lever 45 houses the moving contact 15 between its arms 46, 47. The moving contact consists of a rocker bar comprising a first moving contact arm 58 provided at one end with a foot 59 designed to make an electrical contact with the fixed contact 37. A slot 60 provided in the centre of the moving contact 15, and elongated in an approximately transverse direction with respect to the moving contact, is designed to house the single pivot 42. A second arm 61 of the moving contact 15 opposite the first arm 58, or operating arm 61, has at its free end a fork 62 forming

a seat 63. The intermediate portion 48 of the bracket-shaped engagement lever 45 is housed in said seat 63 of the fork 62. Thus the operating arm 61 of the moving contact can oscillate about the intermediate portion 48 of the engagement lever 45, with the walls of the slot 60 sliding on the single pivot 42. A pin-shaped extension 64 projects from the edge of the moving contact 15 opposite the operating lever 17, and is designed to guide the end of the elastic means 43 which constantly presses the moving contact 15 and the system of levers 25 towards the open position of the circuit breaker 10. The moving contact has a widened portion 65 provided with a flange 66, designed for the electrical connection of the moving contact 15 to the braid 26.

[0017] A release lever 67 is provided, facing the moving contact 15 and housed between the arms 46 and 47 of the bracket-shaped engagement lever 45. In one embodiment, said release lever 67 is a rocker plate, connected freely rotatably to the single pivot 42 by means of a seat 68 formed, for example, by a transverse through hole. In particular, the release lever 67 is positioned with a first arm 69 between said moving contact 15 and the arm 46 provided with the hook 54 of said engagement lever 45. A counter-hook part 70 of said release lever of the rocker type 67 extends from said first arm 69 in such a way as to interact with the hook 54 of the engagement lever 45 to form a gripper for the engagement and release of the bearing end 100 of the link 29. The term "gripper for engagement and release" denotes a device which forms, by means of two half-supports which can be brought together, a support and thrust surface for the end 100 of the rod link 29. In one embodiment, the edge of the plate forming the release lever 67 is shaped in the form of a counter-hook 70. Said counter-hook 70 has a partial support surface 71a inside it for the free end of the link 29 or bearing end 100. Preferably, said counter-hook is tapered externally in such a way as to form a lead-in for the engagement of the link 29 or, in other words, a surface 71b inclined in such a way as to facilitate the passage of the end 100 of the link 29 into the counter-hook 70 is provided on the outside of the counter-hook 70. An extension 72 of the first arm 69 of the release lever 67 forms, on the edge of this lever opposite the operating lever 17, a stop surface 73 interacting with the stop surface 56 provided in the engagement lever 45 to define a position of maximum closing of the gripper. The term "position of maximum closing of the gripper" denotes a position of the hook 54 and the counter-hook 70 which forms a supporting and thrust element for the end 100 of the link 29. A second arm 74 of the release lever of the rocker type 67 is provided opposite the first arm 69 with respect to the seat 68 for the single pivot 42. Said second arm 74 has a rounded end portion 75, designed to interact with the electrical protection device 34 to open the gripper and release the end 100 of the link 29.

[0018] Elastic means 76 constantly press said release lever 67 in such a way as to bring its counter-hook part 70 towards the hook 54 of the engagement lever 45. For example, a bent spring 76 comprises a helical portion 77 from whose ends there extend arms 78 and 79. The helical portion 77 and the arms 78, 79 are positioned parallel to the plane "P" of oscillation of the system of levers 25. A first arm 78 has a terminal supporting portion 80 located in the plane of the bent spring 76, and a second arm 79 has a terminal operating portion 81, positioned orthogonally to the plane of the bent spring 76. Said helical portion 77 is fitted on the pin-shaped edge 53 provided on the second arm 47 of the engagement lever 45.

[0019] The terminal portion 80 of the first arm of the bent spring 76 bears on the striking piece 57 provided on the intermediate portion 48 of the engagement lever 45. The terminal operating portion 81 of the bent spring 76, projecting transversely with respect to the system of levers 25, acts on the first arm 69 of the release lever 67, bringing the stop surface 73 of the extension 72 of this lever against the stop surface 56 provided in the intermediate portion 48 of the engagement lever 45.

[0020] Advantageously, an actuating lever 82 is interposed between the release lever 67 and the striker 39 of the electrical protection device 34. For example, the engagement lever 45 is surrounded by a cradle-shaped actuating lever 82, comprising a channelled body 83 in whose wings 84 and 85 there are provided through holes forming the seat 86 for the single pivot 42. Two curved terminal portions 87 and 88 are provided at the ends of the wings 84 and 85 facing the arm 58 of the moving contact 15 provided with the foot 59 for the electrical contact. Said curved terminal portions 87, 88 have, on their outer lateral surfaces, engagement means such as seats or pins which face each other in apertures provided in the lateral walls of the box-shaped housing 11. Said engagement means make it possible to connect the system of levers 25 to equipment placed adjacent to the circuit breaker 10, such as a second circuit breaker provided with a magneto-thermal release device or a differential circuit breaker. In one embodiment, said actuating lever 82 is made from electrically insulating material.

[0021] The operation of a mechanism for operating a moving contact for an automatic circuit breaker according to the present invention is described below.

[0022] For a clearer understanding of the operation of the automatic circuit breaker, the closing stages of the circuit breaker will be described initially, followed by the description of the stages of automatic release or automatic opening of the circuit breaker by the action of the electrical protection device.

[0023] In the open position (Figure 7), the circuit breaker 10 has its moving contact 15 in a position of separation from the fixed contact 37. The moving contact 15, pressed by the elastic means 43 interposed between it and the box-shaped housing 11, holds the operating arm 61 against the stop surface 44 provided on the rib 19 and also holds the wall of the slot 60 against

the single pivot 42. The end 100 of the link 29 is housed in the slot formed by the hook 54 of the engagement lever 45 brought next to the counter-hook 70 of the release lever 67 or, in other words, inside the closed gripper formed by the hook 54 and the counter-hook 70. Said gripper is kept in the closed position by the action of the bent spring 76 which, with the terminal portion 81 of its second arm 79, constantly presses the extension 72 of the release lever 67 against the stop surface 56 of the engagement lever 45. When the portion of the operating lever 17 projecting from the box-shaped housing 11 is moved (as shown by the arrow "G" in Figure 8), the end 100 is held against the support surfaces 55a and 71a of the hook 54 and the counter-hook 70 respectively. When the rotation of the operating lever 17 is continued, the action of the elastic means 32 acting on the lever and the action of the elastic means 43 acting on the moving contact 15 are opposed. When the action of the elastic means 32, 43 has been overcome, the system of levers 25 and the moving contact are rotated (as shown by the arrow "H") until the foot 59 of the moving contact 15 bears forcefully (as shown by the arrow I) against the fixed contact 37, forming the desired electrical contact which closes the circuit breaker 10. In the closed position of the circuit breaker, the operating member 28, forming the toggle mechanism, is brought into the under-centre position, making the walls of the slot 60 of the moving contact 15 slide (as shown by the arrow "L") on the single pivot 42 and pre-loading the foot 59 against the fixed contact. During the rotation of the system of levers 25, the free end of the portion of the link 29 bent to form a bearing end 100 moves into a channel which is formed in the wall of the box-shaped housing 11, for example by means of two ribs 89 and 90 curved in such a way as to follow the path along which the gripper travels (Figure 8).

[0024] If the electrical protection device 34 is triggered, the striker 39 of the moving element of the electromagnet emerges (as shown by the arrow "M" in Figure 9) until it bears on and pushes the body 83 of the actuating lever 82. After being pushed by the striker 39, the actuating lever oscillates (as shown by the arrow "N") about the single pivot 42, causing the second arm 74 of the release 67 to rotate (as shown by the arrow "O"). As it rotates about the single pivot 42, the release lever 67 opens the gripper (as shown by the arrow "Q"), by raising the counter-hook 70. The end 100 of the link slides on the support surface 55a of the hook 54, allowing the moving contact 15 and the system of levers 25 pressed by the elastic means 43 to rotate (as shown by the arrow "S") about the single pivot 42 until they bear against the stop surface 44 provided on the rib 19. By the opening of the gripper formed by the hook 54 and the counter-hook 70, the operating member 28 is released or disconnected from the system of levers 25, allowing the moving contact 15 to move to a position of separation from the fixed contact 37 or to an open position of the circuit breaker 10. The system of levers 25 in the open position of the circuit breaker is no longer affected by the striker 39. Owing to the action of the bent spring 76, the release lever is brought with the counter-hook 70 brought next to the hook 54 in such a way as to close the gripper (as shown by the arrow "Z"). The operating member 28, pressed by the elastic means 32 acting on the operating lever 17, brings back the end 100 of the link 29, which, guided by the ribs 89, 90, is brought against the inclined surfaces 55b and 71b of the hook 54 and the counter-hook 70 respectively, thus opening the gripper and reinserting itself into the slot formed by these parts.

[0025] As may be appreciated from the above description, the present invention makes it possible to meet the aforesaid requirement to simplify the construction of the operating mechanism for an automatic electrical circuit breaker.

[0026] According to the present invention, the mechanism comprises a limited number of parts, and therefore its assembly becomes simple and rapid, and its maintenance becomes easier. The constructional simplicity of the proposed mechanism also allows automatic assembly, for example by using automatic or robotic assembly lines.

[0027] The novel structural simplicity of the mechanism according to the invention makes it possible to produce it at a very low cost.

[0028] Owing to the provision of flat plate levers, the principal parts of the mechanism can be made by simple fabrication processes, such as a sheet blanking process.

[0029] The material which is used for the flat plate levers must primarily meet requirements of the electrical type, thus proving more economical than the materials used in the complicated processes of fabrication by die-casting.

[0030] The use of flat plate levers advantageously makes the mechanism compact and particularly light.

[0031] Consequently, the mechanism according to the invention makes it possible to obtain fast and reliable automatic opening of the circuit breaker or, in other words, the circuit breaker is ready to react rapidly to the release command received from the electrical protection device.

[0032] The circuit breaker provided with the mechanism according to the invention is advantageously efficient. In particular, for a given force exerted by the striker of the electromagnet on the system of levers, the proposed mechanism provides faster opening of the contacts.

[0033] A person skilled in the art may, in order to meet contingent and specific requirements, make numerous modifications and adaptations to the preferred embodiment of the mechanism for operating a moving contact for an automatic electrical circuit breaker as described above, or replace elements with other functionally equivalent ones, without departing from the scope of the following claims.

Claims

1. Operating mechanism of a moving contact (15) for an automatic electrical circuit breaker (10), comprising an operating member (28), a system of levers (25) for the engagement of the moving contact (15) with the operating member (25) and for the oscillation of the moving contact (15) from an open position of the circuit breaker, separated from a fixed contact (37), to a closed position of the circuit breaker, with the moving contact (15) in electrical contact with the fixed contact (37), as well as elastic means (43) which constantly press the moving contact (15) towards said open position of the circuit breaker, said system of levers (25) interacting with an electrical protection device (34) to release the operating member (28), characterized in that the levers of said system of levers (25) are made from flat plates.

2. Mechanism according to Claim 1, characterized in that said system of levers (25) and the moving contact are supported freely rotatably by a single pivot (42).

3. Mechanism according to Claim 2, characterized in that said system of levers (25) comprises an engagement lever (45) with a body consisting of a flat plate bent into a bracket.

4. Mechanism according to Claim 3, in which said moving contact (15) is a bar of the rocker type, comprising a first arm (58) provided with a foot (59) for electrical contact and a second operating arm (61), characterized in that said bracket-shaped engagement lever (45) houses said operating arm (61) longitudinally between its arms (46, 47).

5. Mechanism according to Claim 4, characterized in that said operating arm (61) of the moving contact (15) has at its free end a fork (62) forming a seat (63) and one portion (48) of the said bracket-shaped engagement lever (45) is housed in said seat (63).

6. Mechanism according to Claim 3, in which the operating member (28) comprises an operating lever (17) to which the end of a link (29) is connected to form a toggle mechanism, characterized in that an arm (46) of said bracket-shaped engagement lever (45) has, at a point remote from said operating lever (17), a hook (54) for housing the free end (100) of said link (29).

7. Mechanism according to Claim 6, characterized in that said hook (54) has its free end tapered to form a lead-in for the engagement of the link (29).

8. Mechanism according to Claim 3, characterized in that eyes (49, 50) capable of housing the single pivot (42) are present at the ends of the arms (46, 47) of said bracket-shaped engagement lever (45).

9. Mechanism according to Claim 2, characterized in that said system of levers (25) comprises a release lever (67) of the rocker type.

10. Mechanism according to Claims 6 and 9, characterized in that said release lever of the rocker type (67) has one part extending to form a counter-hook (70) interacting with the hook (54) of the engagement lever (45) to form a gripper for the engagement and release of the operating member (28).

11. Mechanism according to Claim 10, characterized in that the free end of said counter-hook part (70) is tapered to form a lead-in for the engagement of the link (29).

12. Mechanism according to Claim 10, characterized in that the operating member (28) is constantly pressed by elastic means (32) in such a way that the link (29) is pushed towards the said gripper for engagement and release.

13. Mechanism according to Claim 12, housed in a box-shaped housing (11), characterized in that the said housing (11) has ribs (19) designed to guide the link (29) towards the said gripper for engagement and release.

14. Mechanism according to Claim 10, characterized in that the release lever (67) is constantly pressed by elastic means (76) in such a way that the counter-hook part (70) is brought towards the hook (54) of the engagement lever (45).

15. Mechanism according to Claim 14, characterized in that said release lever (67) has an extension (72) provided with stop surfaces (73) interacting with the engagement lever (45) to define a position of maximum closing of the gripper.

16. Mechanism according to Claim 10, characterized in that said release lever of the rocker type (67) has an arm (74) opposite said counter-hook part (70) with respect to the single pivot (42), said arm (74) interacting with the electrical protection device (34) to open the gripper and release the operating member (28).

17. Mechanism according to Claim 16, characterized in that the portion (75) of said arm (74) interacting with the electrical protection device (34) is rounded.

18. Mechanism according to Claim 16, characterized in that an actuating lever (82) is provided between the release lever (67) and the electrical protection de-

vice (34).

19. Mechanism according to Claim 18, characterized in that said actuating lever (82) is supported freely rotatably on the single pivot (42).

20. Automatic electrical circuit breaker (10), comprising an operating mechanism of a moving contact (15) as claimed in any one of the preceding claims.

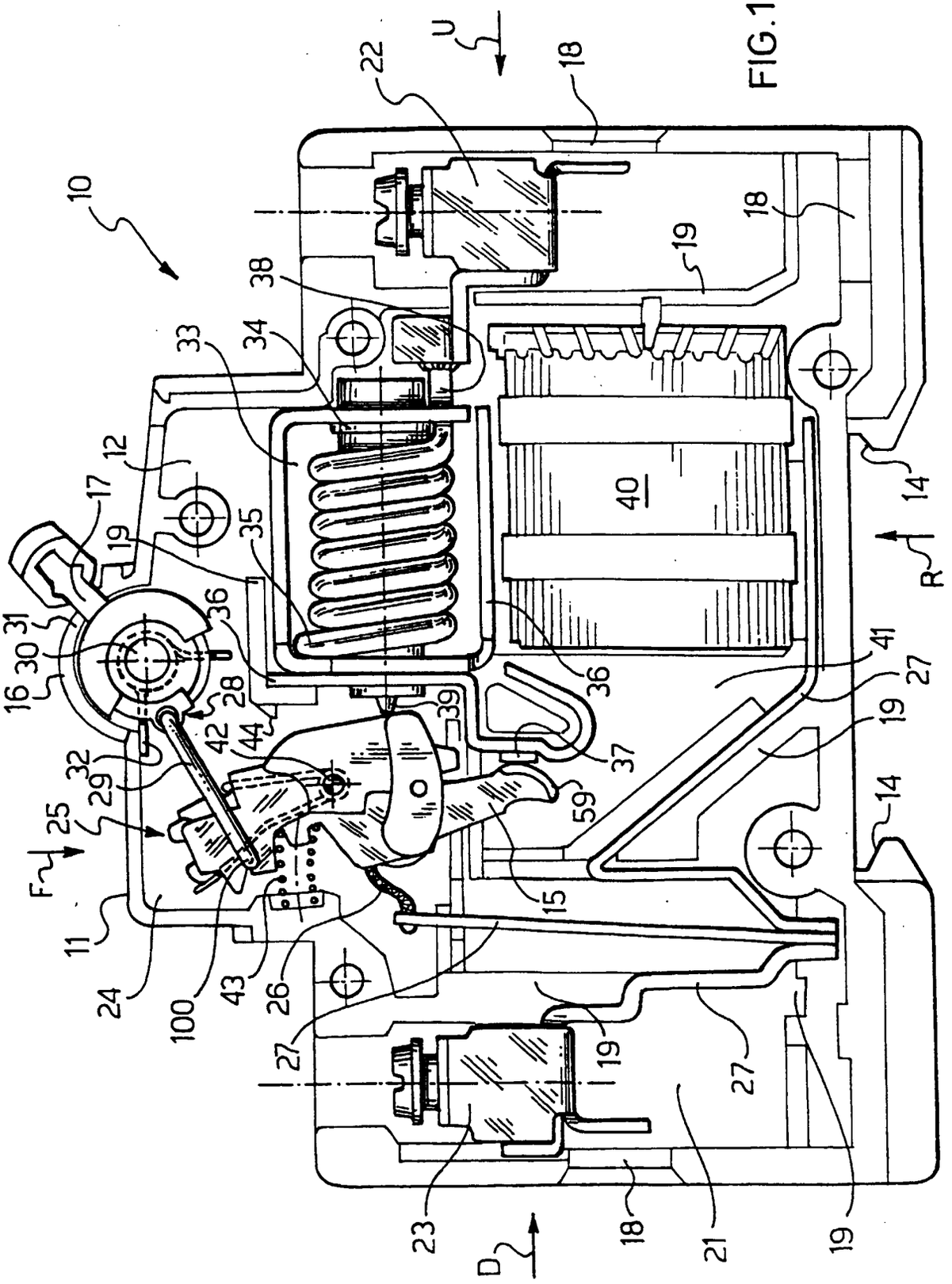
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FIG.1

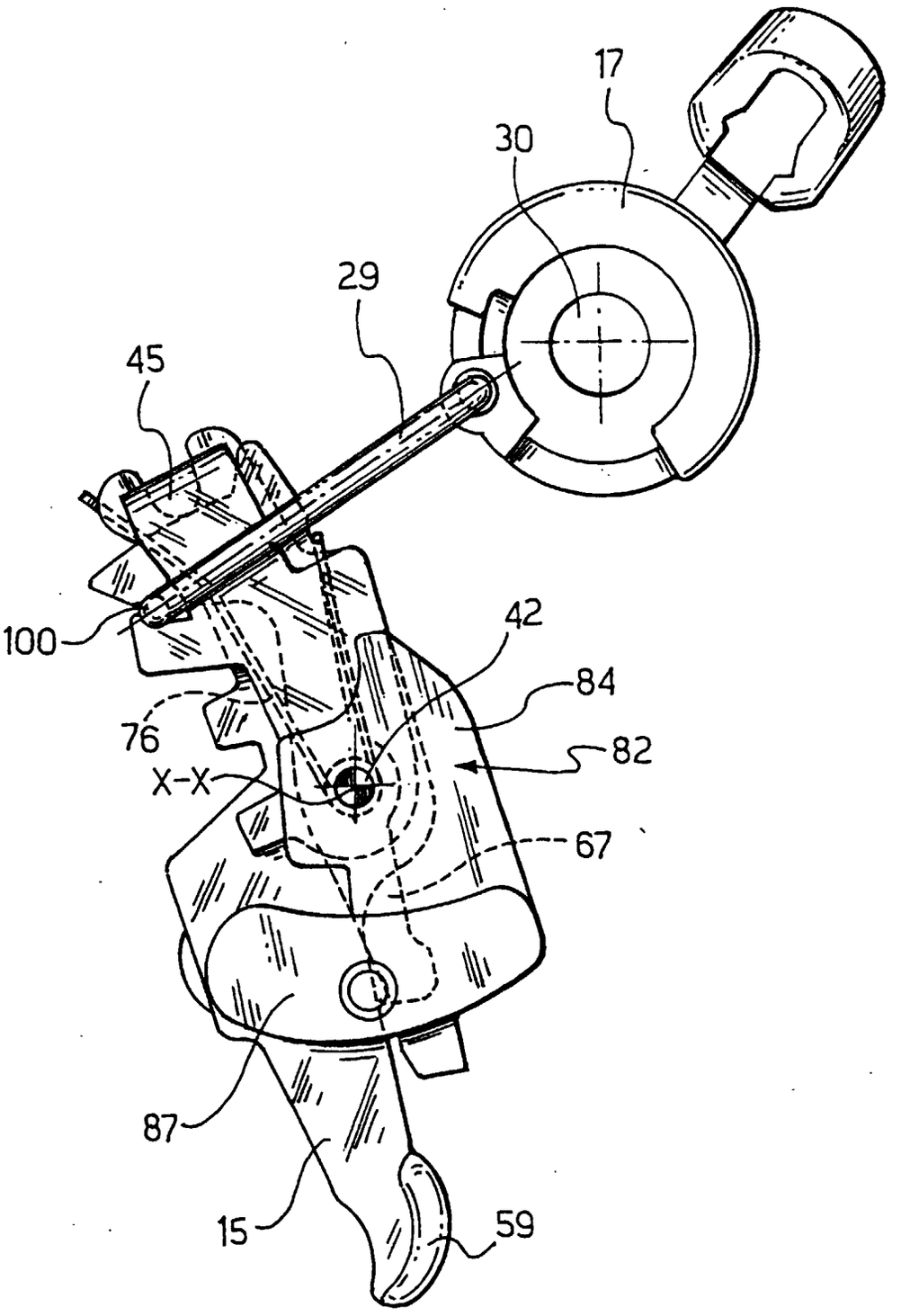

FIG.2

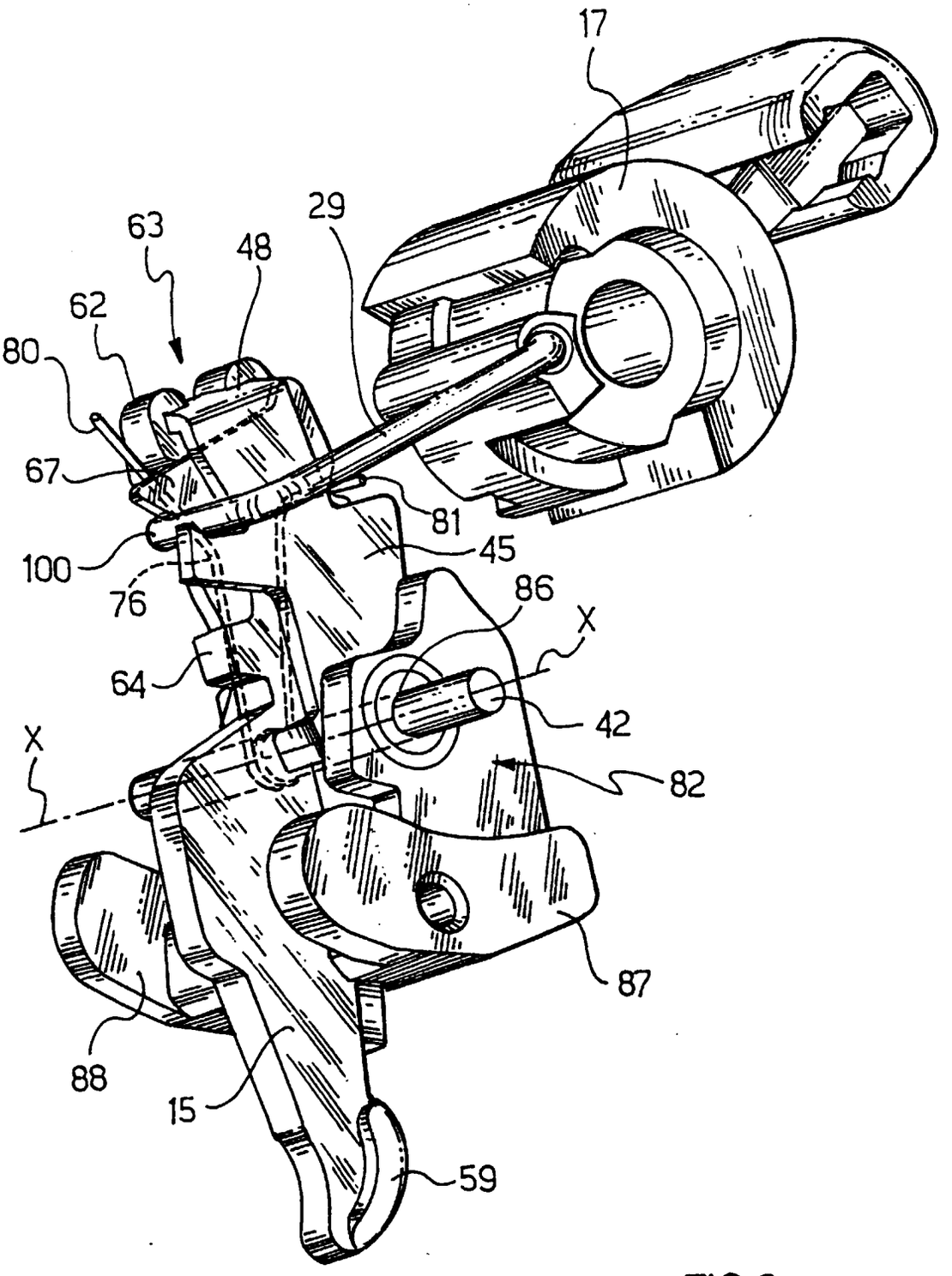

FIG.3

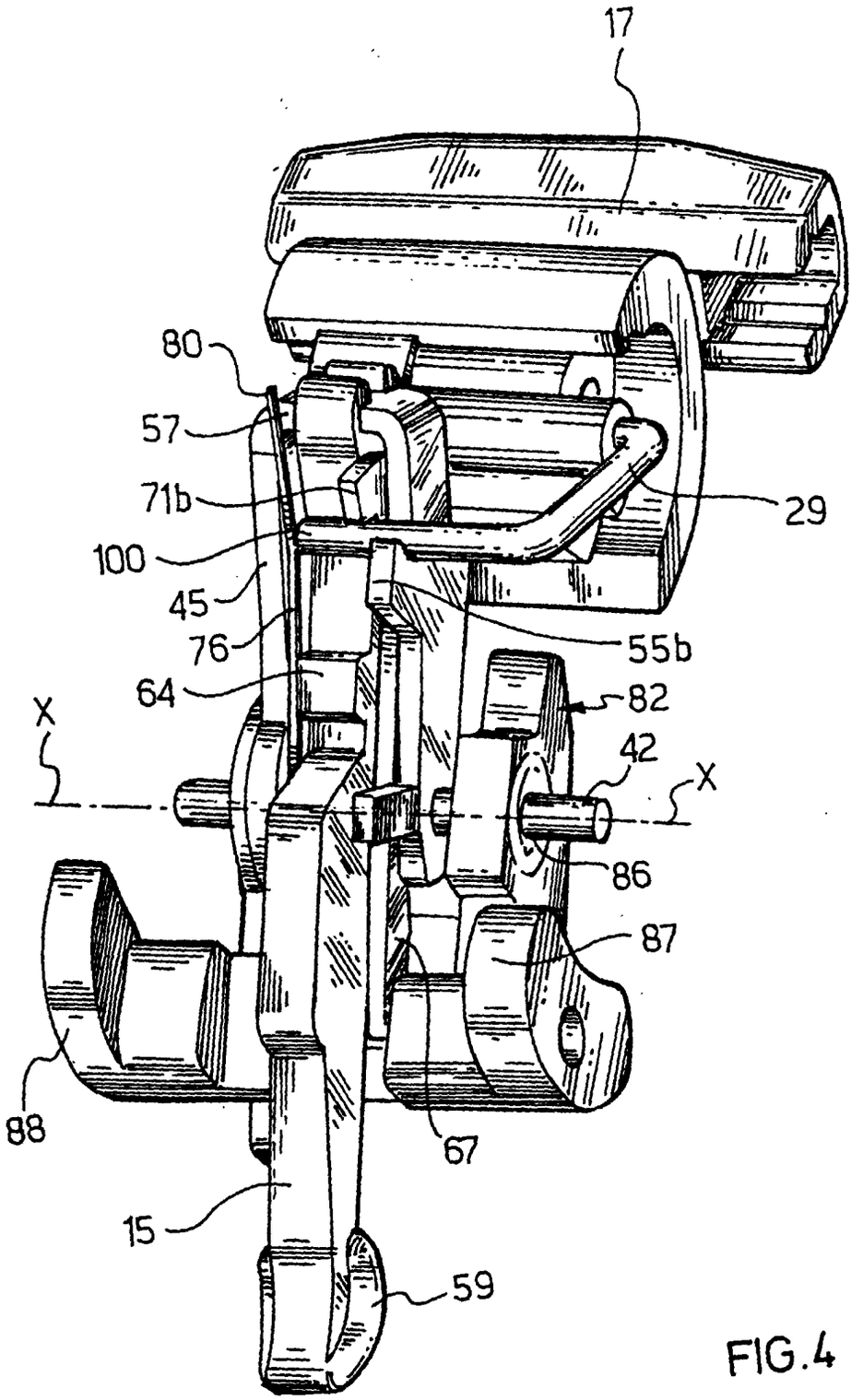

FIG.4

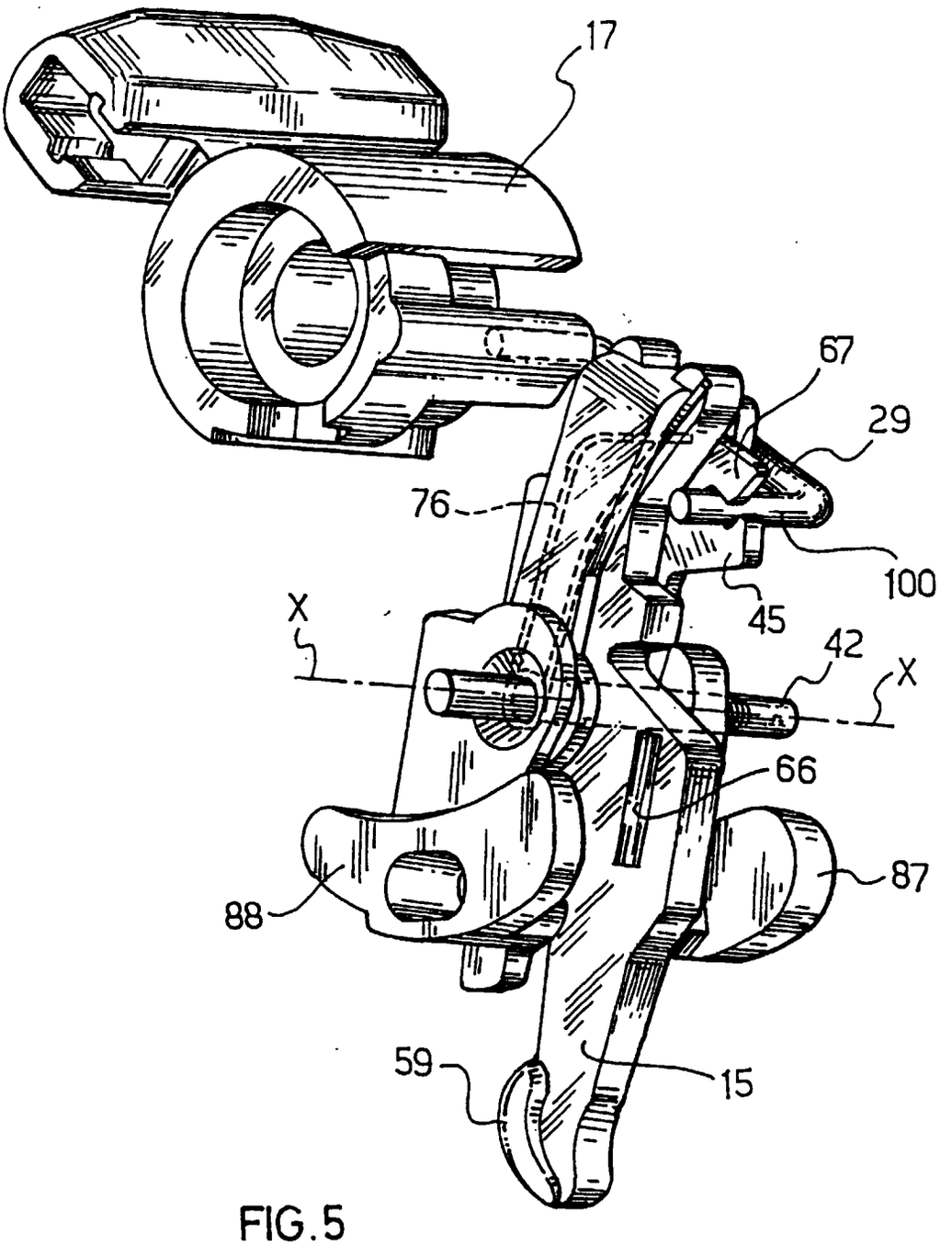

FIG.5

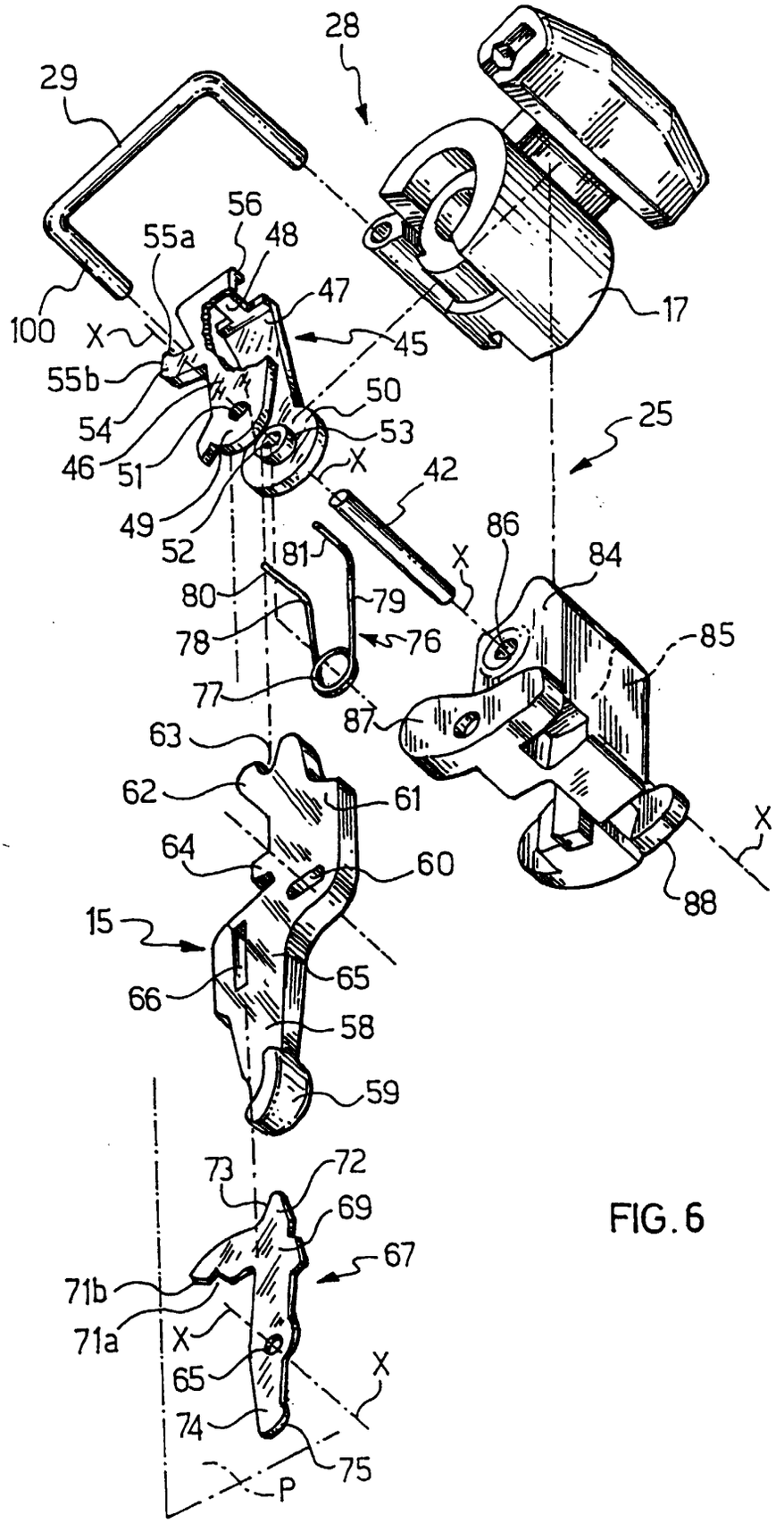
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FIG. 6

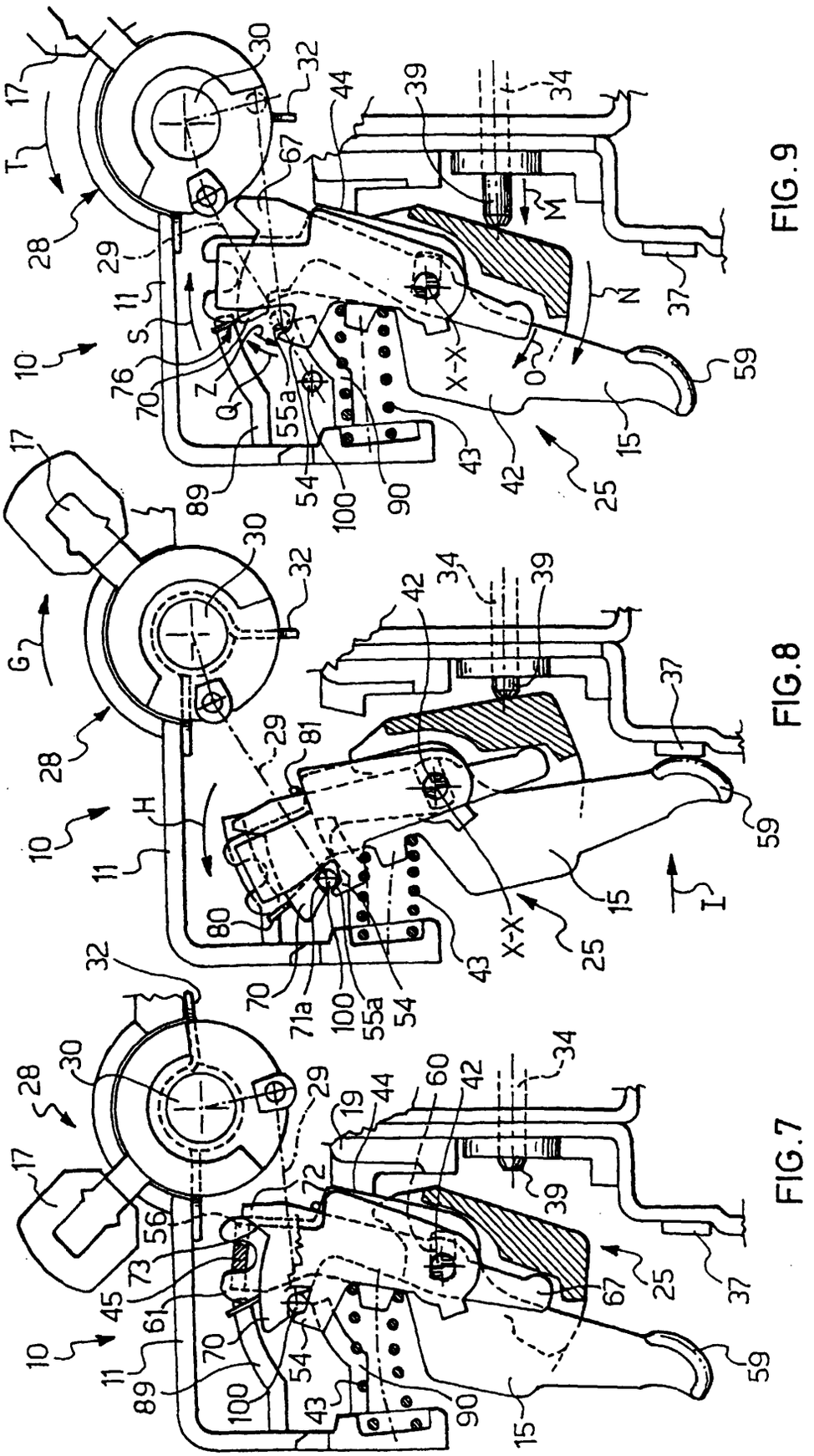

FIG.9

FIG.8

FIG.7

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EUROPEAN SEARCH REPORT

Application Number
EP 99 83 0672

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	10 March 2000	Libberecht, L

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