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(54) **Switch device, particularly for generating feedback signals, such as position and/or limit stop signals**

(57) A switch device, particularly for generating feedback signals, such as position and/or limit stop signals, which device comprises at least one first contact (1), that is designed to be electrically connected to a first conductor (101) of a power line and at least one second contact (2), that is designed to be electrically connected to a second conductor (102) of said line, at least the first or at least the second contact being mounted in a displaceable fashion, so that said first and said second contacts (1,2) alternately assume a mutual adhesion position, in which adhesion position electric connection is generated between said first and said second conductors of said power line, or a mutual retraction position of said contacts (1,2), in which said two conductors (101,102) are electrically disconnected from each other. According to the invention, the first or the second contact has a contact surface, i.e. designed to adhere to the cooperating second or first contact for generating the electrical conduction state, which surface is formed of a plurality of separate contact zones (Zi), which are connected in parallel to the conductor connected to the corresponding contact, and each of which adheres independently of one another to the cooperating second or first contact.

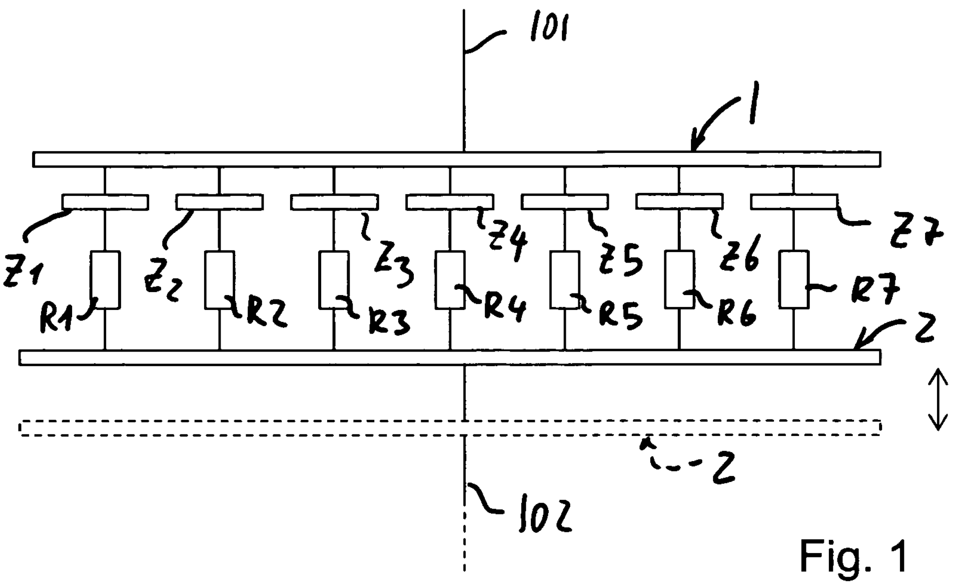

Fig. 1

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Description

[0001] The present invention relates to a switch device, particularly for generating feedback signals, such as position and/or limit stop signals, which device comprises at least one first contact, that is designed to be electrically connected to a first conductor of a power line and at least one second contact, that is designed to be electrically connected to a second conductor of said line, at least the first or at least the second contact being mounted in a displaceable fashion, so that said first and said second contacts alternately assume a mutual adhesion position, in which adhesion position electric connection is generated between said first and said second conductors of said power line, or a mutual retraction position of said contacts, in which said two conductors are electrically disconnected from each other.

[0002] Particularly, the invention relates to devices of the above type that are used as position sensors for generating position feedback signals in railway actuators, such as switch machines for points or in similar devices, and in which the feedback signals are detected by interlocking devices.

[0003] Switch machines for points are equipped with position sensors that are generally known and may consist of switches for changing the conduction condition of feedback contacts, allowing to generate a predetermined feedback signal. In prior art points, the actuating motion of an electric or hydraulic motor is transferred to such points via a kinematic chain composed of movable parts, such as shafts, drawbars, push rods or the like. In addition to limit stop position sensors for indicating the thrown position of the points, each switch machine has feedback signal generating means associated therewith, which are directly controlled by the kinematic chain and are used to determine whether the position of the points matches the position of the operating parts of the kinematic chain, which means consist of a switch device as defined above.

[0004] Nevertheless, the switch devices and particularly their contacts are exposed to a number of drawbacks, namely degraded conduction, for example due to fouling and/or to contact separating vibrations induced by the vibrations generated by moving trains. These drawbacks are particularly serious when using a static interlocking system, i.e. composed of electronic equipment, as well as in highspeed railway lines.

[0005] Therefore, the object of the present invention is to provide a switch device as described hereinbefore which, using relatively simple and inexpensive arrangements, can be immune to vibrations, thereby avoiding the generation of wrong feedback signals, or signals that can be wrongly interpreted by interlocking devices adapted for feedback signal evaluation.

[0006] The present invention fulfils the above objects by a device as described hereinbefore, in which at least the first or the second contact has a contact surface, i.e. designed to adhere to the cooperating second or first contact for generating an electrical conduction state, which surface is formed of a plurality of separate contact zones, which are connected in parallel to the conductor connected to the corresponding contact, and each of which adheres independently of one another to the cooperating second or first contact.

[0007] By dividing the contact surface of an electric contact into a plurality of separate areas, e.g. in the form of a matrix of separate contact zones having a predetermined pattern and a predetermined contact surface, which contact zones are connected in parallel to the connection terminal of the conductor, the total conduction resistance Rtot of the overall contact surface is defined by the following equation:

$$\frac{1}{Rtot} = \sum_i \frac{1}{Rz_i}$$

where Rz_i is the resistance of the i^{th} contact zone of the contact surface.

[0008] Here, it will be appreciated that should any one of the contact zones be no longer electrically conductive, due to either fouling with insulating material or mechanical damages that might prevent the contact zone from reaching the state of adhesion to a cooperating contact surface with which electrical conduction is to be generated, there would be a great, or even infinite conduction resistance of said contact zone and the contact surface would provide a very small or zero contribution to the global conduction resistance, whereby the current therethrough would remain substantially unchanged and the feedback signal would not be changed unless to a negligible extent.

[0009] According to a further improvement, since one of the reasons for the loss of conductivity of feedback contacts is caused by their separation from the associated contact surface of a cooperating contact, due to vibrations causing the cooperating contacts to move away from each other, in addition to the above each contact zone that forms the contact surface of a contact is equipped with separate and independent support means which, in combination with said contact zone, form a mechanical system having a predetermined resonance frequency and each contact zone and/or the corresponding support means being such as to tune the resonance frequency of each system composed of a contact zone and the support means, to a different resonance frequency from that of the systems composed of the other contact zones and the corresponding support means.

[0010] By this arrangement, in case of vibrations induced, for instance, by a moving train, only certain contact zones, whose system (contact zone - support means) accidentally has a resonance frequency in the band of the vibrations generated by the moving train, are potentially displaced with the risk of moving to a non-conducting state, whereas all the other contact zones whose systems (contact zone-support means) have a resonance frequency outside the frequency band of the vibrations induced by the moving train are not disturbed and maintain their conducting state.

[0011] The above feature, whereby the individual contact zones are connected in parallel to the conductor, provides the advantage that any contact zones displaced to the non-conducting condition, have a negligible effect on the feedback signal being generated.

[0012] The principle taught by the present invention is applicable to various configurations.

[0013] In a first possible configuration, both the contact surface of the first contact and the contact surface of the second contact are composed of a plurality of separate contact zones, which are connected in parallel to the conductor connected to the corresponding first or second contact.

[0014] In this case, the contact zones that form the contact surface of the first contact and the contact zones that form the surface of the second contact are arranged in identical patterns and, with said first contact adhering to said second contact, each contact zone of the contact surface of the first contact coincides with and adheres to one contact zone of the contact surface of said second contact.

[0015] In another configuration, the first and second contacts are stationary, and a third contact element is provided, which is alternately movable to a position in which it simultaneously adheres to said first and said second contacts, thereby generating an electric connection between said first and second contacts and to a position in which said third contact is spaced at least from said first and said second contacts.

[0016] Concerning the means for changing or tuning the resonance frequency of each oscillating system composed of one contact zone and the corresponding support means, a number of solutions are possible.

[0017] In a first solution, the support means of each contact zone have elastic means for pressing the corresponding contact zone against the contact surface or a coincident contact zone of another contact, the typical resonance frequency of the system composed of each contact zone and the corresponding support means being controlled by setting a predetermined different coefficient of elasticity or deformation of the elastic pressing means.

[0018] In addition to or instead of the above, the typical resonance frequency of the system composed of each contact zone and the corresponding support means may be characterized by the mass of the contact zone, i.e. the size of the contact zone.

[0019] In this case, each contact zone has a different mass, i.e. a different area of the surface that adheres to the contact surface of a further contact.

[0020] The above is clearly explained by considering that an oscillating system is composed, in its essential form, of a mass and an elastic element that secures the mass to a stationary point. The resonance frequency of the system is given by the stiffness constant of the elastic element and by the mass, whereby the resonance frequency may be regulated by adjusting the coefficient of elasticity of the elastic means, the mass, or both.

[0021] Various embodiments may be provided for the switch of the present invention.

[0022] According to one embodiment that provides advantages in terms of construction, each contact zone consists of one end of a flexible metal armature reed, which is fixed to a load-bearing frame by its opposite end. Such armature reed overhangs towards a movable contact element, in such a position that the end of said armature reed that carries the contact zone intersects the path of the contact surface of a second contact, supported by translation means along said path. Thus, when said second contact is moved to a position coincident with the contact zone on the free end of the armature reed, said reed is elastically bent thereby causing the contact zone to be pressed against the contact surface of the second contact. The total contact surface of the first contact is composed of at least two, three or more contact zones, each being supported by a separate armature reed. These armature reeds are arranged in side-by-side relation along their longitudinal sides, whereas the contact surface of the other contact cooperating with said first contact has such an extension as to simultaneously adhere to all the contact zones of said first contact. Each armature reed is made of an electrically conductive material and connects the contact zone on one of its ends with a terminal connecting to the first electrical conductor, which is common to all the armature reeds of all the contact zones of said first contact.

[0023] Due to the above, the armature reeds of the contact zones that form the contact surface of a contact may substantially have identical shapes and lengths, the contact zones being aligned along an axis perpendicular to the displacement path of the contact surface of the other contact cooperating with said first contact and parallel to the contact surface of said other contact.

[0024] According to a further optional characteristic, each of the armature reeds is elastically preloaded in the direction of adhesion to the contact surface of the movable contact, means being provided for stable retention of said reeds in said preloaded state and in a position of interference with the displacement path of the contact surface of the movable contact.

[0025] The resonance frequency of each oscillating system composed of a contact zone and the corresponding armature reeds may be tuned by causing each of the reeds to have a different flexural modulus and/or a different elastic preload condition in its bending towards the movable contact, or by providing different masses for each contact zone associated with an armature reed, or by both arrangements.

[0026] According to yet another advantageous feature, each armature reed has a contact zone supporting end which is bent at an angle in a direction diverging from the direction of incidence with the path of the contact surface of the movable contact, whereby each contact zone adheres to the contact surface of the movable contact by a mutual sliding motion of the contact zone and the contact surface of the movable contact.

[0027] This is advantageous because it allows self-cleaning of the contact surfaces.

[0028] According to an advantageous variant embodiment, when a third movable contact is provided to connect the first and second contacts together, said movable contact consists of a cam that rotates about an axis that passes through its center, which cam has a longer axis and a shorter axis intersecting at said center. At the ends corresponding to the ends of the longer axis, the cam has contact surfaces electrically connected to each other at the ends corresponding to the ends of the longer axis, which contact surfaces cooperate with a plurality of contact zones in side-by-side relation in the direction of the axis of rotation of the cam, which form the contact surfaces of first and second contacts respectively, whereas said contact surfaces of the first and second contacts are disposed in diametrically opposite positions with respect to the axis of rotation of the cam.

[0029] By providing a rotationally symmetrical configuration of the device with respect to the axis of rotation of the cam, the switch of the present invention may be simply equipped with further fourth and fifth contacts. These are formed like said first and said second contacts and are oriented, relative to the third contact and to said first and second contacts, at 180° to said first and second contacts, whereby when the third contact adheres to said first and second contacts, it does not adhere to said fourth and fifth contacts and vice versa.

[0030] In this variant embodiment, in which the rotating cam is the third movable contact, each reed extends in a direction that is secant to the circular path of the contact surfaces on the periphery of the cam, whereas the end portion of each armature reed, which carries a contact zone, is folded radially outwards and to such an extent as to extend substantially parallel to the tangent of said circular path of the contact surfaces of the cam when the contact zone adheres to said contact surface of said cam.

[0031] Still according to another construction variant, the switch of the present invention may easily have a modular construction, allowing a large number of separate feedback contacts to be combined together in the same switch. In this case, the switch has a base for fixing said armature reeds for the contact zones, which is made of an electrically insulating material, which fixing base has means for fixing it to a bedplate in a predetermined position with respect to the axis of a rotary control shaft. This shaft has the cam that acts as the third movable contact fitted and locked thereto and rotating therewith, which cam is shaped like a plate whose axial extension is at least equal to the axial extension of the contact zones of the corresponding contact, at least one additional identical fixing base being provided for further armature reeds of the contact zones of further contacts, which additional fixing base is identical to the first base and can be fixed to the bedplate in an overlapping position in the direction of the rotary control shaft, and congruent to the first fixing base. Likewise, an additional cam is mounted to the rotary control shaft, and is identical and disposed in a position congruent to the first cam, said cams or the contacts carried by each cam being electrically insulated from those of the other cams overlapping them, and said additional cam cooperating with the contact zones of the armature reeds mounted to the additional fixing base axially coincident with said additional cam, with reference to the axis of rotation of the rotary control shaft.

[0032] Thus, the stationary and movable contacts are provided in the form of stackable elements, forming stacks of stationary contacts and adjacent movable contacts.

[0033] According to a variant, two stacks of fixing bases can be attached to the bedplate, each for the armature reeds of the contact zones of a corresponding number of fixing contacts, which fixing bases are identical and symmetrically arranged at 180° from each other, with respect to the axis of the rotary control shaft.

[0034] According to yet another advantageous embodiment, each fixing base is symmetrical with respect to the center axis that passes through the axis of the rotary shaft and divides into halves the two stacks of fixing bases, disposed diametrically opposite to each other relative to said axis and the armature reeds for the contact zones of two different contacts are fixed to each base symmetrically with respect to said center axis of symmetry.

[0035] Further different construction variants will be described hereinafter with reference to the drawings.

[0036] Further characteristics of the invention will form the subject of the dependent claims.

[0037] These and other characteristics and advantages of the invention will be more apparent from the following description of a few embodiments shown in the accompanying drawings, in which:

Figure 1 is a schematic view of first and second contacts, in which the first contact is composed of a plurality of separate contact zones.

Figure 2 shows, like Figure 1, the embodiment in which each contact zone, in combination with the corresponding support means, also forms an oscillating system having a characteristic resonance frequency.

Figure 3 is a schematic plan view, as seen in the direction of the axis of rotation of a movable contact, of a switch of the present invention, which comprises at least two stationary contacts and particularly four stationary contacts that are designed to be electrically connected to each other in pairs of contacts diametrically opposite with respect to the axis of rotation of the movable contact, by the rotating movable contact, when the latter assumes a predetermined angular position, said movable contact being shown in Figure 4 as non adhering to said stationary contacts.

Figure 4 is a view like that of Figure 3, in which the movable contact is rotated to adhesion to a first pair of diametrically opposite stationary contacts, for generating an electrically conductive connection therebetween.

Figure 5 is a view like that of Figure 4, in which the movable contact is rotated to adhesion to a second pair of diametrically opposite stationary contacts, for generating an electrically conductive connection therebetween.

Figure 6 is an enlarged plan view of the fixing base for two stationary contacts, as seen in a direction parallel to that of the axis of rotation of the third movable contact.

Figure 7 is an enlarged, side elevation view of a stationary contact as it is mounted to the fixing base, showing the vertical separation of the contact to multiply the contact point.

Figures 8a to 8d and 9a to 9d are different construction views of the rotating contact.

Figures 10 to 11 are two sectional views of a switch having a plurality of contacts, as seen in two perpendicular planes, parallel to the axis of rotation that controls the rotation of the movable contact.

Fig. 12 is a partially cross sectional top plan view of the switch of Figures 10 and 11.

Figure 13 is an additional cross-sectional view of the switch as shown in Figures 10 to 12.

Fig. 14 is a top plan view of the upper clamping plate for the packs or stacks of fixing bases and rotating contacts.

Figure 15 is an exploded view of a variant embodiment of the multipole switch as shown in the previous figures.

Figures 16 and 17 are two views of a switch according to claim 16, as seen in two perpendicular sectional planes, parallel to the axis of rotation of the movable contact.

[0038] Referring to figure 1, there is shown a principle schematic view of the construction of a switch as generally taught by the present invention. The device comprises at least one first contact 1, that is designed to be electrically connected to a first conductor 101 of a power line and at least one second contact 2, that is designed to be electrically connected to a second conductor 102 of said power line. As shown in the figures, at least the second contact 2 is mounted in a displaceable fashion, so that said first and said second contacts alternately assume:

a mutual adhesion position (with the second contact 2 being shown by a solid line in Figures 1 and 2), which adhesion position creates electrical connection of said first and said second conductors 101, 102 of said electrical line;

a mutual retraction position of said contacts 1, 2, in which said two conductors 101, 102 are electrically disconnected from each other (as shown with the second contact 2 defined by broken lines).

[0039] Referring to Figure 1, at least the first contact 1 has a contact surface, i.e. designed to adhere to the cooperating second contact 2 for generating an electrical conduction state, which surface is formed of a plurality of separate contact zones Zi, with i = 1, 2, 3, ..., N which are connected in parallel to the conductor 101, and each of which adheres independently of one another to the cooperating second contact 2, when the latter is displaced into adhesion to the first contact 1.

[0040] Each of said contact zones Zi has a predetermined conduction resistance when adhering to the contact 2, which is schematically indicated by the Ri component, with i = 1, 2, 3, 4, ..., N.

[0041] Thus, the total resistance between the contact 1 and the contact 2, as said contacts adhere to each other to generate an electrical conduction state therethrough is defined by the following equation:

$$\frac{1}{Rtot} = \sum_i \frac{1}{Rz_i}$$

where Rz_i is the resistance of the ith contact zone of the contact surface.

[0042] Whenever the electrical conduction condition degrades at one contact zone, the resistance of the latter obviously increases. Nevertheless, even in case of a very large or infinite resistance (contact zone Zi fully separated from the contact 2), such contact zone provides a very small or quasi-zero contribution to the total resistance, whereby the total contact resistance between the contact 1 and the contact 2 remains substantially unchanged, and the current strength of the signal generated as contacts close also remains substantially unchanged.

[0043] Obviously, as anticipated above, the second contact may be formed like the first contact. Here, two variants may be provided.

[0044] In a first variant, the two contacts 1 and 2 are always moved to direct adhesion to each other, to generate the conduction state. Therefore, in this case, the second contact 2 shall advantageously have contact zones substantially identical to those of the first contact and arranged in an identical pattern, whereby each contact zone of a contact may be moved to adhesion to the contact zone of the other contact.

[0045] In a second variant, as better described hereafter, the electrical connection between the first and second contacts 1, 2 is generated by a third connection element 3 in the form of a movable contact, whereas the second contact 2 is also stationary and is located in a predetermined position and at a predetermined distance from the first contact and from the actuation path of the third contact.

[0046] In this case, the third contact advantageously has a continuous contact surface, like the second contact of Figures 1 and 2.

[0047] Referring to Figure 2, there is shown an improvement to the present invention, in which each contact zone Zi is also supported independently of the other zones and forms an oscillating system (pendulum) in combination with the support means. This is shown in Figure 2 by the interposition of a separate elastic element between each contact area and a base plate of the contact 1, which elastic element is indicated by its coefficient of elasticity Ki, with i = 1, 2, 3, ... N.

[0048] In this case each assembly composed of the contact area Zi and the support element has characteristic oscillating system or pendulum parameters, i.e. the system mass and particularly, assuming the ideal condition in which the support means have no mass, the mass of the contact zone Zi and the coefficient of elasticity Ki of the support means. By adjusting one or both of said parameters, the system may be tuned to a particular resonance frequency.

[0049] By this arrangement, at least part of the contact zones and the corresponding support means may have different resonance frequencies whereby, in case of vibrations induced by a moving train, at least part of the systems composed of a contact zone and its supporting element may be arranged to have resonance frequencies outside the frequency band of the vibrations generated by the moving train, whereby at least some of the contact zones is immune from displacements from the state of adhesion to the corresponding contact 2, and hence maintain the electrical conduction state.

[0050] In combination with the above described effect, concerning the total resistance of the contact surface of the contact composed of the individual contact zones Zi, it will be appreciated that, in this case, should some of the contact zones become separated from the other cooperating contact, thereby stopping electrical conduction, there would be no significant change in the total resistance, which will remain substantially unchanged, wherefore the feedback signal so generated would also not be changed to a substantial extent, i.e. to an extent that might cause it to be judged as wrong.

[0051] As shown with reference to Figure 2, the resonance frequency of each system composed of support means and the corresponding contact zone may be assigned by setting a particular coefficient of elasticity, by changing the mass, for instance of the contact zone, or both. For example, when each contact zone Zi is equipped with support means comprising elastic means for pressing the contact zone against an associated contact 2, then the resonance frequency of each oscillating system composed of the support means and the corresponding contact zone Zi may be set by selecting a different coefficient of elasticity for each support element. An alternative would be to provide identical support elements and change the mass of the contact zones, by accordingly adjusting, for instance, the thickness and/or surface of the flat elements that form these contact zones Zi.

[0052] The subsequent figures show several different construction embodiments of a switch according to the principles of the present invention.

[0053] Referring to Figures 3 to 15, a switch device of the present invention has four stationary contacts, generally designated by numerals 1, 2, 4 and 5. These stationary contacts are disposed in symmetric pairs with respect to two perpendicular axes of symmetry S1 and S2, intersecting at the axis of rotation A of a rotating contact, generally designated by numeral 3.

[0054] Each pair of contacts is supported by a common fixing base 6, two identical fixing bases being provided in symmetric positions with respect to one of the above mentioned axes of symmetry S1, whereas each of the fixing bases 6 is symmetric with respect to a center axis coinciding with the other axis of symmetry S2, perpendicular to the axis of symmetry S1.

[0055] Each of the two fixing bases is formed like a plate and has two lateral sides oriented in the direction of the axis of symmetry S2, which are inclined towards the intersection of said axis of symmetry S2 with the axis of symmetry S1. The inclined sides of each fixing base 6 converge along at least part of their extension towards said center and hence towards the axis of rotation A and are oriented in a substantially radial direction and symmetrically with respect to said axis of symmetry S2.

[0056] Corresponding contacts 1, 2, 4, 5 are secured to said sides by a clamping block 106 and clamping screws 7, whereby each fixing base 6 only carries a pair of contacts, i.e. 1 and 4 and 2 and 5 respectively, as shown in Figures 3 to 6.

[0057] Each contact 1, 2, 4, 5 is formed of at least two, particularly three or more armature reeds or strips 301, which are made of an electrically conductive material, and extend parallel to the corresponding side of the fixing base against which they are clamped by a clamping block 106. The block 106 clamps a common end part from which the two, three or more armature reeds or strips 301 extend in side-by-side relation, and leaves the remaining part free, overhanging towards the axis of rotation A of the rotating contact 3. Also, at the clamping end, said end part has an appendage 401 projecting towards the corresponding side of the fixing base 6 and is designed to engage in a corresponding hole formed in said side. The block 106 is made of a conductive material and has an appendage 201, 202, 204, 205 for connection of a corresponding conductor of a power line (not shown), which is thus connected in parallel to each armature reed or strip 301. The end of each armature reed or strip 301 at one of the two sides of the fixing base 6, which is designated by numeral 501 is folded in a diverging direction with respect to the end 501 of the armature reeds or strips 301 attached to the opposite side of the same fixing base 6 and form the other contact 4 carried by the same fixing base 6. Said end part 501 of the reeds is folded at a certain distance from the end of the corresponding reed and said end part 501 forms or carries a respective contact zone of the corresponding contact. Therefore, each contact in the present embodiment is formed of three contact zones Z1, Z2, Z3, each carried by a reed 301 of three adjacent reeds that extend from a common end whereby they are secured to the fixing base 6.

[0058] It will be understood that the three reeds are perfectly congruent and aligned in the direction of the axis of rotation A of the movable contact.

[0059] The diverging end portion 501 that forms the contact zone Zi has such an orientation and is in such position as to intersect the circular path of the peripheral contact surface 103 of the rotating contact 3, as defined by the longer radius thereof. The rotating contact 3 is of elongate shape and has a longer radius and a shorter radius whereby, in a predetermined angular position, the contact surface 103 at the end of the longer radius slips against the diverging end portion 501 of the armature reeds 301 of a contact 1, 2, 4 or 5 and at the same time against the diverging end portion of the armature reeds of the contact 2, 1, 5, 4 which is located in a position diametrically opposite to the first contact, with reference to the axis of rotation A of the movable contact 3.

[0060] The diverging end portions 501 of the armature reeds 301 have such an orientation that, upon contact thereof with the contact surface 103 at the end of said rotating contact 3 at the longer radius of the rotating contact 3, said portions are arranged substantially parallel to a tangent of the peripheral contact surface 103 and/or substantially perpendicular to said longer axis, whereas the diverging portions of the two other contacts are at a distance from the peripheral contact surface 103 of the rotating contact 3. This condition is shown in Figures 4 and 5 in which the rotating contact 3 adheres to the contacts 1 and 2 and 4 and 5 respectively, while remaining at a distance from the contacts 4 and 5 and 1 and 2.

[0061] Figure 6 shows the enlarged detail of the fixing base 6 with the armature reeds 301 of the contacts 1 and 4, whereas Figure 7 is a lateral view showing that each contact 1, 2, 4 and 5 is composed of three armature reeds parallel and adjacent to each other and extending from the same common end whereby they are clamped against the side of the fixing base by the screw 7 and the block 106. It also appears that different resonance frequencies may be easily set for each armature reed 301 and for each contact zone Z1, Z2 and Z3, by simply causing each armature reed 301 within the overall width of the assembly of armature reeds 301 (i.e. in the dimension parallel to the axis of rotation a of the rotating contact 3) to have a different width from the other reeds, thereby setting, for each of the armature reeds, at least the parameter of mass and possibly also the coefficient of elasticity to a different value from the other armature reeds, and hence adjusting the resonance frequency of the reed and contact zone system to a different value for each assembly composed of the armature reed 301 and the contact zone Z1, Z2, Z3.

[0062] It shall be noted that, as the rotating contact 3 adheres to two diametrically opposite contacts 1, 2 or 4, 5 respectively in Figures 4 and 5, the reeds are radially outwardly bent to a predetermined extent, thereby exerting an elastic return force that pushes the corresponding contact zone Z1, Z2, Z3 on the diverging terminal 501 against the peripheral contact surface 103 of the rotating contact 3.

[0063] The armature reeds may be elastically preloaded in a direction opposing the rotating contact and, in this case, for said reeds to be held in the limit stop condition in which they have a certain bending preload, each fixing base has a limit stop abutment 306 on the side against which the corresponding contact is fixed, which retains the armature reeds 301 against any inward displacement, thereby maintaining the elastic preload condition in the outward radial bending direction.

[0064] Such arrangement, as well as the provision of four contacts, are not strictly required, but may be the subject of variant embodiments. Therefore, the present description also encompasses and applies to subcombinations in which only two of the four contacts 1, 2, 4, 5 are provided, such as the two contacts 1 and 2, or no elastic bending preload is exerted on the reeds and no inner limit stop 306 is provided.

[0065] The two fixing bases 6 are secured to a common plate by through clamping means, which extend through the holes 206 of said fixing bases, which holes are designed to be coincident with the median axis of symmetry S2 of said fixing bases 6.

[0066] Referring to Figures 8a to 9d, there are shown the elements that form the rotating contact 3. The rotating contact 3 is mounted to a drive shaft, designated by numeral 10 in Figure 11, and rotates therewith. The shaft has a non-round section and the rotating contact 3 is formed of a plate-like element with a substantially rhomboidal shape with rotational symmetry with respect to its own center, through which the axis of rotation A also passes. Coaxially with said axis A and said center, the rotating contact 3 has a non-round through hole 303 which is designed to engage on the shaft 10, the shape of said hole 303 matching the shape of the section of the rotary control shaft 10.

[0067] The rotating contact has a fastening bush 402 that can be fitted onto the shaft 10 and has a central through hole 303 whose shape matches the section of the shaft 10. Such bushing 403 is made of an electrically insulating material and has a peripheral frame member 203 engaged therewith, which is made of an electrically conductive material and forms two diametrically opposite contact zones 103 at the ends of the longer radius. These two contact zones are electrically connected together, as they are formed of a single-piece member 203.

[0068] The contact zones 103 of the rotating contact 3 have such an axial dimension as to simultaneously adhere to all three contact zones Z1, Z2, Z3 formed by the diverging end portions 501 of the armature reeds 301 of each contact 1, 2, 4, 5 when the rotating contact 3 is in its position of interference with said contacts 1, 2, 4, 5.

[0069] As a result, it will be appreciated that the contact zones Z1, Z2, Z3 of the individual contacts 1, 2, 4 and 5 form parallel branches between the connection terminals 201, 202 or 204 and 205, when the rotating contact assumes one of the two angular positions as shown in Figures 4 and 5, i.e. when it is rotated to a position in which it adheres with the contact surfaces 103 to the contact zones of the contacts 1 and 2 and 4 and 5 respectively.

[0070] The above construction provides considerable advantages in terms of a modular and multipole design for a switch, particularly adapted to generate feedback signals.

[0071] As shown in figures 10 to 14, by forming the fixing bases 6 of an insulating material, and with a greater thickness than the total width of the armature reeds 301 of each contact 1, 2, 4, 5, a plurality of fixing bases 6 may be mounted into the same switch in overlapping and congruent positions, parallel to the axis of rotation A of the rotary control shaft 10 of the rotating contact 3, whereas a rotating contact 3 may be mounted to the rotary control shaft for each pair of diametrically opposite fixing bases 6.

[0072] The provision of identical fixing bases 6 for the contacts, and identical rotating contacts 3 affords a simple and quickly assembled modular construction.

[0073] Two pairs of fastening pins 12, 14 extend from a common bedplate 11 symmetrically with respect to a central hole 111 for receiving the rotary control shaft 10 that drives the rotating contacts 3 and is coaxial with said hole 111, said pairs being aligned on a common axis S2 that passes through the axis of rotation of the rotary control shaft 10 and the hole 111 in the bedplate 11. The pins 12, 13 of the two pairs extend parallel to the axis of the rotary control shaft 10 and are spaced from each other to the same extent as the pairs of through holes 206 in each of the fixing bases 6 for the contacts. Therefore, as shown in Figures 10 to 14, the individual fixing bases, as described with reference to Figures 3 to 7, with the contacts consisting of the armature reeds 301 and the contact zones on the end portions 501 are simply fitted one above the other to form two stacks of congruent and overlapping fixing bases 6 that carry the contacts in the form of armature reeds 301 and diverging terminals 501 also congruent with each other, the two stacks being diametrically opposite and symmetrical with respect to the axis of rotation A of the rotary control shaft for driving the rotating contacts 3. An upper plate is clamped on the two stacks by nuts 16 that are tightened on the end portions of the pins 12 and 13, as shown in Figure 14.

[0074] The rotary control shaft 10 is rotatably and overhangingly mounted in the hole 111 of the bedplate 11 by bearings 110 and extends parallel to the pins 12 and 13 to pass through a through hole in the upper clamping plate 15 and rotatably engage in an upper rotary support 17 mounted in a coaxial hole in a closing cover 14. The projecting end of the bedplate 11 of the rotary control shaft 10 carries a gearwheel 18 for engagement with a kinematic chain that transverse the driving motion of said shaft. Such kinematic chain may be, for instance, a kinematic chain connected to means for driving railway points.

[0075] A plurality of rotating contacts 3 are fitted onto the rotary drive shaft 10, and are formed as described with reference to Figures 8a to 9d. The number of rotating contacts 3 matches the number of fixing bases 6 of each stack and each rotating contact is designed to cooperate with the contacts of a pair of fixing bases 6 provided in the same axial position with reference to the axial extension of the rotary control shaft 10. An insulating member 19 is interposed between each rotating contact 3 and the one above it, whereas the stack of alternated rotating contacts and insulating members is held in position by the clamping plate 15 via a terminal 20 which fits into a coincident through hole of said clamping plate 15 which has the shape of an overturned cup.

[0076] As shown in Figure 13, the insulating members 19 also extend between the fixing bases 6.

[0077] A remarkable construction simplicity results from the above disclosure. Particularly, it will be appreciated from Figure 10 that each contact associated with each fixing base comprises three armature reeds that extend from a common clamping end and terminate in the area of interference with the movable contact 3, with three different and separate contact zones consisting of the diverging end portions 501.

[0078] While the contacts are shown herein as being identical, at least some of the fixing bases 6 may have a construction that allows contacts with four or more reeds to be fixed thereto. This is obtained either when maintaining the same axial extension of the rotary control shaft for driving the rotating contact 3 or when providing a greater axial extension of the fixing bases and the armature reeds 301 and the associated contact zones Zi.

[0079] Figures 15 to 17 show a construction variant of the switch as shown in the previous figures. Such construction substantially complies with the same principles, both concerning the general teaching of the present invention and more specific construction characteristics. Therefore, in the following description, same parts, or parts having same purposes will be designated by the same reference numerals as used in the previous embodiment, to only highlight the characteristics that differ from the previous embodiments.

[0080] Apart from a few minor changes, as more clearly shown in Figures 16 and 17, each contact is formed of four armature reeds 301 which extend from a common clamping end and terminate separate from each other, each carrying a contact zone on the end portion 501 Unlike the previous embodiment, in which the contact zones were oriented parallel to the axis of rotation A of the rotating contact 3, here the reeds and the contact zones are oriented perpendicular to said axis, and have a curved shape. to generate a predetermined elastic force for pressing against the contact surface 103 of the rotating contact 3, which is also oriented perpendicular to the axis of rotation and is formed of two diametrically opposite ends of a reed that is rotatably driven about its center.

[0081] Advantageously, each contact has a pair of opposed armature reeds which are designed to cooperate with one of the two faces of the contact strips 104 of the rotating contact 3 when one of these is interposed between the two pairs of armature reeds and the corresponding contact zones on the end portions 501. Advantageously, the armature reeds of the two pairs are arranged to be symmetrical and coincident with reference to an intermediate plane perpendicular to the axis of rotation of the rotating contact 3. The end portions 501 diverge from each other to form a lead-in section for the contact strips 103 of the rotating contact 3.

[0082] The same considerations concerning the selection of different resonance frequencies for each contact zone carried by one of the armature reeds 301 also apply to this embodiment. Likewise, the shape of the armature reeds may generate an elastic preload thereof against the facing surface of the contact strips 103 of the rotating contact and set the coefficient of elasticity, whereas the width of the armature reeds 301 and/or the contact zones may also cause the resonance frequency to be set according to the mass of the oscillating system.

[0083] Other construction variants may be envisaged, similar to the above disclosed and illustrated embodiments.

Claims

1. A switch device, particularly for generating feedback signals, such as position and/or limit stop signals, which device comprises at least one first contact, that is designed to be electrically connected to a first conductor of a power line and at least one second contact, that is designed to be electrically connected to a second conductor of said line, at least the first or at least the second contact being mounted in a displaceable fashion, so that said first and said second contacts alternately assume a mutual adhesion position, in which adhesion position electric connection is generated between said first and said second conductors of said power line, or a mutual retraction position of said contacts, in which said two conductors are electrically disconnected from each other,
<u>characterized in that</u>
at least the first or the second contact has a contact surface, i.e. designed to adhere to the cooperating second or first contact for generating the electrical conduction state, which surface is formed of a plurality of separate contact zones, which are connected in parallel to the conductor connected to the corresponding contact, and each of which adheres independently of one another to the cooperating second or first contact.

2. A device as claimed in claim 1, **characterized in that** both the contact surface of the first contact and the contact surface of the second contact are composed of a plurality of separate contact zones, which are connected in parallel to the conductor connected to the corresponding first or second contact.

3. A device as claimed in claim 2, **characterized in that** the contact zones that form the contact surface of the first contact and the contact zones that form the surface of the second contact are arranged in identical patterns and, with said first contact adhering to said second contact, each contact zone of the contact surface of the first contact coincides with and adheres to one contact zone of the contact surface of said second contact.

4. A device as claimed in claim 1 or 2, **characterized in that** the first and second contacts are stationary, and a third contact element is provided, which is alternately movable to a position in which it simultaneously adheres to said first and said second contacts, thereby generating an electric connection between said first and second contacts and to a position in which said third contact is at a distance from at least said first and said second contacts.

5. A device as claimed in one or more of the preceding claims, **characterized in that** each separate contact zone of the contact zones that form the contact surface of the first and/or the second contact, is supported by dedicated support means, which are independent of the support means of the other contact zones, the support means for said contact zones being mechanically calibrated so that, as contacts adhere to each other, the mechanical system composed of each contact zone and the corresponding support means has a typical mechanical resonance frequency, other than that of the systems composed of all or part of the other contact zones and the corresponding support means.

6. A device as claimed in claim 5, **characterized in that** the support means of each contact zone of the contact surface of one of the contacts have elastic means for pressing the corresponding contact zone against the contact surface or a coincident contact zone of another contact, the typical resonance frequency of the system composed of each contact zone and the corresponding support means being controlled by setting a predetermined different coefficient of elasticity or deformation of the elastic pressing means.

7. A device as claimed in claim 5 or 6, **characterized in that** the typical resonance frequency of the system composed of each contact zone and the corresponding support means is determined by the mass of the contact zone, i.e. the size of the contact zone.

8. A device as claimed in claim 7, **characterized in**

that each contact zone has a different mass, i.e. a different area of the surface that adheres to the contact surface of a further contact.

9. A device as claimed in one or more of the preceding claims, **characterized in that** each contact zone consists of one end of a flexible metal armature reed, which is fixed to a load-bearing frame by its opposite end, said armature reed overhanging towards a movable contact element, in such a position that the end of said armature reed that carries the contact zone intersects the path of the contact surface of a second contact, supported by translation means along said path whereby, when said second contact is moved to a position coincident with the contact zone on the free end of the armature reed, said reed is elastically bent, the contact surface of the first contact being formed of at least two, three or more contact zones, each being supported by a separate armature reed and said armature reeds being arranged in side-by-side relation along the longitudinal sides thereof, whereas the contact surface of the other contact cooperating with said first contact has such an extension as to simultaneously adhere to all the contact zones of said first contact and whereas each armature reed is made of an electrically conductive material and connects the contact zone on one of its ends with a terminal connecting to the first electrical conductor, which is common to all the armature reeds of all the contact zones.

10. A device as claimed in claim 8, **characterized in that** the armature reeds of the contact zones that form the contact surface of a first contact substantially have identical shapes and lengths, the contact zones being aligned along an axis perpendicular to the displacement path of the contact surface of the other contact cooperating with said first contact and parallel to the contact surface of said other contact.

11. A device as claimed in claim 10, **characterized in that** each of the armature reeds is elastically preloaded in the direction of adhesion to the contact surface of the movable contact, means being provided for stable retention of said reeds in said preloaded state and in a position of interference with the displacement path of the contact surface of the movable contact.

12. A device as claimed in one or more of claims 9 to 11, **characterized in that** each of the reeds has a different flexural modulus and/or a different elastic preload condition in its bending towards the movable contact.

13. A device as claimed in one or more of the preceding claims 9 to 12, **characterized in that** each armature reed has a contact zone supporting end which is bent at an angle in a direction diverging from the direction of incidence with the path of the contact surface of the movable contact, whereby each contact zone adheres to the contact surface of the movable contact by a mutual sliding motion of the contact zone and the contact surface of the movable contact.

14. A device as claimed in one or more of the preceding claims, **characterized in that** the third movable contact consists of a cam that rotates about an axis that passes through its center, which cam has a longer axis and a shorter axis intersecting at said center, whereas said cam has contact surfaces electrically connected to each other at the ends corresponding to the ends of the longer axis, which contact surfaces cooperate with a plurality of contact zones in side-by-side relation in the direction of the axis of rotation of said cam, and which form the contact surfaces of first and second contacts respectively, said contact surfaces of the first and second contacts being disposed in diametrically opposite positions with respect to the axis of rotation of the cam.

15. A device as claimed in claim 14, **characterized in that** further fourth and fifth contacts are provided which are formed like said first and said second contacts and are oriented, relative to the third contact and to said first and second contacts, at 180° to said first and second contacts, whereby when the third contact adheres to said first and second contacts, it does not adhere to said fourth and fifth contacts and vice versa.

16. A device as claimed in one or more of claims 14 or 15, **characterized in that** each reed extends in a direction that is secant to the circular path of the contact surfaces on the periphery of the cam, whereas the end portion of each armature reed, which carries a contact zone, is folded radially outwards and to such an extent as to extend substantially parallel to the tangent of said circular path of the contact surfaces of the cam when the contact zone adheres to said contact surface of said cam.

17. A device as claimed in one or more of the preceding claims, **characterized in that** it has a modular construction, there being provided an electrically insulating base for fixing said armature reeds for the contact zones, which fixing base has means for fixing it to a bedplate in a predetermined position with respect to the axis of a rotary control shaft, which has the cam that acts as the third movable contact fitted and locked thereto and rotating with said shaft, which cam is shaped like a plate whose axial dimension is at least equal to the axial extension of the contact zones of the corresponding contact, at least one additional identical fixing base being provided for further armature reeds of the contact zones of further contacts, which additional fixing base is identical to the first base and can be fixed to the bedplate in an overlapping position in the direction of the rotary control shaft, and congruent to the first fixing base, whereas an additional cam is mounted to the rotary control shaft, and is identical and disposed in a position congruent to said first cam, said cams or the contacts carried by each cam being electrically insulated from those of the other cams overlapping them, and said additional cam cooperating with the contact zones of the armature reeds mounted to the additional fixing base axially coincident with said additional cam, with reference to the axis of rotation of the rotary control shaft.

18. A device as claimed in claim 17, **characterized in that** two stacks of fixing bases can be attached to the bedplate, each for the armature reeds of the contact zones of a corresponding number of fixing contacts, which fixing bases are identical and symmetrically arranged at 180° from each other, with respect to the axis of the rotary control shaft.

19. A device as claimed in claim 17 or 18, **characterized in that** each fixing base is symmetrical with respect to the center axis that passes through the axis of the rotary shaft and divides into halves the two stacks of fixing bases, disposed diametrically opposite to each other relative to said axis and the armature reeds for the contact zones of two different contacts are fixed to each base symmetrically with respect to said center axis of symmetry.

20. A device as claimed in one or more of the preceding claims, **characterized in that** it is a switch for operating state feedback contacts, i.e. those that check the displacement position of the points of a railway switch machine, the rotary control shaft for driving the movable contacts being dynamically connected to the kinematic chain that drives the points.

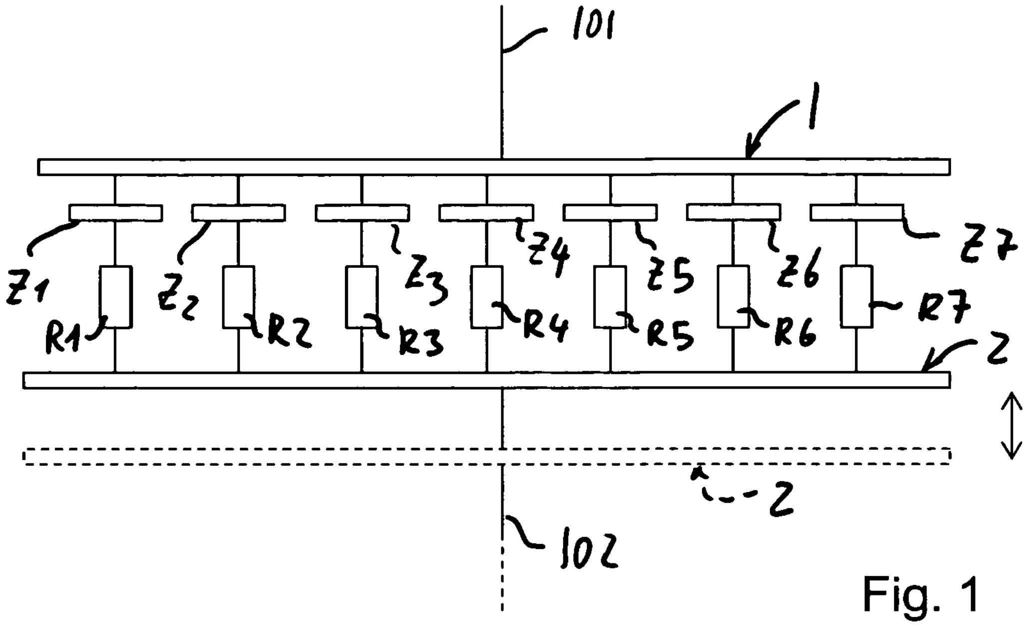
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Fig. 1

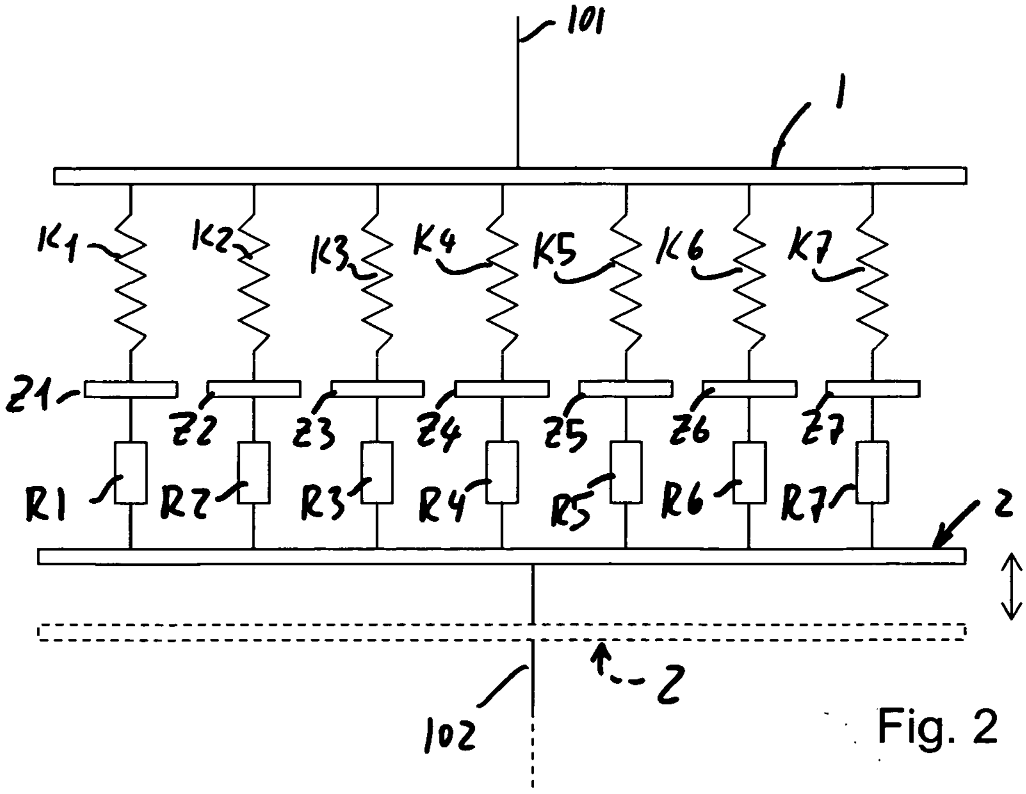
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Fig. 2

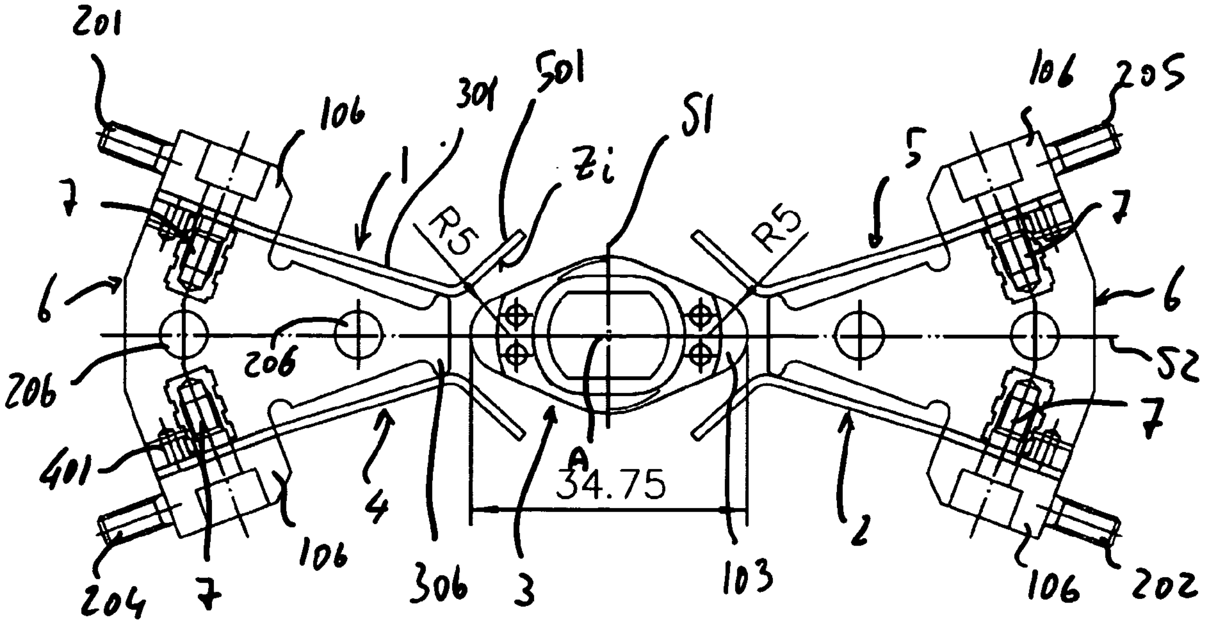
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Fig. 3

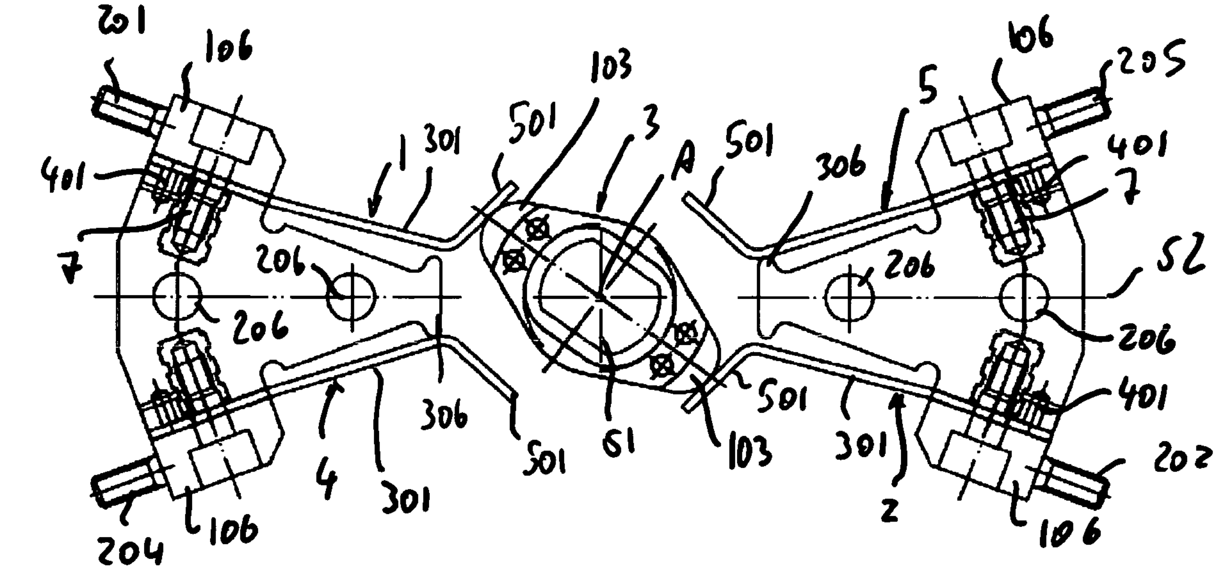
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Fig. 4

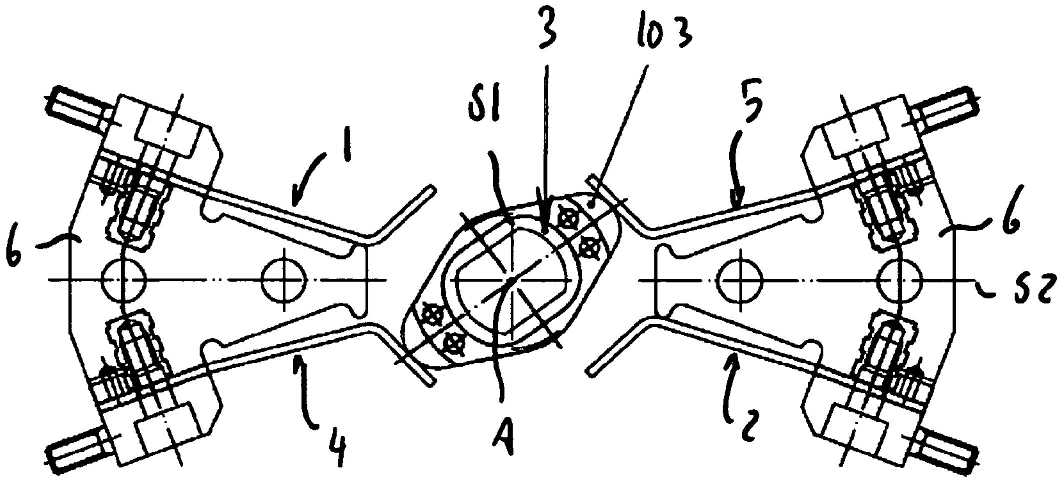

Fig. 5

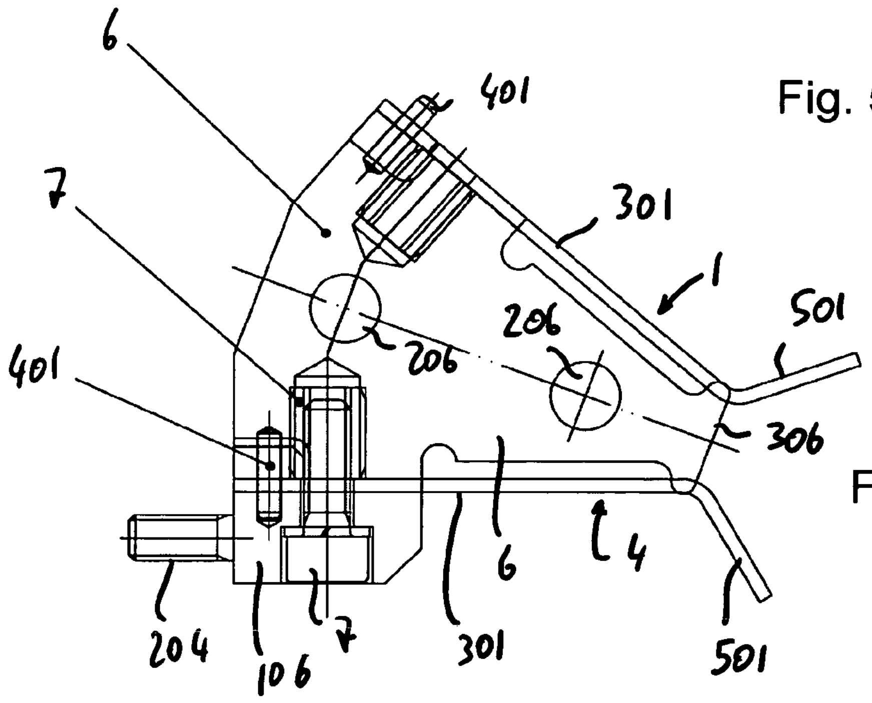

Fig. 6

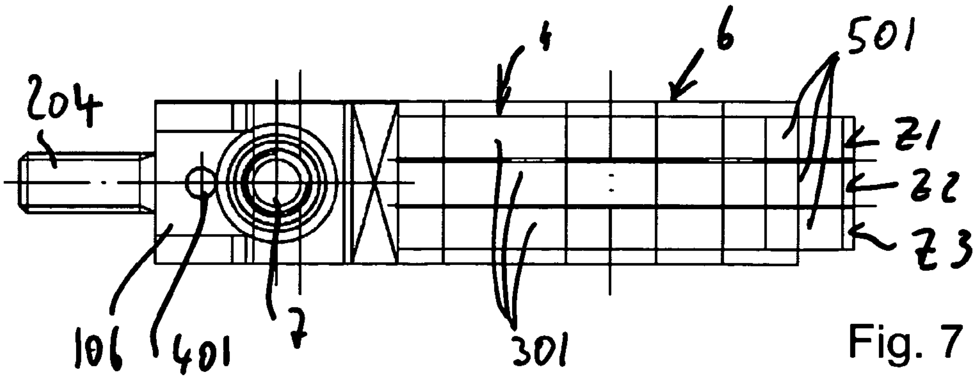

Fig. 7

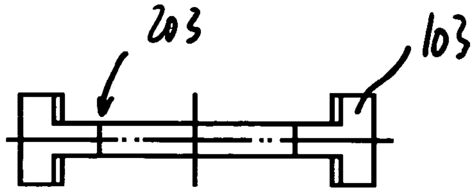

Fig. 8a

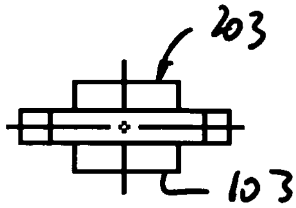

Fig. 8b

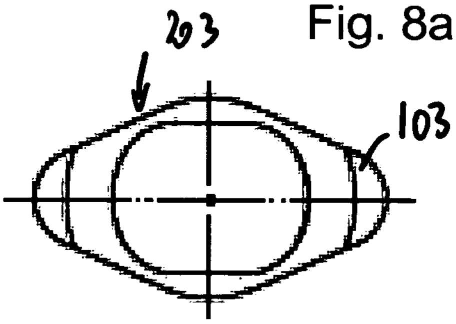

Fig. 8c

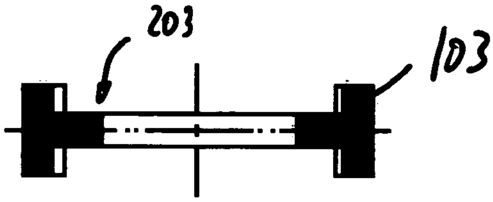

Fig. 8d

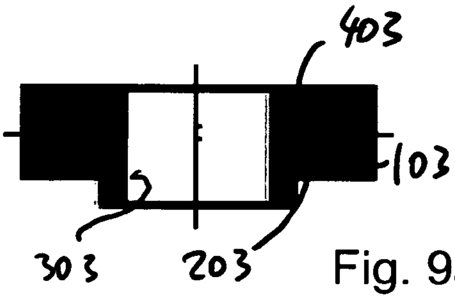

Fig. 9a

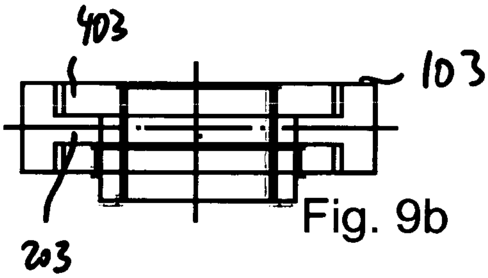

Fig. 9b

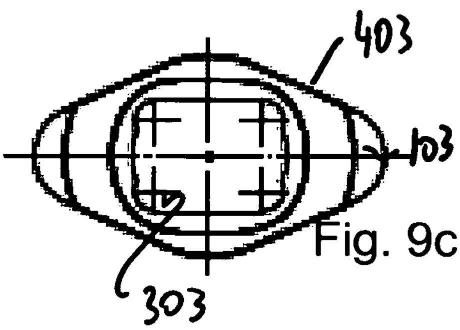

Fig. 9c

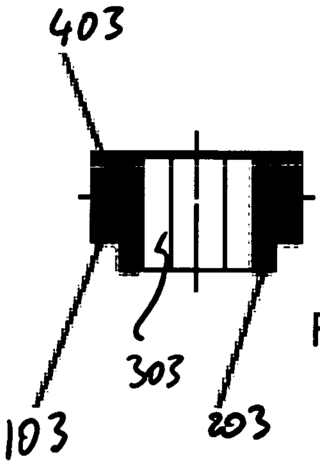

Fig. 9d

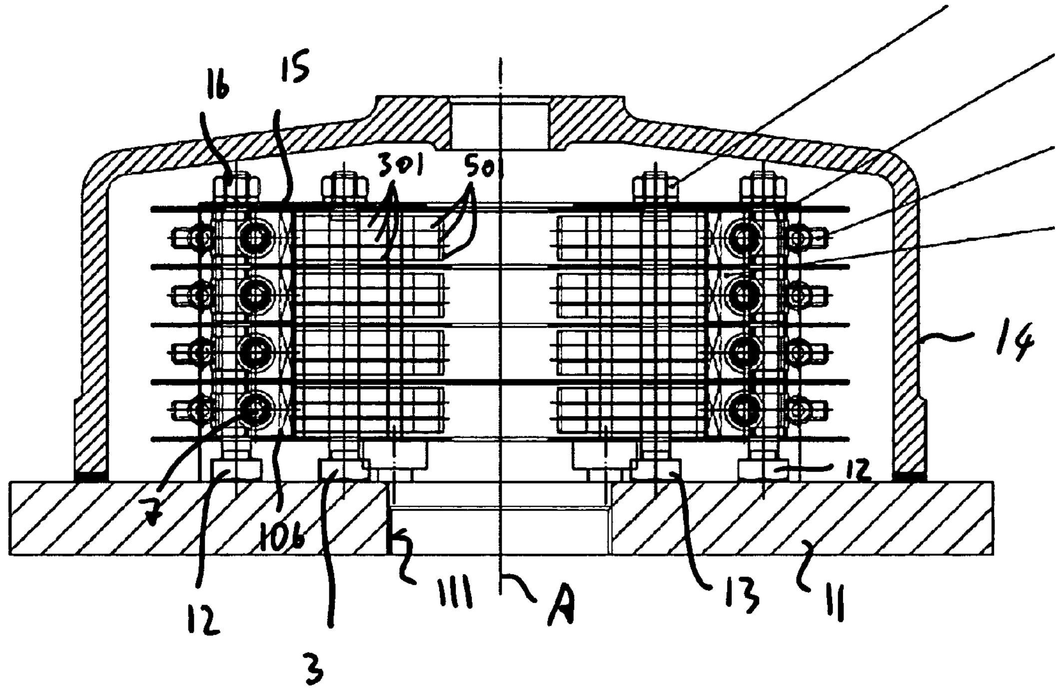
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Fig. 10

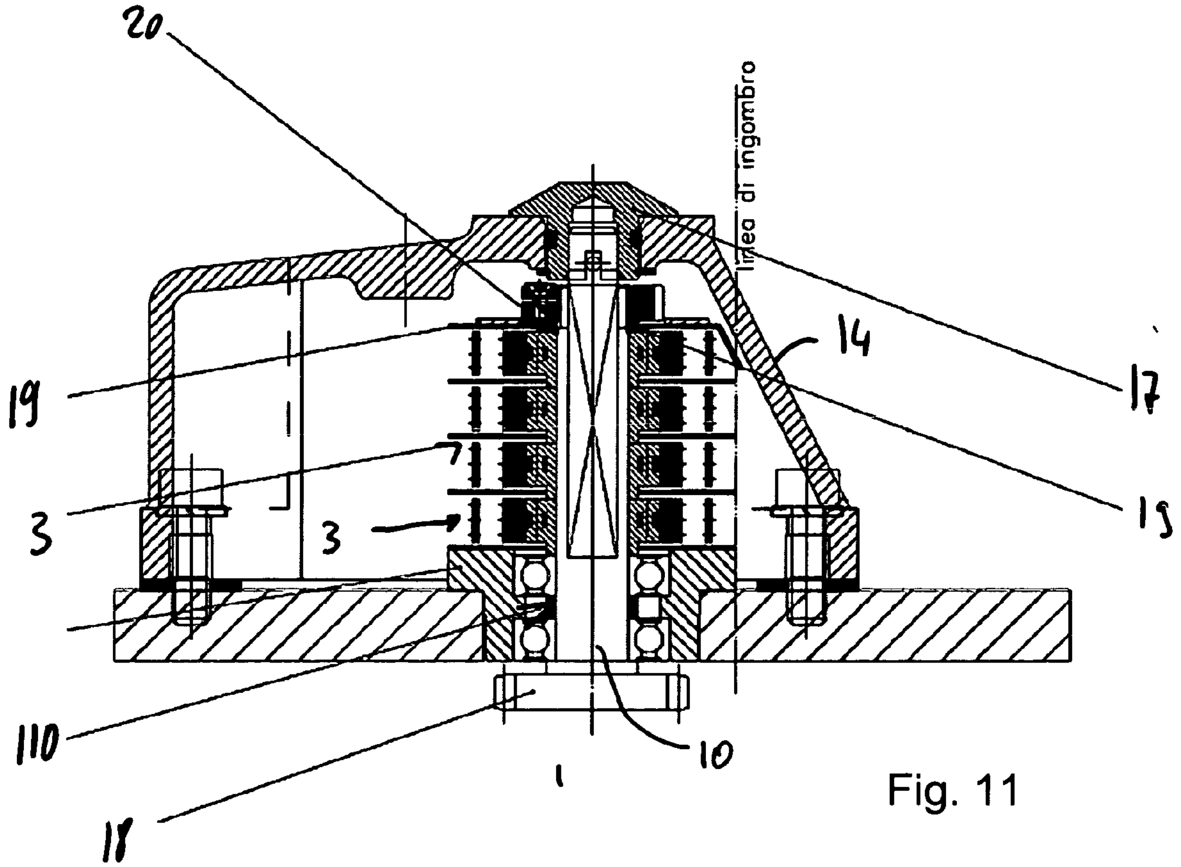
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Fig. 11

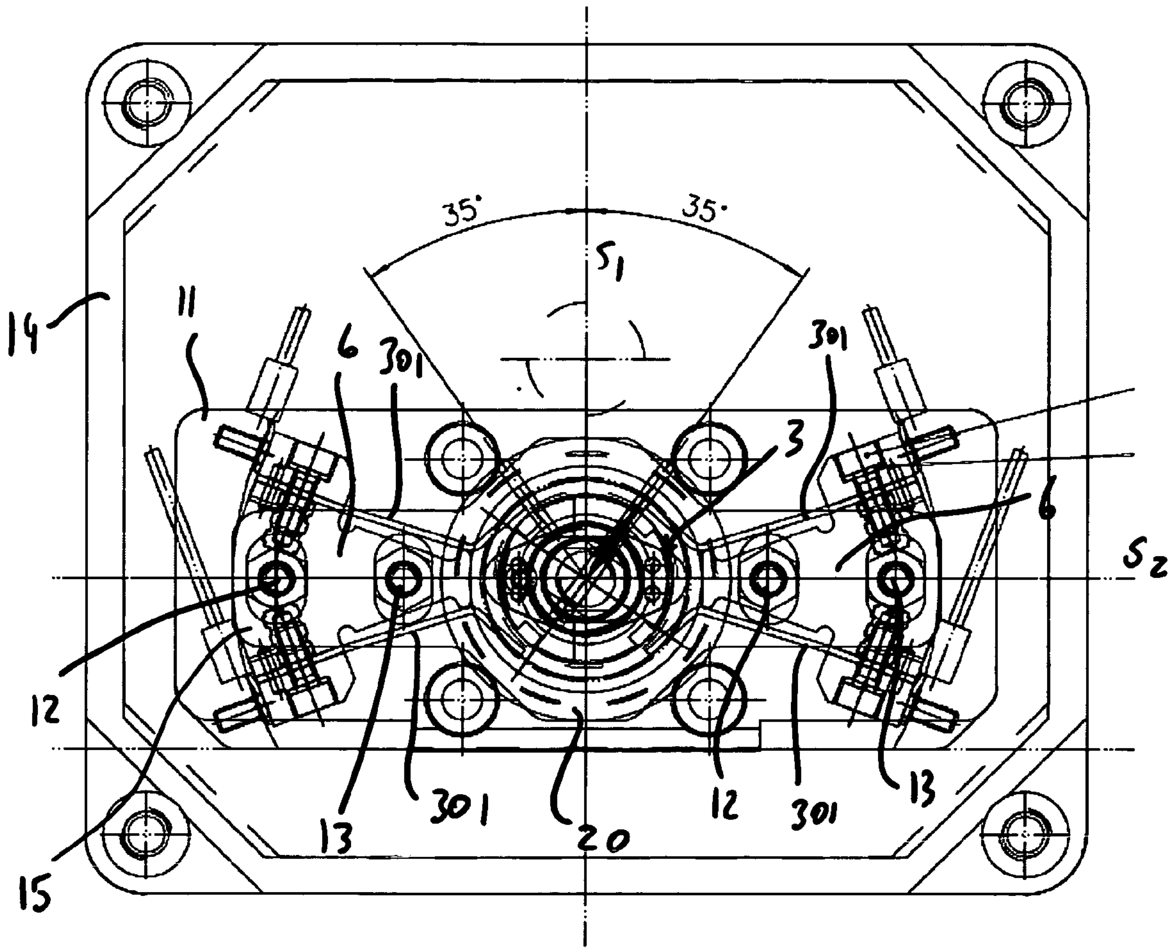

Fig. 12

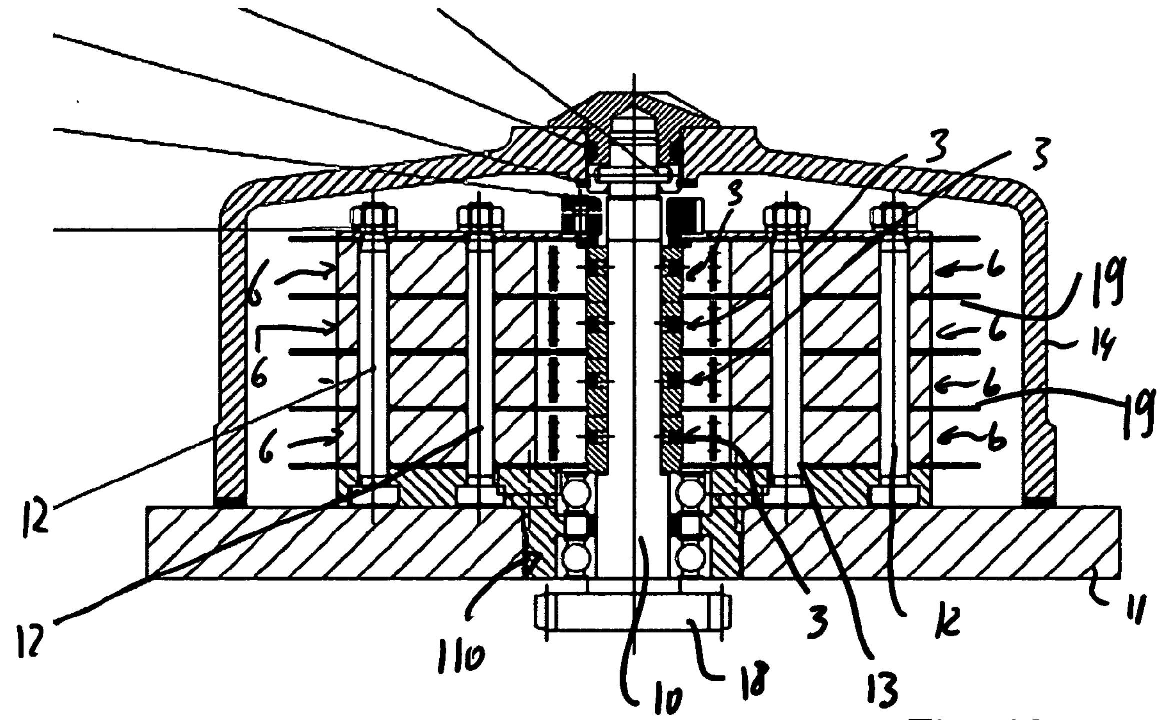

Fig. 13

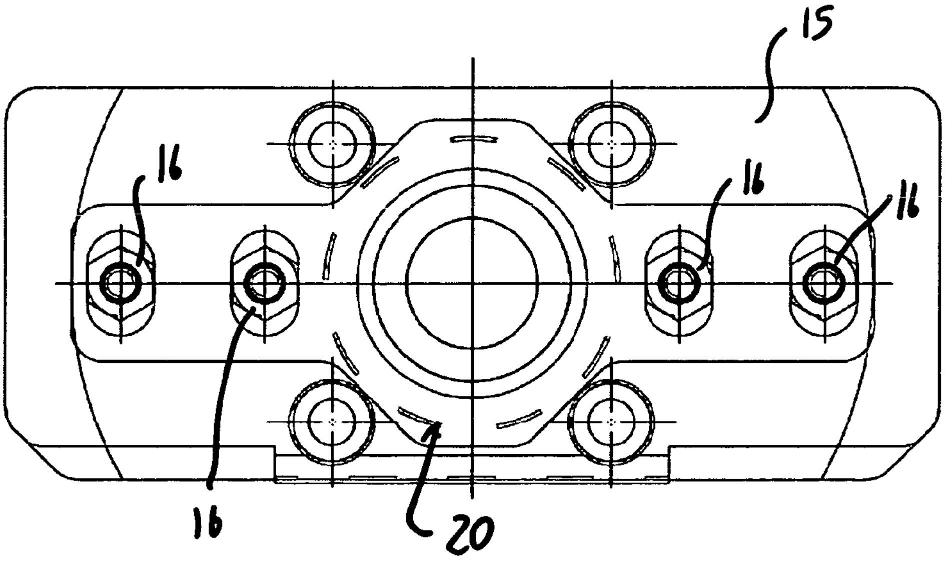

Fig. 14

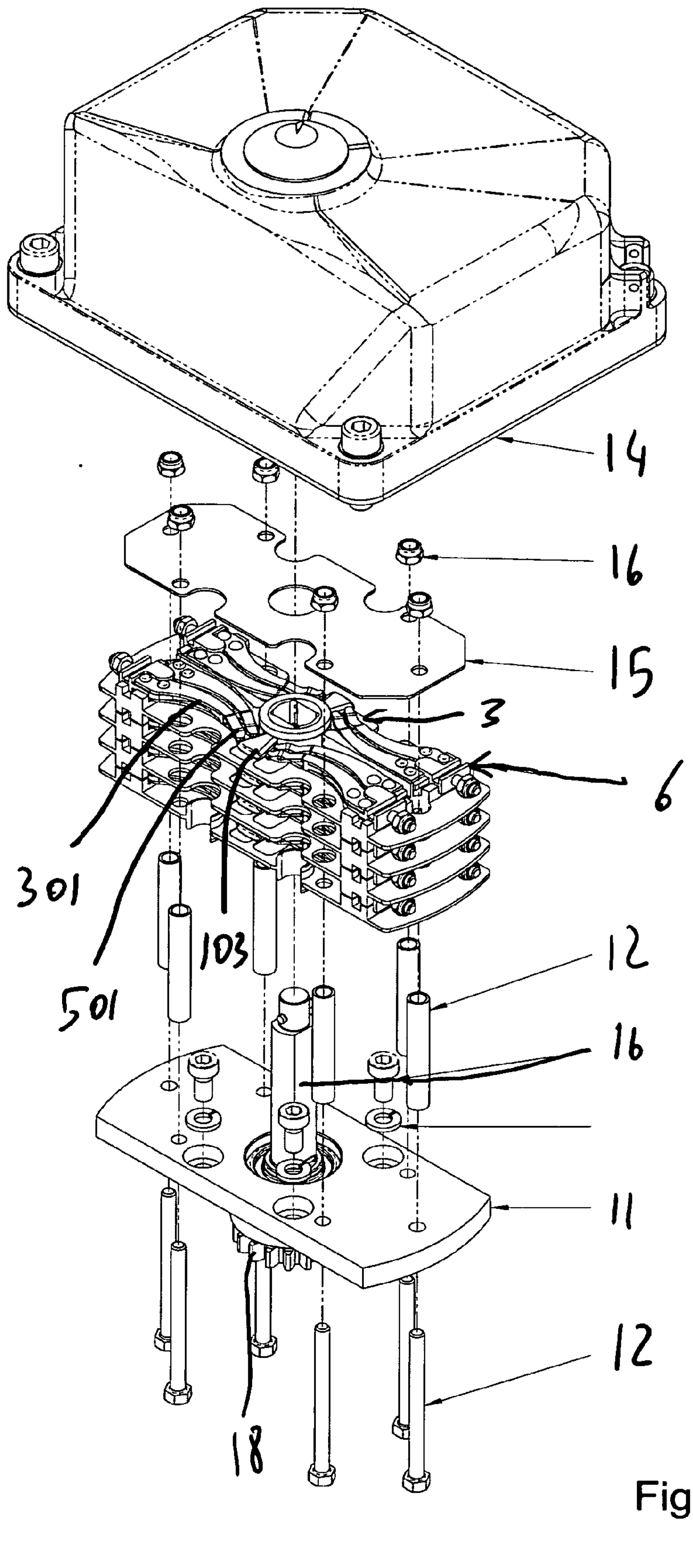

Fig. 15

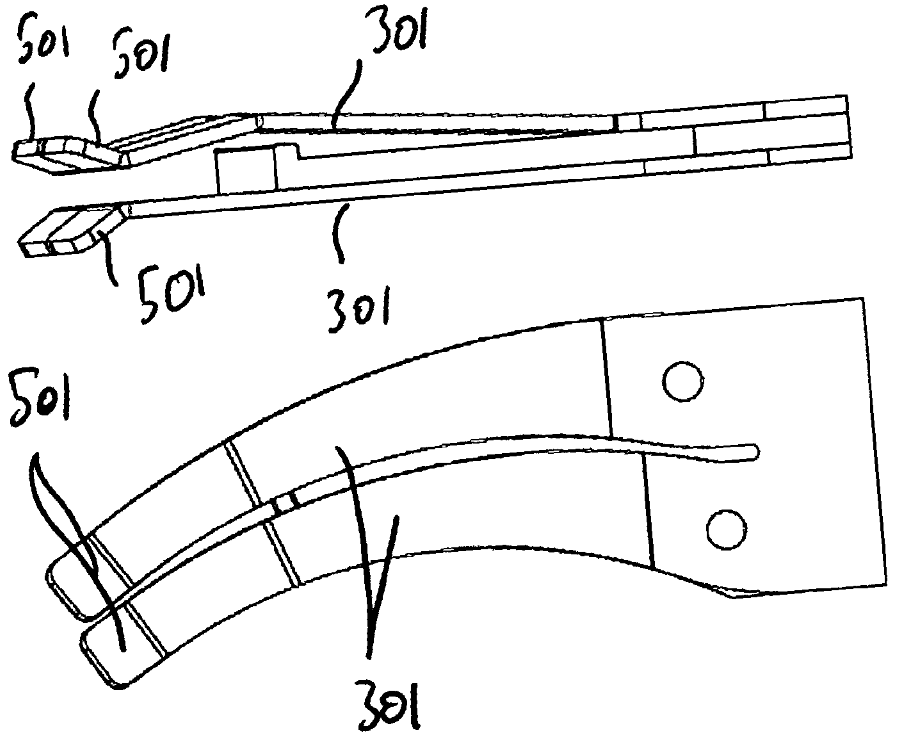

Fig. 16

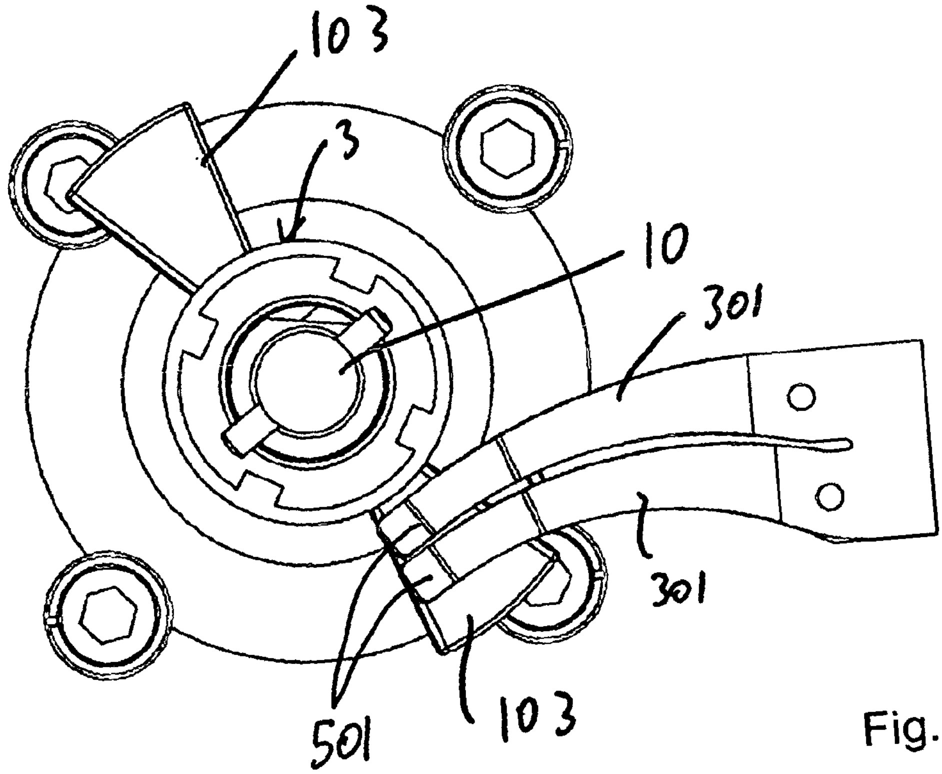

Fig. 17

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EUROPEAN SEARCH REPORT

Application Number
EP 09 42 5265

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X	JP 01 320713 A (OMRON TATEISI ELECTRONICS CO) 26 December 1989 (1989-12-26) * the whole document *	1,2	
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Y	* the whole document *	5-13	
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Y	* figures 1,4 * * column 10, line 18 - line 37 * * column 12, line 32 - line 46 *	15-19	
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	10 December 2009	Desmet, Willy

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
O : non-written disclosure
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T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

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EPO FORM 1503 03.82 (P04C01)

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EUROPEAN SEARCH REPORT

Application Number
EP 09 42 5265

DOCUMENTS CONSIDERED TO BE RELEVANT

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TECHNICAL FIELDS SEARCHED (IPC)

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	10 December 2009	Desmet, Willy

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 09 42 5265

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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