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(54) **RAIL SOCKET WITH IMPROVED CURRENT TRANSMISSION**

SCHIENENSOCKEL MIT VERBESSERTER STROMÜBERTRAGUNG

PRISE DE RAIL À TRANSMISSION DE COURANT AMÉLIORÉE

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Description

[0001] The invention relates to a rail socket for connecting a module device to a conductor member, the rail socket comprising a conductor receptacle adapted to receive the conductor member, wherein at least one electrically conductive resilient contact member is provided, which extends into the conductor receptacle.

[0002] Rail sockets are known from the art and are in general used to connect electronic devices, such as module devices, to a conductor rail. Rail sockets are used, e.g. to connect electronic devices electrically and/or mechanically to either provide the electronic device with electric energy via the conductor rail or to apply the conductor rail as a drain channel for electric excess energy. The latter application is for instance used in surge protection devices, which protect electric circuits from over voltage or over current, which may damage the device. In the case of the occurrence of voltage or current peaks, the surge protection device, which acts as an electric connection member between the electric power source and the electric device, prevents the voltage or current peak to be transmitted to the electric device and redirects the voltage or current peak to an appropriate grounding member.

[0003] In general, a conductor rail is used as a grounding member. Preferably, DIN rails are used as grounding member. Standardized rails allow high flexibility and exchangeability of the components used.

[0004] In general, a surge protection device is mechanically and electrically connected to such a DIN rail, that is, the surge protection device is fixed, for instance clamped, to the rail and provides an electric contact to the DIN rail.

[0005] US patent US 8,647,158 B2 describes for example a device for mounting a protection on a DIN rail, wherein the protection comprises a slideable member providing the mechanical fixation of the protection to the DIN rail. Electrical connection between the protection and the DIN rail is established by abutment between surfaces and/or edges of the protection and edges of the DIN rail.

[0006] In EP 0 233 458 A1, a rail socket is shown which applies two separate round wires and are used as spring members provided in the socket. The spring members provide bent portions that extend into recesses of the socket for receiving the spring members with a play. Two portions of each of the two spring members extend into a conductor receptacle of the rail.

[0007] US 2011/070755 A1 deals with a ground conductor that includes a conductor body formed from a sheet of conductive metal material of a given thickness. The conductor body has a horizontal base portion and a pair of downwardly extending vertical leg portions that contain opposed mounting rail cavities that terminate at one end in a pair of flange recesses.

[0008] A detachable securement apparatus for a mounting rail is disclosed in US 6 431 909 B1. The mounting rail has first and second mounting flanges extending lengthwise along opposite sides of a support section and comprises a body, a securement assembly and a release assembly.

[0009] EP 1 182 735 A2 concerns a device having a plastic terminal housing with a metal earth conductor connecting element in its foot. A metal foot that clamps onto at least one arm of the rail is a flat, narrow metal strip. A contact spring has two parallel sprung arms being in lateral contact with the metal foot and being curved towards the one arm of a bearer rail.

[0010] A fixing device for fixing onto it a symmetrical rail comprising a fastening piece and a blade spring is shown in US 5 049 094 A. The fastening piece includes a body having first and second hooks, with a third hook between them.

[0011] In DE 10 2013 114 315 A1 a metal protective conductor connection element is disclosed that has a metal foot arrangement, which has at least one first metal foot and at least one second metal foot for supporting on a support rail.

[0012] One problem which arises in the solutions of the prior art relates to certain construction tolerances of the applied conductor rail. The conductor rail may comprise ridges, dents and may be distorted in one or more directions.

[0013] If applied as a means for dissipation of voltage or current peaks, the electrical connection between the surge protection and the connector rail needs to fulfill electrical requirements. One DIN standard concerned with surge protection is for instance DIN-VDE 185-305.

[0014] In order to guarantee the dissipation of the electric excess energy according to the standard, it is essential to provide a good electrical contact between the surge protection device and the conductor rail. In the solutions of the prior art the electric connection between the surge protection device and the connector rail may be degraded by means of tolerances of the rail. It may be possible that the number of contact points between the surge protection device and the conductor rail may be decreased by means of a distortion of the rail or surface structures like ridges or dents.

[0015] In order to provide an efficient dissipation of electrical excess energy, it is preferred to divide or split the path of the electric current into a plurality of current paths. By doing so, the current density may be drastically reduced.

[0016] Contrarily, if the number of contact points between the surge protection device and the conductor rail is reduced due to tolerances of the conductor rail, the dissipation of the electric excess energy may be degraded, which, in the worst case, might lead to a non-fulfillment of the required electric standards.

[0017] Therefore, an object of the present invention is to provide a stable connection, in particular a mechanical and electrical connection, between a module device and a conductor member independent of tolerances of said connector member.

[0018] These problems are solved by a rail socket according to claim 1.

[0019] In the following, further embodiments of the invention will be described, each embodiment being advantageous in itself. The described technical features of the embodiments below may be arbitrarily combined or omitted as long as the basic idea of the invention is maintained.

[0020] A rail socket is to be understood as an intermediate element between a conductor member and a module device, whereas the connection between the rail socket and the module device may be electric or mechanic or, in a preferred embodiment, electric and mechanic.

[0021] A conductor member may be any structure suitable to be connected to the inventive rail socket, whereas the conductor member is preferentially embodied as a conductor rail, more preferably embodied as a DIN conductor rail. Therefore, the cross-section of the conductor rail may be square, triangular, hat-shaped (EN 50022), G-Shaped or the like. The main advantages of a DIN conductor rail are a standardized size, shape and tolerances, which allow a high versatility and exchangeability of the components used.

[0022] The conductor receptacle is to be understood as an opening in the cubage of the rail socket into which a conductor element may be inserted. Commonly, the conductor receptacle is defined by at least one surface of the rail socket, the surface facing away from the rail socket, and preferentially two side portions partially extending along the sides of the conductor element to be received. Preferentially, e.g. when using a connector rail, more preferentially at DIN conductor rail, the two side portions comprise attachment sections being located opposite to each other and facing towards the conductor receptacle, whereas said attachment sections may comprise hook-like holding features which are adapted to engage with the bent side edges of the conductor rail.

[0023] The conductor receptacle is to be further understood as a volume which may be surrounded only partially by surfaces and/or walls of the rail socket. The conductor receptacle may be located adjacent to the receptacle opening and/or adjacent to hollow spaces of the rail socket, which are located in between wall sections of the rail socket.

[0024] Most preferably, the conductor rail is a top hat rail according to European standard EN 50022 with a rail height of 7.5mm or 15mm. Using two attachment sections as described above, a relocation of the rail socket along the extension of the DIN rail may therefore be possible.

[0025] In a first advantageous embodiment of the inventive rail socket, the at least one resilient contact member is a flat spring. Such a flat spring is easily manufactured and designed in terms of its spring constant, maximum current transmission, heat dissipation and the like.

[0026] The flat spring may, to a certain extent, adapt to tolerances of the conductive element by a torsional or rotational movement. The flat spring may be embodied in a straight shape or in a curved manner.

[0027] In a second advantageous embodiment of the inventive rail socket, the flat spring comprises lamellas. The inventive rail socket may comprise at least two lamellas, but may comprise a larger number of lamellas as well.

[0028] Such a flat spring with lamellas has the advantage that locally adjacent dents and/or ridges, which may not be compensated for by the afore-mentioned flat spring, may be compensated by the individual lamellas. The lamellas of the flat spring may be connected to each other at both ends of the lamellas or may be connected only at one end of the lamellas.

[0029] Freestanding, that is, not connected lamella ends, allow for compensation of larger tolerances, but may reduce the force exerted by the flat spring in a direction opposite a deflection direction when the resilient contact member is deflected. This force may be a contact force exerted onto the conductor element to be inserted into the conductor receptacle.

[0030] The lamellas of the inventive rail socket and electrically conductive resilient contact member may be obtained by performing one or more cuts along an extension direction of the flat spring. In order to obtain slits along said extension direction, the lamellas are formed between the slits or between a slit and a side edge of the flat spring.

[0031] The lamellas may be embodied over substantially the entire length of the flat spring or may be embodied only in the region of the flat spring which extends into the conductor receptacle. The lamellas may be embodied similar to each other or may be different in length and/or width and/or thickness.

[0032] The lamella may comprise a surface treatment, such as for instance a surface modification (roughening) or a metal plating (using for instance gold, nickel, tin, silver or the like) in the region which extends into the conductor receptacle, but may also be modified by methods like isolation, galvanization or coverage of regions which do not extend into the conductor receptacle.

[0033] Such a treatment may also be applied in the afore-mentioned embodiment of the flat spring without lamellas.

[0034] In a third embodiment of the inventive rail socket it is advantageous if the at least one resilient contact member comprises a first end, a second end and a contact zone located between the first end and the second end, the contact zone extending into the conductor receptacle. Locating the contact zone in between two ends of the resilient contact member has the advantage that the contact force exerted by the deflected flat spring in a direction substantially opposite to the deflection direction may be increased. This force may be the contact exerted onto the conductor element.

[0035] Preferentially, the contact zone may be treated by any of the above methods in order to decrease the electrical resistance between the resilient contact member and the conductor member.

[0036] Furthermore, two ends of the resilient contact member may increase the confinement of the resilient contact member and the lifetime of the resilient contact member, as deflection of the resilient contact member may be controlled.

[0037] In another advantageous embodiment of the inventive rail socket, the at least one resilient contact member comprises at least two contact zones, each contact zone extending into the conductor receptacle. A resilient contact member embodied with two or more contact zones has the advantage of a symmetric electrical and/or mechanical connection between the rail socket and the conductor member.

[0038] Furthermore, in order to contact both side edges of a conductor rail used as a conductor element, two contact zones are advantageous as the first side edge of the conductor rail may be connected with the first contact zone and the second side edge of the conductor rail may be connected with the second contact zone.

[0039] In another advantageous embodiment of the inventive rail socket, the at least one resilient contact member has a convex shape. With such a convex shape, an extension of the resilient contact member into the conductor receptacle is easily realized as the convex shape allows to only extend the contact zone into the conductor receptacle without extending the first and/or second end of the resilient contact member into the contact receptacle.

[0040] The convex shape may be understood as a U-shape or V-shape of the resilient spring member. If the resilient contact member comprises two contact zones, such a resilient contact member therefore comprises two convex regions whereas a part of these convex regions, the contact zone, extends into the conductor receptacle. Such a resilient contact member may have a W-shape with each of the two U-parts of the W having a convex shape.

[0041] In another embodiment of the rail socket, the resilient contact member way may have a concave shape, that is a U-shape or a V-shape, wherein the U or V is opened towards the opposite direction compared to the previous embodiment. The center portion of such an embodied resilient contact member may be located outside the conductor receptacle and one or both ends of such a concave resilient contact member may extend into the conductor receptacle. As described above, the latter embodiment may suffer from a decreased spring force exerted by the flat spring in the direction substantially opposite to the deflection direction as compared to the convex shaped embodiment of the flat spring. The exerted force may be the contact force of the resilient contact member to the conductor element.

[0042] In another advantageous embodiment of the inventive rail socket, the first end is held in or attached to the rail socket. The first advantage of this embodiment is that the resilient contact member is detatchably or undetachably mounted to the rail socket. Furthermore, by holding or attaching the first end in or to the rail socket the deflection of the resilient contact member is determined and/or confined. Such defined behavior of the deflection of the resilient contact member may allow for a precise design of the resilient spring member with respect to the spring constant, current transmission, heat dissipation and the like.

[0043] The first end of the resilient contact member may be held in a pocket embodied in the rail socket, whereas said pocket may allow the movement of the first end within the pocket within a certain range. In any position within this range, the contact zone or zones may still contact the conductor member. The first end may also be mounted to the rail socket by means of a through hole for fixing the first end to the rail socket using a screw, bolt, rivet or the like. Further means for attaching the resilient contact member to the rail socket are all types of welding, soldering or clamping.

[0044] If a W-shaped resilient contact member is applied, this resilient contact member may be attached to the rail socket in its center region, wherein this center region may be understood as the first end of the first U or V-shaped part of the resilient contact member as well as the first end of the second U or V-shaped part of the resilient contact member.

[0045] Attaching the resilient contact member to the rail socket may comprise electrical contacting and/or mechanical contacting between both elements, wherein the combination of electrical and mechanical contacting is preferred.

[0046] The rail socket provides at least one limit stop, adapted to confine the deflection of the at least one resilient contact member. Such a confinement, as explained above, has the advantage that the deflection movement of the resilient contact member may be precisely predicted, which allows for an accurate assessment of the spring forces exerted in the direction opposite to the deflection direction. This force may be the contact force exerted onto the conductor element and facilitates the designing the resilient contact member.

[0047] The limit stop may be one inner wall of the rail socket against which the resilient contact member may abut.

[0048] The resilient contact member may abut the limit stop and may slidably move along the limit stop. In the case of a U or V-shaped resilient contact member, wherein the first end is held or attached to the rail socket, a deflection of the resilient contact member abutting the limit stop may result in a compression of the resilient contact member, whereas the height of the U or V-shaped resilient contact member decreases and its width increases.

[0049] A resilient contact member embodied in the W-shape, that is comprising two contact zones, may be attached to the rail socket in the center region of the resilient contact member, wherein both ends of the W-shaped resilient contact member may abut a corresponding limit stop, each of the limit stops allowing a slidable movement of the contact member end along the limit stop leading to a compression of the W-shaped resilient contact member.

[0050] The at least one limit stop is embodied as a stop lug being monolithically formed with the rail socket. Such a monolithically formed stop lug avoids the production of a separate limit stop which may facilitate manufacturing of the rail socket.

[0051] The stop lug may abut the resilient contact member at a position spaced apart from the above-mentioned inner wall of the rail socket.

[0052] The rail socket and the at least one resilient contact member are formed monolithically. Such a monolithic design has the advantage that the production is easy, production costs may be reduced and an additional step of connecting the resilient contact member to the rail socket may be avoided.

[0053] Therefore the rail socket as well as the resilient spring resilient contact member may be fabricated as one single stamped and bent part by stamping out a respective stamping layout and subsequent bending of the stamped part.

[0054] The previous embodiments of the inventive rail socket, that is the non-monolithic embodiments, may be bent such that a center part of the stamping layout constitutes an upper rail wall, which is bent by 90° on a first and a second side forming the side walls of the rail socket. The upper rail socket wall and the side walls may at least partially enclose an inner volume in which the resilient contact member may be received. This inner volume may further comprise the conductor receptacle which may be formed by a cutout region in the sidewalls of the rail socket.

[0055] In the monolithic embodiment of the inventive rail socket, the at least one resilient contact member may be formed from the center part of the stamping layout. By bending the resilient contact member and the sidewalls, a rail socket is formed with openings in the upper rail socket wall, as the according material constitutes the resilient contact member. Preferably, two resilient contact members are formed.

[0056] Resilient contact members formed this way may not abut the upper rail socket wall as they are actually constituted by the material stamped out in the center region of the stamping layout, resulting in the openings.

[0057] Confining the deflection of the resilient contact member is realized by the stop lugs, which may be realized by stamping out a substantially U-shaped slit in a region which will later, that is after bending, constitute the side wall and subsequent bending of the lug towards respectively into the inner volume.

[0058] Such an embodiment of the inventive rail socket may be understood to comprise one W-shaped resilient contact member, whereas the residual part of the center region of the stamping layout is considered as the center part of the W-shaped resilient contact member. Furthermore, such an embodiment of the inventive rail socket may also be understood as comprising two resilient contact members.

[0059] The arms of the W-shaped resilient contact member, respectively, the two U-shaped resilient contact members, may be embodied symmetrically with respect to the center region of the stamping layout.

[0060] In the non-monolithic embodiments of the inventive rail socket, the resilient contact member and the rail socket may be constituted from different materials. In these embodiments, the resilient contact member may for instance be comprised of a highly conductive metal such as copper, whereas the rail socket may comprise a metal being less conductive than copper such as for instance stainless steel.

[0061] Applying two different metals, however, results in an uneven splitting of the currents to be dissipated from the rail socket to the conductor element. A high maximum current density of a resilient contact member made of copper may be advantageous for low current applications, that is, for applications well below 0.5 kA.

[0062] If the rail socket is applied for dissipation of short voltage or current peaks from the rail socket to the conductor element, currents on the order of several kA (for the present invention up to 20kA) need to be dissipated within a short time frame on the order of several microseconds (the so-called 8/20 electrical test pulse has a rising edge of 8 μs, which fades within 20 μs to 50% of its amplitude value).

[0063] If a rail socket applying a copper resilient contact member is used to dissipate the above-mentioned high current, approximately more than 3 quarters of the current peak may be transmitted via the copper resilient contact member, resulting in an unbalanced electrical end thermal load of substantially only the copper resilient contact member.

[0064] For such applications, it is more preferable to evenly split the current peak into different paths along the side walls of the rail socket as well as along the resilient contact members. An equal splitting of the current peak into different current paths may be easily performed by a monolithic design of the rail socket.

[0065] In order to comply with stability requirements for the mechanical connection of the rail socket to the conductor element, preferably a DIN rail, the monolithically embodied DIN rail and resilient contact member or members are preferably made of stainless steel.

[0066] In a further embodiment of the inventive rail socket it is advantageous if two resilient contact members are provided. Two resilient contact members allow for a symmetric mechanical and/or electric connection between the rail socket and the conductor member, which is especially advantageous when using a conductor rail, as both edges of the conductor rail may be connected simultaneously.

[0067] The two resilient contact members may be held in or attached to a central portion of the conductor receptacle of the rail socket. The two resilient contact members may even be held or attached to the central portion of the conductor receptacle of the rail socket by means of a single common holding or attachment means. Further, it is also possible that the two resilient contact members are held or attached to the rail socket in two separate portions of the rail socket being spaced apart from each other. Said separate portions may be located in two distal ends of the rail socket, the portions may be located opposite to each other.

[0068] The two resilient contact members may be embodied equal to each other but may well be different to each other. Application of two resilient contact members of the same type is preferred as this allows for an even splitting or distribution of the electric excess energy to be dissipated from the rail socket to the conductor element.

[0069] In another advantageous embodiment of the inventive rail socket, connection openings are provided which open towards a module side, the connection openings are adapted to receive at least one connection member for electrically and/or mechanically connecting the rail socket and the module device. Such connection openings have the advantage of an improved connection between a connection member and the rail socket.

[0070] At least one connection opening is provided, which open towards the module side, the at least one connection opening is adapted to receive at least one connection member for electrically and/or mechanically connecting the rail socket and the module device.

[0071] The at least one connection opening is preferably located in the center region of the stamping layout of the rail socket, which is on the side of the rail socket located opposite to the conductor receptacle.

[0072] The rail socket may comprise one connection opening adapted to receive several connection members or may comprise several connection openings each adapted to receive one or several connection members.

[0073] The at least one connection opening has preferably a shape similar to the connection member to be inserted, whereas it is more preferable if the size of the connection opening is sufficiently smaller than the size of the connection member, that is to say the relation of the dimensions of the connection member and connection opening may be adapted to allow a press fit between said two element.

[0074] The connection member may be any electrically conductive element that is, a simple stripped cable or a cable with a cable end member shaped as a tab or pin. Furthermore the connection member may comprise an outer thread and the connection with the at least one connection opening may comprise a complementary inner thread allowing to electrically and/or mechanically connect the connection member with the connection opening by screwing both elements to each other.

[0075] It is preferred if the mechanical connection is combined with the electrical connection. Therefore the at least one connection opening may be embodied as a through hole and the connection member may be embodied with a length exceeding a wall thickness of the rail socket, such that the connection member extends through the at least one connection opening into the inner volume of the rail socket.

[0076] If the rail socket is embodied as a stamped and bent sheet metal part, the inner volume of the rail socket may be accessible from the side of the rail socket on which the conductor receptacle is located. The connection members being stitched through the at least one connection opening may therefore be connected to the rail socket by welding those parts of the connection members extending into the inner volume of the rail socket to the rail socket.

[0077] By doing so, a mechanically stable and electrically low-resistance connection may be established. Such a welding process may furthermore have the advantage that, if provided, several connection members may be attached to each other.

[0078] It is preferred that the voltage or current peak to be dissipated to the conductor member is transferred from the at least one connection member to the rail socket via contact points between the latter two elements established by means of the connection opening.

[0079] In order to maintain the current density in the material of the rail socket as small as possible, it is advantageous if the at least one connection member is firmly inserted into the at least one connection opening of the rail socket. Such a firm insertion guarantees a large contact surface between the at least one connection member and the at least one connection opening, consequently reducing the current density.

[0080] The at least one connection member may be adapted to simultaneously provide the functionality of electrically and/or mechanically connecting the rail socket and additionally mechanically and/or electrically connecting a module device. The at least one connection member may therefore be understood as intermediate connection means between the module device, for instance a surge protection device, and the rail.

[0081] In another embodiment of the inventive rail socket, it is advantageous if the rail socket comprises at least one flexibility cutout forming a flexibility portion of the conductor receptacle at a receptacle wall distal to a conductor receptacle opening.

[0082] The at least one flexibility cutout is preferably located in a side wall of the rail socket close to an abutment surface in the conductor receptacle onto which the conductor member, for instance the DIN rail, rests.

[0083] The flexibility cutout may be embodied as a slit in the side wall of the rail socket. The slit may separate the flexibility portion from the rigid side wall of the rail socket, whereas both the flexibility portion and the rigid portion may still be monolithically connected to each other at the ends of the slit. The flexibility portion may have dimensions still allowing a deflection of the flexibility portion substantially in a direction from the conductor receptacle towards an upper surface of the rail socket which is formed by the center portion of the stamping layout.

[0084] If the rail socket simply rests on a conductor member, the mechanical connection between the rail socket and the conductor member may be over-determined and may result in that the rail socket contact connects to the conductor member at three connecting points, not using a fourth possible connecting point. Flexibility cutouts forming the flexibility portion may avoid that the over-determination of the mechanical connection results in one possible connection point not being in contact with the conductor element. By doing so, the rail socket may adapt to tolerances of the conductor member as well.

[0085] Said flexibility portions may also be advantageous in other embodiments of the inventive rail socket, as the contact force exerted from the rail socket onto the conductor element, preferably the conductor rail, may be increased, which improves mechanical and/or electrical connection between the rail socket and the conductor member.

[0086] In another advantageous embodiment of the inventive rail socket the flexibility portion comprises a contraction member adapted to at least partially constrict portions of the conductor receptacle. Such a constriction by means of the contraction member has the advantage of a well defined area of the connection between the rail socket and the conductor member.

[0087] The contraction member may comprise a contraction surface which has a convex shape and extends into the conductor receptacle. Such a convex shape may allow the deflection of the flexibility portion away from the conductor receptacle. Said deflection may be prevented if a force is uniformly exerted onto the flexibility portion along the whole length of the flexibility portion.

[0088] The convex shape may furthermore provide the flexibility to receive connector members with angular tolerances of the conductor members. That is, independent of the angle of the conductor member, it is mechanically and or electrically connected to the rail socket by the contraction member.

[0089] In another advantageous embodiment of the inventive rail socket, the conductor receptacle comprises two attachment sections being located opposite to each other and adjacent to the conductor receptacle opening, wherein the contraction members extend into the attachment sections. Such an embodiment of the inventive rail socket combines the advantages of a mechanical and electrical connection between the rail socket and the conductor member by means of the attachment sections and the advantage of a well-defined contact point between the rail socket and the conductor member by means of the contraction members.

[0090] Different embodiments of the attachment sections may be conceivable, such as for instance resilient clamping edges of the conductor receptacle, which are adapted to clampingly contact the conductor member located in between the clamping edges. Screw members are conceivable as well, wherein the conductor member is contacted electrically and/or mechanically by screws which are fixed in the rail socket.

[0091] In all rail sockets comprising one of the above embodiments of the attachment section, the resilient contact member additionally provides the electrical and/or mechanical connection between the rail socket and the conductor member.

[0092] Preferably, if the conductor member is embodied as a rail, more preferably a DIN rail, the attachment sections are embodied as hook-like sections in the side walls of the rail socket, whereas the hook-like sections are adapted to engage in a positive fit with the longitudinal edges of the conductor rail.

[0093] In such an embodiment of the inventive rail socket, the first longitudinal edge of the conductor rail may be inserted into a first hook-like attachment section, wherein during insertion of this first longitudinal edge a preferably slidably embodied second hook-like attachment section is translated into a direction away from the conductor rail, thereby increasing the width of the conductor receptacle opening and allowing the second longitudinal edge of the conductor rail to pass along the second hook-like attachment section, thereby receiving both the first and the second longitudinal edge of the conductor rail into the conductor receptacle.

[0094] Subsequent to passing the second longitudinal edge of the conductor rail along the second hook-like slidable attachment section, said second slidable hook-like attachment section may be released, thereby engaging in a positive lock between the second attachment section and the second longitudinal edge of the conductor rail and further exerting a contact force from the rail socket onto the conductor rail. For exerting said force, the second hook-like attachment section may comprise an inclined surface substantially facing towards the resilient contact member.

[0095] In the following individual embodiments of the invention will be described with reference to the accompanying figures. In the exemplary description of the figures, the same reference numerals are used for elements which are identical or similar in design and/or function. Furthermore, overlapping descriptions of technical features are omitted.

[0096] In the Figures:

- Fig. 1 shows a surge protection assembly;
- Fig. 2 shows a first embodiment of the inventive rail socket in a semi-transparent perspective view;
- Fig. 3 shows a second embodiment of the inventive rail socket in two perspective views;
- Fig. 4 shows the second embodiment of the rail socket of Fig. 3 in a side view;
- Fig. 5 shows the second embodiment of the rail socket attached to a DIN rail in a perspective view;
- Fig. 6 shows the second embodiment of the rail socket of Fig. 5 shown in a cut view; and

[0097] Fig. 1 shows a surge protection assembly 1 which comprises a module device 2 embodied as a surge protection device 3 in the embodiment shown in Fig. 1.

[0098] The surge protection device comprises a socket 7, a card module 9, and cables 11 for inbound and outbound electrical signals and/or currents and a rail socket 13. The card module 9 may be provided individually by a customer.

[0099] The surge protection assembly 1 of Fig. 1 is shown exemplarily to allow for categorization of the inventive rail socket 13.

[0100] Fig. 2 shows a rail socket 13 in a first embodiment in a perspective view, whereas the rail socket is drawn semi-transparent. The rail socket is connected to a resilient contact member 15 and a connection member 17, wherein the connection member 17 is indicated by a cuboid element 17a The connection member 17 of the embodiment of the rail socket 13 shown in Fig. 2 is inserted into a connection opening 18 located in an upper rail wall 19, which is monolithically connected to two side walls 21 which are bent by 90° with respect to the upper rail wall 19. The side walls 21 may also be referred to as receptacle walls.

[0101] Opposite to the connection member 17, that is, in a direction opposite the z-direction, the sidewalls 21 of the rail socket 13 define a conductor receptacle 23 which is indicated by a volume enclosed by the dashed lines.

[0102] The connection member 17 extends into a module side M whereas a conductor receptacle opening 23a faces towards a rail side R.

[0103] The resilient contact member 15 of the embodiment shown in Fig. 2 is a flat spring 16 with a W-shape, wherein the center portion 25 of the resilient contact member 15 is attached to the upper rail wall 19 of the rail socket 13. The two resilient wings 27 of the resilient contact member 15 have a convex shape, that is, they are formed in a U-shape and two ends 29 are provided. As shown in Fig. 2, a first end 29a is attached to the center portion 25 and a second end 29b rests against an inner wall 31 of the rail socket 13. The inner wall 31 acts as a limit stop 32 for the deflection of the second end 29b.

[0104] The upper rail wall 19 and the sidewalls 21 enclose an inner volume 33 which excludes the conductor receptacle 23. The resilient wings 27 of the resilient contact member 15 comprise lamellas 35, whereas in Fig. 2 an exemplary number of four lamellas 35 is shown. The exemplary lamellas 35 extend partially into the conductor receptacle 23, whereas the inserted portions of the lamellas 35 constitute a contact zone 37.

[0105] In different embodiments of the resilient contact member, as for instance in case of a flat spring without lamellas, the contact zone 37 is constituted by the part of the flat spring extending into the conductor receptacle 23.

[0106] Fig. 2 furthermore shows a slideable attachment member 39 which may be partially moved in the inner volume 33 along or opposite to the x-direction.

[0107] Further details of the rail socket 13 will be described in the following figures.

[0108] Fig. 3 shows a second embodiment of the inventive rail socket 13 in two perspective views. This second embodiment is characterized by a monolithic design, in which the rail socket 13 and the resilient contact member 15 are manufactured from one and the same stamped and bent sheet metal part 41.

[0109] In this embodiment, the upper rail wall 19 is separated into three portions due to breakout portions 43, which result from stamping out the resilient contact member 15 and the bending of the resilient wings 27 in a direction opposite to the z-direction. The upper rail wall furthermore comprises the connection opening 18. The second embodiment shown in Fig. 3 furthermore shows four additional breakout portions 43 located in each of the side walls 21; the functionality of which will be explained in the following figures.

[0110] In Fig. 3 the conductor receptacle 23 is again indicated by the dashed lines. It is to be noted that a contour 45 of the side walls 21, which is facing in a direction opposite to the z-direction, determines the shape of the conductor receptacle 23. Furthermore, it is pointed out that the y-direction and the z-direction are inverted for the perspective view shown in the lower part of Fig. 3.

[0111] Also in the second embodiment of the rail socket 13, the resilient contact member 15 is embodied as flat spring 16. This flat spring 16 and the contact zone 37 extends into the conductor receptacle 23. Only one contact zone 37 is visible for one of the two resilient wings 27 and is indicated by an oval. Furthermore, also in the second embodiment of the rail socket 13 the resilient contact member 15, respectively the resilient contact members 15, comprise lamellas 35.

[0112] Fig. 3 furthermore shows two attachment sections 47 also indicated by two ovals. Although the shown attachment sections 47 are indicated on one single side wall 21, the attachment sections 47 actually include the corresponding similar contour of the rail socket 13 of the opposite side wall 21 as well.

[0113] In Fig. 3 the rail socket 13 is shown without an assembled attachment member 39 (see Fig. 2) and therefore clearly shows that the attachment section 47 limiting the conductor receptacle 23 in the x-direction is distinct from the attachment section 47 limiting the conductor receptacle 23 in a direction opposite to the x-direction. The latter attachment section 47, however, is altered when the attachment member 39 is assembled to the rail socket 13 again. This will be shown in Fig. 4.

[0114] Fig. 4 shows a rail socket 13 in a side view with a connection member 17, an attachment member 39 and a conductor member 4 attached to the rail socket 13. The conductor member 4 is embodied as a rail 5. The rail 5 is a DIN rail 5a in the embodiment shown in Fig. 4. The attachment member 39 is in the closed position 49, which is characterized by an entrance width 51 of the conductor receptacle 23 being smaller than the rail width 53.

[0115] The rail 5 is shown in the inserted position 55, whereas in said inserted position 55 no element of the rail socket extends beyond the rail 5 in a direction opposite to the z-direction.

[0116] The attachment member 39 shown in Fig. 4 comprises an attachment end 57 which is slidable along and opposite to the x-direction together with the attachment member body 59 and an attachment lever 61.

[0117] Prior to reaching the inserted position 55 of the rail 5, a first longitudinal side 63 of the rail 5 is inserted through the conductor receptacle 23 into a recess 65 of the first attachment section 47a, which is realized by rotation of the rail 5 around the y-direction with a sense of rotation indicated by arrow 67 (corresponding to a negative sense of rotation around the y-direction in a right-handed coordinate system).

[0118] When the first longitudinal side 63 of the rail 5 is inserted into the recess 65 of the first attachment section 47a, said first longitudinal side 63 contacts the contact zone 37 of the resilient contact member 15 and deflects the resilient contact member 15 in the z-direction (details referring to the deflection of the resilient contact member 15 will be described with reference to Fig. 6).

[0119] In the next step the end-user may pull the attachment lever 61 in a direction opposite to the x-direction, whereas such a pulling movement also moves the attachment member body 59 and the attachment end 57 in the same direction.

[0120] This movement enlarges the entrance width 51 such that a second longitudinal side 69 of the rail 5 may pass an entrance edge 71 of a second attachment section 47b while rotating the rail 5 around the y-direction back to the horizontal position shown in Fig. 4 around a pivot point located in the recess 65 in which the first longitudinal side 63 is received.

[0121] After the second longitudinal side 69 of the rail 5 passes the tip 73 of the attachment end 57 in the z-direction, the attachment lever 61 may be released by the end-user, whereupon a resilient spring 75 pulses the attachment member 39 into the x-direction, wherein an inclined attachment surface 77 abuts the second longitudinal side 69 of the rail 5 and exerts a force F onto the second longitudinal side 69. By doing so the resilient contact member 15 extending into the conductor receptacle 23 in the second attachment section 47b is also deflected into the z-direction by the rail 5.

[0122] Fig. 5 shows the rail socket 13 of Fig. 4 in a perspective view showing the attachment lever 61 which allows to be easily pulled in a direction opposite to the X-direction by means of a lever opening 61a.

[0123] In Fig. 5, two longitudinal breakout portions 43 are shown in the side walls 21 which are embodied as flexibility cutouts 79 forming flexibility portions 81. The flexibility portions 81 are to a certain extent deflectable in the z-direction, whereas a center portion 25 of the flexibility portion 81 shows the highest deflectability of the in the z-direction.

[0124] The flexibility portions 81 further comprise contraction members 83 which constrict portions of the recess 65 into which the first and second longitudinal side 63, 69 of the rail 5 are received. The contraction members 83 extend into the conductor receptacle 23 and comprise contact points 85 between the rail socket 13 and the rail 5. Those contraction members 83 allow the first and the second longitudinal edge 63, 69 of the rail 5 to deflect the flexibility portions 81 into the z-direction. The deflection of the flexible portions 81 may be smaller than the possible deflection of the resilient contact member 15 out of the conductor receptacle 23.

[0125] Fig. 6 shows the rail socket 13 of Fig. 5 cut along the line A-A (see Fig. 5) and viewed along the y-direction. For clarification, it is advisable to compare the coordinate systems of Figs, 5 and 6.

[0126] Fig. 6 therefore reveals the inner volume 33 of the rail socket 13, comprising the resilient spring 75, the resilient wings 27 with two lamellas 35 at each resilient wing 27 (the other two lamellas 35 are not visible due to the cut view) and the ends 29 of the resilient wings 27.

[0127] Fig. 6 furthermore shows two additional breakout portions 43 which are not completely stamped out but rather comprise a U-shaped cut, such that a stop lug 87 is obtained by bending the material of the stamped and bent sheet metal part 41, which is partially surrounded by the U-shaped cut, into the inner volume 33 of the rail socket 13. The stop lug 87 is the limit stop 32 in this second embodiment of the rail socket 13.

[0128] The second end 29b of each of the resilient wings 27, respectively the resilient contact members 15 rest in the z-direction against the corresponding stop lug 87. The stop lug 87 therefore confines the deflection of the resilient spring members 15 in the z-direction.

[0129] If the force F is exerted onto the contact zones 37 of the resilient contact members 15, the confinement of the deflection of the resilient contact member 15 by means of abutment of the second end 29b of the resilient contact member 15 with the stop lug 87 results in a compression of the resilient contact member 15 in the z-direction.

[0130] As the resilient contact members 15 are attached to the rail socket 13 in the center portion 25, said compression leads to an expansion of the resilient spring members 15 along or opposite to the x-direction away from the center portion 25. The second ends 29b of the resilient contact members 15 therefore slidably move along the stop lugs 87.

[0131] As the second end 29b of the resilient contact member 15 comprises the additional rest at the stop lug 87, the counter force F' pointing in the opposite direction as the force F, is increased compared to the identical resilient contact member 15 not comprising such a rest with the stop lug 87. For reasons of clarity the counter force F' is indicated only once in Fig. 6.

[0132] Fig. 6 furthermore shows that the connection member 17 is inserted into the connection opening 18, extends through the connection opening 18 and may be attached to the center portion 25 of the rail socket 13 by different attachment means as for instance welding.

List of Parts

[0133]

1	Surge protection assembly
2	Module device
3	Surge protection device

4 Conductor member
5 Rail
5a DIN rail
7 Socket
9 Card module
11 Cable
13 Rail socket
15 Resilient contact member
16 Flat spring
17 Connection member
17a Cuboid element
18 Connection opening
19 Upper rail wall
21 Side wall
23 Conductor receptacle
23a Conductor receptacle opening
25 Center portion
27 Resilient wing
29 End
29a First end
29b Second end
31 Inner wall
32 Limit stop
33 Inner volume
35 Lamella
37 Contact zone
39 Attachment member
41 Stamped and bent sheet metal part
43 Breakout portion
45 Contour
47 Attachment section
47a First attachment section
47b Second attachment section
49 Closed position
51 Entrance width
53 Rail width
55 Inserted position
57 Attachment end
59 Attachment member body
61 Attachment lever
61a Lever opening
63 First longitudinal side
65 Recess
67 Sense of rotation
69 Second longitudinal side
71 Entrance edge
73 Tip
75 Resilient spring
77 Inclined attachment surface
79 Flexibility cutout
81 Flexibility portion
83 Contraction member
85 Contact point
87 Stop lug

F Force
F' Counter Force
M Module side
R Rail side
x x-Direction
y y-Direction
z z-Direction

Claims

1. Rail socket (13) for connecting a module device (2) to a conductor member (4), the rail socket (13) comprising a conductor receptacle (23) adapted to receive the conductor member (4), wherein at least one electrically conductive, resilient contact member (15) is provided which extends into the conductor receptacle (23), **characterized in that** the rail socket (13) and the at least one resilient contact member (15) are formed monolithically, and that the rail socket (13) provides at least one limit stop (32), adapted to confine the deflection of the at least one resilient contact member (15), wherein the at least one limit stop (32) is embodied as a stop lug (87) being monolithically formed with the rail socket (13).

2. Rail socket (13) according to claim 1, **characterized in that** the at least one resilient contact member (15) is a flat spring (16).

3. Rail socket (13) according to claim 2, **characterized in that** the flat spring (16) comprises lamellas (35).

4. Rail socket (13) according to any one of claims 1 to 3, **characterized in that** the at least one resilient contact member (15) comprises a first end (29a), a second end (29b) and a contact zone (37) located between the first end (29a) and the second end (29b), the contact zone (37) extending into the conductor receptacle (23).

5. Rail socket (13) according to claim 4, **characterized in that** the at least one resilient contact member (15) comprises at least two contact zones (37), each contact zone (37) extending into the conductor receptacle (23).

6. Rail socket (13) according to any one of claims 4 or 5, **characterized in that** the first end (29a) is held in or attached to the rail socket (13).

7. Rail socket (13) according to any one of claims 1 to 6, **characterized in that** the at least one resilient contact member (15) has a convex shape.

8. Rail socket (13) according to any one of claims 1 to 7, **characterized in that** two resilient contact members (15) are provided.

9. Rail socket (13) according to any one of claims 1 to 8, **characterized in that** connection openings (18)

are provided, which open towards a module side (M), the connection openings (18) are adapted to receive at least one connection member (17) for electrically and/or mechanically connecting the rail socket (13) and the module device (2).

10. Rail socket (13) according to any one of claims 1 to 9, **characterized in that** the rail socket (13) comprises at least one flexibility cutout (79) forming a flexibility portion (81) of the conductor receptacle (23) at a receptacle wall distal to a conductor receptacle opening (23a).

11. Rail socket (13) according to claim 10, **characterized in that** the flexibility portion (81) comprises a contraction member (83) adapted to at least partially constrict portions of the conductor receptacle (23).

12. Rail socket (13) according to claim 10 or 11, **characterized in that** the conductor receptacle (23) comprises two attachment sections (47a, 47b) being located opposite to each other and adjacent to the conductor receptacle opening (23a), wherein the contraction members (83) extend into the attachment sections (47a, 47b).

Patentansprüche

1. Schienensockel (13) zum Verbinden einer Modulvorrichtung (2) mit einem Leiter-Element (4), wobei der Schienensockel (13) eine Leiter-Aufnahme (23) umfasst, die zum Aufnehmen des Leiter-Elementes (4) eingerichtet ist, wobei wenigstens ein elektrisch leitendes, federndes Kontakt-Element (15) vorhanden ist, das sich in die Leiter-Aufnahme (23) hinein erstreckt, **dadurch gekennzeichnet, dass** der Schienensockel (13) und das wenigstens eine federnde Kontakt-Element (15) monolithisch ausgebildet sind, und dass der Schienensockel (13) wenigstens einen Begrenzungsanschlag (32) aufweist, der so eingerichtet ist, dass er die Durchbiegung des wenigstens einen federnden Kontakt-Elementes (15) begrenzt, wobei der wenigstens eine Begrenzungsanschlag (32) als eine mit dem Schienensockel (13) monolithisch ausgebildete Anschlagnase (87) ausgebildet ist.

2. Schienensockel (13) nach Anspruch 1, **dadurch gekennzeichnet, dass** das wenigstens eine federnde Kontakt-Element (15) eine Blattfeder (16) ist.

3. Schienensockel (13) nach Anspruch 2, **dadurch gekennzeichnet, dass** die Blattfeder (16) Lamellen (35) umfasst.

4. Schienensockel (13) nach einem der Ansprüche 1 bis 3, **dadurch gekennzeichnet, dass** das wenigstens eine federnde Kontakt-Element (15) ein erstes Ende (29a), ein zweites Ende (29b) sowie eine zwischen dem ersten Ende (29a) und dem zweiten Ende (29b) befindliche Kontaktzone (37) umfasst, wobei sich die Kontaktzone (37) in die Leiter-Aufnahme (23) hinein erstreckt.

5. Schienensockel (13) nach Anspruch 4, **dadurch gekennzeichnet, dass** das wenigstens eine federnde Kontakt-Element (15) wenigstens zwei Kontaktzonen (37) umfasst, wobei sich jede Kontaktzone (37) in die Leiter-Aufnahme (23) hinein erstreckt.

6. Schienensockel (13) nach einem der Ansprüche 4 oder 5, **dadurch gekennzeichnet, dass** das erste Ende (29a) in dem Schienensockel (13) gehalten wird oder daran angebracht ist.

7. Schienensockel (13) nach einem der Ansprüche 1 bis 6, **dadurch gekennzeichnet, dass** das wenigstens eine federnde Kontakt-Element (15) eine konvexe Form hat.

8. Schienensockel (13) nach einem der Ansprüche 1 bis 7, **dadurch gekennzeichnet, dass** zwei federnde Kontakt-Elemente (15) vorhanden sind.

9. Schienensockel (13) nach einem der Ansprüche 1 bis 8, **dadurch gekennzeichnet, dass** Verbindungs-Öffnungen (18) vorhanden sind, die sich zu einer Modul-Seite (M) hin öffnen, wobei die Verbindungs-Öffnungen (18) so eingerichtet sind, dass sie wenigstens ein Verbindungs-Element (17) zum elektrischen und/oder mechanischen Verbinden des Schienensockels (13) und der Modulvorrichtung (2) aufnehmen.

10. Schienensockel (13) nach einem der Ansprüche 1 bis 9, **dadurch gekennzeichnet, dass** der Schienen Sockel (13) wenigstens einen Flexibilitäts-Ausschnitt (79) umfasst, der einen Flexibilitäts-Abschnitt (81) der Leiter-Aufnahme (23) an einer Aufnahme-Wand distal zu einer Öffnung (23a) der Leiter-Aufnahme bildet.

11. Schienensockel (13) nach Anspruch 10, **dadurch gekennzeichnet, dass** der Flexibilitäts-Abschnitt (81) ein Kontraktions-Element (83) umfasst, das so eingerichtet ist, dass es Abschnitte der Leiter-Aufnahme (23) wenigstens teilweise einengt.

12. Schienensockel (13) nach Anspruch 10 oder 11, **dadurch gekennzeichnet, dass** die Leiter-Aufnahme (23) zwei Anbringungs-Teilabschnitte (47a, 47b) umfasst, die einander gegenüberliegend und an die Öffnung (23a) der Leiter-Aufnahme angrenzend angeordnet sind, wobei sich die Kontraktions-Elemente (83) in die Anbringungs-Teilabschnitte (47a, 47b) hinein erstrecken.

Revendications

1. Prise de rail (13) pour connecter un dispositif modulaire (2) à un élément conducteur (4), la prise de rail (13) comprenant un réceptacle de conducteur (23) conçu pour recevoir l'élément conducteur (4), dans lequel au moins un élément de contact élastique, électriquement conducteur (15) est prévu qui s'étend dans le réceptacle de conducteur (23), **caractérisée en ce que** la prise de rail (13) et ledit au moins un élément de contact élastique (15) sont formés de manière monolithique, et **en ce que** la prise de rail (13) constitue au moins une butée (32), conçue pour limiter la déflexion dudit au moins un élément de contact élastique (15), dans lequel ladite au moins une butée (32) est sous la forme d'une patte d'arrêt (87) formée de manière monolithique avec la prise de rail (13).

2. Prise de rail (13) selon la revendication 1, **caractérisée en ce que** ledit au moins un élément de contact élastique (15) est un ressort plat (16).

3. Prise de rail (13) selon la revendication 2, **caractérisée en ce que** le ressort plat (16) comprend des lamelles (35).

4. Prise de rail (13) selon l'une quelconque des revendications 1 à 3, **caractérisée en ce que** ledit au moins un élément de contact élastique (15) comprend une première extrémité (29a), une seconde extrémité (29b) et une zone de contact (37) située entre la première extrémité (29a) et la seconde extrémité (29b), la zone de contact (37) s'étendant dans le logement du conducteur (23).

5. Prise de rail (13) selon la revendication 4, **caractérisée en ce que** ledit au moins un élément de contact élastique (15) comprend au moins deux zones de contact (37), chaque zone de contact (37) s'étendant dans le réceptacle de conducteur (23).

6. Prise de rail (13) selon l'une quelconque des revendications 4 ou 5, **caractérisée en ce que** la première extrémité (29a) est maintenue ou fixée dans la prise de rail (13).

7. Prise de rail (13) selon l'une quelconque des revendications 1 à 6, **caractérisée en ce que** ledit au moins un organe de contact élastique (15) présente une forme convexe.

8. Prise de rail (13) selon l'une quelconque des revendications 1 à 7, **caractérisée en ce que** deux éléments de contact élastiques (15) sont prévus.

9. Prise de rail (13) selon l'une quelconque des revendications 1 à 8, **caractérisée en ce que** des ouvertures de connexion (18) sont prévues, qui s'ouvrent vers un côté du module (M), la connexion des ouvertures (18) sont conçues pour recevoir au moins un élément de connexion (17) pour connecter électriquement et/ou mécaniquement la prise de rail (13) et le dispositif de module (2).

10. Prise de rail (13) selon l'une quelconque des revendications 1 à 9, **caractérisée en ce que** la prise de rail (13) comprend au moins une découpe de flexibilité (79) formant une partie de flexibilité (81) du réceptacle de conducteur (23) au niveau d'une paroi de réceptacle distale d'une ouverture de réceptacle de conducteur (23a).

11. Prise de rail (13) selon la revendication 10, **caractérisée en ce que** la partie flexible (81) comprend un élément de contraction (83) conçu pour rétrécir au moins partiellement des parties du réceptacle de conducteur (23).

12. Prise de rail (13) selon les revendications 10 ou 11, **caractérisée en ce que** le réceptacle de conducteur (23) comprend deux sections de fixation (47a, 47b) situées à l'opposé l'une de l'autre et adjacentes à l'ouverture de réceptacle de conducteur (23a), dans lequel les éléments de contraction (83) s'étendent dans les sections de fixation (47a, 47b).

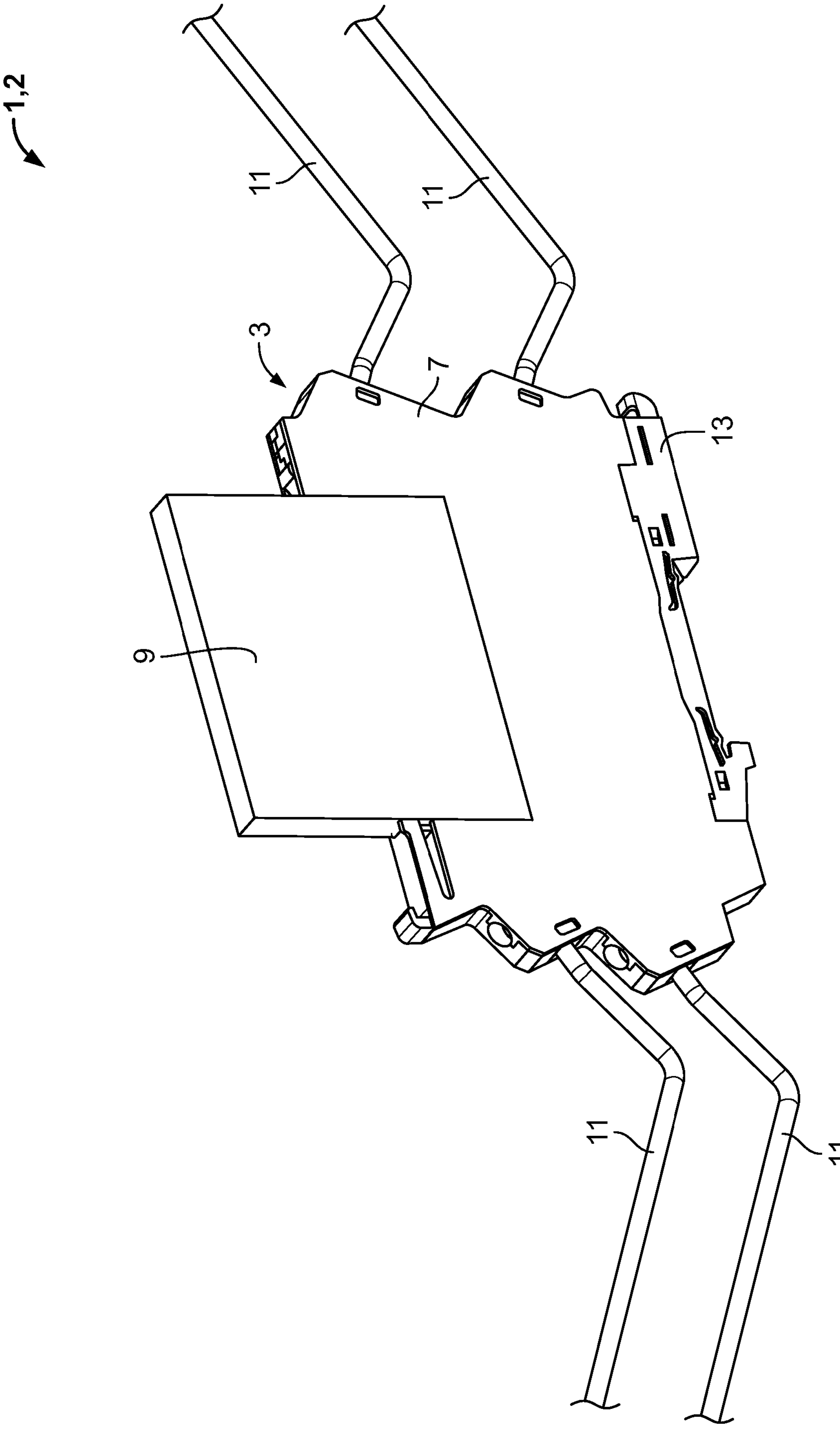
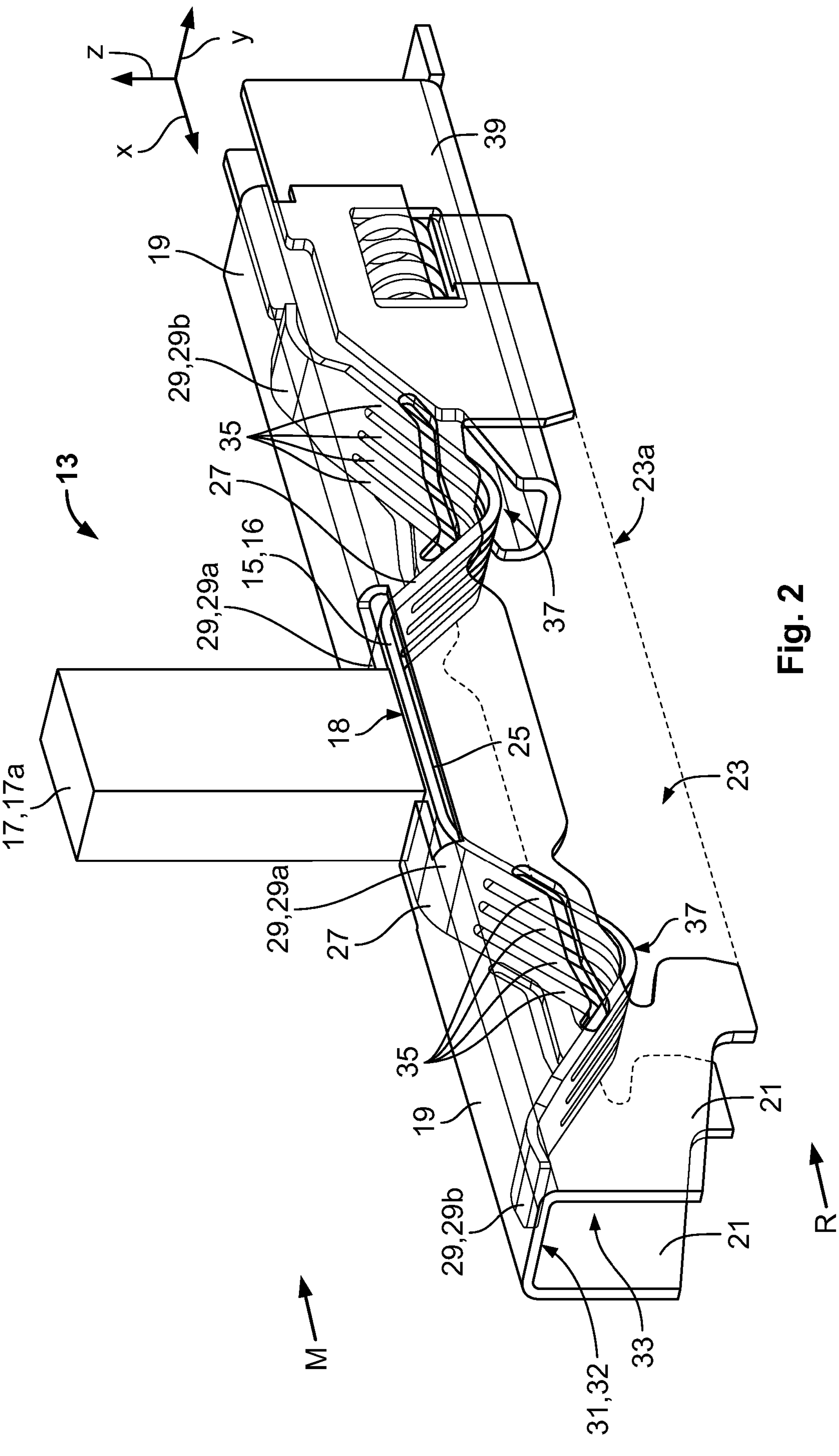


Fig. 1



z
y
x
39
19
29,29b
35
13
27
15,16
29,29a
37
23a
18
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19
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29,29b
21
R
M
31,32
33

Fig. 2

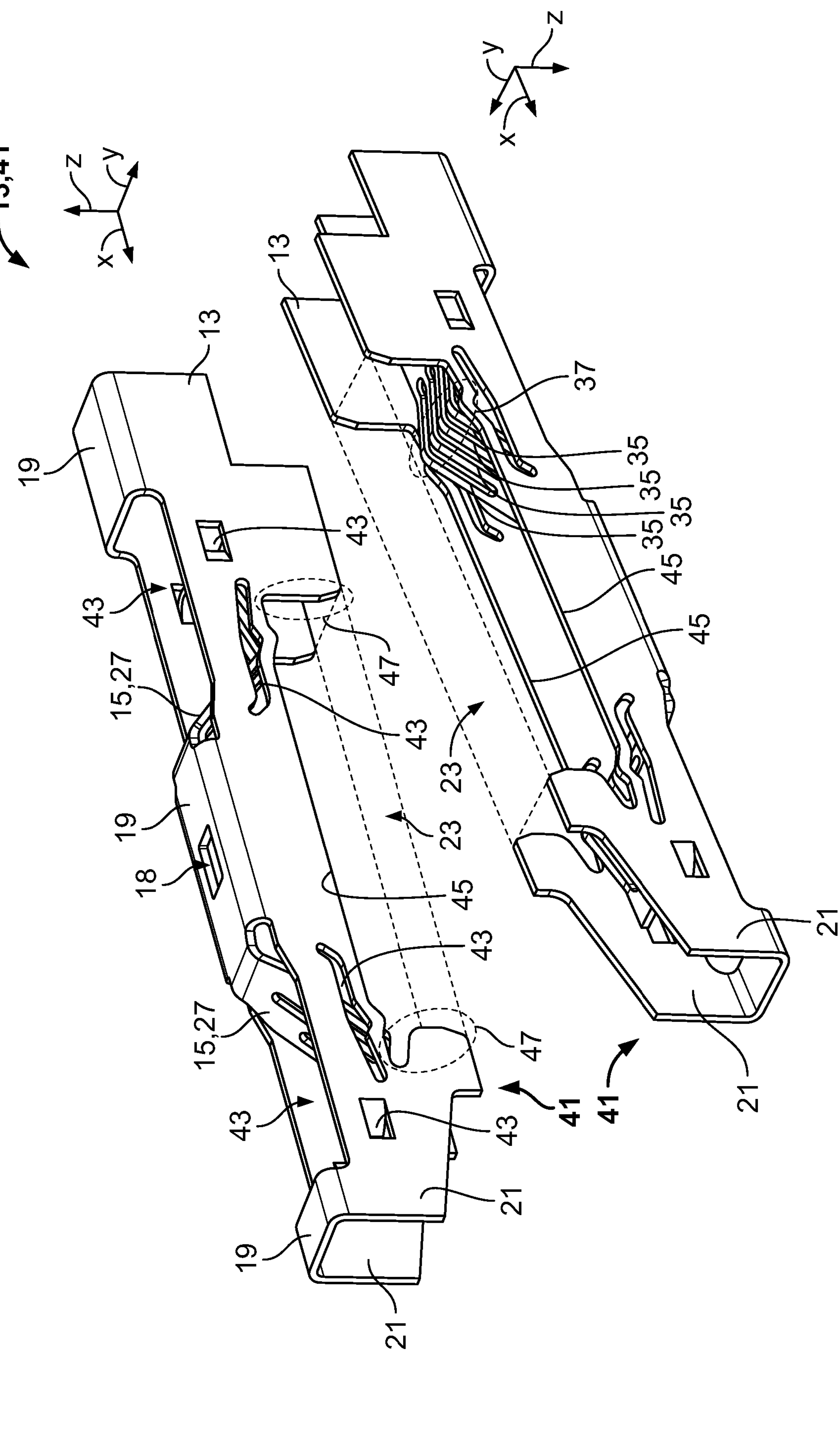
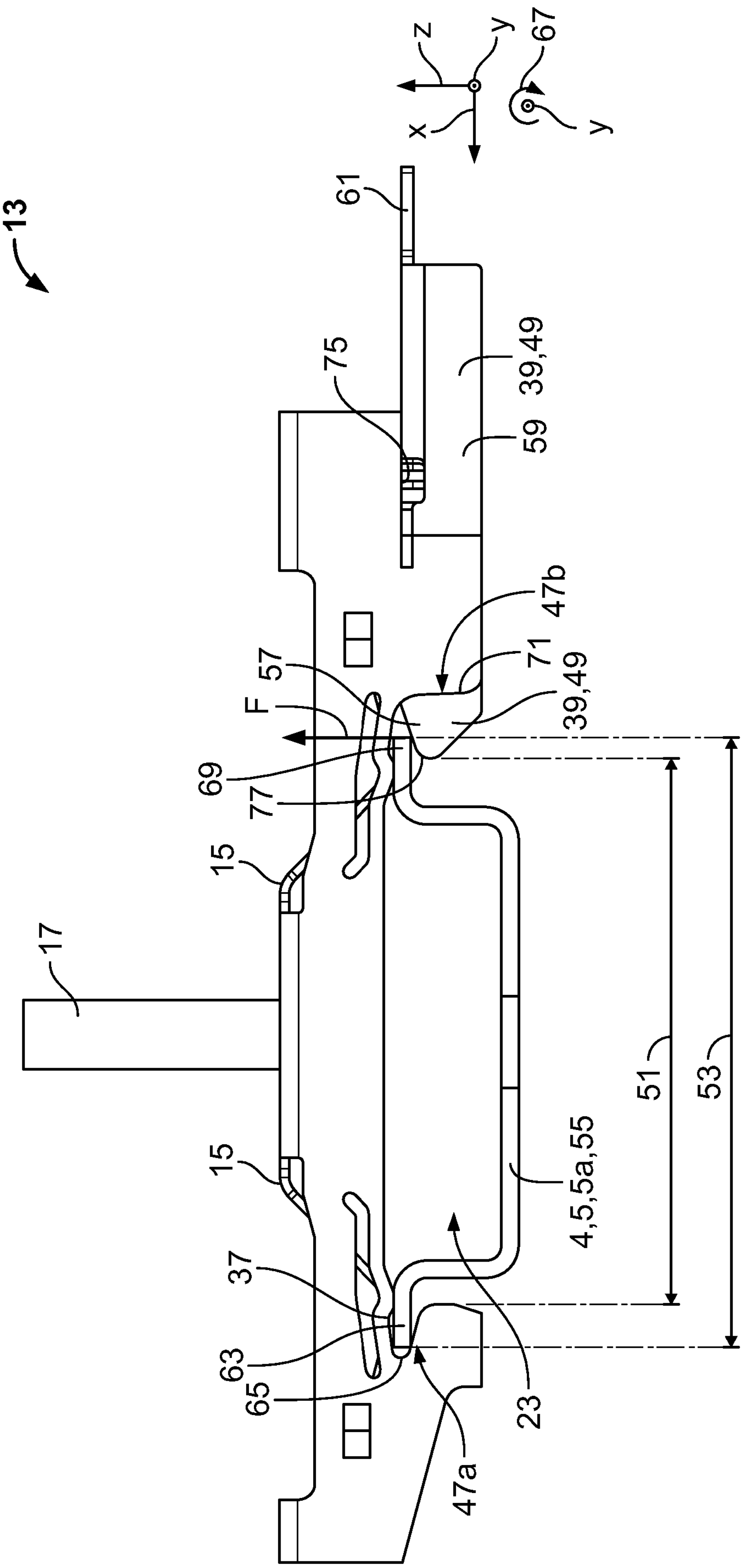


Fig. 3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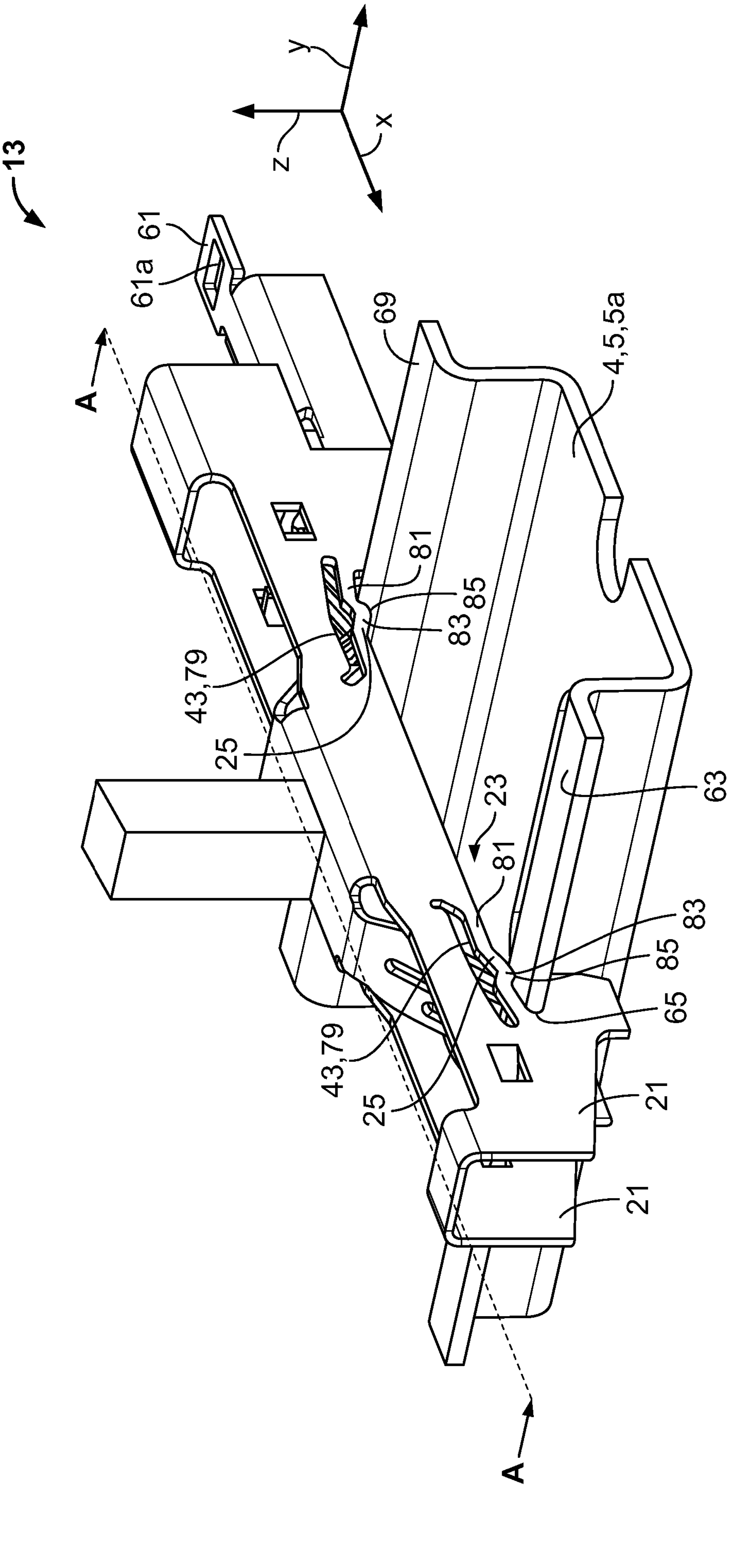
51
53

Fig. 4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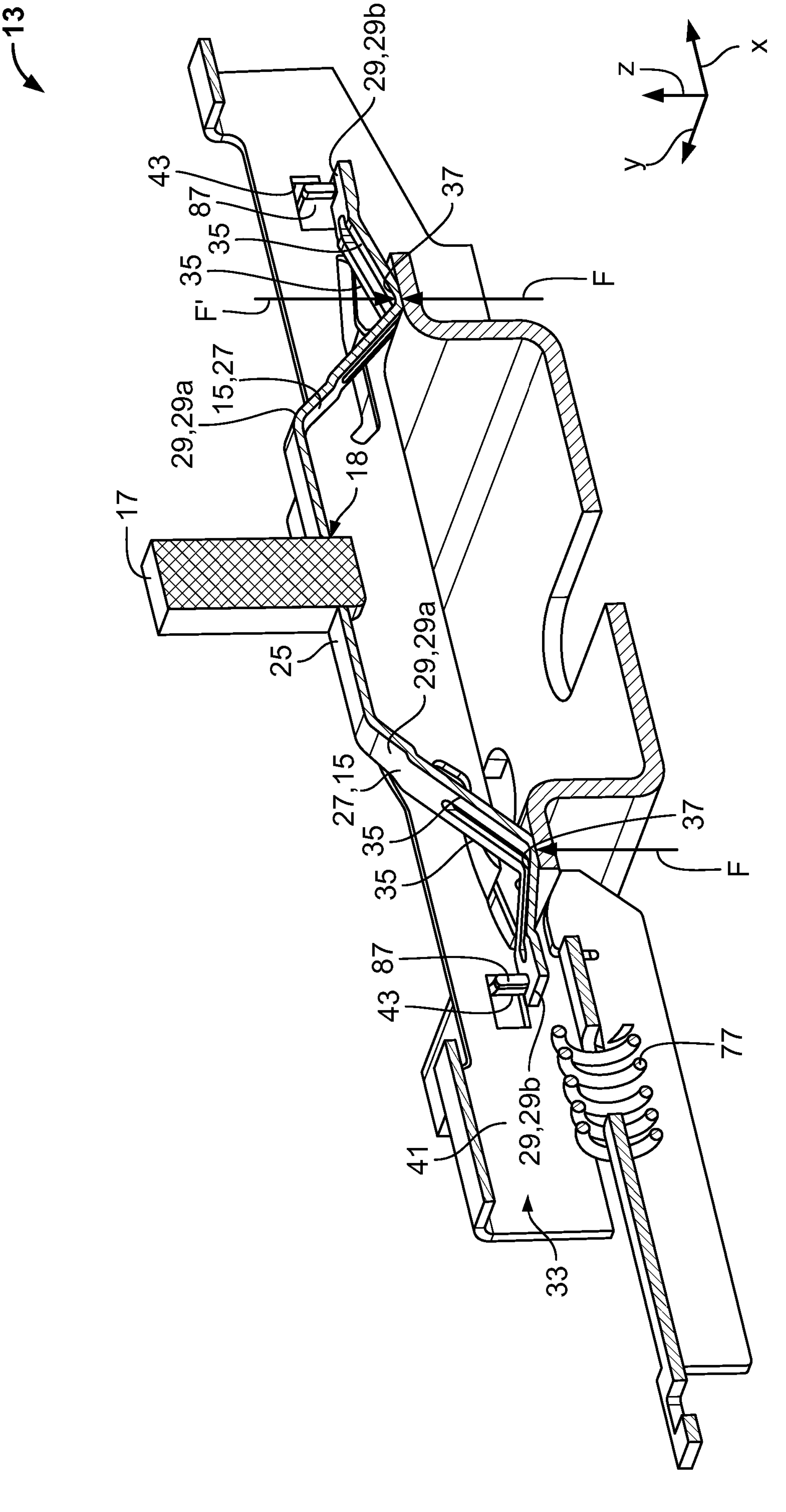
21
A

Fig. 5



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F'
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F
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29,29a
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35
35
37
F
87
43
77
29,29b
41
33
z
x
y

Fig. 6

REFERENCES CITED IN THE DESCRIPTION

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