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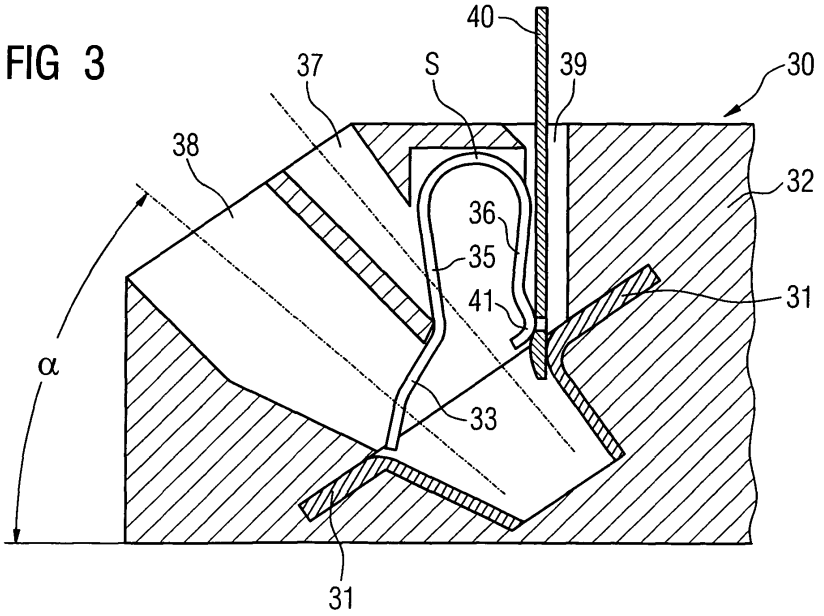
(71) Applicant: **SIEMENS AKTIENGESELLSCHAFT**
80333 München (DE)

(72) Inventors:
- **Brandl, Wolfgang**
  92224 Amberg (DE)
- **Bäuml, Alfred**
  92421 Schwandorf (DE)
- **Drexler, Johann**
  92421 Schwandorf (DE)
- **Hartinger, Peter**
  92439 Bodenwöhr (DE)
- **Mayer, Eugen**
  92237 Sulzbach-Rosenberg (DE)
- **Streble, Daniela**
  92224 Amberg (DE)

(54) **A connecting device and a low-voltage switching device comprising the same**

(57) A connecting device (30) comprises a housing (32) comprising an opening (38) for receiving an electrical conductor, and a tool opening (37) and at least one spring-force clamp connector (S, 31, 32) in said housing (32), comprising a bent leaf spring (S) and a responsive counterpart wall (31), the bending of the leaf spring (S) forming a first leg (33) and a second leg (36), said leaf spring (S) adapted i) to clamp an electrical conductor between said first leg (33) and said counterpart wall (31) and ii) to release said electrical conductor upon being pressed through said tool opening (37) by a pressing tool- The housing (32) further comprises a further opening (39) for receiving a second electrical conductor (40). The leaf spring (S) is adapted, in response to receiving a second electrical conductor (40) through said further opening (39), to allow bending of said second leg (36) and so to clamp said second electrical conductor (40) between said second leg (36) and a second counterpart wall (31). An independent claim for a low-voltage switching device.

FIG 3



EP 1 837 887 A1

Description

Field of the invention

[0001] The invention relates to connecting devices to which an electrical conductor can be connected. Furthermore, the invention relates to low-voltage switching devices.

Background art

[0002] Low-voltage switching devices comprise contact positions, such as spring-force clamp terminals or screw terminals, to which electrical conductors can be connected. The contact positions can then be used for electrical contacting of devices, such as load feeders or reversing contact assemblies.

[0003] The electrical connecting of devices via spring-force clamp terminals can be carried out by using wires as shown in Figure 1 where contactors of a contactor group have been so interconnected.

[0004] DE 102 36 790 C1 discloses a switching device that has an insulating housing, each switch pole having incoming and outgoing contacts provided with respective terminals for connection with an external electrical lead, at least one of the contacts having a second terminal for connection with a second electrical conductor, positioned between its opposite ends, respectively provided with the first external electrical lead terminal and a stationary switch contact. Each second terminal can be provided by an opening for reception of an electrical conductor pin contact. A problem of this solution is that when a second connector is connected to the contact position, its contact to the opening in the terminal piece may not be very stable.

[0005] An improvement in this respect is disclosed in the connection block for electrical devices in published patent application EP 1 026 782 A1, where a connection block is used to provide a link between sockets on two adjacent appliances. The connection assembly comprises two items of electrical apparatus placed side by side, with sockets formed in adjacent positions on the same sides of the items. A connector plug with an insulating body and terminal pins is engaged in the side of the two items into the tool opening of a spring-force clamp of the CAGE CLAMP reigstered type (registered trademark of WAGO Kontakttechnik GmbH & Co. KG). But even though that the contact of the second connector may be better than in the switching device of DE 102 36 790 C1, the spring-force clamp cannot provide a good mechanical contact to a first electrical conductor together with a second electrical conductor, since the second electrical conductor would jam the tool opening and thus prevents the spring-force clamp from clamping the first electrical conductor.

Summary of the invention

[0006] A first objective of the invention is to bring out a connecting device that can be used to contact a first and a second electrical connector with one spring-force clamp connector.

[0007] This objective of the invention can be reached, if to a connecting device comprising a housing comprising an opening for receiving an electrical conductor and a tool opening, and at least one spring-force clamp connector in said housing, the spring-force clamp connector comprising a bent leaf spring and a responsive counterpart wall, the bending of the leaf spring forming a first leg and a second leg, said leaf spring adapted i) to clamp an electrical conductor between said first leg and said counterpart wall and ii) to release said electrical conductor upon being pressed through said tool opening by a pressing tool, there is provided a further opening in the housing for receiving a second electrical conductor, and the leaf spring is adapted, in response to receiving a second electrical conductor through said further opening, to allow bending of said second leg and so to clamp said second electrical conductor between said second leg and a second counterpart wall.

[0008] A second objective of the invention is to provide a low-voltage switching device, especially a contactor, a circuit breaker, an overload relay, or a motor starter, that would be easily connectable to another low-voltage switching device via a link module, and that would enable easy connecting of further electrical conductors. This objective can be achieved as set out in claim 7, by using a plurality of connecting devices according to the first objective of the invention in said low-voltage switching device connected to switch poles of said low-voltage switching device.

[0009] The dependent claims describe various advantageous aspects of both objectives of the invention.

Advantages of the invention

[0010] If the bent leaf spring is substantially U-shaped, the design of the connecting device may be easier, since then there is no support extra support needed for the leaf spring, but it can be simply placed in an appropriate slot.

[0011] If said counterpart wall and said second counterpart wall comprise conductive material, the electrical current does not need to be passed through the leaf spring. Depending on the application and the amount of electrical current to be transferred, this may be useful since the leaf spring does not need to be used as current transport medium, but the counterpart walls are used as the main current transport media. Especially in the case of low-voltage switching applications, this may be very important because the losses in the transport medium are thus easier to reduce, for example.

[0012] If said counterpart wall and said second counterpart wall are electrically connected to each other, the first electrical conductor can be used for measurement

purposes, whereas the second electrical conductor can be used to connect the connecting device to a current supply or to another connecting device, or vice versa. If said counterpart wall and said second counterpart wall are furthermore integrally formed, the first and the second electrical conductor can be connected to an essentially same potential at both connecting points.

List of drawings

[0013] In the following, advantageous embodiments of the invention are discussed in more detail with reference to Figures 2 to 5 in the accompanying drawings, of which:

Figure 1 shows a contactor group in which the contactors have been connected to each other using wires;

Figure 2 shows a section of a connecting device according to the first objective of the invention;

Figure 3 shows a section of the connecting device of Figure 2 with a second conductor inserted;

Figure 4 illustrates a group of low-voltage switching devices comprising connecting devices, the low-voltage switching devices connected to each other using a link module between each other; and

Figure 5 illustrates a group of low-voltage switching devices, one of which comprises a connecting device according to the invention, the low-voltage switching devices connected to each other using a link module between each other.

[0014] Same reference numerals refer to similar structural elements throughout the Figures.

Detailed description

[0015] Figure 2 shows a section of a connecting device 30 according to the first objective of the invention. The connecting device 30 comprises a housing 32 comprising an opening 38 for receiving an electrical conductor, a tool opening 37, and a further opening 39 for receiving a second electrical conductor.

[0016] The connecting devi,ce 30 further comprises at least one spring-force clamp connector located in the housing 32 and comprising a bent leaf spring S and a responsive counterpart wall 31, the bending of the leaf spring S forming a first leg 33 and a second leg 36. Preferably, the spring-force clamp connector is a push-in clamp.

[0017] The leaf spring S is adapted to clamp an electrical conductor that has been introduced to the spring-force clamp connector through the opening 38 in between said first leg 33 and said counterpart wall 31. The electrical conductor can be released by pressing the first leg 33 with a pressing tool, such as a screw driver, through the tool opening 37. The pressing tool bends the first leg 33 which then releases the electrical conductor. In the preferred embodiment of the invention, the spring S and the counterpart wall 31 are adapted to clamp an electrical conductor that is entered into the opening 38 in angle α, where preferably $\alpha = 40°$.

[0018] As illustrated in Figure 3, the leaf spring S is adapted to, in response to receiving a second electrical conductor 40, to allow bending of the second leg 36 and so to clamp said second electrical conductor 40 between the second leg 36 and a second counterpart wall 31. A part 41 of the second leg 36 transfers the spring force caused by the leaf spring S to the electronic conductor 40 and presses it against the counterpart wall 31.

[0019] The bent leaf spring S is preferably shaped to substantially have the shape of an U. The counterpart wall 31 and the second counterpart wall preferably comprise conductive material, and they are preferably electrically connected to each other. In the preferred embodiment, the counterpart wall 31 and said second counterpart wall 31 are integrally formed, so that an element comprising both preferably consists of one part only.

[0020] The electrical conductor 40 may have latches or be bent, to provide a latch between the second leg 36 of the leaf spring S which is preferably shaped to match with the latches or bending of the electrical conductor 40. The shape of the second leg 36, especially around the force transfer part 41, is preferably bent to increase pressure exerted on the electrical conductor 40. Furthermore, if the electrical conductor 40 is bent appropriately, the bending of the second leg 36 may match to the bending of the electrical conductor 40 in a form-locking manner, thereby making removing of the electrical conductor 40 by pulling more difficult.

[0021] The housing 32 preferably consists of electrically insulating material.

[0022] In other words, according to one aspect of the invention, the housing 32 of connecting device 30 comprising a push-in clamp 32 has a further opening 39 in addition to the conductor opening 38 and the tool opening 37. The further opening 39 is preferably so placed that a second conductor 40 can be pushed in. In this manner, also the rear side of the push-in clamp can be used as the plug-in position.

[0023] Figure 4 shows a group of low-voltage switching devices 51, 53 comprising connecting devices 30. The low-voltage switching devices 51, 53 in Figure 4 have been connected to each other using a link module 50.

[0024] A low-voltage switching device 51, 53 may comprise a plurality of connecting devices 30 according to any one of the preceding claims; at the input side (as in low-voltage switching device 51 that is preferably a contactor), at the output side (as in low-voltage switching device 53 that is preferably a circuit breaker) or both. The low-voltage switching devices 51, 53 may also comprise

spring-force clamps 55 or screw terminals, but preferably only on the side on which there are no connecting devices 30 according to the invention.

[0025] The connecting devices 30 are preferably arranged on the input and/or output side of the low-voltage switching device 51, 53, and they are preferably provided for each of the poles for receiving the phases of a three-phase current. Optionally, there may be a fourth connecting device 30 on one or both sides for a control input. Accordingly, there are thus preferably three, four, six, seven or eight connecting devices 30 in each low-voltage switching device 51, 53. The housing 32 comprises now preferably the housing of the low-voltage switching device 51, 53.

[0026] The link module 50 can be used to connect two low-voltage switching devices 51, 53 to each other both mechanically and electrically. The link module 50 comprises electric conductors 40 for connecting both to low-voltage switching device 51 and to low-voltage switching device 53, the electric conductors 40 being strip-like and sticking out of the link module 50. On the back side of the link module 50, the electric conductors 40 are preferably covered by providing a shielding 58 of electrically insulating material.

[0027] The link module 50 is preferably simply pushed from the top side T of the low-voltage switching devices 51, 53 until the connecting devices 30 have clamped the electric conductors 40 of the link module 50.

[0028] The link module 50 may further comprise a wall 57 at least partly covering area between the transverse faces of the low-voltage switching devices 51, 53, the wall 57 preferably consisting of electrically insulating material. The link module 50 preferably further comprises connecting slots, rails or latch noses (omitted from Fig. 4) adapted to match with corresponding latch noses, rails or latch openings (omitted from Fig. 4) of said low-voltage switching devices 51, 53. In the dimensioning of the link module 50 and said latch noses, rails or latch openings it is preferably ensured that the effects of plasma that may escape from one or more of the low-voltage switching devices 51, 53 in the event of a the low-voltage switching device 51, 53 breaking a short circuit will not cause the link module 50 or the system comprising two switching low-voltage switching devices 51, 53 connected via the link module 50 will not explode. This may require some considerations about strength of materials, especially what comes to dimensioning of the latch noses, rails or latch openings.

[0029] Figure 5 shows a group of low-voltage switching devices 51, 63. The low-voltage switching device 51 comprises a plurality of connecting devices 30 whereas the low-voltage switching device 63 comprises a plurality of spring-force clamps 55 only. One side of the contacting element 50 is now pushed into the spring-force clamp 55, whereas the other side of the contacting element 50 is pushed into a series of the connecting devices 30 according to the invention.

Claims

1. A connecting device (30) comprising:

- a housing (32) comprising an opening (38) for receiving an electrical conductor, and a tool opening (37);
- at least one spring-force clamp connector (S, 31, 32) in said housing (32), comprising a bent leaf spring (S) and a responsive counterpart wall (31), the bending of the leaf spring (S) forming a first leg (33) and a second leg (36), said leaf spring (S) adapted i) to clamp an electrical conductor between said first leg (33) and said counterpart wall (31) and ii) to release said electrical conductor upon being pressed through said tool opening (37) by a pressing tool;

characterized in that:

said housing (32) comprises a further opening (39) for receiving a second electrical conductor (40);
and that said leaf spring (S) is adapted, in response to receiving a second electrical conductor (40) through said further opening (39), to allow bending of said second leg (36) and so to clamp said second electrical conductor (40) between said second leg (36) and a second counterpart wall (31).

2. A connecting device (30) according to claim 1, wherein: the bent leaf spring (S) is substantially U-shaped.

3. A connecting device (30) according to claim 1 or 2, wherein: said counterpart wall (31) and said second counterpart wall (31) comprise conductive material.

4. A connecting device (30) according to claim 3, wherein: said counterpart wall (31) and said second counterpart wall (31) are electrically connected to each other.

5. A connecting device (30) according to claim 4, wherein: said counterpart wall (31) and said second counterpart wall (31) are integrally formed.

6. A connecting device (30) according to any one of the preceding claims, wherein: said housing (32) consists of isolating material.

7. A connecting device (30) according to any one of the preceding claims, wherein said spring-force clamp connector (5, 31, 32) is a push-in clamp.

8. A low-voltage switching device (51, 53) comprising: switch poles and a plurality of connecting devices

(30) according to any one of the preceding claims connected to said switch poles.

9. A low-voltage switching device (51, 53) according to claim 8, wherein: the low-voltage switching device (51, 53) comprises, on its input or output side, three connecting devices (30) for switch poles for phases of a three-phase current, and optionally a fourth connecting device (30) for a control input.

10. A low-voltage switching device (51, 53) according to claim 8, wherein: the low-voltage switching device (51, 53) comprises, on both of its input and output sides, three connecting devices (30) for switch poles for phases of a three-phase current, and optionally a fourth connecting device (30) for a control input.

11. A low-voltage switching device (51, 53) according to any one of claims 8 to 10, wherein: said low-voltage switching device (51, 53) is connected to another low-voltage switching device (51, 53) according to any one of claims 8 to 10 between said connecting means (30) in both low-voltage switching devices (51, 53) using a link module (50).

12. A low-voltage switching device (51, 53) according to claim 11, wherein: said link module (50) comprises a wall (57) at least partly covering area between transverse faces of said low-voltage switching devices (51, 53).

13. A low-voltage switching device (51, 53) according to claim 12, wherein: said link module (50) further comprises connecting slots, rails or latch noses adapted to match with corresponding latch noses, rails or latch openings of said low-voltage switching devices (51, 53).

FIG 1
(PRIOR ART)

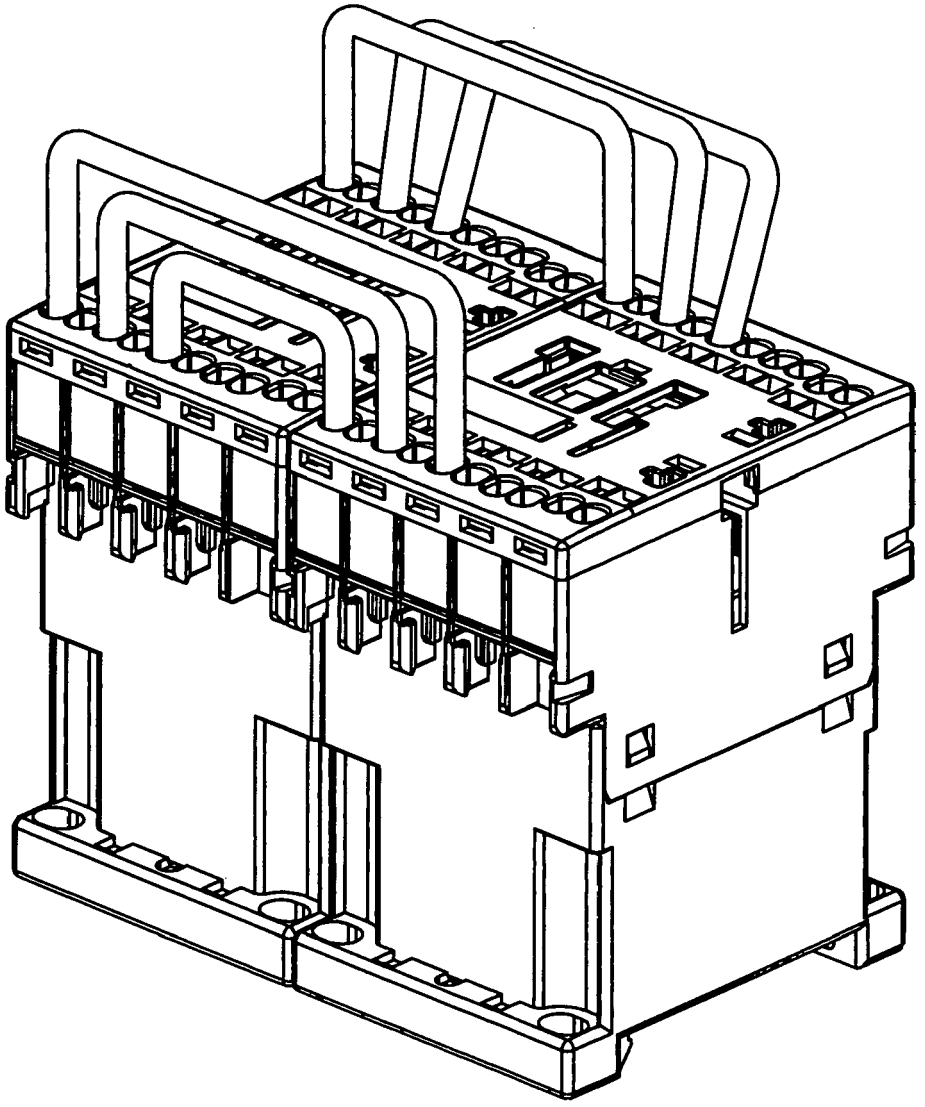


FIG 2

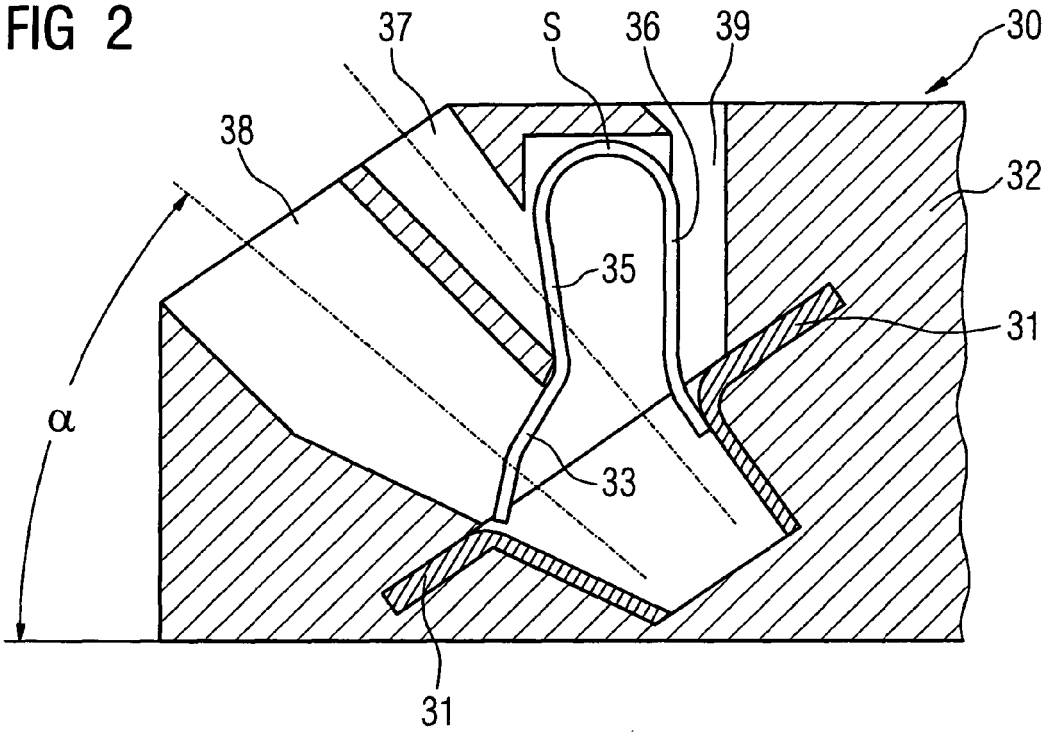
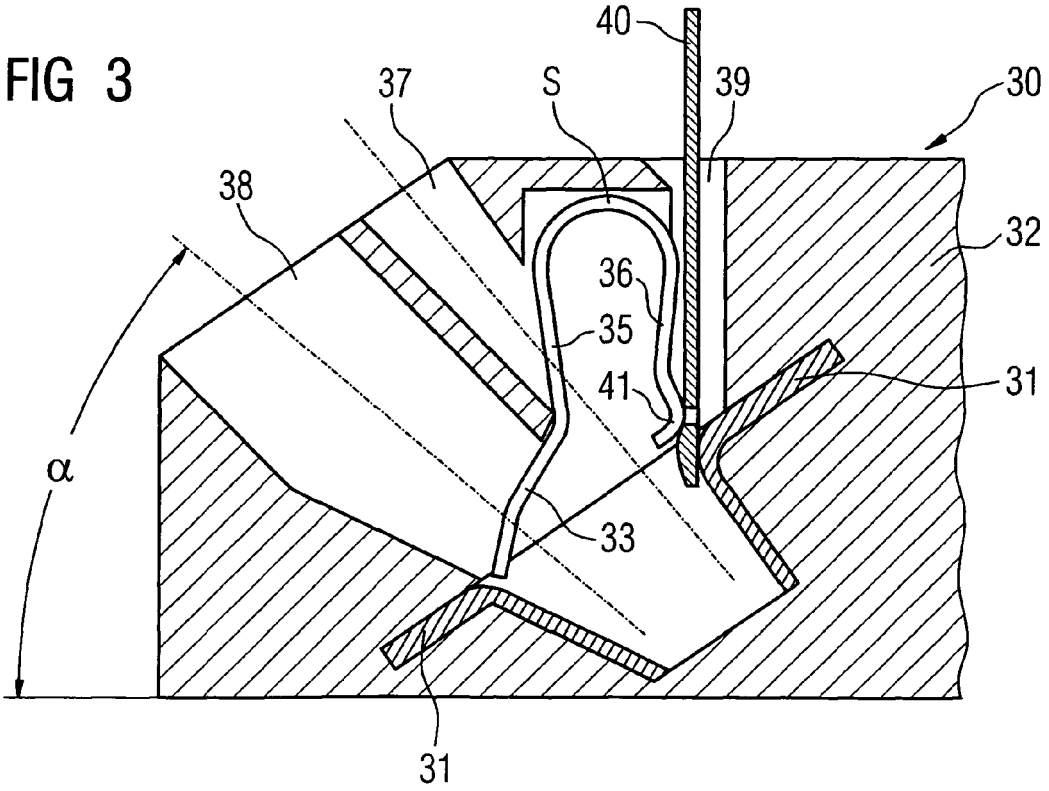


FIG 3



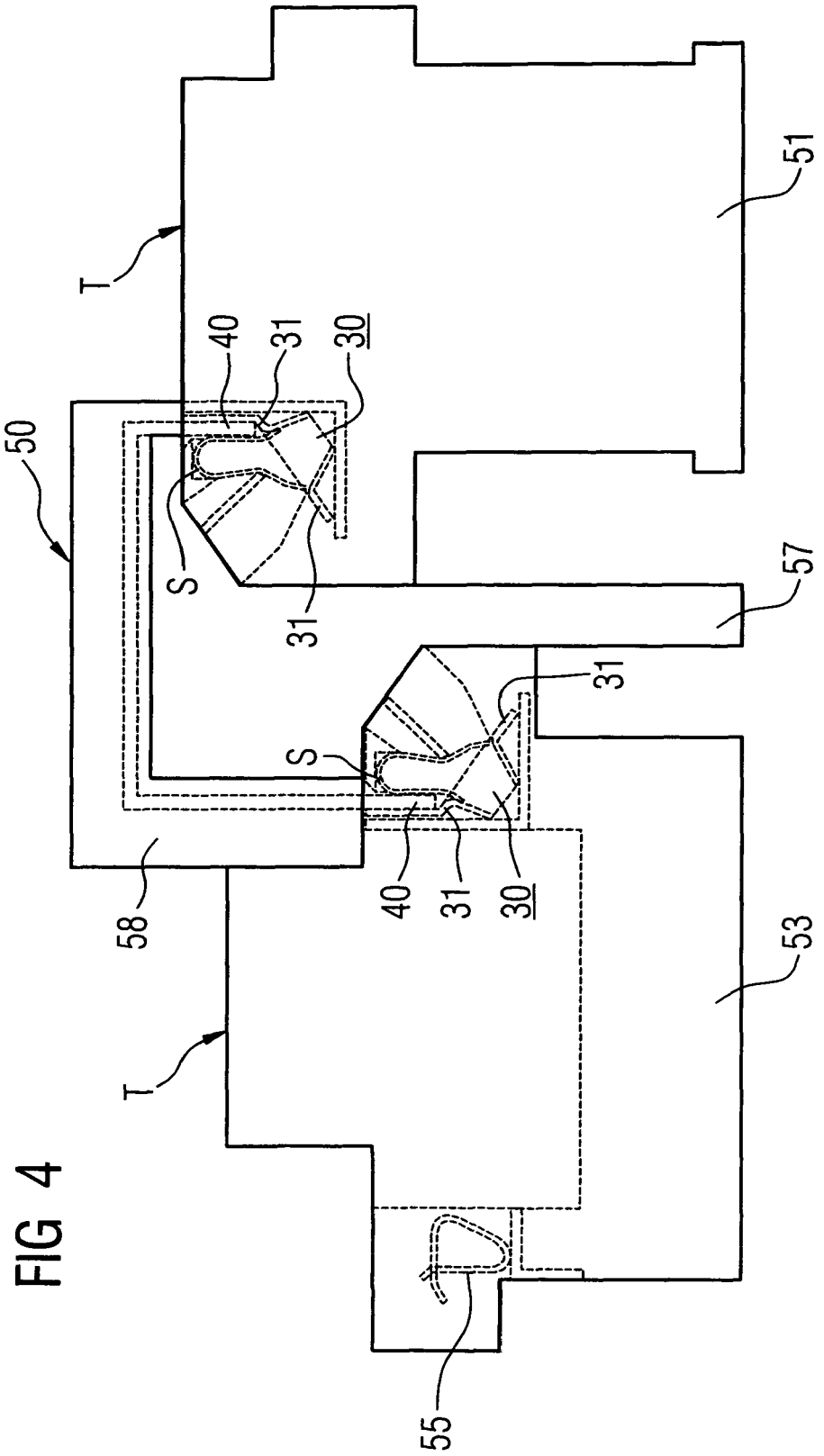


FIG 4

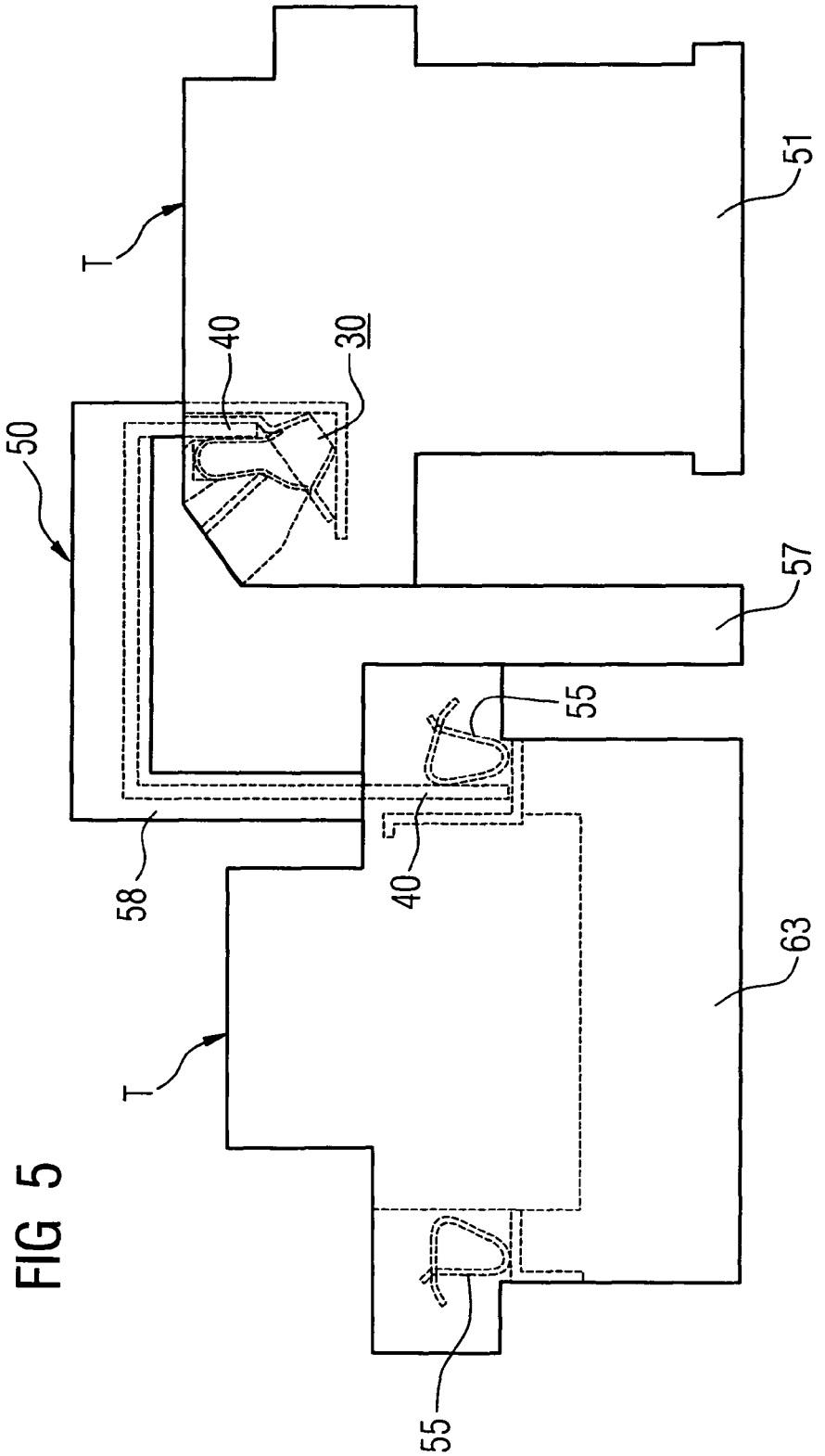


FIG 5

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EUROPEAN SEARCH REPORT

Application Number
EP 06 00 5650

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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X	US 6 126 494 A (FUCHS ET AL) 3 October 2000 (2000-10-03) * the whole document *	1-13	
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	16 August 2006	Chelbosu, L

CATEGORY OF CITED DOCUMENTS

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