HU000035548T2

(19) **HU** (11) Lajstromszám: **E 035 548** (13) **T2**

MAGYARORSZÁG
Szellemi Tulajdon Nemzeti Hivatala

EURÓPAI SZABADALOM
SZÖVEGÉNEK FORDÍTÁSA

(21) Magyar ügyszám: **E 14 162923**
(22) A bejelentés napja: **2012. 02. 09.**

(96) Az európai bejelentés bejelentési száma:
EP 20120162923
(97) Az európai bejelentés közzétételi adatai:
EP 2752863 A1 **2014. 07. 09.**
(97) Az európai szabadalom megadásának meghirdetési adatai:
EP 2752863 B1 **2017. 10. 25.**

(51) Int. Cl.:

H01H 1/50	*(2006.01)*
H01H 50/30	*(2006.01)*
H01H 51/22	*(2006.01)*
H01H 50/54	*(2006.01)*
H01H 50/64	*(2006.01)*
H01H 1/54	*(2006.01)*
H01H 50/44	*(2006.01)*

(30) Elsőbbségi adatok:
931820 **2011. 02. 11.** **US**

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(54) **Bistabil elektromágneses relé X-hajtású motorral**

(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 752 863 B1

(12) EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention of the grant of the patent:
25.10.2017 Bulletin 2017/43

(21) Application number: **14162923.8**

(22) Date of filing: **09.02.2012**

(51) Int Cl.:
H01H 1/50 (2006.01) ***H01H 50/64*** (2006.01)
H01H 51/22 (2006.01) ***H01H 50/30*** (2006.01)
H01H 1/54 (2006.01) ***H01H 50/44*** (2006.01)
H01H 50/54 (2006.01)

(54) **Bi-stable electromagnetic relay with X-drive motor**

Bistabiles elektromagnetisches Relais mit einem X-Drive-Motor

Relais électromagnétique bistable avec moteur X-drive

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

(30) Priority: **11.02.2011 US 931820**

(43) Date of publication of application:
09.07.2014 Bulletin 2014/28

(62) Document number(s) of the earlier application(s) in accordance with Art. 76 EPC:
12746573.0 / 2 673 793

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EP 2 752 863 B1

Description

BACKGROUND OF THE INVENTION

FIELD OF THE INVENTION

[0001] The disclosed invention generally relates to an electromagnetic relay assembly incorporating a rotatable coil-core assembly. More particularly, the disclosed invention relates to an electromagnetic relay assembly having a magnetically actuable coil assembly rotatable about an axis of rotation extending orthogonally relative to the coil assembly axis.

BRIEF DESCRIPTION OF THE PRIOR ART

[0002] Generally, the function of an electromagnetic relay is to use a small amount of power in the electromagnet to move an armature that is able to switch a much larger amount of power. By way of example, the relay designer may want the electromagnet to energize using 5 volts and 50 milliamps (250 milliwatts), while the armature can support 120 volts at 2 amps (240 watts). Relays are quite common in home appliances where there is an electronic control turning on (or off) some application device such as a motor or a light. Several exemplary electromagnetic relay assemblies reflective of the state of the art and disclosed in United States patents are briefly described hereinafter.

[0003] United States Patent No. 4,743,877 ('877 Patent), which issued to Oberndorfer, discloses an Electromagnetic Relay. The '877 Patent describes an electromagnetic relay comprising, in relevant portion, a coil assembly, opposed pairs of opposed magnets, and a switch assembly. The coil assembly comprises a coil, a coil axis, and certain core-rotating means.

[0004] The core comprises opposed core terminals or extremities, and the core-rotating means have an axis of rotation orthogonal to the coil axis. The opposed pairs of opposed magnets are respectively and fixedly positioned adjacent the core terminals or extremities, and the core terminals or extremities are respectively displaceable intermediate the opposed pairs of opposed magnets.

[0005] The coil creates a magnetic field, which magnetic field is directable through the core into the opposed magnets for imparting rotation about the axis of rotation. The core terminals or extremities function to actuate the switch assembly intermediate an open switch position and a closed switch position. The closed switch position functions to enable current to pass through the switch assembly.

[0006] Japanese Patent No. S57 166 015 ('015 Patent), owned by Omron Tateisi Electronics, discloses an electromagnetic relay comprising, in relevant portion, a core and a coil that both rotate in the same motion when a magnetic field is generated in the core by the coil. The '015 Patent may thus be said to provide certain teachings to adapt an electromagnetic assembly having a fixed coil and a rotatable or pivotable core (relative to the fixed coil) to one that comprises a movable coil and core combination, which combination rotates or pivots in unison.

[0007] United States Patent No. 6,046,660 ('660 Patent), which issued to Gruner, discloses a Latching Magnetic Relay assembly with a Linear Motor. The '660 Patent describes a latching magnetic relay capable of transferring currents of greater than 100 amps for use in regulating the transfer of electricity or in other applications requiring the switching of currents of greater than 100 amps. A relay motor assembly has an elongated coil bobbin with an axially extending cavity therein. An excitation coil is wound around the bobbin. A generally U shaped ferromagnetic frame has a core section disposed in and extending through the axially extending cavity in the elongated coil bobbin.

[0008] Two contact sections extend generally perpendicularly to the core section and rises above the motor assembly. An actuator assembly is magnetically coupled to the relay motor assembly. The actuator assembly is comprised of an actuator frame operatively coupled to a first and a second generally U-shaped ferromagnetic pole pieces, and a permanent magnet. A contact bridge made of a sheet of conductive material copper is operatively coupled to the actuator assembly.

[0009] United States Patent No. 6,246,306 ('306 Patent), which issued to Gruner, discloses an Electromagnetic Relay with Pressure Spring. The '306 Patent teaches an electromagnetic relay having a motor assembly with a bobbin secured to a housing. A core is adjacently connected below the bobbin except for a core end, which extends from the bobbin. An armature end magnetically engages the core end when the coil is energized. An actuator engages the armature and a plurality of center contact spring assemblies. The center contact spring assembly is comprised of a center contact spring which is not pre bent and is ultrasonically welded onto a center contact terminal.

[0010] A normally open spring is positioned relatively parallel to a center contact spring. The normally open spring is ultrasonically welded onto a normally open terminal to form a normally open outer contact spring assembly. A normally closed outer contact spring is vertically positioned with respect to the center contact spring so that the normally closed outer contact spring assembly is in contact with the center contact spring assembly, when the center contact spring is not being acted upon by the actuator. The normally closed spring is ultrasonically welded onto a normally closed terminal to form a normally closed assembly. A pressure spring pressures the center contact spring above the actuator when the actuator is not in use.

[0011] United States Patent No. 6,252,478 ('478 Patent), which issued to Gruner, discloses an Electromagnetic Relay. The '478 Patent describes an electromagnetic relay having a motor assembly with a bobbin secured to a frame. A core is disposed within the bobbin except for a core end which extends from the bobbin. An armature end magnetically engages the core end when the coil is energized. An actuator engages the armature and a plurality of movable blade assemblies. The movable blade assembly is comprised of a movable blade ultrasonically welded onto a center contact terminal.

[0012] A normally open blade is positioned relatively parallel to a movable blade. The normally open blade is ultrasonically welded onto a normally open terminal to form a normally open contact assembly. A normally closed contact assembly comprised of a third contact rivet and a normally closed terminal. A normally closed contact assembly is vertically positioned with respect to the movable blade so that the normally closed contact assembly is in contact with the movable blade assembly when the movable blade is not being acted upon by the actuator.

[0013] United States Patent No. 6,320,485 ('485 Patent), which issued to Gruner, discloses an Electromagnetic Relay Assembly with a Linear Motor. The '485 Patent describes an electromagnetic relay capable of transferring currents of greater than 100 amps for use in regulating the transfer of electricity or in other applications requiring the switching of currents of greater than 100 amps. A relay motor assembly has an elongated coil bobbin with an axially extending cavity therein. An excitation coil is wound around the bobbin. A generally U shaped ferromagnetic frame has a core section disposed in and extending through the axially extending cavity in the elongated coil bobbin.

[0014] Two contact sections extend generally perpendicularly to the core section and rises above the motor assembly. An actuator assembly is magnetically coupled to the relay motor assembly. The actuator assembly is comprised of an actuator frame operatively coupled to a first and a second generally U-shaped ferromagnetic pole pieces, and a permanent magnet. A contact bridge made of a sheet of conductive material copper is operatively coupled to the actuator assembly.

[0015] United States Patent No. 6,563,409 ('409 Patent), which issued to Gruner, discloses a Latching Magnetic Relay Assembly. The '409 Patent describes a latching magnetic relay assembly comprising a relay motor with a first coil bobbin having a first excitation coil wound therearound and a second coil bobbin having a second excitation coil wound therearound, both said first excitation coil and said second excitation coil being identical, said first excitation coil being electrically insulated from said second excitation coil; an actuator assembly magnetically coupled to both said relay motor, said actuator assembly having a first end and a second end; and one or two groups of contact bridge assemblies, each of said group of contact bridge assemblies comprising a contact bridge and a spring.

[0016] Other patent disclosures of particular interest are U.S. Patent Nos. 4,743,877, which issued to Oberndorfer et al.; 5,568,108, which issued to Kirsch; 5,910,759; 5,994,987; 6,020,801; 6,025,766, all of which issued to Passow; 5,933,065, which issued to Duchemin; 6,046,661, which issued to Reger et al.; 6,292,075, which issued to Connell et al.; 6,426,689, which issued to Nakagawa et al.; 6,661,319 and 6,788,176, which issued to Schmelz; 6,949,997, which issued to Bergh et al.; 6,940,375, which issued to Sanada et al.; and U.S. Patent Application Publication No. 2006/0279384, which was authored by Takayama et al.

[0017] The Schmelz, Duchemin, and certain of the Gruner disclosures were particularly relevant to the subject matter as described in U.S. Patent Nos. 7,659,800 (the '800 Patent) and 7,710,224 (the '224 Patent), which issued to Gruner et al. The '800 and '224 Patents describe electromagnetic relays essentially comprising a coil assembly, a rotor or bridge assembly, and a switch assembly. The coil assembly comprises a coil and a C-shaped core. The coil is wound round a coil axis extending through the core. The core comprises core terminals parallel to the coil axis. The bridge assembly comprises a H-shaped bridge and an actuator.

[0018] The bridge comprises medial, lateral, and transverse field pathways. The actuator extends laterally from the lateral field pathway. The core terminals are coplanar with the axis of rotation and received intermediate the medial and lateral field pathways. The actuator is cooperable with the switch assembly. The coil creates a magnetic field directable through the bridge assembly via the core terminals for imparting bridge rotation about the axis of rotation. The bridge rotation displaces the actuator for opening and closing the switch assembly.

[0019] Notably, the Kirsch Patent No. 5,568,108; the Reger et al. Patent No. 6,046,661; the Nakagawa et al. Patent No. 6,426,689; the Schmelz Patent Nos. 6,661,319 and 6,788,176 and the Gruner et al. '800 and 224 patents teach or describe armature assemblies having an H-shaped portion pivotable about a pivot axis of rotation, which H-shaped portion comprises or is otherwise attached to an elongated actuator arm extending from the H-shaped portion.

[0020] It is noted that an inherent problem with conventional electromagnetic relays incorporating a coil assembly and an armature of the foregoing type(s) is that they are quite susceptible to magnetic tampering. This is primarily because the rotating armature houses a permanent magnet. These permanent magnets react to the magnetic field generated by the coil and are either repelled or attracted, thereby creating a mechanical motion to open and/or close the contacts.

[0021] This leaves the relay(s) vulnerable to tampering by using a very large magnet (i.e. positioning a large conflicting magnetic field) external to the relay. Since the permanent magnets are housed in a rotating plastic casing, this means t will only hold its state as long as no other magnetic or mechanical force is exerted to the relay which is larger than the magnetic holding force of the permanent magnets.

[0022] It is noted that certain international standards require that the relay hold its state in either the open or closed position when a magnetic field measuring at least

5000 Gauss is brought within 40 millimeters of the relay. During this test, many relays cannot operate due to the conflicting 5000 Gauss magnetic field. This type of tampering is common in developing countries or in lower income areas to turn the electricity meter back on after the utility company has remotely shut it off.

[0023] The prior art thus perceives a need for an electromagnetic relay that is resistant to magnetic tampering whereby the permanent magnets are fixed or anchored and the coil assembly itself rotates with minimized displacements so as to intensify the operative magnetic field otherwise inherent to the same size magnets.

SUMMARY OF THE INVENTION

[0024] It is thus on object of the present invention to provide a so-called bi-stable electromagnetic relay assembly in which the permanent magnets are fixed inside the plastics and the coil itself rotates, unlike conventional relays incorporating fixed coils and moving permanent magnets cooperably associated with rotating armatures. To achieve this and other readily apparent objectives, the present invention essentially provides an electromagnetic relay assembly for selectively enabling current to pass through switch terminals, which relay comprises a rotatable electromagnetic coil assembly, first and second pairs of opposed permanent magnets, and a switch assembly.

[0025] The rotatable coil assembly comprises a current-conductive coil, an axially extending coil core, and a rotatable coil housing. The coil is wound around the core, which core is collinear or parallel with the axis of the coil. The coil comprises electromagnet-driving terminals, the core comprises opposed core terminals, and the coil housing has a housing axis of rotation orthogonal to the coil axis.

[0026] The first and second pairs of opposed permanent magnets are respectively and fixedly positioned adjacent the core terminals such that the core terminals are respectively displacable intermediate the pairs of magnets. The switch assembly comprises first and second linkage arms, and first and second spring arms. The linkage arms interconnect the core terminals and spring arms. The spring arms each comprise opposed pairs of contacts and a switch terminal.

[0027] The coil operates to create a magnetic field directable through the core for imparting coil housing rotation about the housing axis of rotation via attraction to the positioned/anchored permanent magnets. The core terminals displace linkage arms, and the linkage arms actuate the spring arms intermediate an open switch assembly position and a closed switch assembly position, the latter of which enables current to pass through the switch assembly via the contacts and the switch terminals.

[0028] Certain peripheral features of the essential electromagnetic relay assembly include, for example, certain spring means for damping contact vibration intermediate the contacts when switching from the open position to the closed position. In this regard, it is contemplated that the spring arms each may preferably comprise first and second spaced spring sections cooperable with the linkage arms and laterally spaced from the contacts so as to maximize the damping effect when switching from the open to closed switch assembly positions.

[0029] In this last regard, it is noted that a major problem for all electro-mechanical switchgear is the contact bounce when closing into an electric load. To overcome this, many have added additional leaf or coil springs to buffer the bounce of the contacts. The present invention takes advantage of a simple stamping process which enables the incorporation of an integrated bounce reduction spring on both sides of the contact site rather than just one.

[0030] While the loose end of a spring is the most likely place to open when operating the relay, it can still occur that the contacts open even if the loose end of the spring is set to the closed position. To overcome this, an additional stamping procedure has been incorporated into the present invention so as to apply contact pressure both the left and right side of the contact, ensuring equal contact pressure and making sure that the contacts stay closed when the relay is operated.

[0031] Other objects of the present invention, as well as particular features, elements, and advantages thereof, will be elucidated or become apparent from, the following description and the accompanying drawing figures.

BRIEF DESCRIPTION OF THE DRAWINGS

[0032] Other features of my invention will become more evident from a consideration of the following brief description of patent drawings:

Figure No. 1 is top perspective view of an assembled and preferred (exemplary single-pole) relay assembly according to the present invention with relay housing cover removed to show internal components.

Figure No. 2 is an exploded top perspective view of the preferred relay assembly according to the present invention showing from top to bottom, a bracket structure, an assembled coil assembly, linkage structures, contact-spring assemblies, permanent magnets, and the relay bottom casing.

Figure No. 3 is an exploded top perspective view of the coil assembly according to the present invention.

Figure No. 4 is top plan view of the assembled and preferred relay assembly according to the present invention with relay housing cover removed to show internal components in an open switch assembly position.

Figure No. 5 is top plan view of the assembled and preferred relay assembly according to the present invention with relay housing cover removed to show internal components in a closed switch assembly position.

Figure No. 6 is an enlarged plan view of the rotatable coil assembly (positioned intermediate fixed permanent magnet pairs) and contact-spring assemblies in the open switch assembly position.

Figure No. 7 is an enlarged plan view of the rotatable coil assembly (positioned intermediate fixed permanent magnet pairs) and contact-spring assemblies in the closed switch assembly position.

Figure No. 8 is an enlarged diagrammatic type depiction of the rotatable coil assembly positioned intermediate fixed permanent magnet pairs in the open switch assembly position.

Figure No. 9 is an enlarged diagrammatic type depiction of the rotatable coil assembly positioned intermediate fixed permanent magnet pairs in the closed switch assembly position.

Figure No. 10 is an enlarged depiction of the contact-spring assemblies in the open switch assembly position.

Figure No. 11 is an enlarged depiction of the contact-spring assemblies in the closed switch assembly position.

Figure No. 12 is an enlarged plan view of the rotatable coil assembly of a multi-pole alternative embodiment according to the present invention showing the rotatable coil assembly in the open switch assembly position.

Figure No. 13 is an enlarged plan view of the rotatable coil assembly of a multi-pole alternative embodiment according to the present invention showing the rotatable coil assembly in the closed switch assembly position.

Figure No. 14 is a fragmentary exploded top perspective view of the preferred relay assembly sectioned along the coil assembly axis of rotation.

Figure No. 15 is a fragmentary exploded sectional view of the structures otherwise depicted in Figure No. 14 showing the coil axis orthogonal to the coil assembly axis of rotation.

Figure No. 16 is top perspective view of an assembled and alternative multi-pole relay assembly according to the present invention with relay housing cover removed to show internal components.

Figure No. 17 is an exploded top perspective view of the alternative multi-pole relay assembly according to the present invention showing from top to bottom, a bracket structure, an assembled coil assembly, linkage structures, contact-spring assemblies, permanent magnets, and the relay bottom casing.

Figure No. 18 is top plan view of the assembled and alternative multi-pole relay assembly according to the present invention with relay housing cover removed to show internal components in an open switch assembly position.

Figure No. 19 is top plan view of the assembled and alternative multi-pole relay assembly according to the present invention with relay housing cover removed to show internal components in a closed switch assembly position.

Figure No. 20 is a diagrammatic depiction of X-shaped plane boundaries that define the limits of movement of the core terminals intermediate the fixedly positioned permanent magnets according to the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0033] Referring now to the drawings, the preferred embodiment of the present invention concerns a so-called bi-stable electromagnetic relay (with X-drive motor) assembly 10 as generally illustrated and referenced in Figure Nos. 1,2,4, and 5. Assembly 10 is believed to teach the basic structural concepts supporting the present invention, which basic structural concepts may be applied to either single pole assemblies as generally depicted and supported by assembly 10, or multiple pole assemblies. In this last regard, an exemplary four-pole assembly 20 is generally illustrated and referenced in Figure Nos. 16-19.

[0034] The electromagnetic relay assembly 10 essentially functions to selectively enable current to pass through switch terminals 11. The electromagnetic relay assembly 10 preferably comprises an electromagnetic coil assembly 12, first and second pairs of opposed permanent magnets 13, and a switch assembly comprising various components, including first and second linkage arms 14 (comprising one or more L-shaped portion(s)), and first and second spring arms 15, which arms 15 are in electrical communication with, or otherwise (conductively) fastened extensions of the switch terminals 11.

[0035] The coil assembly 12 may preferably be thought to comprise a current-conductive coil 16 (with spool assembly 26), a coil core 17, and a coil housing 18 (comprising a coil lid 18(a) (outfitted with coil lid conductor(s) 25) and a coil base or coil box 18(b)). The coil 16 is wound around the core 17, which core 17 is collinear with a coil axis as at 100. The coil 16 comprises electromagnet-driving terminals as at 19, and the core 17 comprises (linearly) opposed core terminals as at 21.

[0036] Notably, the coil housing 18 has a housing axis of rotation 101, which axis 101 extends orthogonally relative to the coil axis 100. The housing axis of rotation 101 extends through pin structures 22 formed in axial alignment on the coil lid 18(a) and the coil box 18(b) of the housing 18, which pin structures 22 are received in pin-receiving structures 23 formed in a bracket 27 and relay housing 24.

[0037] The first and second pairs of opposed permanent magnets 13 are respectively and fixedly obliquely positioned (via housing anchor structures 28) adjacent the core terminals 21 such that the core terminals 21 are respectively displacable intermediate the respective pairs of magnets 13. The opposed pairs of permanent magnets 13 each comprise substantially planar opposed magnet faces 29, which faces 29 extend in intersecting planes 102 thereby exhibiting an X-shaped planar configuration as at 103 in Figure No. generally defining the boundaries of movement of the core terminals 21.

[0038] In this last regard, it will be noted that the core 17 has a thickness as at 104, and the magnets 13 are positioned (via anchor structures 28) accordingly so as to properly contact the core terminals 21. In other words, the core 17 preferably comprises substantially planar opposed core faces as at 30 such that the core faces 30 and magnet faces 29 are similarly angled when contacting one another for maximizing contact surface area and enhancing current flow through the maximized contacting surface area intermediate the core 17 and permanent magnets 13.

[0039] It will be understood form a consideration of the drawings that the linkage arms 14 (or linkage arms 14(a) of the multi-pole embodiment) function to interconnect the core terminals 21 and spring arms 15. The spring arms 15 each comprise (i.e. are in electrical communication with or otherwise conductively fastened to) opposed pairs of contacts 31 and a switch terminal as at 11. The opposed pairs of contacts 31 are juxtaposed adjacent one another such that when the switch assembly is in a closed position, the contacts 31 contact one another as generally depicted in Figure Nos. 5, 7, 11, and 19. Conversely, the open switch assembly position is generally and comparatively depicted in Figure Nos. 4, 6, 10, and 18.

[0040] The coil 16, when provided with current, functions to create a magnetic field as at 105, which magnetic field 105 is directable through the core 17 and cooperable with the magnets 13 (as generally pole aligned and depicted in Figure Nos. 8 and 9) for imparting coil housing (pivot type) rotation (as at 106) about the housing axis of rotation 101. The core terminals 21 thus function to displace the linkage arms 14, which linkage arms 14, in turn actuate the spring arms 15 intermediate the open position and the closed position as previously referenced. The closed position enables current to pass through the switch assembly via the contacts 31 and the switch terminals 11.

[0041] As earlier noted the linkage arms of assembly 10 are preferably L-shaped from a top plan view and thus comprise a first link portion as at 32 and a second link portion as at 33. With assembly 20, the linkage arms 14 comprise a first link portion as at 34 and a series of second link portions as at 35 (or a series of interconnected L-shaped structures). The second link portions 33 and 35 of each assembly 10/20 respectively extend toward one another orthogonal to the first link portions 32 and 34 of each assembly 10/20. The core terminals 21 are connected to the first link portions 32 or 34 and the spring arms 15 extend substantially parallel to the second link portions 33 or 35 when in an open switch assembly position.

[0042] The spring arms 15 are preferably parallel to one another whether in the open or closed switch assembly positions and each comprise opposed faces, the inner faces 40 of which face one another as generally depicted and referenced in Figure Nos. 10 and 11. The opposed inner faces 40 are magnetically attracted to one another (as generally referenced at 107) during a short circuit scenario, and thus the magnetically attracted faces 40 function to maintain the contacts 31 in the closed switch assembly position during a short circuit scenario.

[0043] In this last regard, it is noted that during a short circuit the magnetic fields generated inside a relay will grow as the current increases. The contacts, however, tend to separate during the rush of current. To structurally address this, the present invention enables the manufacturer to form one type of contact-spring assembly, and use the same assembly twice as generally depicted and illustrated by spring arm(s) 15, terminals 11, and contacts 31.

[0044] It should be noted that half the current will flow through the top contact-spring assembly and half the current will flow through the bottom contact-spring assembly. Since these assemblies are carrying the same current in the same direction, the magnetic forces generated thereby are therefore equal. This means that when the bottom of the top spring is generating a magnetic field with a south polarity, the top of the bottom spring will generate a magnetic field with a north polarity. Since north and south attract one another (as at 107), the attraction forces the contacts 31 into the closed position during a short circuit. The greater the current during the short circuit, the greater will be the magnetic field; therefore, the magnetic attraction 107 to maintain the contacts 31 in a closed position is maximized.

[0045] The described contact-spring assembly is similar to existing assemblies insofar as the terminals 11 and spring arms 15 are preferably constructed from copper whereby the spring arm 15 is placed on top of the copper terminal and then riveted together via the contact buttons 31. By arranging the spring arms 15 so that faces 40 oppose one another, a resulting contact system allows for one input from a copper terminal, then splits the load through two springs and outputs the load again on the other copper terminal. Since the two springs (i.e. spring arms 15) are preferably identical in terms of their manufacturability, they will bear a very similar, if not identical, resistance. Furthermore, these two springs are running directly parallel to one another, resulting in the same magnetic fields generated around the spring arms 15.

[0046] The spring arms 15 preferably comprise first and second spring portions or means for effecting bistability. The first spring portions or means are generally contemplated to be exemplified by resiliently bends in the arms 15 as generally depicted and referenced at 36. The first spring means are preferably relaxed when in an open switch assembly position and preferably actuated when in a closed switch assembly position, but not necessarily so. It is contemplated that the actuated first spring means may well function to dampen contact vibration intermediate the contacts 31 when switching from the open switch assembly position to the closed switch assembly position.

[0047] The second spring portions or means are generally contemplated to be exemplified by resilient spring extensions as generally depicted and referenced at 37. The second spring portions or means 37 are preferably relaxed when in an open switch assembly position and preferably actuated when in a closed switch assembly position, but not necessarily so configured. It is contemplated that the actuated second spring means may well function to enhance damped contact vibration intermediate the contacts 31 when switching from the open switch assembly position to the closed switch assembly position.

[0048] It should be noted that first spring means are preferably actuable adjacent the first link portions 32 or 34 and that the second spring means are preferably actuable adjacent the second link portions 33 or 35. The first and second spring means thus provide spaced damping means for each contact pair. It is contemplated that the spaced damping means may well function to further enhance damped contact vibration intermediate the contacts 31 when switching from the open switch assembly position to the closed switch assembly position.

[0049] In this last regard, it should be further noted that each contact pair is preferably positioned intermediate the spaced first and second damping means, which spaced damping means thus provide laterally opposed damping means relative to each contact pair for still further enhancing damped contact vibration intermediate the contacts 31 when switching from the open switch assembly position to the closed switch assembly position.

[0050] As earlier noted, a major problem for all electromechanical switchgear is the contact bounce when closing into an electric load. To overcome this, the typical structural remedy is to include additional leaf or coil springs to buffer the bounce of the contacts. The present invention takes advantage of a simple stamping process which enables the incorporation of an integrated bounce reduction spring as exemplified by resilient bends 36 and resilient extensions 37, which structural features are spaced laterally relative to the contacts 31. The present design thus applies contact pressure both the left and right side of the contact, ensuring equal contact pressure and making sure that the contacts stay closed when the relay is operated.

[0051] While the above descriptions contain much specificity, this specificity should not be construed as limitations on the scope of the invention, but rather as an exemplification of the invention. For example, the invention may be said to essentially teach or disclose an electromagnetic relay assembly comprising a rotatable coil assembly, opposed pairs of opposed magnets, and a switch assembly.

[0052] The coil assembly comprises a coil, a core, and certain core-rotating means as exemplified by the rotatable coil housing with peripheral, pivot type rotation-enabling structures. The core is preferably collinear with or parallel to the axis of the coil and comprises exposed and opposed core terminals. Notably, the core-rotating means have an axis of rotation that extends orthogonally relative to the coil axis.

[0053] The opposed pairs of opposed magnets are respectively and fixedly positioned adjacent the core terminals such that the core terminals are respectively displacable intermediate the magnet pairs. The coil function to create a magnetic field directable through the core into opposed magnets for imparting rotation about the axis of rotation. The core terminals actuate the switch assembly intermediate an open position and a closed position, the latter of which positions enable current to pass through the switch assembly.

[0054] The electromagnetic relay assemblies further comprise certain linkage means and opposed spring assemblies. The linkage means as exemplified by the linkage arms 14 and 14(a) interconnect the core terminals and spring assemblies. The spring assemblies essentially function to dampen contact vibration when switching from the open position to the closed position. The spring assemblies preferably comprise first and second spring means, which means are preferably relaxed when in the open position and preferably actuated when in the closed position, but the reverse structural configuration, namely that the first and second spring means may be relaxed when in the closed position and actuated when in the open position are also viable alternatives.

[0055] The first and second spring means are spaced from one another opposite the contacts for providing spaced, laterally opposed damping means for further enhancing damped contact vibration of the switch assembly when switching from the open to closed positions. The spring arms of the spring assemblies are preferably parallel to one another and comprise opposed arm faces as at 40. The opposed arm faces 40 are magnetically attracted to one another during a short circuit scenario, which magnetically attracted arm faces for maintaining the switch assembly in the closed position during the short circuit scenario.

[0056] The opposed magnets comprise opposed magnet faces, which opposed magnet faces are substantially planar and extend in intersecting planes, and the core (terminals) have substantially planar opposed core faces. The contacting core faces and magnet faces are similarly angled for maximizing contact surface area for further enhancing current flow through contacting surface area intermediate the core and magnet faces.

[0057] In addition to the foregoing structural considerations, it is further believed that the inventive concepts discussed support certain new methodologies and/or processes. In this regard, it is contemplated that the foregoing structure considerations support a method for switching an electromagnetic relay comprising the steps of outfitting a coil assembly with means for rotating the coil assembly about an axis of rotation orthogonal to coil assembly axis whereafter a magnetic field may be created via the coil assembly and directed through the coil assembly into opposed magnets for imparting rotation about the axis of rotation. The coil assembly is then rotated (or pivoted) about the axis of rotation, and the switch assembly is actuated intermediate open and closed positions via the rotating coil assembly.

[0058] The method is believed to further comprise the step of damping contact vibration via opposed contact-spring assemblies when displacing the switch assembly from the open to closed position, which may involve the step of laterally spacing the damping means relative to contacts of the switch assembly before the step of damping contact vibration. Certain faces (as at 40) of the contact-spring assemblies may be opposed before the step of damping contact vibration such that the opposed faces are magnetically attracted to one another during a short circuit scenario for maintaining the switch assembly in the closed position during said scenario.

Claims

1. An electromagnetic relay assembly (10, 20), the electromagnetic relay assembly (10, 20) comprising a coil assembly (12), opposed pairs of opposed magnets (13), and a switch assembly,

   wherein the coil assembly (12) is **characterized by** comprising a coil (16), a core (17), and core-rotating means (18, 22, 23), the core (17) being collinear with a coil axis (100), the core (17) comprising opposed core terminals (21), the core-rotating means (18, 22, 23) having an axis of rotation (101) orthogonal to the coil axis (100), the coil (16) and core (17) both being rotatable about the axis of rotation (100) via the core-rotating means (18, 22, 23) such that both the coil (16) and the core (17) rotate, the coil axis (100) thereby being rotatively displaceable intermediate X-shaped planar boundaries (103);

   the opposed pairs of opposed magnets (13) being respectively and fixedly positioned adjacent the core terminals (21), the core terminals (21) being respectively displaceable intermediate the pairs; and

   wherein the switch assembly is **characterized by** comprising linkage means (14, 14(a)) and opposed contact-spring assemblies (15, 11, 31), the linkage means (14, 14(a)) interconnecting the core terminals (21) and contact-spring assemblies (15, 11, 31), the contact-spring assemblies (15, 11, 31) comprising first and second spring arms (15) and further comprising first spring means (36), the coil (16) for creating a magnetic field, the magnetic field being directable through the core (17) into opposed magnets (13) for imparting rotation about the axis of rotation (101), the core terminals (21) for actuating the switch assembly intermediate an open position and a closed position, the closed position for enabling current to pass through the switch assembly, the first spring means (36) for damping contact vibration when switching from the open position to the closed position.

2. The electromagnetic relay assembly of claim 1 wherein the contact-spring assemblies (15, 11, 31) comprise second spring means (37), the second spring means (37) for enhancing damped contact vibration when switching from the open position to the closed position.

3. The electromagnetic relay assembly of claim 2 wherein the first and second spring means (36, 37) are spaced from one another for providing spaced damping means (36, 37), the spaced damping means (36, 37) for enhancing damped contact vibration when switching from the open to closed positions.

4. The electromagnetic relay assembly of claim 3 wherein the switch assembly comprises opposed sets of paired contacts (31), the opposed sets of paired contacts (31) each being positioned intermediate the spaced damping means (36, 37), the spaced damping means (36, 37) thus providing laterally opposed damping means for each opposed set of paired contacts (31) for enhancing damped contact vibration when switching from the open to closed positions.

5. The electromagnetic relay assembly of claim 1 wherein the first and second spring arms (15) are parallel and comprise opposed arm faces (40), the opposed arm faces (40) being magnetically attracted to one another during a short circuit scenario, the magnetically attracted arm faces (40) for maintaining

the switch assembly in the closed position during the short circuit scenario.

6. The electromagnetic relay assembly of claim 1 wherein the opposed magnets (13) comprise opposed magnet faces (29), the opposed magnet faces (29) being substantially planar and extending in intersecting planes (102), the core terminals (21) having substantially planar opposed core faces (30), the core faces (30) and magnet faces (29) being similarly angled when contacting one another, the similarly angled core and magnet faces (30, 29) for enhancing current flow through contacting surface area intermediate the core and magnet faces (30, 29).

Patentansprüche

1. Elektromagnetische Relaisanordnung (10, 20), wobei die elektromagnetische Relaisanordnung (10, 20) eine Spulenanordnung (12), entgegengesetzte Paare entgegengesetzter Magnete (13) und eine Schalteranordnung umfasst,

   wobei die Spulenanordnung (12) **dadurch gekennzeichnet ist, dass** sie eine Spule (16), einen Kern (17) und Kerndrehmittel (18,22,23) umfasst, wobei der Kern (17) mit einer Spulenachse (100) kollinear ist, der Kern (17) entgegengesetzte Kernmpole (21) umfasst, die Kerndrehmittel (18, 22, 23) eine zur Spulenachse (100) orthogonale Drehachse (101) aufweisen, die Spule (16) und der Kern (17) beide über die Kerndrehmittel (18, 22, 23) um die Drehachse (100) drehbar sind, sodass sich sowohl die Spule (16) als auch der Kern (17) drehen, und die Spulenachse (100) dadurch zwischen X-förmigen ebenflächigen Grenzen (103) drehend verschiebbar ist;
   wobei die entgegengesetzten Paare entgegengesetzter Magnete (13) fest den jeweiligen Kernpolen (21) benachbart positioniert sind, wobei die Kernpole (21) zwischen den jeweiligen Paaren verschiebbar sind; und
   wobei die Schalteranordnung **dadurch gekennzeichnet ist, dass** sie Gestängemittel (14, 14(a)) und entgegengesetzte Kontakt-Feder-Anordnungen (15, 11, 31) umfasst, wobei die Gestängemittel (14,14(a)) die Kernpole (21) und die Kontakt-Feder-Anordnungen (15, 11, 31) miteinander verbinden, wobei die Kontakt-Feder-Anordnungen (15, 11, 31) einen ersten und einen zweiten Federarm (15) umfassen und weiter erste Federmittel (36) umfassen, wobei die Spule (16) zum Erzeugen eines Magnetfelds dient, wobei das Magnetfeld durch den Kern (17) in entgegengesetzte Magnete (13) gerichtet werden kann, um Drehung um die Drehachse (101) zu bewirken, wobei die Kernpole (21) zum Betätigen der Schalteranordnung zwischen einer offenen Stellung und einer geschlossenen Stellung dienen, wobei die geschlossene Stellung dazu dient, zuzulassen, dass Strom durch die Schalteranordnung gelangt, wobei die ersten Federmittel (36) zum Dämpfen von Kontaktschwingungen beim Schalten von der offenen Stellung in die geschlossene Stellung dienen.

2. Elektromagnetische Relaisanordnung nach Anspruch 1, wobei die Kontakt-Feder-Anordnungen (15, 11, 31) zweite Federmittel (37) umfassen, wobei die zweiten Federmittel (37) zum Verbessern gedämpfter Kontaktschwingungen beim Schalten von der offenen Stellung in die geschlossene Stellung dienen.

3. Elektromagnetische Relaisanordnung nach Anspruch 2, wobei die ersten und die zweiten Federmittel (36,37) voneinander beabstandet sind, um beabstandete Dämpfungsmittel (36, 37) bereitzustellen, wobei die beabstandeten Dämpfungsmittel (36, 37) zum Verbessern gedämpfter Kontaktschwingungen beim Schalten von der offenen in die geschlossene Stellung dienen.

4. Elektromagnetische Relaisanordnung nach Anspruch 3, wobei die Schalteranordnung entgegengesetzte Sätze gepaarter Kontakte (31) umfasst, wobei die entgegengesetzten Sätze gepaarter Kontakte (31) jeweils zwischen den beabstandeten Dämpfungsmitteln (36, 37) positioniert sind, wobei die beabstandeten Dämpfungsmittel (36, 37) so in Querrichtung entgegengesetzte Dämpfungsmittel für jeden entgegengesetzten Satz gepaarter Kontakte (31) zum Verbessern gedämpfter Kontaktschwingungen beim Schalten von der offenen in die geschlossene Stellung bereitstellen.

5. Elektromagnetische Relaisanordnung nach Anspruch 1, wobei der erste und der zweite Federarm (15) parallel sind und entgegengesetzte Armoberflächen (40) umfassen, wobei die entgegengesetzten Armoberflächen (40) während eines Kurzschlussszenarios magnetisch aneinander angezogen werden, wobei die magnetisch angezogenen Armoberflächen (40) zum Halten der Schalteranordnung in der geschlossenen Stellung während des Kurzschlussszenarios dienen.

6. Elektromagnetische Relaisanordnung nach Anspruch 1, wobei die entgegengesetzten Magnete (13) entgegengesetzte Magnetoberflächen (29) umfassen, wobei die entgegengesetzten Magnetoberflächen (29) im Wesentlichen ebenflächig sind und sich in einander schneidenden Ebenen (102) erstrecken, wobei die Kernpole (21) im Wesentlichen

ebenflächige entgegengesetzte Kernoberflächen (30) aufweisen, wobei die Kernoberflächen (30) und die Magnetoberflächen (29) ähnlich schräggestellt sind, wenn sie einander berühren, wobei die ähnlich schräggestellten Kern- und Magnetoberflächen (30, 29) zum Verbessern des Stromflusses durch die Kontaktfläche zwischen dem Kern- und den Magnetoberflächen (30, 29) dienen.

Revendications

1. Ensemble de relais électromagnétique (10, 20), l'ensemble de relais électromagnétique (10, 20) comprenant un ensemble bobine (12), des paires opposées d'aimants opposés (13) et un ensemble commutateur,
dans lequel l'ensemble bobine (12) est **caractérisé en ce qu'**il comprend une bobine (16), un noyau (17), et un moyen de rotation de noyau (18, 22, 23), le noyau (17) étant colinéaire avec un axe de bobine (100), le noyau (17) comprenant des bornes de noyau opposées (21), le moyen de rotation de noyau (18, 22, 23) ayant un axe de rotation (101) orthogonal à l'axe de bobine (100), la bobine (16) et le noyau (17) pouvant tous les deux être tournés autour de l'axe de rotation (100) par l'intermédiaire du moyen de rotation de noyau (18, 22, 23) de telle sorte qu'à la fois la bobine (16) et le noyau (17) tournent, l'axe de bobine (100) étant ainsi déplaçable de manière rotative entre des frontières planes en forme de X (103) ;
les paires opposées d'aimants opposés (13) étant positionnées respectivement et fixement adjacentes aux bornes de noyau (21), les bornes de noyau (21) étant déplaçables respectivement entre les paires ; et
dans lequel l'ensemble commutateur est **caractérisé en ce qu'**il comprend des moyens de couplage (14,14(a)) et des ensembles de ressorts de contact opposés (15, 11, 31), les moyens de couplage (14, 14(a)) interconnectant les bornes de noyau (21) et les ensembles de ressorts de contact (15, 11, 31), les ensembles de ressorts de contact (15, 11, 31) comprenant des premier et second bras de ressort (15) et comprenant en outre un premier moyen de ressort (36), la bobine (16) servant à créer un champ magnétique, le champ magnétique étant dirigeable à travers le noyau (17) dans des aimants opposés (13) pour conférer une rotation autour de l'axe de rotation (101), les bornes de noyau (21) servant à actionner l'ensemble commutateur entre une position ouverte et une position fermée, la position fermée permettant au courant de passer à travers l'ensemble commutateur, le premier moyen de ressort (36) servant à amortir la vibration de contact lors de la commutation de la position ouverte à la position fermée.

2. Ensemble de relais électromagnétique selon la revendication 1 dans lequel les ensembles de ressorts de contact (15, 11, 31) comprennent un second moyen de ressort (37), le second moyen de ressort (37) servant à rehausser la vibration de contact amortie lors de la commutation de la position ouverte à la position fermée.

3. Ensemble de relais électromagnétique selon la revendication 2 dans lequel les premier et second moyens de ressorts (36, 37) sont espacés l'un de l'autre pour fournir des moyens d'amortissement espacés (36, 37), les moyens d'amortissement espacés (36, 37) étant prévus pour rehausser la vibration de contact amortie lors de la commutation de la position ouverte à la position fermée.

4. Ensemble de relais électromagnétique selon la revendication 3 dans lequel l'ensemble commutateur comprend des jeux opposés de contacts pairés (31), les jeux opposés de contacts pairés (31) étant chacun positionnés entre les moyens d'amortissement espacés (36,37), les moyens d'amortissement espacés (36, 37) fournissant ainsi des moyens d'amortissement opposés latéralement pour chaque jeu opposé de contacts pairés (31) afin de rehausser la vibration de contact amortie lors de la commutation de la position ouverte à la position fermée.

5. Ensemble de relais électromagnétique selon la revendication 1 dans lequel les premier et second bras de ressort (15) sont parallèles et comprennent des faces de bras opposées (40), les faces de bras opposées (40) étant attirées magnétiquement l'une vers l'autre durant un scénario de court-circuit, les faces de bras attirées magnétiquement (40) servant à maintenir l'ensemble commutateur dans la position fermée durant le scénario de court-circuit.

6. Ensemble de relais électromagnétique selon la revendication 1 dans lequel les aimants opposés (13) comprennent des faces d'aimant opposées (29), les faces d'aimant opposées (29) étant sensiblement planes et s'étendant dans des plans d'intersection (102), les bornes de noyau (21) ayant des faces de noyau sensiblement planes opposées (30), les faces de noyau (30) et les faces d'aimant (29) étant inclinées de la même façon lorsqu'elles sont en contact les unes avec les autres, les faces de noyau et d'aimant inclinées de la même façon (30, 29) servant à rehausser le passage de courant à travers la surface de contact entre les faces de noyau et d'aimant (30,29).

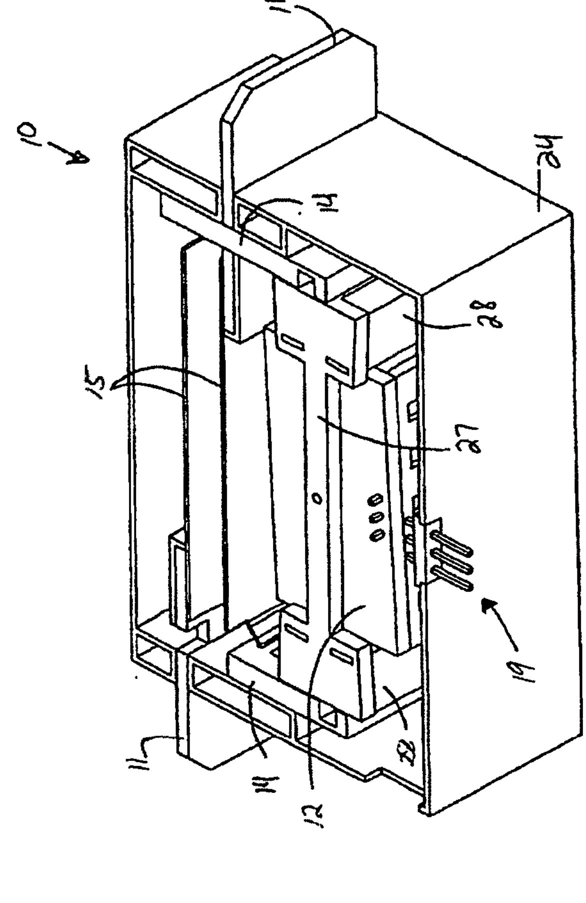

FIG. 1

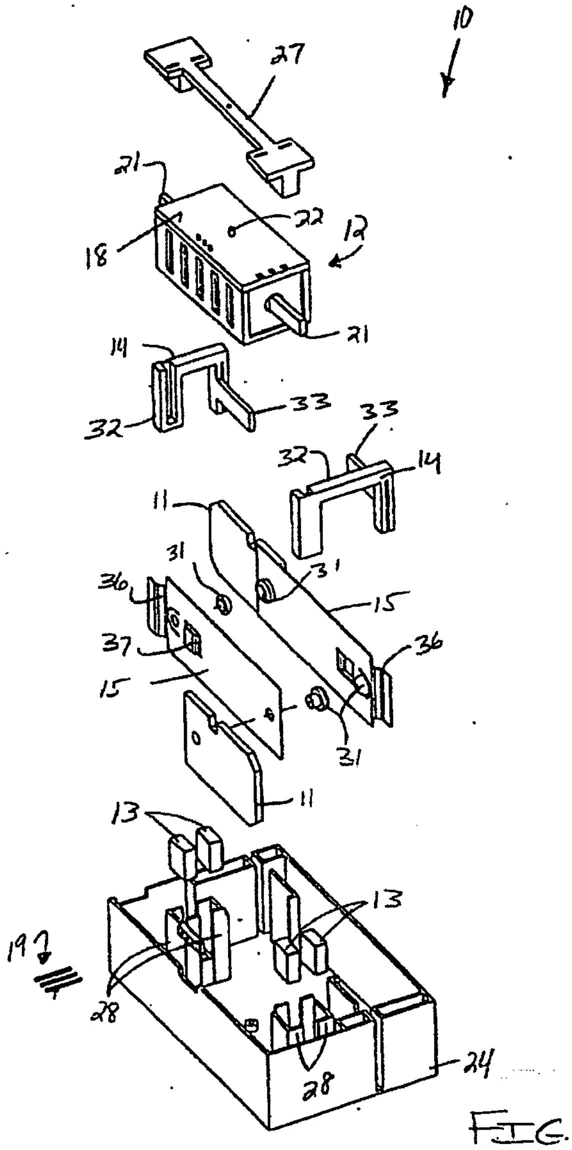
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FIG. 2

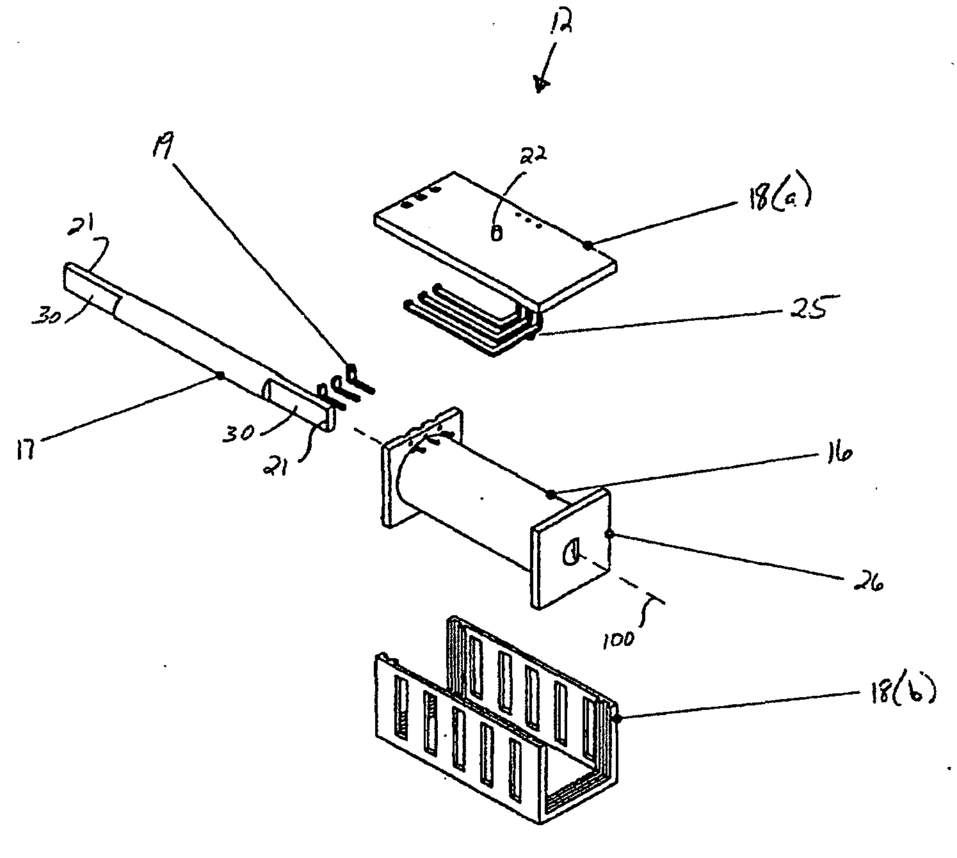
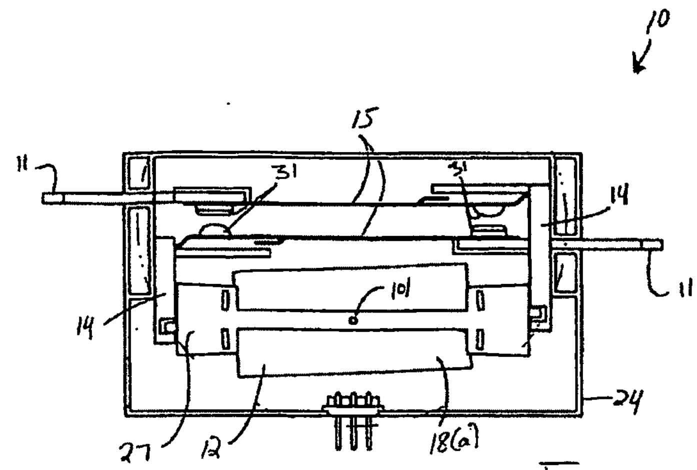


FIG. 3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31
31
14
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101
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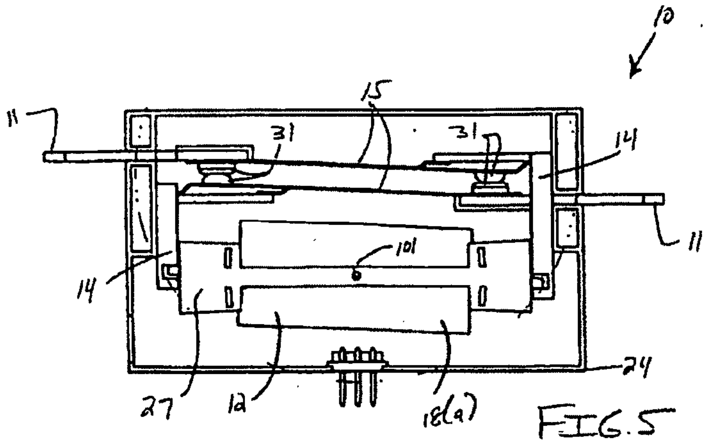
24
27
12
18(a)

FIG. 4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15
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31
31
14
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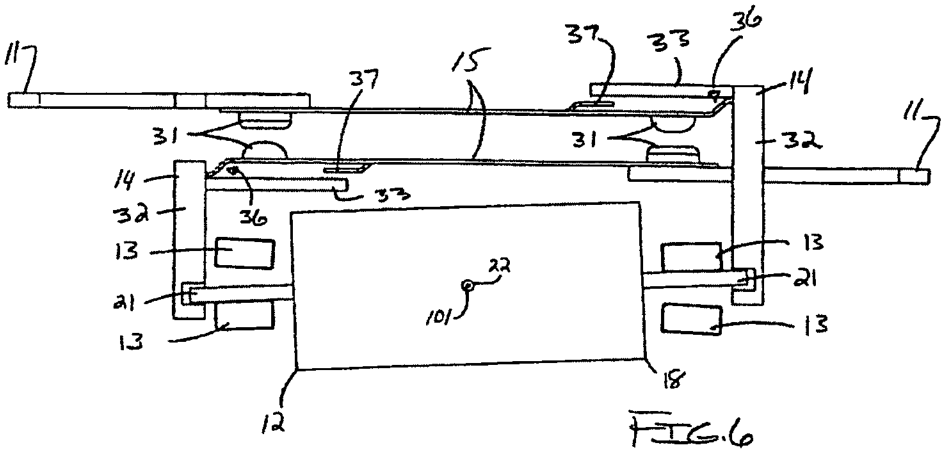
101
14
24
27
12
18(a)

FIG. 5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12

FIG.6

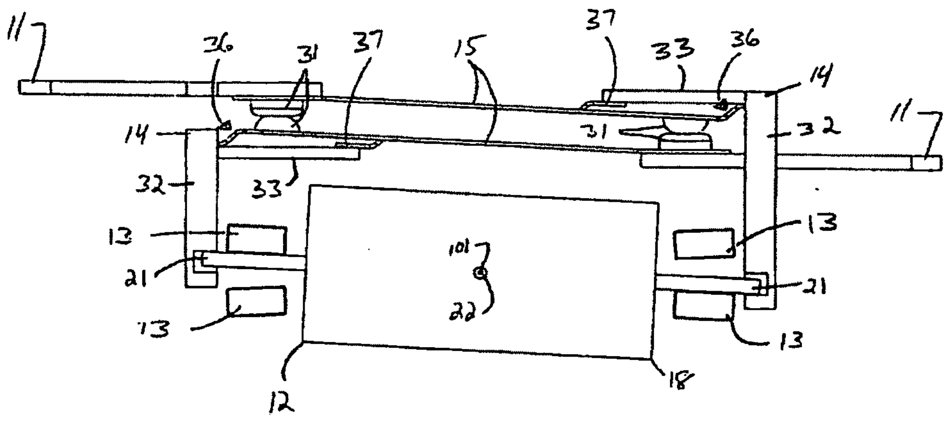
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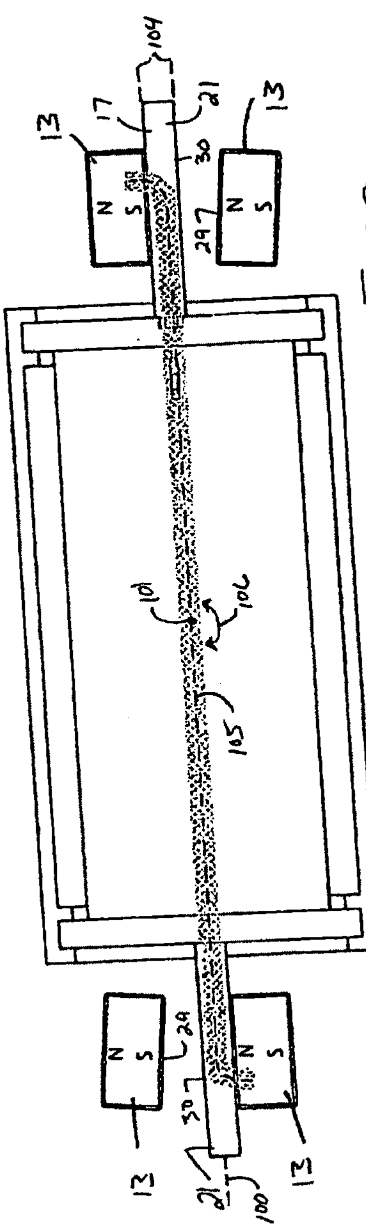
FIG.7


104
13
17
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N
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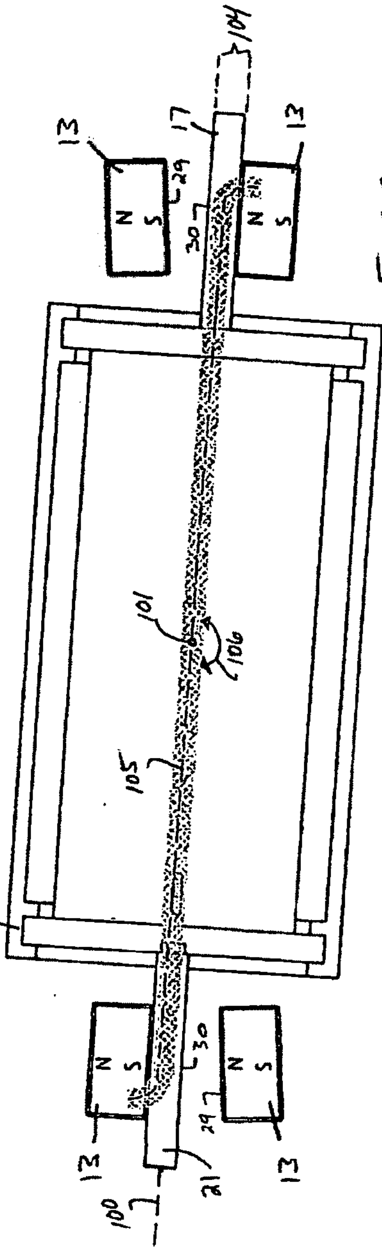
101
106
105
12
100

FIG. 8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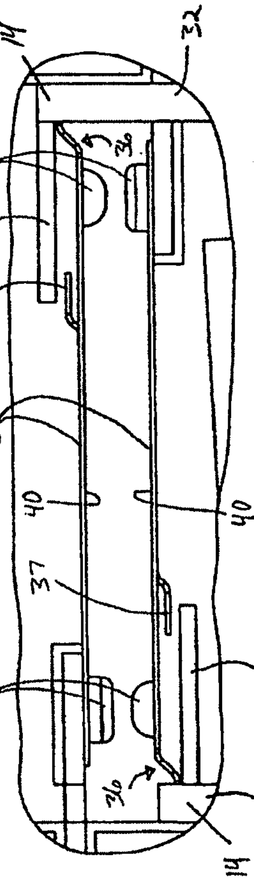
100

FIG. 9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31
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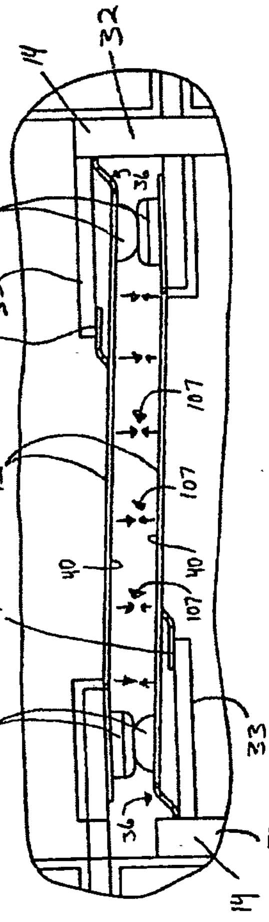
15
40
40
37
31
33
36
36
32
32
14

FIG.10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107
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40
40
107
37
31
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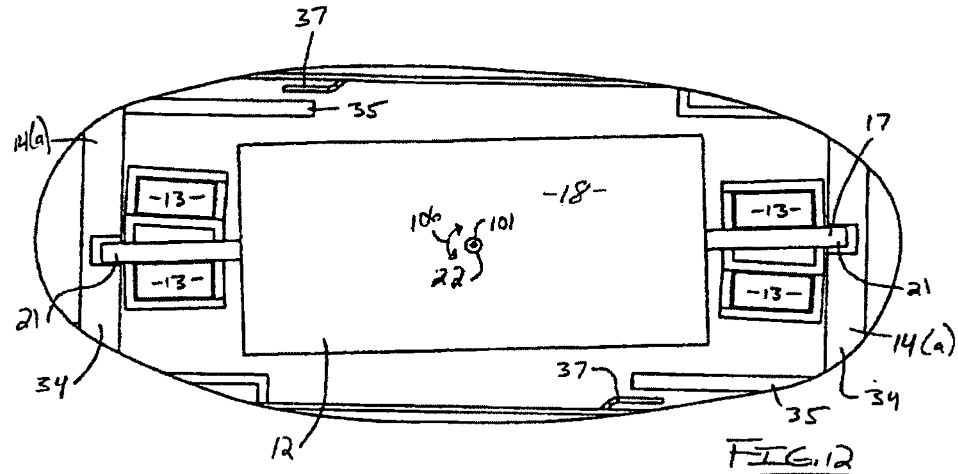
36
36
32
14

FIG.11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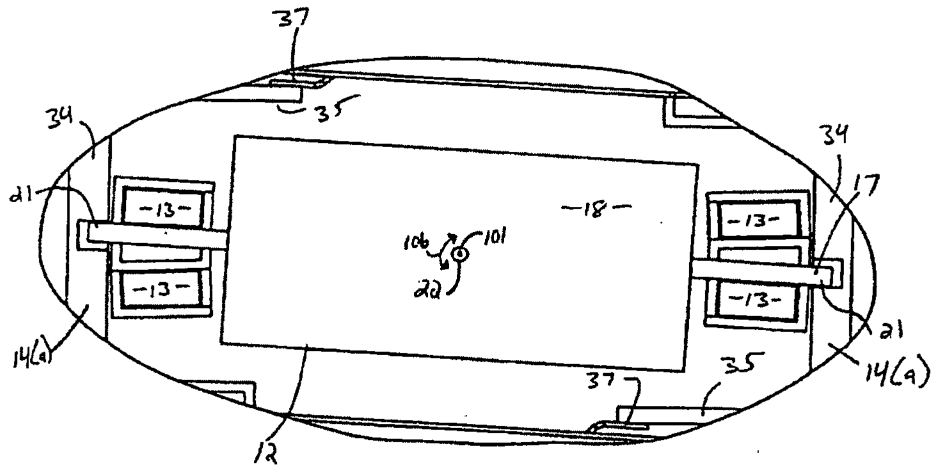
14(a)
17
-13-
-18-
106
101
22
21
34
12

FIG.12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-13-
-18-
106
101
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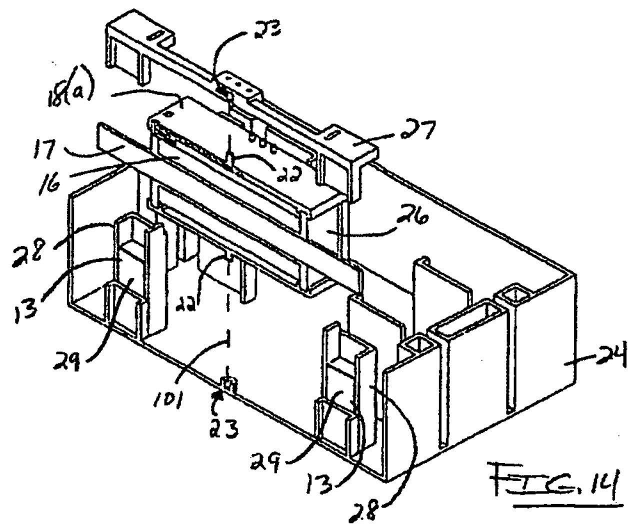
14(a)
12

FIG.13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18(a)
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101
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FIG. 14

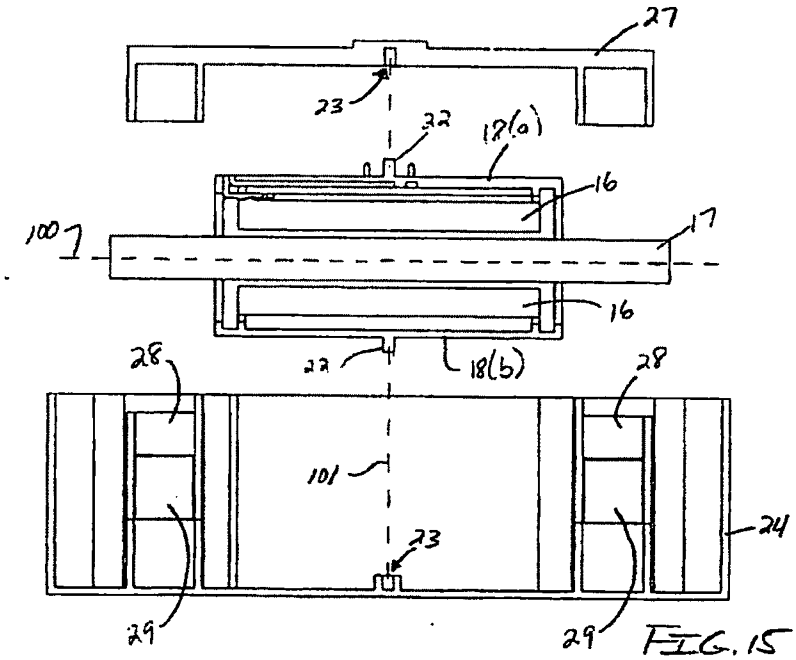
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FIG. 15

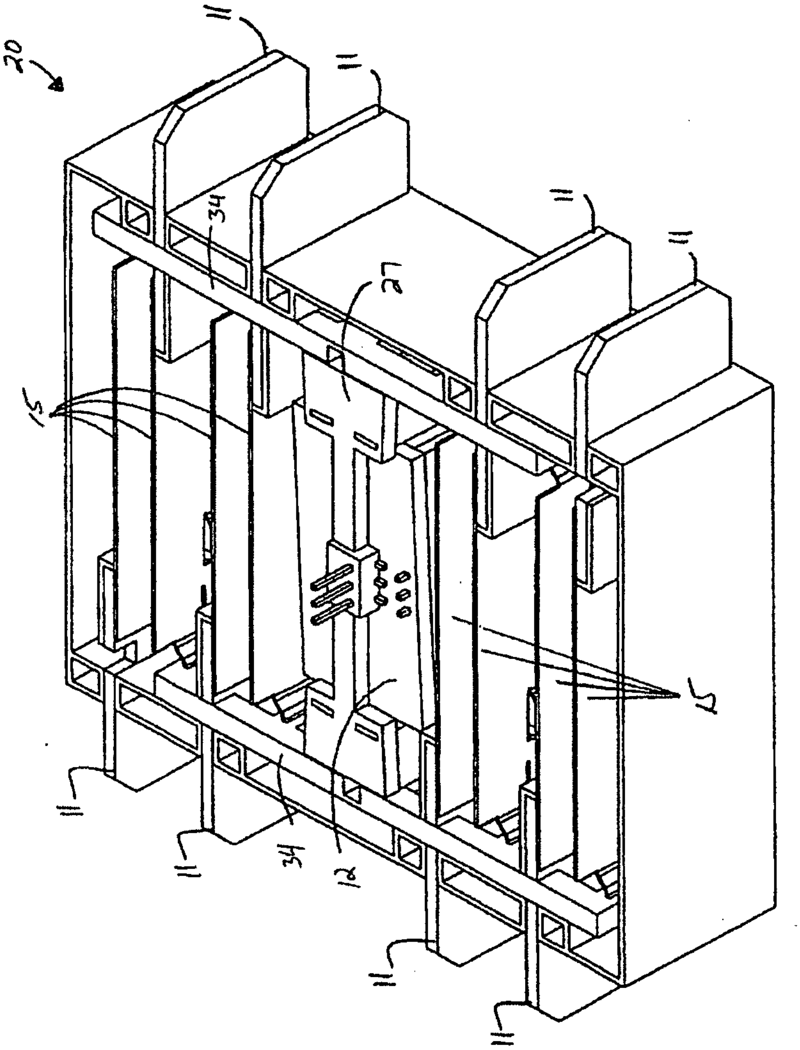


FIG.16

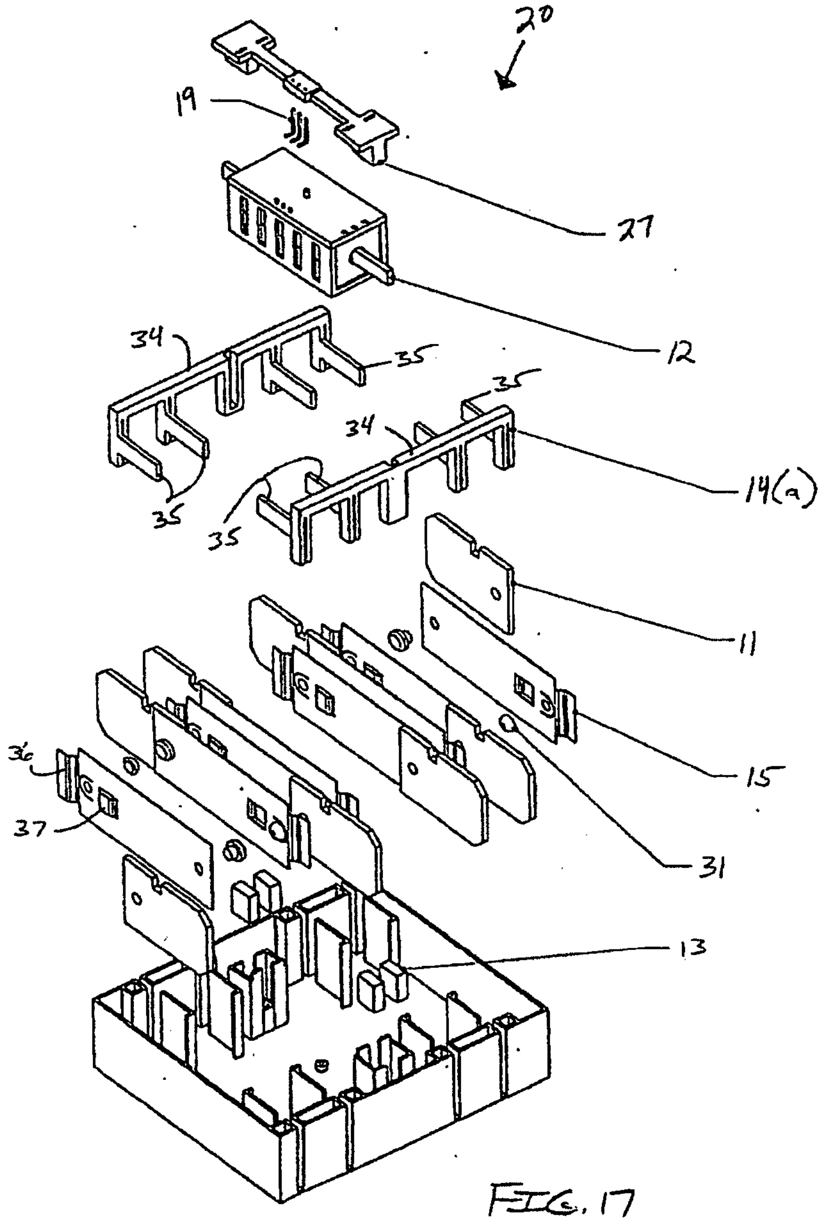
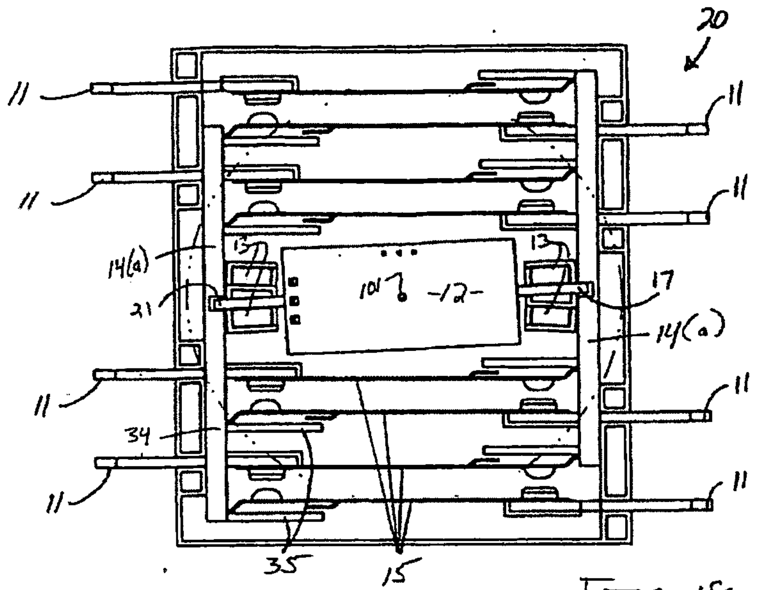


FIG. 17


20
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101
-12-
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35
15

FIG. 18

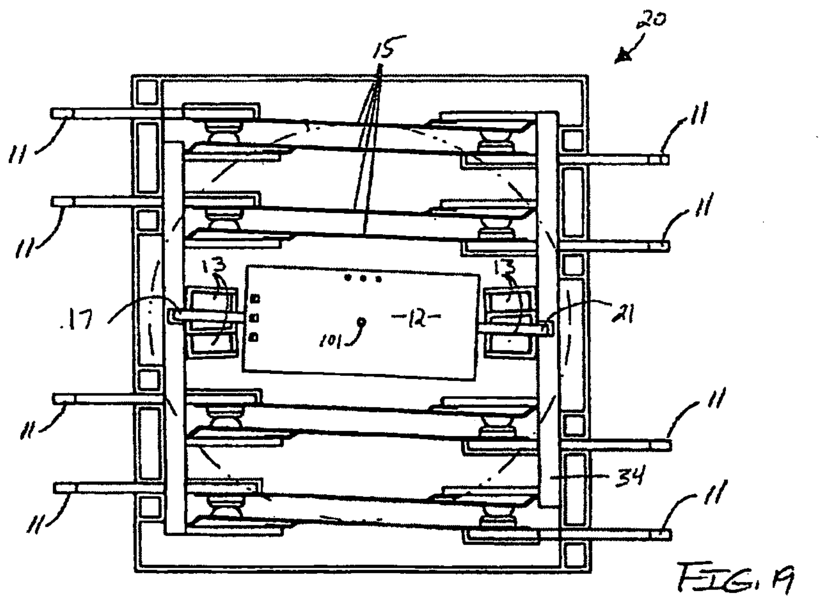
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FIG. 19

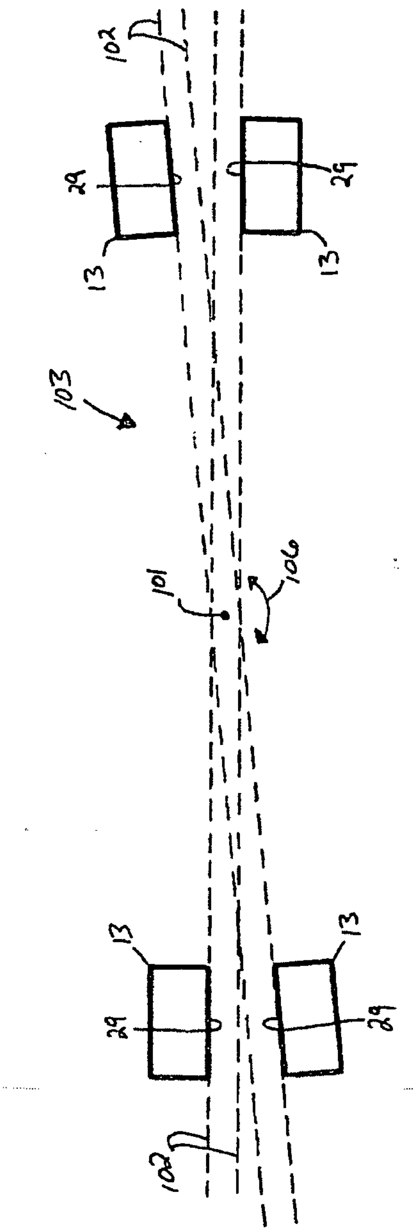

FIG. 20

REFERENCES CITED IN THE DESCRIPTION

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123095-325 ONE

Bistabil elektromágneses relé X-hajtású motorral

Szabadalmi igénypontok

1. Elektromágneses relészerkezet (10, 20), amely elektromágneses relészerkezet (10, 20) tekercsszerkezetet (12), szemközti mágnesek (13) szemközti párjait és kapcsolószerkezetet tartalmaz,

ahol a tekercsszerkezetet (12) **az jellemzi**, hogy tekercset (16), magot (17) és magforgató szerveket (18, 22, 23) tartalmaz, a mag (17) egy tekercstengellyel (100) egy vonalban van, a mag (17) szemközti magvégeket (21) tartalmaz, a magforgató szerveknek (18, 22, 23) a tekercstengelyre (100) merőleges forgástengelye (101) van, a tekercs (16) és a mag (17) a magforgató szervek (18, 22, 23) révén a forgástengely (100) körül elfordítható úgy, hogy a tekercs (16) és a mag (17) elfordul, ezáltal a tekercstengely (100) X-alakú sík határok (103) között elfordítható;

a szemközti mágnesek (13) szemközti párjai rendre a magvégek (21) közelében rögzítetten vannak elhelyezve, a magvégek (21) rendre a párok között elmozdíthatók;

ahol a kapcsolószerkezetet **az jellemzi**, hogy tartalmaz összekapcsoló elemeket (14, 14(a)) és szemközti érintkezőrugó-szerkezeteket (15, 11, 31), az összekapcsoló elemek (14, 14(a)) a magvégeket (21) és az érintkezőrugó-szerkezeteket (15, 11, 31) összekapcsolják, az érintkezőrugó-szerkezetek (15, 11, 31) első és második rugós kart (15) és első rugóelemet (36) tartalmaznak, a tekercs (16) olyan mágneses mezőt kelt, amely a forgástengely (101) körüli elfordulás kiváltásához a magon (17) át szemközti mágnesekbe (13) irányítható, a magvégek (21) a kapcsolószerkezetet nyitott helyzet és zárt helyzet között mozgatják, ahol a zárt helyzet lehetővé teszi az áramnak a kapcsolószerkezeten való áthaladását, és az első rugóelem (36) csillapítja az érintkezési rezgést a nyitott helyzetből a zárt helyzetbe történő átkapcsoláskor.

2. Az 1. igénypont szerinti elektromágneses relészerkezet, ahol az érintkezőrugó-szerkezetek (15, 11, 31) második rugóelemet (37) tartalmaznak, a második rugóelem (37) nyitott helyzetből zárt helyzetbe történő átkapcsoláskor az érintkezési rezgéscsillapítást fokozza.

3. A 2. igénypont szerinti elektromágneses relészerkezet, ahol az első és a második rugóelem (36, 37) távközzel elválasztott csillapítóelemeket (36, 37) képezőn egymástól távközzel van elválasztva, amely távközzel elválasztott csillapítóelemek (36, 37) a nyitott helyzetből a zárt helyzetbe történő átkapcsoláskor az érintkezési rezgéscsillapítást fokozzák.

4. A 3. igénypont szerinti elektromágneses relészerkezet, ahol a kapcsolószerkezet párosított érintkezők (31) szemközti csoportjait tartalmazza, amely párosított érintkezők (31) szemközti csoportjai a távközzel elválasztott csillapítóelemek (36, 37) között vannak elhelyezve, ezáltal a távközzel elválasztott csillapítóelemek (36, 37) oldalirányban szemközti csillapítóelemeket képeznek a párosított érintkezők (31) egyes szemközti csoportjai számára a nyitott helyzetből a zárt helyzetbe történő átkapcsoláskor az érintkezési rezgéscsillapítás fokozásához.

5. Az 1. igénypont szerinti elektromágneses relészerkezet, ahol az első és a második rugókar (15) egymással párhuzamos és szemközti karfelületekkel (40) rendelkeznek, amely szemközti karfelületek (40) rövidzárlat esetén egymást mágnesesen vonzzák, a mágnesesen vonzott karfelületek (40) a kapcsolószerkezetet rövidzárlat esetén zárt helyzetben tartják.

6. Az 1. igénypont szerinti elektromágneses relészerkezet, ahol a szemközti mágnesek (13) szemközti mágnesfelületekkel (29) rendelkeznek, amely szemközti mágnesfelületek (29) lényegében síkok és egymást metsző síkokban (102) terjednek, a magvégeknek (21) lényegében sík szemközti magfelületei (30) vannak, a magfelületek (30) és mágnesfelületek (29) az egymással való érintkezésükkor hasonló szögben állnak, a hasonló szögben álló mag- és mágnesfelületek (30, 29) a mag- és mágnesfelületek (30, 29) közötti érintkező felszínen átfolyó áramerősséget fokozzák.