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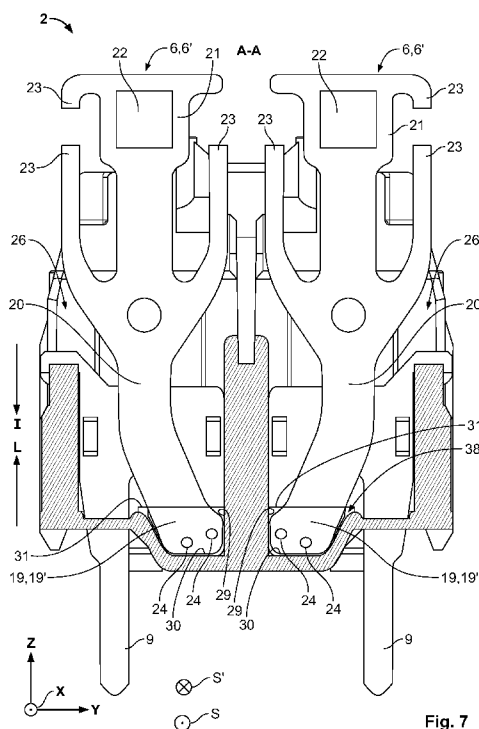
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- (54) **Title:** SWITCH CONTACT SUBASSEMBLY AND METHOD FOR THE PRODUCTION THEREOF



(57) **Abstract:** The invention relates to a switch contact subassembly (2) for contactors and relays (1) comprising a contact element (6, 6') having a contact spring (16) which has a securing region (19, 19') and a contact region (21), between which a resilient portion (20) extends, and having a carrier (15) which is at least partially laterally in abutment with the contact spring (16) and which is connected to the contact spring (16). The invention further relates to a method for producing a switch contact subassembly (2), in particular for use in connectors and relays (1), wherein a contact element (6, 6') is composed of a contact spring (16) and a carrier (15) by the carrier (15) being connected to a securing region (19, 9') of the contact spring (16). In order to connect the carrier (15) to the contact spring (16) in the most intimate manner possible, there is provision according to the invention for the contact spring (16) and the carrier (15) to be welded to each other in the securing region (19, 19').

Switch contact subassembly and method for the production thereof

The present invention relates to a switch contact subassembly for contactors and relays comprising a contact element having a contact spring which has a securing region and a contact region, between which a resilient portion extends, and having a carrier which is at least partially laterally in abutment with the contact spring and which is connected to the contact spring.

The invention further relates to a method for producing a switch contact subassembly, in particular for use in contactors and relays, a contact element being composed of a contact spring and a carrier by the carrier being connected to a securing region of the contact spring.

Switch contact subassemblies and methods for the production thereof of the above-mentioned type are known from the prior art. Such switch contact subassemblies perform mostly switching functions in electrical switching elements, such as, for example, relays. The switching elements have drive devices which move the contact elements by means of actuation members in order to move them into electrically conductive contact with counter-contact elements or to release them therefrom. Therefore, the actuation members move the contact elements in and counter to a switching direction towards the counter-contacts or away from them and retain an electrical circuit which is formed by the contact elements and counter-contact elements in the closed or open state.

In particular with switching elements such as contactors and relays, contact forces acting in the switching direction are applied by the drive device or actuation member in order to move the contact elements into contact with the counter-contact elements. A restoring force which is required to release the contact elements from the counter-contact elements and which generally acts counter to the switching direction can be applied by the resilient portions of the contact elements. In order to optimise the required resilient force of the resilient portions, the contact springs are generally produced from a material which, with sufficient electrical conductivity, has resilient properties which are as good as possible, that is to say, a desired resilient rigidity and stability, such as, for example, phosphor bronze.

In contrast, carriers of the contact elements are generally optimised in terms of their electrical conductivity since they mostly serve to electrically connect the contact elements. In order to ensure good power transmission between the carrier and the contact spring,

these are intended to be connected to each other as securely as possible. However, with a view to a constant desire to miniaturise switch contact subassemblies, it has become increasingly difficult to produce a sufficiently stable connection between the contact spring and the carrier. There is the risk that the contact elements do not achieve the necessary service-life or number of switching cycles since the contact element may become damaged beforehand. The damage may, for example, involve the material of the contact spring or the material in the connection region between the contact spring and carrier becoming worn and breaking.

Taking into account the above-mentioned problems in switch subassemblies or contact elements known from the prior art, an object of the invention is to provide a switch contact subassembly with the smallest possible dimensions and at the same time to construct the contact element or the connection between the contact spring and carrier in the most stable manner possible.

For the switch contact subassembly mentioned in the introduction, this object is achieved in that the contact spring and the carrier are welded to each other in the securing region.

For the method known in the introduction, the object is achieved in that the contact spring and the carrier are welded to each other in the securing region. The welding is preferably carried out by means of a laser.

This solution which at first appears simple has the advantage that an intimate connection is produced between the contact spring and carrier and has good electrical and thermal conductivity. At the same time, the connection is very stable. Contact springs and carriers were previously not welded since the heat which occurs during welding can change the material of the contact element beyond the securing region, in particular in the resilient portion adjoining the securing region, in such a manner that the desired resilient properties can no longer be achieved and premature fatigue of the material occurs. That is to say, the welding operation may damage the material of the contact spring, in particular the resilient portion. If the damage extends as far as a clamping region of the contact element or the resilient portion of the contact spring, the region may become prematurely fatigued and may, for example, break the contact spring. The Applicant has successfully configured the welding and the securing region in such a manner that the resilient portion remains undamaged.

The solutions according to the invention may be freely combined and further improved with the following additional embodiments which are advantageous per se:

The contact spring and the carrier may be riveted to each other in the securing region. The riveting may be carried out in addition to the welding and may help to increase the stability of the connection between the contact spring and the carrier.

5 The carrier may be in abutment with the contact spring in the securing region and at least partially in the resilient portion. That is to say, the contact spring and carrier may be arranged so as to closely adjoin each other in the securing region and beyond the securing region in the resilient portion. Consequently, the carrier may support the contact spring in the resilient portion and may help to stabilise it.

10 The at least one contact spring may be retained beyond the securing region as far as a location in the resilient portion in at least one contact receiving member of a housing member of the switch contact subassembly at least in a direction parallel with a switching direction of the contact element. That is to say, the contact element may be retained or clamped at both sides as far as a location above the securing region. It is thereby possible for any occurrences of material impairment or damage which may occur as a result of the
15 welding in the securing region to be arranged in a region in which the contact element is retained and consequently immobilised. This region may consequently be free from switching or resilient forces. The welding is therefore located in a region in which the contact element is not subjected to loading by switching and/or restoring forces.

A retention projection may be formed on the contact receiving member whose height
20 measured from a base of the contact receiving member to an upper edge of the retention projection is greater than a length of the securing region measured parallel with a longitudinal direction of the contact spring. It can consequently be ensured that the retention projection retains the contact spring or the contact element as far as a location beyond the securing region and, furthermore, switching and/or restoring forces which
25 occur have no influence on the securing region where possible.

The upper edge may at least partially be provided with a chamfer in the direction towards the contact element. Thus, the chamfer may extend, for example, substantially transversely relative to the longitudinal direction of the contact spring. This helps to minimise notching effects of the retention projection or the upper edge thereof on the
30 contact element and consequently to increase the service-life of the contact element.

In the method mentioned in the introduction, the solution according to the invention may, for example, be further improved in that the contact spring and the carrier are riveted to each other in the securing region. As already mentioned above, the riveting may be

carried out in addition to the welding and provides a good possibility for stabilising the connection between the contact spring and carrier.

The at least one contact spring may be retained beyond the securing region as far as a location in a resilient portion of the contact spring in at least one contact receiving member of a housing member of the switch contact subassembly at least substantially parallel with a switching direction of the contact element. For example, the contact element may be inserted into the contact receiving member of the housing member. Owing to the insertion, the contact element may be immobilised beyond the securing region, that is to say, for example, as far as a location in the resilient portion, and the securing region may thus be protected from switching and/or restoring forces which act during the switching operation.

A retention projection for lateral support of the securing region may be formed on the housing member after the contact element has been inserted into the contact receiving member. Alternatively, the retention projection may naturally be formed beforehand in the housing member, for example, by the housing member being formed as an integral injection-moulded component together with the retention projection. It is also possible to form the retention projection by partially casting the contact receiving member.

The invention will be described in greater detail below by way of example with reference to possible embodiments with reference to the appended drawings. The feature combinations illustrated in these embodiments merely serve the purposes of illustration. Individual features may also be omitted in accordance with the advantages thereof described above if the advantage of the respective feature is not relevant for specific applications.

In the description of the embodiments, features and elements which are identical have been given the same reference numerals for the sake of simplicity. Features and elements with a functionality which is the same or at least similar generally have the same reference numeral or the same reference letter, which is appended with one or more apostrophes in order to designate another embodiment.

In the drawings:

Figure 1 is a schematic, perspective view of an electrical switching element having a switch contact subassembly according to the invention;

Figure 2 is a front view of a first embodiment of contact elements according to the invention;

Figure 3 is a plan view of a second embodiment of contact elements according to the invention;

Figure 4 is a schematic, perspective view of a switch contact subassembly according to the invention;

5 Figure 5 is a schematic cross-section of a portion of the switch contact subassembly shown in Figure 4;

Figure 6 shows a detail V from Figure 5; and

Figure 7 is a schematic cross-section of the switch contact subassembly shown in Figures 4 to 6 along the line of section A-A shown in Figure 5.

10 Figure 1 is a schematic, perspective view of a switching element 1 according to the invention in the form of a relay. The switching element 1 extends in the longitudinal direction X of a transverse direction Y which extends perpendicularly relative to the longitudinal direction X and a vertical direction Z which extends perpendicularly relative to the longitudinal direction X and transverse direction Y, which together define a Cartesian
15 coordinate system. The switching element 1 comprises a switch contact subassembly 2 according to the invention, a drive device 3 and an actuation device 4.

The switch contact subassembly 2 comprises a housing member 5, which carries the drive device 3, the actuation device 4, a pair of electrical contact elements 6, a pair of electrical counter-contact elements 7 and a pair of additional electrical counter-contact
20 elements 8. In a switching direction S, the contact elements 6 are constructed so as to be able to be joined together with the counter-contact elements 7. In a counter-switching direction S', the contact elements 6 are constructed so as to be able to be joined together with the additional counter-contact elements 8. Each of the contact elements 6 has an electrical connection 9, each counter-contact element 7 has an electrical counter-
25 connection 10 and each of the additional counter-contact elements 8 has an additional electrical counter-connection 11. The connections 9 to 11 are, for example, constructed as contact pins or soldering lugs.

The drive device 3 is constructed, for example, as an electromotive drive comprising an electric coil, a magnetic core and a yoke and has, for example, a pair of electrical power
30 supply connections 12 by means of which the drive device 3 can be supplied with an electrical power or switching voltage. The supply connections 12 may also be constructed as pin contacts or soldering lugs. Furthermore, the actuation device 4 may, for example,

comprise a folding armature 13 and a sliding member 14, the folding armature 13 acting in the form of a lever on the sliding member 14 which is displaceably received so as to extend substantially parallel with the longitudinal direction X in the switching direction S and counter-switching direction S' and cooperates with the contact elements 6 in such a manner that it can apply a switching force F_s which acts in a switching direction S or a counter-switching force $F_{s'}$ which acts in a counter-switching direction S' to the contact elements 6.

Figure 2 is a schematic front view of a first embodiment of two contact elements 6 according to the invention which are constructed in a substantially mirror-symmetrical manner relative to each other. Each of the contact elements 6 comprises a carrier 15 and a contact spring 16 and extends in a longitudinal extent L which extends substantially parallel with the vertical direction Z from a lower end 17 to an upper end 18. The lower end 17 is formed by a downwardly facing tip of the connection 9 which is formed on the carrier 15. Above the connection 9 is a securing region 19 of the contact element 6, which region is constructed to be retained by the housing member 5 or by means of which the contact element is fixed in the housing member 5. The securing region 19, as shown in the present case, may be formed together by the carrier 15 and contact spring 16.

Above the securing region 19, there extends a resilient portion 20 of the contact element 6 which is constructed so as to be resiliently movable relative to the securing region 19 in the switching direction S or in the counter-switching direction S'. Above the resilient portion 20 there extends a contact region 21 of the contact element 6, in which region a contact face 22 of the contact element 6 is arranged for contacting a corresponding counter-contact face of one of the counter-contact elements 7 or additional counter-contact elements 8. Furthermore, the contact element 6 has resilient arms 23 which can cooperate with the sliding member 14 or on which the sliding member 14 can transmit the switching force F_s and counter-switching force $F_{s'}$ to the contact element 6.

The carrier 15 and contact spring 16 are connected to each other in the securing region 19. The carrier 15 is in lateral abutment with the contact spring 16, in the present case at the front side, so that the carrier 15 and contact spring 16 overlap each other at the front or rear side thereof, which has the advantage with respect to abutment with the end faces or narrow sides that more material or surface-area is available for the connection thereof. That is to say, the carrier 15 and contact spring 16 overlap each other in the switching direction S or counter-switching direction S'. In the present embodiment of the contact spring 16, the carrier 15 and the contact spring 16 are welded to each other at welding

locations 24. The welding locations 24 may first be present as welding projections on the carrier 15 and/or on the contact spring 16 and, during the welding operation of the carrier 15, may be melted with the contact spring 16 and be pressed into the material of the respective connection partner, that is to say, the carrier 15 and/or contact spring 16, so that they form a materially engaging connection with each other.

Figure 3 is a schematic front view of another embodiment of a pair of contact elements 6' according to the invention. In contrast to the contact element 6, the contact element 6' has a securing region 19' with a welding location 24' and additionally a securing element 25. The welding location 24' is constructed as a weld seam which extends in the region of a lower edge of the securing region 19' substantially in the transverse direction Y and at which the carrier 15 is connected to the contact spring 16. The securing element 25 may be constructed to connect the carrier 15 to the contact spring 16 in a positive-locking and/or non-positive-locking manner. For example, the securing element 25 may be constructed as a rivet.

Figure 4 is a schematic, perspective view of a switch contact subassembly 2 according to the invention. The switch contact subassembly 2 comprises the housing member 5 and at least one of the contact elements 6, 6'. The contact elements 6, 6' are each received in a contact receiving member 26 formed in the housing member 5. There is formed in the contact receiving member 26 a retention projection 27 which assists in fixing the contact element 6, 6' to the securing region 19, 19' in the contact receiving member 26.

Figure 5 is a schematic cross-section of one of the contact receiving members 26 together with the contact element 6, 6' received therein in a plane of section which extends substantially parallel with the longitudinal direction X and vertical direction Z. The contact element 6, 6' is, for example, introduced into the contact receiving member 26 in an introduction direction I which extends counter to the longitudinal extent L or vertical direction Z. The connection 9 protrudes below a base 28 of the housing so that it contacts in an electrically conductive manner or can be provided with an electrical conductor (not shown). The securing region 19, 19' together with the welding location 24, 24' is retained in a retention region 29 of the contact receiving member 26 which is formed at least partially by the retention projection 27. The resilient portion 20 of the contact element 6, 6' protrudes upwards from the retention region 29 as far as a location beyond the contact receiving member 26 so that an upper portion of the resilient portion 20 together with the adjacent contact region 21 is arranged at the outer side of the contact receiving member 26.

Figure 6 shows a detail V from Figure 5. In this instance, it becomes clear that the securing region 19, 19' is arranged completely in the retention region 29 of the contact receiving member 26, which region extends substantially from a base 30 of the contact receiving member as far as a front edge 31 of the retention projection 27. In the retention region 29, the contact receiving member 26 forms a front wall portion 32 which extends substantially parallel with the longitudinal extent L of the contact element 6, 6' and a rear wall portion 33 which also extends substantially parallel with the longitudinal extent F, which portions face in a counter-switching direction S' or switching direction S and together securely clamp the securing region 19, 19'. Consequently, when viewed in the longitudinal extent L thereof, the contact element 6, 6' is resiliently movable only from the front edge 31 in the switching direction S and counter-switching direction S' and the welding location 24, 24' is received in a protected manner in the retention region 33 in the switching direction S or counter-switching direction S' so as to be substantially covered by the front wall portion 32 or rear wall portion 33 from the action of the switching force F_S or counter-switching force $F_{S'}$. A length or height L_{29} of the retention region 29 measured from the base 30 to the front edge 31 is therefore greater than a length l_{19} of the securing region 19 measured substantially parallel with the longitudinal extent L.

Furthermore, a chamfer 34 which is fitted to the contact receiving member 26 extends substantially in the transverse direction Y. The chamfer 34 begins when viewed in the vertical direction Z at the front edge 31 and terminates at an upper edge 35 of the retention projection 27. An upper side 36 of the retention projection adjoins the upper edge 35 of the retention projection. Below the base 30, a passage 37 extends as an opening in the base portion 28 of the housing member 5. The connection 9 extends through the passage 37 in a downward direction out of the contact receiving member 26 and protrudes below the base portion 28 of the housing member 5.

Figure 7 is a schematic cross-section of the switch contact subassembly 2 illustrated in Figures 4 to 6 along the line of section A-A drawn in Figure 5 or approximately in the region of the front wall portion 32 in a plane which extends substantially parallel with the transverse direction Y and vertical direction Z, when viewed in the counter-switching direction S'. In this instance, it is clear that the retention region 29 forms a type of pocket 38 which is for receiving the securing region 19, 19' and which is closed in the introduction direction I by the base 30 of the contact receiving member 26 and which is delimited counter to the introduction direction I or in the vertical direction Z by the front edge 31 of the retention projection 27. The securing region 19, 19' and the pocket 38 which opens in the introduction direction I are constructed so as to complement each other so that the

securing region 19, 19' is fixed in the pocket 38 or in the retention region 29 in a positive-locking and/or non-positive-locking manner.

The welding locations 24 are arranged completely in the pocket 38 and are consequently arranged so as to be protected from loads, at least resulting from switching forces F_S and counter-switching forces $F_{S'}$. Outside the pocket 38 or above the front edge 31, the resilient portion 20 is arranged so as to be resiliently movable so that the contact face 22 can be brought into electrically conductive contact with a counter-contact face by means of movement of the contact region 21 in the switching direction S or counter-switching direction S' and/or, as a result of the resilient force of the resilient portion 20, restoring forces F_R which act counter to the switching direction S or counter-restoring forces $F_{R'}$ which act counter to the counter-switching direction S' can be applied and activated by the resilient portion 20 in order to release the contact face 22 from the respective counter-contact face.

In the context of the notion of the invention, deviations from the embodiments described above are possible. A switching element 1 according to the invention may thus have any number of switch contact subassemblies 2, drive devices 3 and actuation devices 4 constructed in accordance with the respective requirements.

The switch contact subassembly 2 may, in accordance with the respective requirements, comprise for this purpose a housing member 5, contact elements 6, 6', counter-contact elements 7, additional counter-contact elements 8 and contact receiving members 26 which may be constructed in accordance with respective requirements in order to be able to receive contact elements 6, 6', counter-contact elements 7 and additional counter-contact elements 8. The contact elements 6, 6', counter-contact elements 7 and additional counter-contact elements 8 may be constructed in accordance with the respective requirements and may be provided with connections 9, counter-connections 10 or additional counter-connections 11 which may be constructed in accordance with the respective requirements in order to secure an electrical conductor to the contact elements.

The carrier 15 and the contact spring 16 may be constructed in accordance with the respective requirements and form a lower end 17, an upper end 18, a securing region 19, 19', a resilient portion 20, a contact region 21, a contact face 22 and resilient arms 23 in any number and form. In order to connect the carrier 15 and contact spring 16, welding locations 24, 24' and securing elements 25 may be selected in accordance with the respective requirements and be arranged within the securing region 19, 19'. The contact

receiving members 26 may form in accordance with the respective requirements retention projections 27, bases 30, front edges 31, front wall portions 32, rear wall portions 33, chamfers 34, upper edges 35, upper sides 36, passages 37 and pockets 38 in any number and form in order to retain the securing region 19, 19' and where possible protect

5 it from damaging effects of force.

List of reference numerals

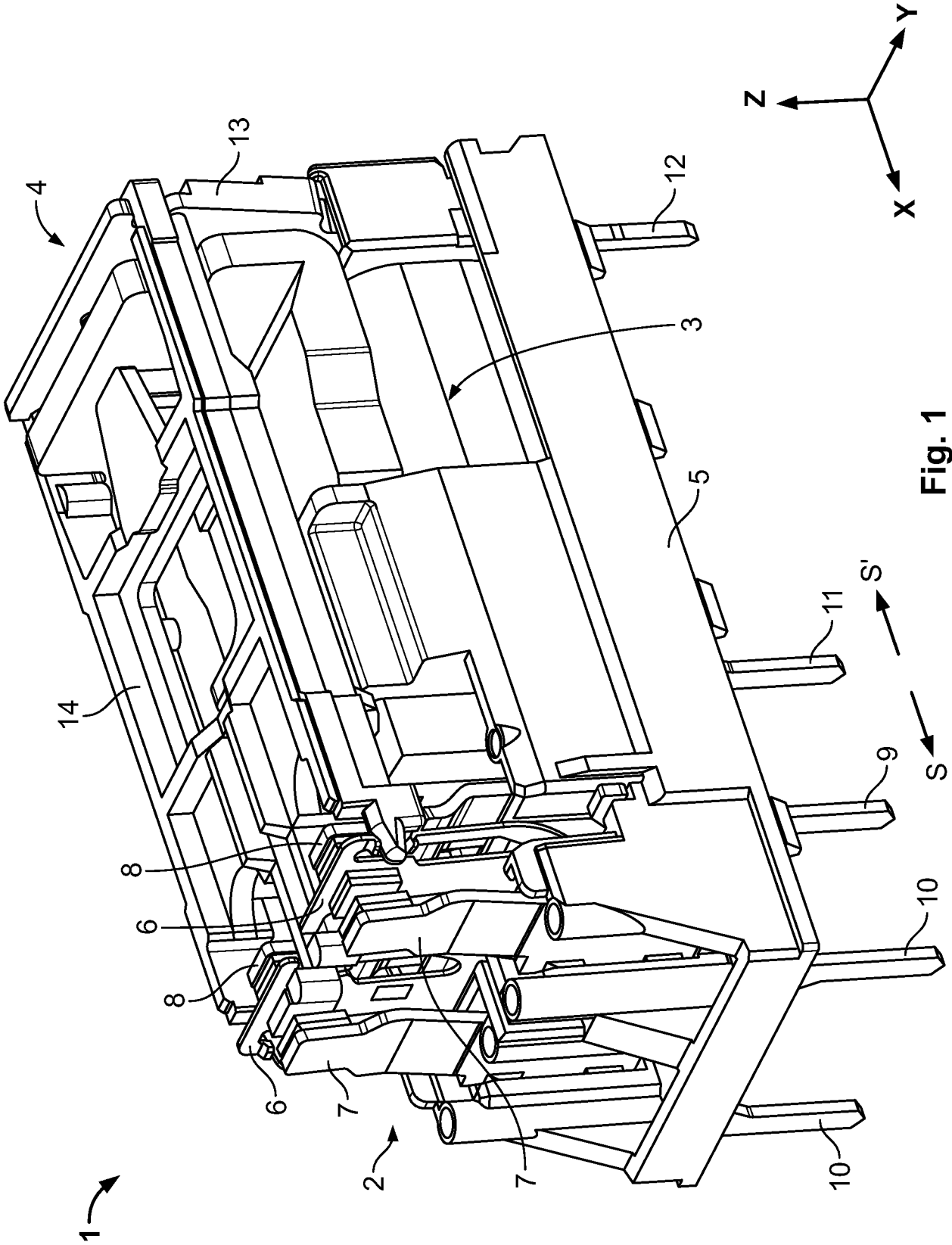
1	Switching element (relay)
2	Switch contact subassembly
3	Drive device
4	Actuation device
5	Housing member
6, 6'	Contact element
7	Counter-contact element
8	Additional counter-contact element
9	Connection
10	Counter-connection
11	Additional counter-connection
12	Power supply connection
13	Armature
14	Sliding member
15	Carrier
16	Contact spring
17	Lower end
18	Upper end
19, 19'	Securing region
20	Resilient portion
21	Contact region
22	Contact face
23	Resilient arm
24, 24'	Welding location
25	Securing element
26	Contact receiving member
27	Retention projection
28	Base portion
29	Retention region
30	Base
31	Front edge
32	Front wall portion
33	Rear wall portion
34	Chamfer
35	Upper edge
36	Upper side
37	Passage
38	Pocket
F_S	Switching force
$F_{S'}$	Counter-switching force
F_R	Restoring force
$F_{R'}$	Counter-restoring force
I	Introduction direction
L	Longitudinal extent
S	Switching direction
S'	Counter-switching direction
X	Longitudinal direction
Y	Transverse direction
Z	Vertical direction

Claims

1. Switch contact subassembly (2) for contactors and relays (1) comprising a contact element (6, 6') having a contact spring (16) which has a securing region (19, 19') and a contact region (21), between which a resilient portion (20) extends, and having a carrier (15) which is at least partially laterally in abutment with the contact spring (16) and which is connected to the contact spring (16), characterised in that the contact spring (16) and the carrier (15) are welded to each other in the securing region (19, 19').
2. Switch contact subassembly (2) according to claim 1, characterised in that the contact spring (16) and the carrier (15) are riveted to each other in the securing region (19, 19').
3. Switch contact subassembly (2) according to claim 1 or claim 2, characterised in that the carrier (15) is in abutment with the contact spring (6, 6') in the securing region (19, 19') and at least partially in the resilient portion (20).
4. Switch contact subassembly (2) according to any one of claims 1 to 3, characterised in that the at least one contact spring (6, 6') is retained beyond the securing region (19, 19') as far as a location in the resilient portion (20) in at least one contact receiving member (26) of a housing member (5) of the switch contact subassembly (2) at least in a direction parallel with a switching direction (S, S') of the contact element (6, 6').
5. Switch contact subassembly (2) according to claim 4, characterised in that a retention projection (27) is formed on the contact receiving member (26) whose height (h_{27}) measured from a base (30) of the contact receiving member (26) to an upper edge (35) of the retention projection (27) is greater than a length (l_{19}) of the securing region (19, 19') measured parallel with a longitudinal extent (L) of the contact spring (6, 6').
6. Switch contact subassembly (2) according to claim 5, characterised in that the upper edge (35) is at least partially provided with a chamfer (34) in the direction towards the contact element (6, 6').
7. Method for producing a switch contact subassembly (2), in particular for use in connectors and relays (1), a contact element (6, 6') being composed of a contact

spring (16) and a carrier (15) by the carrier (15) being connected to a securing region (19, 19') of the contact spring (16), characterised in that the contact spring (16) and the carrier (15) are welded to each other in the securing region (19, 19').

8. Method according to claim 7, characterised in that the contact spring (16) and the carrier (15) are riveted to each other in the securing region (19, 19').
9. Method according to claim 7 or claim 8, characterised in that the at least one contact spring (16) is retained beyond the securing region (19, 19') as far as a location in a resilient portion (20) of the contact spring in at least one contact receiving member (26) of a housing member (5) of the switch contact subassembly (2) at least substantially parallel with a switching direction (S, S') of the contact element (6, 6').
10. Method according to claim 9, characterised in that a retention projection (27) for lateral support of the securing region (19, 19') is formed on the housing member (5) after the contact element (6, 6') has been inserted into the contact receiving member (26).



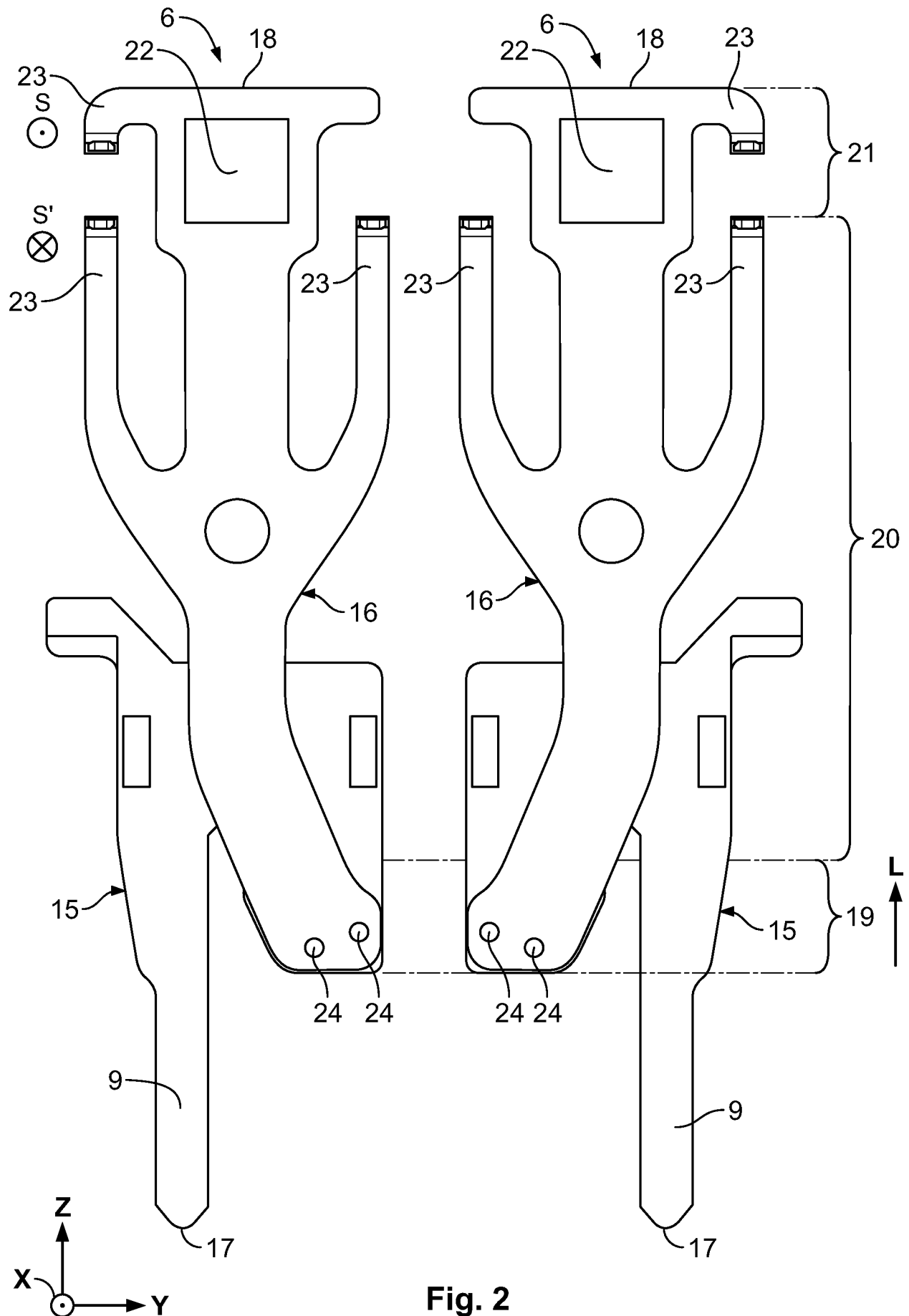


Fig. 2

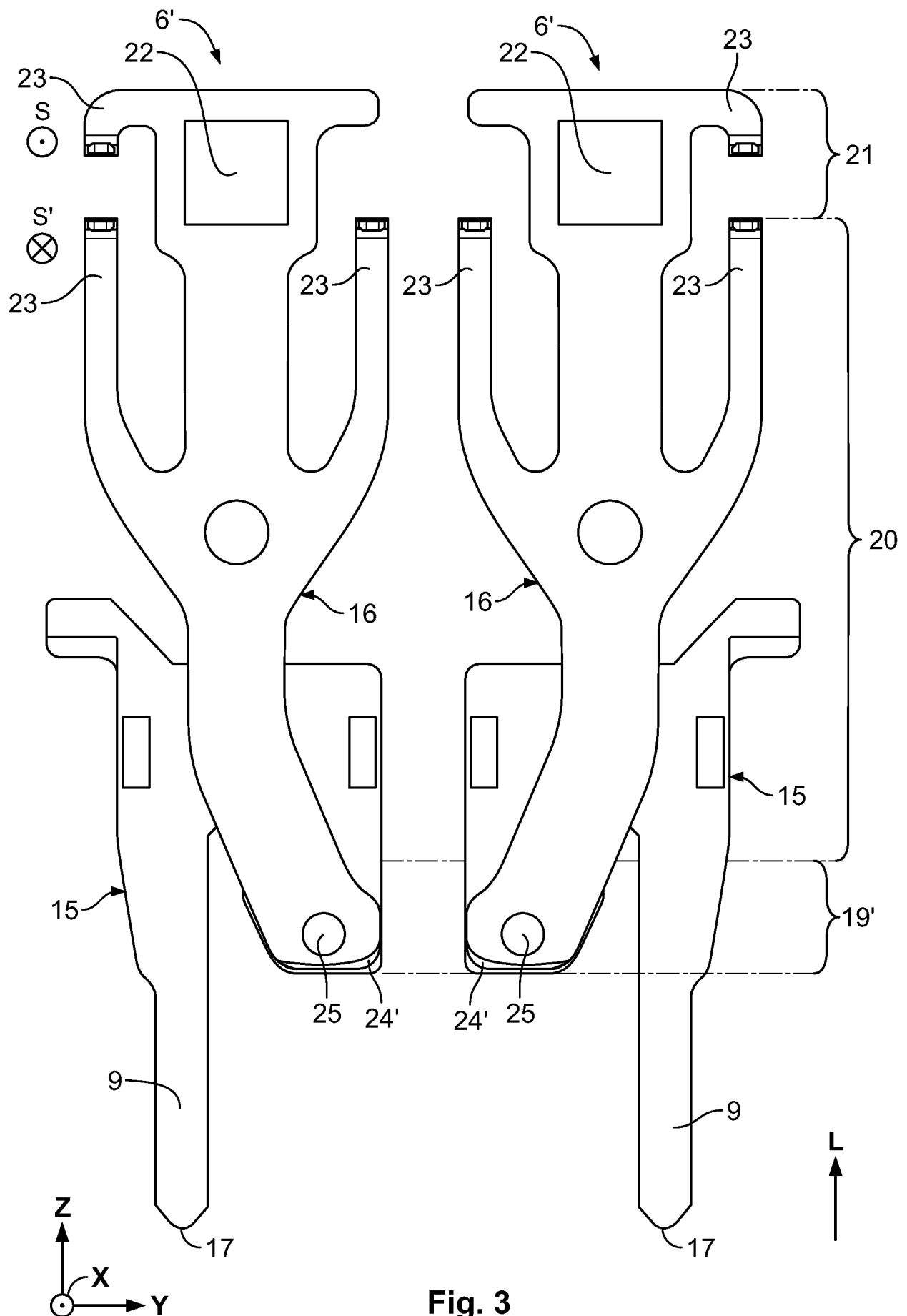


Fig. 3

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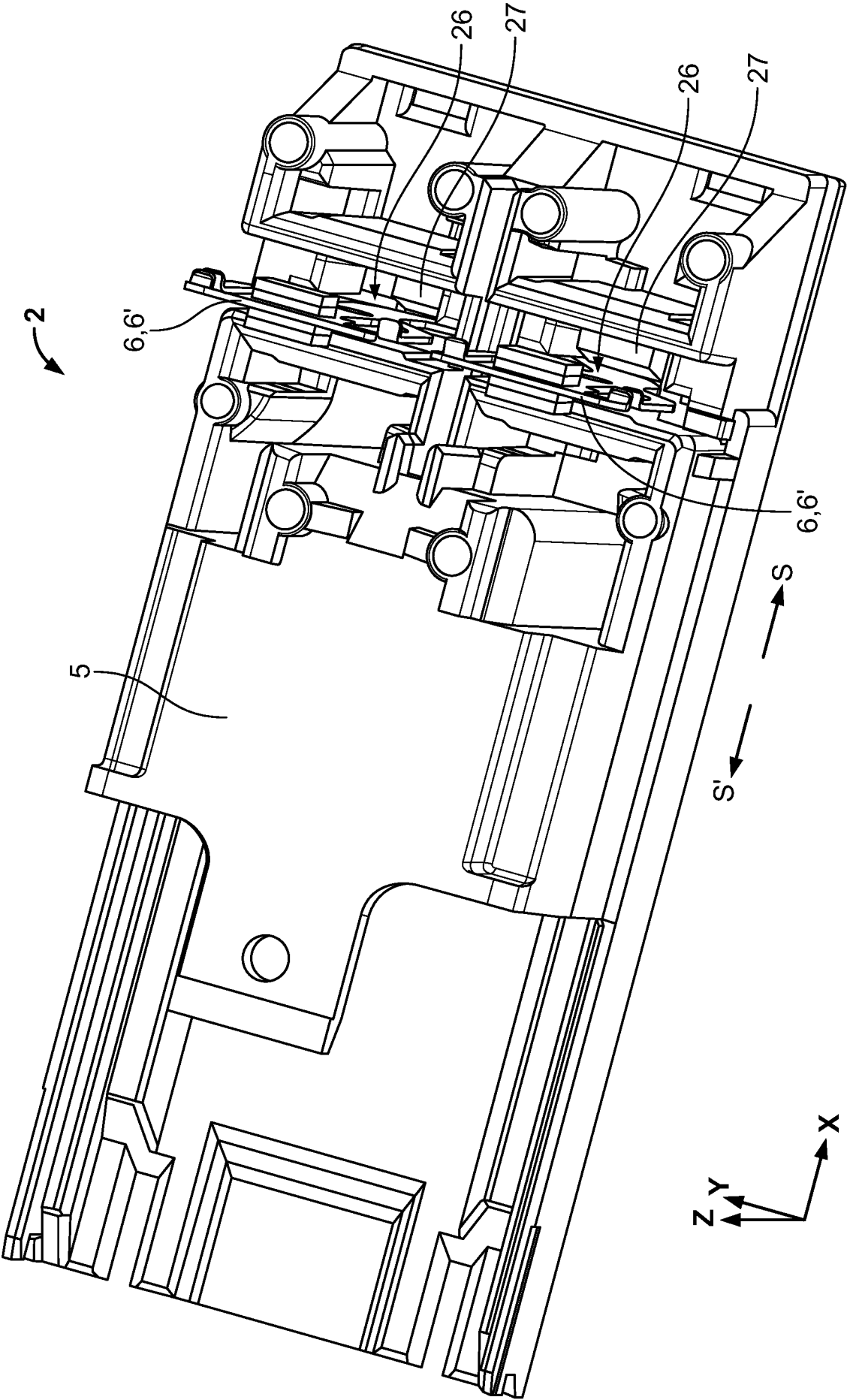
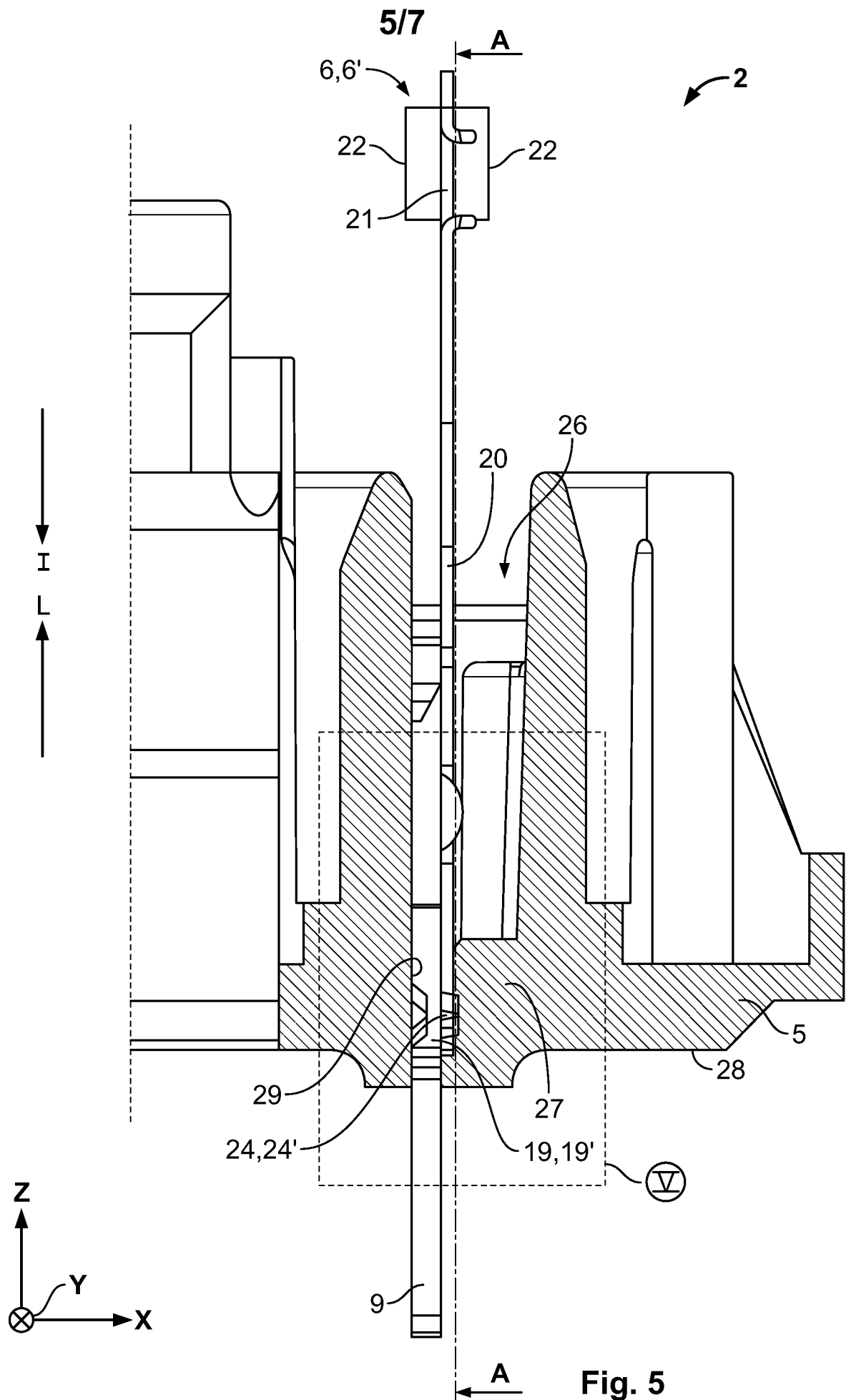
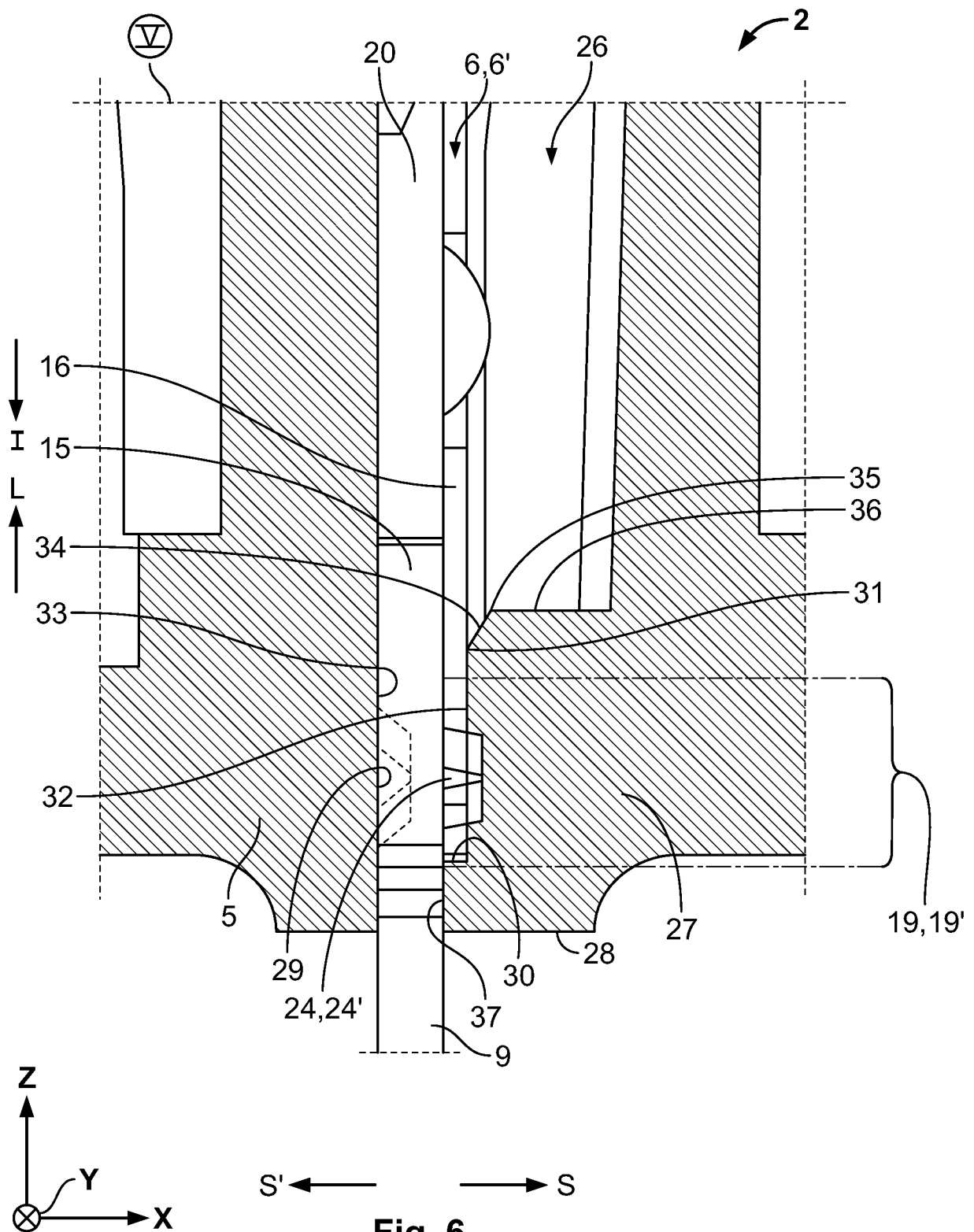


Fig. 4





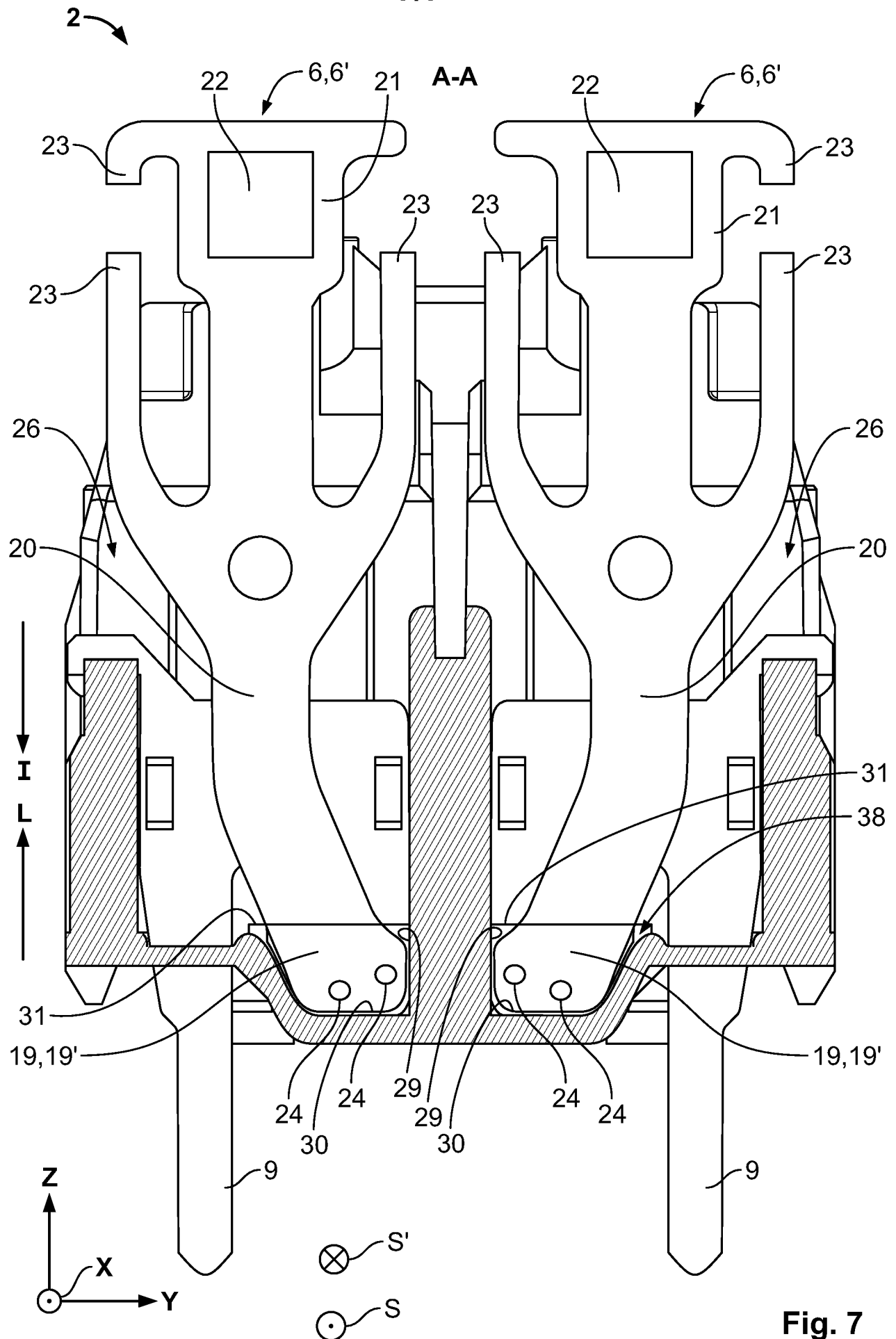


Fig. 7

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2014/063342

A. CLASSIFICATION OF SUBJECT MATTER
INV. H01H50/56
ADD. H01H9/02

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)
H01H

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

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

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4 027 131 A (AIDN MARTIN ET AL) 31 May 1977 (1977-05-31)	1,3-7,9, 10
Y	column 3, line 36 - column 4, line 50; figures 1-2	2,8

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Y	page 1, line 80 - page 2, line 77; figure 3	2,8

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Further documents are listed in the continuation of Box C.



See patent family annex.

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INTERNATIONAL SEARCH REPORT

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