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(54) Electromagnetic relay

(57) An electromagnetic relay in which an asymmetrically-shaped armature (6) is tiltingly mounted about a U-shaped magnetic yoke structure (15) and pivoting about two shoulder lateral surfaces on one arm (15a) of the magnetic yoke. The tilting mechanism allows the mechanical friction generated during relay reclosings to be directed to the lateral surfaces and prolongs the life of the relay. A permanent magnet is incorporated in an interior location of the U-shaped magnetic yoke and attached to one arm of the yoke, in a position near and parallel to the bottom centre arm of the U-shape. A support clamp (7) is mounted on one arm of the magnetic yoke to support the armature in its tilting position. A mechanical damper in the form of a sheet cover is mounted over the armature to transfer the stress associated with the reclosing of relay circuit away from the polar contact surfaces. A flap cover is provided to facilitate the assembly of the relay resetting mechanism (21) in the form of a pivot, allowing the pivot to be inserted through an aperture in the flap cover, and the whole flap assembly is snap-fittingly mounted on the relay.

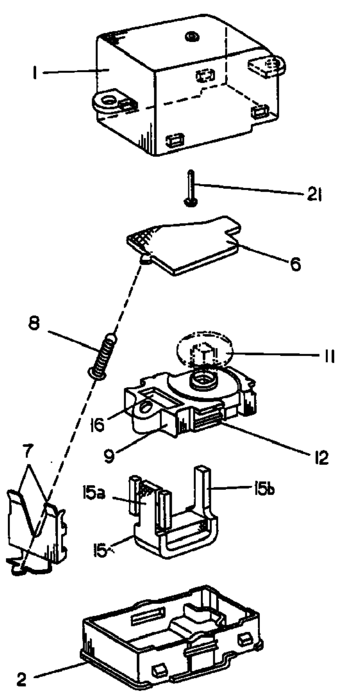

FIG. 1

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Description

[0001] This invention relates to relays generally, and more specifically, to electromagnetic relays with tilting armatures.

[0002] Functional control of electric circuits is customarily accomplished with automatic mechanisms of various kinds, among which are relays, with which it is possible to establish a variety of operating functions in automatic or semiautomatic operation. Electromagnetic trip relays operate by means of which circuits are automatically opened in case of faults such as accidental leakage of current, to prevent damage to other connected devices if the circuits remain active.

[0003] Relays employing tilting armatures are known, for example, from EP Published Patent Application No. 643410. As set forth therein, such a relay is encased in a housing cover having an aperture at the top through which an actuating pivot is inserted. The relay includes a magnetic core formed by a coil wrapped about a coil bobbin in concentric with an electromagnet core. The core is one of the two arms of a U-shaped electromagnet yoke with a permanent magnet attached to the bottom of the yoke. An armature is tiltingly mounted above the magnet yoke, pivoting about an anchor shaft integrally welded onto it. The permanent magnet creates a magnetic circuit keeping the armature on the U-shaped electromagnet yoke. When the electromagnet is activated by current flowing through the coil, it creates an opposing magnetic circuit that cancels out the action of the permanent magnet, thus the armature is allowed to tilt away from the U-shaped electromagnet yoke by the operation of a spring. Once the relay is deactivated and the current is gone, a pivot is actuated to reclose the armature, thrusting it into contact with the electromagnet again.

[0004] Since the permanent magnet is attached to the bottom center arm of the magnetic yoke and external to the yoke, it means that an intermediate air gap is present through which some of the magnetic flux of the magnet is lost making it necessary to use a high power magnet. High power magnets on the order of 100 μVA are often required to obtain the magnetic force necessary to maintain the armature against the action of the spring acting in the opposing direction.

[0005] The presence of foreign particles in miniature relays is one of the major causes of relay malfunctions. Therefore, in tilting armature relays, designers have attempted to minimize the friction created at the polar contact surfaces to lessen contamination in the relay by reducing the amount of abrasion-caused contaminants, thus prolonging the life of the relay. It is also critical in the assembly of relays to reduce contaminants from the open air from entering. However, in the construction of the relay as described above, when the relay is faced up for the mounting of the cover and actuating pivot, dirt and foreign particles can enter the relay. Besides the objective of prolonging the relay life, designers also consider other factors, such as finding ways to reduce material costs as well as to simplify the assembly to reduce labor and manufacturing costs.

[0006] It is therefore a object of the invention to overcome the aforementioned problems as well as to provide an improved electromagnetic relay that is less costly and simple to assemble, and making much more effective use of the action of the permanent magnet in its operation.

[0007] In keeping with this object and others which will become apparent hereafter, one feature of the invention resides in an electromagnetic relay with a permanent magnet incorporated in an interior location of the U-shaped yoke and attached to one arm of the yoke, particularly by soldering to an arm of said U-shaped part, in a position near and parallel to the bottom center arm of the U-shape.

[0008] Another novel feature of the present invention is an electromagnetic relay with the mechanical contact surface being separate from the magnetic contact surface to lessen the polar surface wear due to friction. The top surface of the free arm of the magnetic yoke is mechanically separated into a central polar surface and two lateral surfaces. The armature is tiltingly mounted above the magnetic yoke and pivoting about the two lateral surfaces, directing the flux conduction to the central surface and the mechanical friction to the side surfaces. A novel support clamp with inclined projecting shoulders is mounted on the free arm of the magnetic yoke for relieving some of the reclosing stress from the armature and providing support to the armature. The present invention further reduces material and assembly costs with the armature surfaces being easily identified with an asymmetrical shape, thus requiring only one side to be surface-treated and helping assembly workers easily identify the treated side.

[0009] Another novel feature of the present invention is a mechanical damper in the form of a thin sheet mounted above the armature to transfer the stress associated with the reclosing of circuit away from the polar contact surfaces.

[0010] Yet another novelty of the relay of the present invention is a flap for the external assembly of the actuating pivot, thus greatly reducing the chances for foreign particles to enter the relay during assembly. The flap assembly with an aperture at the top for the insertion of the pivot, snaps click onto a depression on the cover of the relay, allowing the pivot to be assembled after the installation of the relay housing cover.

[0011] The novel features which are considered to be characteristic of the invention are set forth in the appended claims. The invention itself together with additional objects and advantages thereof, will be best understood from the following description of the preferred embodiments when read in connection with the accompanying drawings.

[0012] Referring now to the drawings wherein like elements are numbered alike in the several Figures:

Figure 1 is an exploded perspective view of the assembly of the relay in accordance to one preferred embodiment the present invention.

Figure 2A shows a perspective view and Figures 2B and 2C show two side views of the magnetic yoke of the relay in Figure 1.

Figures 3A and 3B are perspective views representing possible embodiments of the yoke having an orifice or recess in the bottom center arm of the U-shape.

Figure 4A is a perspective view of the clamp device and Figures 4B and 4C show the various view forms of the clamp device.

Figure 5 is a perspective view showing the armature positioned in relation to the magnetic yoke.

Figure 6 is a perspective view showing the cover flap and its snap-fit relation with the housing cover of the relay.

Figure 7 is a side view of the U-shaped yoke and permanent magnet in prior art.

Figure 8 is a side view of the relay in its de-energized state.

Figure 9 is a side view of the relay in its energized state.

Figure 10 is a side view of the relay according to a second preferred embodiment of the invention with a novel damper system, showing the relay in its de-energized state.

Figure 11A is a perspective view of the leaf cover.

Figure 11B is a top view showing the armature positioned in relation to the leaf cover.

Figures 12A, 12B, and 12C are side views showing how the damper mechanism operates.

[0013] Figure 1 is an exploded perspective of the relay according to the first embodiment of the present invention, showing a relay including a housing cover 1, closed off by a snap-fit base 2. The magnetic circuit of the relay as seen comprises a U-shaped yoke 15 of a soft magnetic material, to which a permanent magnet 18 is attached (not shown in Figure 1). One arm 15b of the yoke is encased in bobbin 11, around which a winding coil is wound, forming a coil core 10. The other arm of the yoke, the free arm 15a, passes through an opening 16 in a support base 9, encasing the bottom of the magnetic yoke in the support base 9. The top surface of arm 15a is mechanically indented with two notches, dividing the top polar surface of the free arm into a center polar surface and two shoulder or lateral surfaces. An armature 6 is mounted directly over the magnet yoke and tiltingly pivoting about the two shoulder surfaces of the free arm 15a of the magnetic yoke. Both the armature 6 and the yoke 15 are made out of a "soft" magnetic material.

[0014] The geometry of the armature 6 lends itself to a further advantage of the invention. It has proved economical to surface treat or to provide a higher-quality treatment to only one side of the armature, the side facing and contacting the magnetic core. In this first embodiment, the armature has an asymmetrical shape to enable assemblers to quickly and almost automatically identify the treated side. However, the invention should not be limited to this construction. Alternatively, the armature may have distinguishing characteristics to mark its surfaces to enable assemblers to quickly and automatically identify its sides to correctly assemble the armature into the relay.

[0015] In the first embodiment, the armature 6 is an asymmetrically paddle-shaped plate with a broad end and a narrow end, with the broad end overlapping the two lateral shoulders of the yoke and the narrow end overlapping the coil core 10 when the magnetic circuit is de-activated. (See Figure 5, showing the armature positioned in relation to the magnetic yoke.) When the magnetic circuit is activated by a supply of current to the coil, the armature tilts under the tension force of spring 8 with one end of the spring 8 being hooked on a projection arm at the broad end of the armature 6, and the other end of the spring 8 being hooked on a clamp device 7 mounted on the free arm 15a of the magnetic yoke. The spring 8 tends to tilt the armature 6 in the direction of opening or separated from arm 15b.

[0016] Figures 2A, 2B and 2C respectively show a perspective view and two side views of the magnetic yoke 15. A permanent magnet 18 is placed between the two arms of the yoke and welded to the smaller arm 15b, forming the core of the magnetic core. The part of the yoke below the magnet is known as the magnetic shunt. Permanent magnet 18 creates a circulation of magnetic flux in the path formed by the two yoke 15 and the armature 6 as shown in Figure 2B so that when the armature 6 rests on arm 15b, the magnetic action maintains the armature 6 in position against the action of spring 8.

[0017] Figures 2A and 2C also show two notches at the top surface of the free arm 15a, dividing the polar surfaces into a larger central polar surface, and two smaller lateral shoulder surfaces. During reclosing cycles of the relay, a rather large impact action is generated and absorbed by the polar surfaces of the yoke 15 as well as the armature 6. Such reclosing stress is significant relieved by a clamp device 7, which is to be discussed next.

[0018] Figures 3A and 3B show two possible embodiments for the magnetic yoke 15, with an orifice or recess in the bottom center arm 15c of the U-shape. The orifice 15' can be in the form of a drill hole as in Figure 3A, or a plurality of notches as in Figure 3B. The orifice 15' permits better control of the opening of the relay, i.e., overcoming the magnetic action retaining the armature 6 resting on arm 15b and allowing the armature 6 to tilt under action of spring 8.

[0019] Figures 4A, 4B, and 4C show various views of a clamp 7 with a number of projecting side arms, allowing it to be tightly clamped around the free arm 15a of the magnetic yoke. There is an inclined projecting part

7" at one end of the clamp device 7, allowing a closed end of spring 8 to be hooked onto the clamp 7. At the opposite end of the clamp device are two inclined surfaces 7' which provide support for the armature 6. The two inclined surfaces 7' also provide another useful function, limiting the rotation of the armature 6 as well as avoiding displacement of the armature 6 caused by the traction of the spring 8 when the magnetic circuit opens.

[0020] As discussed before, one of the objects of the present inventions is to simplify the assembly to reduce labor and manufacturing costs. The open hook of the support spring in the prior art relay can be easily entangled, causing a nuisance during the assembly process. The projection parts of the armature 6 and the clamp device 7 allow the use of spring 8 with closed-end hooks, facilitating the assembly of the relay.

[0021] Another improvement in the design, as well as the assembly, of the relay is in a new flap cover 20 which minimizes the chances for foreign particles to enter the relay. Figure 6 depicts the flap cover 20 and its snap-fit relation with the housing cover 1 of the relay. The flap 20 has a center aperture 19 for the external insertion and assembly of the actuating pivot 21, allowing the housing cover 1 of the relay to be installed at an earlier stage than in the prior art. The housing cover 1 is provided with a slightly-formed depression on top of the cover with two protruding features 22 forming a snap-lock fit with the windows 23 in the flap 20. The housing cover 1 is also provided with an small open hole at the top for the pivot 21 to go through. With the flap cover 20 of the present invention, the cover 1 can be first installed with only the small hole being open and exposed at the top. Next, the pivot 21 inserted through the aperture 19 of the flap, and the flap assembly 20 with the pivot 21 is snapped onto the relay cover 1 and completing the relay assembly.

[0022] In order to further understand the advantages of the optimized design of the present invention, let first review the operating principles of a tilting-amarture type of electromagnetic relays. In these types of relays, the magnetic circuit must always provide a path for the permanent magnet's flux to go through the air gaps between the armature and the magnetic yoke. This open path A begins with one pole of the magnet, ends with the other pole, and closed by the permanent magnet. There is also another path B in the magnetic circuit of the relay for the flux generated by the flow of current in the coil, which flows through the same armature and air gaps as with path A for the relay to operate. However, path B cannot be closed by the permanent magnet as with path A. The reason being that the permanent magnet is made out of a "hard" magnetic material and has a much lower permeability than the magnetic circuit which is made out of a "soft" magnetic material. Therefore, another secondary circuit C is required, which creates another problem because the permanent magnet's flux now has two paths A and C to flow instead of one like before. This means that only a certain amount of the permanent magnet's flux will be used to actually hold the armature and the yoke together. The remaining part of the permanent magnet's flux will be lost through the secondary circuit.

[0023] Figure 7 shows a prior art relay, with the permanent magnet 18 being external to the U-shaped magnetic yoke and attached to the bottom center arm 15c of the yoke. The arrangement of the permanent magnet outside of the U-shaped yoke gives rise to two magnetic circuits. Circuit C is between the permanent magnet and the center bottom arm 15c of the U-shaped part. The other circuit A runs through the U-shaped arms of the yoke and the amarture resting on the arms of the U-shape. The external arrangement of the permanent magnet means that some of the flux is lost, requiring high intensity magnet on the order of 100μVA to obtain the magnetic force necessary to maintain the armature against the tilting action of the spring.

[0024] In the present invention, the magnetic circuit of the relay is optimized with: 1) a permanent magnet being placed much closer to the armature and internal within the U-shaped yoke; and 2) an optimized U-shaped magnetic yoke with a secondary circuit having a reduced cross-section area in the form of the central polar surface of the yoke.

[0025] The permanent magnet is incorporated within the U-shaped yoke, affixed by soldering on one arm of the yoke, being near and parallel to the bottom center arm 15c. The location of the permanent magnet means that there is no air gap between the permanent magnet and the yoke, facilitating circulation of the magnetic flux without losses. Additionally, this design allows the two magnetic circuits A and B formed (see Figure 2B) to have the same direction where they coincide, whereby an optimum magnetic effect is obtained in maintaining the armature 6 in a resting position on the yoke 15 and allowing a permanent magnet of much lower intensity in the order of 30 μVA or so, compared with the prior art relay of 100 μVA or so.

[0026] The optimized design of the yoke further allows the use of a smaller and less expensive permanent magnet in the relay. Figures 8 and 9 illustrate the operation of the relay of the present invention with the optimized design. In Figure 8, the magnetic circuit is deactivated, i.e., the coil is NOT energized by a supply of current. When the coil is de-energized, the flux of the permanent magnet 18 placed within the two arms of the yoke 15, flows from one pole to another following two different paths: 1) through the bottom of the yoke 15, and 2) through the armature 6, flowing across the polar surfaces of the yoke 15 and the air gaps separating the armature 6 and the yoke 15. This flux overcomes the counterforce of spring 8 and urges the armature 6 close to the magnetic yoke 15. As the armature 6 is held close to the yoke 15 due to the force of the permanent magnet's flux, the pivot 21 is in a "withdrawn" position inside the cover 1 of the relay.

[0027] In Figure 9, the magnetic circuit is activated, i.e., the coil is energized by a supply of current. When the coil is energized, it produces an alternating magnetic flux in the magnetic circuit. This flux flows through armature 6, down one of the arms of the yoke 15, through the magnetic shunt (the part of the yoke 15 below the permanent magnet 18), and up the other arm to close the magnetic circuit. The alternating magnetic flux creates an oscillation of the flux through the air gaps between the armature 6 and the yoke 15, bringing about a similar oscillation of the magnetic force holding the armature 6 and the yoke 15 together. When the current is sufficient large, the alternating magnetic flux is created in the opposite direction of and overcoming the permanent magnet's flux, canceling out its effect and causing the magnetic force holding the armature 6 to the yoke 15 to fall below the level necessary to overcome the counterforce of the spring 8 to keep the armature 6 from tilting. The armature 6 tilts away from the magnetic yoke 15 and the tilting magnifies the air gaps between itself and the yoke 15. At that point, the reluctance in the magnetic circuit of the relay is increased and the magnetic flux in the circuit is decreased, preventing the circuit from reclosing by itself.

[0028] As the armature 6 tilts, it pushes the pivot 21 upward and forces the end of the pivot through the aperture in the cover 1 to act upon a tripping mechanism. One of the mechanisms that may employ the relay of the present invention is the tripping of a residual current circuit breaker (RCCB). In RCCBs, fault current is detected through a magnetic core, i.e., current transformer, which feeds an electromagnetic relay as in the present invention. The present invention allows the tripping of devices such as RCCBs at very low power, e.g., 30μVA, yet having all the features and stability of higher power relays while employing a much smaller and less costly magnetic core.

[0029] After the armature 6 tilts open, the relay is reclosed by an external push on the pivot 21 to force it back into the cover. As the pivot 21 is pushed back inside the cover, the armature 6 is forced against the yoke 15 until the air gaps between them are small enough to allow the permanent magnet's flux to hold the two pieces together with the armature resting on the yoke, and for the magnetic circuit to be back in its de-energized state. During the re-closing cycles of the relay, the armature 6 pivots around the edges of the two lateral and smaller polar surfaces of the yoke 15.

[0030] The titling mechanism of the present invention considerably prolongs the life of the electromagnetic relay. The design of the yoke having a top surface in contact with the armature being mechanically separated into a central polar surface and two lateral surfaces, allows the flux conduction to be directed mainly to the central polar surface with a greater surface area, and the mechanical open-close operations to be directed mainly to the lateral surfaces with smaller surface areas. Since most of the wear-and-tear caused by the open-close movements of the relay is concentrated on the two lateral surfaces, the electrical and magnetic properties of the operative magnetic polar surfaces remain little affected during the life of the relay. Additionally, the mechanical separation of the top surface of the yoke creates two notches or gaps separating the two lateral surfaces from the central polar surface, thus allowing loose particles generated from impact or friction during the open-close operations of the armature to accumulate in the notches instead of reaching the central polar surface and affecting the magnetic characteristics of the circuit.

[0031] Figure 10 is a side view showing another embodiment of the invention with a novel armature design and a damper mechanism. Figures11A and 12A show the damper in the form of a leaf cover 30, preferably made out of a metallic sheet, mounted on top of armature 6, and separating the armature from the reclosing action of the pivot 21. On the side of the leaf cover 30 facing the armature 6 is a projection arm 31, which can be attached to the sheet cover by welding or soldering. The projection arm 31 and the bend 30' at one end of the leaf cover 30 provide the force necessary to urge and restore the leaf cover 30 under the reclosing actions of the resetting pivot. The projection arm 31 and a mating cavity 32, which is a pocket in armature 6, define the touching point where the reclosing force is transmitted to the armature 6 and forcing armature 6 against the yoke 15 to reset the relay. Figure 12B is a top view showing the armature positioned in relation to the leaf cover 30. In the figure, one end of the damper cover 30 extends over the tilting end of the armature 6, allowing spring 8 to be hooked onto the end of the damper cover 30 as well as onto the projection arm of the armature 6.

[0032] In order to fully realize the advantageous features of the novel damper of the invention, it is important to review a tripping operation in a device such as a residual current device (RCD). In this operation, the dynamic energy expended by the RCD to reset the relay is about ten times the energy required to close the relay. When the relay is reset, this large amount of energy is directed to the armature to close the relay. Testing has shown that in such re-closing operations, the normal relay wear-and-tear initially appears at the polar surfaces 15a where there armature is tiltingly in contact with the magnetic yoke. After the relay has been used for a period of time and after a number of open-close operations, the wear-and-tear appears at the polar surfaces 15b above the coil core, where the energy is directed to the armature to close the relay.

[0033] The first embodiment of the present invention, with a novel tilting mechanism a the yoke design with a central surface and two lateral surfaces, minimizes the wearing at the polar surfaces 15a. The novel damper mechanism describes above relieves the stress and wearing on the remaining polar contact surface 15b. Figures 12A, 12B, and 12C show how the damper mechanism operates to relieve the polar surfaces of the yoke 15 and the armature 6 from most of the reclosing stress. After the relay is tripped, it can be re-closed by an external push on the pivot 21 to force it back into the cover. As the pivot 21 is pushed back inside the cover to reset the relay, the reclosing force is not directly transmitted to the armature 6 since the armature 6 is shielded from the pivot by the damper cover 30. The reclosing energy is instead directed to the damper cover 30, and then transmitted to the armature 6 via the touching point 32.

Claims

1. An electromagnetic relay, comprising:

    a. a housing (1) for containing the relay;
    b. a permanent magnet (18) for providing a magnetic field;
    c. a magnetic yoke (15) connected to said permanent magnet for completing a magnetic flux path, said magnetic yoke having a first arm (15a) and a second arm (15b) having a top surface, said top surface being mechanically separated into a central surface and two lateral surfaces;
    d. a relay winding (11) wrapped around the second arm (15b) of said magnetic yoke;
    e. an armature piece (6) mounted above said magnetic yoke, said armature being operated in response to said magnetic field and pivoting about said first arm (15a) of said magnetic yoke;
    f. support means (7) mounted on said first arm (15a) of said magnetic yoke providing support to said armature piece;
    g. a spring (8) mounted about an exterior side of said first arm (15a) of said magnetic yoke having a first end and second end, said first end being connected to said support means (7) and said second end being connected to said armature (6) for providing a spring force against said armature; and
    h. a resetting (21) means for resetting the relay.

2. An electromagnetic relay, comprising:

    a. a housing (1) for containing the relay;
    b. a permanent magnet (18) for providing a magnetic field;
    c. a magnetic yoke (15) connected to said permanent magnet for completing a magnetic flux path, said magnetic yoke having a first arm (15a) and a second arm (15b);
    d. a relay winding (11) wrapped around the second arm (15b) of said magnetic yoke;
    e. an armature piece (6) mounted above said magnetic yoke, said armature being operated in response to said magnetic field and tiltingly pivoting about said first arm (15a) of said magnetic yoke;
    f. a clamp (7) having a plurality of side projection arms for mounting said clamp on said first arm (15a) of the magnetic yoke and an inclined support means (7') for providing support to said armature (6) in its tilting position;
    g. a spring (8) mounted about an exterior side of said first arm (15a) of said magnetic yoke, said spring having a first and a second end, said first end being connected to said clamp (7), and said second end being connected to said armature (6) for providing a spring force against said armature (6); and
    h. a resetting means (21) for resetting the relay.

3. An electromagnetic relay, comprising:

    a. a housing (1) for containing the relay;
    b. a permanent magnet (18) for providing a magnetic field;
    c. a magnetic yoke (15) connected to said permanent magnet for completing a magnetic flux path, said magnetic yoke having a first arm (15a) and a second arm (15b);
    d. a relay winding (11) wrapped around said second arm (15b) of said magnetic yoke (15);
    e. an armature (6) mounted above said magnetic yoke (15), said armature being operated in response to said magnetic field and tiltingly pivoting about said first arm (15a) of said magnetic yoke;
    f. a support means (7) mounted on said first arm (15a) of the magnetic yoke for providing support to said armature piece in its tilting position;
    g. a spring (8) mounted about a exterior side of said first arm (15a) of said magnetic yoke (15), said spring having a first end a second end, said first end being connected to said support means (7) and said second end being connected to said armature (6) for providing a spring force against said armature;
    h. a resetting means (21) for resetting the relay; and
    i. a damper means comprising a sheet cover (30) mounted above said armature (6) separating said armature (6) from said resetting means, said sheet cover having a projection arm (31) for providing the urging and restoring force necessary to said sheet cover during resetting operations.

4. An electromagnetic relay, comprising:

    a. a housing (1) for containing the relay;
    b. a permanent magnet (18) for providing a

magnetic field;

c. a magnetic yoke (15) connected to said permanent magnet for completing a magnetic flux path, said magnetic yoke having a first arm (15a) and a second arm (15b);

d. a relay winding (11) wrapped around the second arm (15b) of said magnetic yoke;

e. an armature (6) mounted above said magnetic yoke (15) having a top surface and a bottom surface, said top and bottom surfaces having marking means for distinguishing said top and bottom surfaces, said armature being operated in response to said magnetic field and pivoting about said first arm (15a) of said magnetic yoke;

f. a support means (7) mounted on said first arm (15a) of said magnetic yoke for providing support to said armature piece;

g. a spring (8) mounted about a exterior side of said first arm (15a) of said magnetic yoke (7), said spring having a first end and a second end, said first end being connected to said support means and said second end being connected to said armature (6) for providing a spring force against said armature; and

g. a resetting means (21) for resetting the relay.

5. An electromagnetic relay, comprising:

a. a permanent magnet (18) for providing a magnetic field;

b. a U-shaped magnetic yoke (15) connected to said for completing a magnetic flux path having a first arm (15a) and a second arm (15b);

c. a relay winding (11) wrapped around the second arm (15b) of said magnetic yoke;

d. an armature (6) mounted above said magnetic yoke (15), said armature being operated in response to said electromagnetic field and pivoting about the first arm (15a) of said magnetic yoke;

e. a support means (7) for providing support to said armature;

f. a spring (8) mounted about an exterior side of said first arm (15a) of said magnetic yoke (15), said spring having a first end and a second end, said first end being connected to said support means (7) and said second end being connected to said armature (6) for providing a spring force against said armature;

g. a resetting means (21) for resetting the relay;

h. a housing (1) for containing the relay, said housing having an open top for said resetting means (21) to be inserted through; and

i. a flap cover (22) for external mounting over said open top of said housing, said flap cover having a small aperture (19) for said resetting means (21) to be inserted through.

6. An electromagnetic relay, comprising:

a. a U-shaped magnetic yoke (15) having a first arm (15a) and a second arm (15b) and a bottom center arm (15c);

b. a relay winding (11) wrapped around said second arm (15b) of said magnetic yoke;

c. a permanent magnet (18) for providing an magnetic field and located in the interior of the magnetic yoke (15) and attached to one arm of said yoke (15) in a position near and parallel to the center arm (15c) of said yoke (15);

d. an armature piece (6) mounted above said magnetic yoke (15), said armature being operated in response to said magnetic field and pivoting about the first arm (15a) of said magnetic yoke;

e. a support means (7) for providing support to said armature (6);

f. a spring (8) mounted about an exterior side of said first arm (15a) of said magnetic yoke, said spring having a first end and a second end, said first end being connected to said support means (7) and said second end being connected to said armature (6) for providing a spring force against said armature;

g. a resetting means (21) for resetting the relay; and

h. a housing (1) for containing the relay.

7. An electromagnetic relay, comprising:

a. a housing (1) for containing the relay;

b. a permanent magnet (18) for providing a magnetic field;

c. a magnetic yoke (15) connected to said permanent magnet for completing a magnetic flux path, said magnetic yoke having a first arm (15a), a second arm (15b), and a center bottom arm (15c), said center bottom arm (15c) is provided with an orifice or recess (15') defined by a center drill hole or by way of lateral notches.

d. a relay winding (11) wrapped around the second arm (15b) of said magnetic yoke;

e. an armature piece (6) mounted above said magnetic yoke (15), said armature being operated in response to said magnetic field and pivoting about the first arm (15a) of said magnetic yoke;

f. a support means (7) mounted on said first arm (15a) of said magnetic yoke for providing support to said armature piece;

g. a spring (8) mounted about a exterior side of said first arm (15a) of said magnetic yoke (7), said spring having a first end and a second end, said first end being connected to said support means and said second end being connected to said armature (6) for providing a spring force against said armature; and

h. a resetting means (21) for resetting the relay.

8. The electromagnetic relay of claims 1, 2, 3, 4, 5, 6, or 7, wherein said armature (6) is asymmetrical in shape.

9. The electromagnetic relay of claims 1, 2, 3, 4, 5, or 6, wherein the ends of said spring (8) are closed hooks.

10. The electromagnetic relay of claim 5, wherein said housing (1) and said flap cover (22) have matching male and female structures to create a snap-fit assembly.

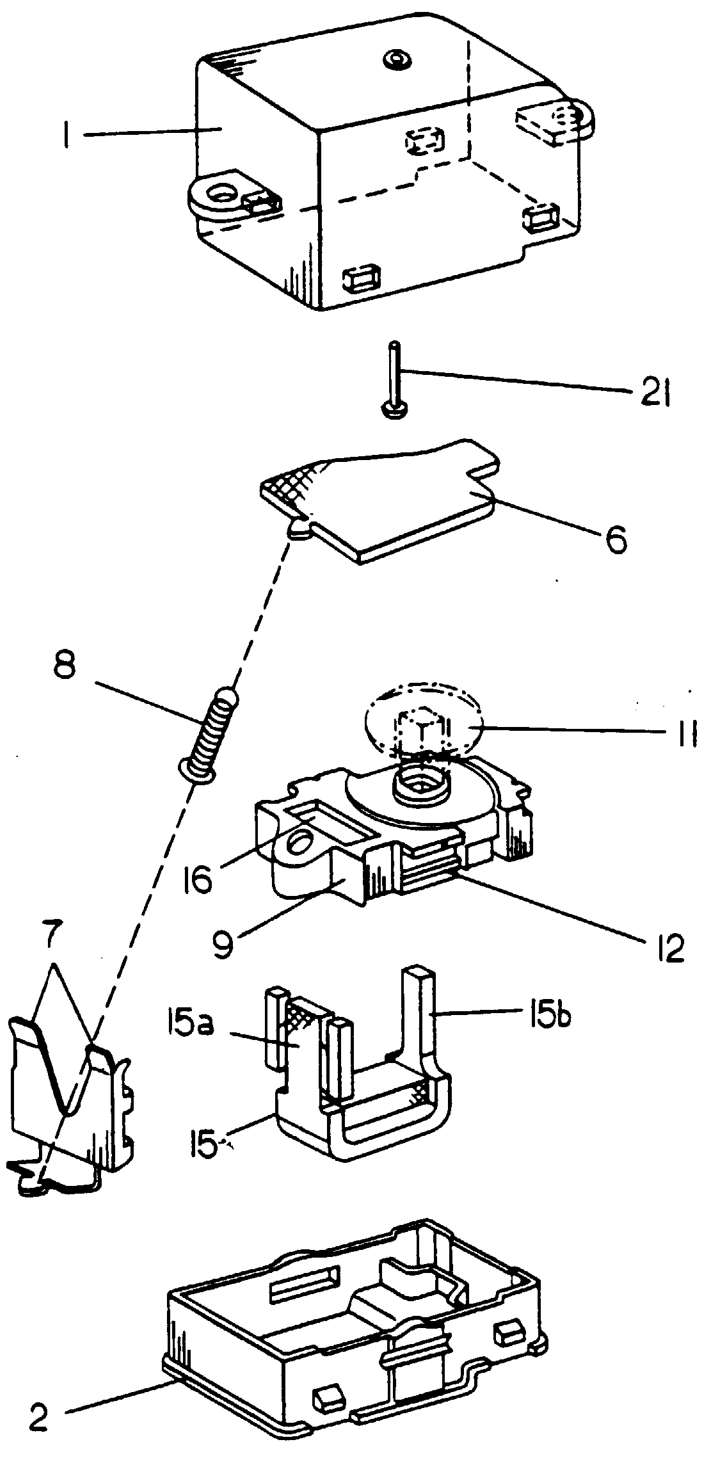

FIG. 1

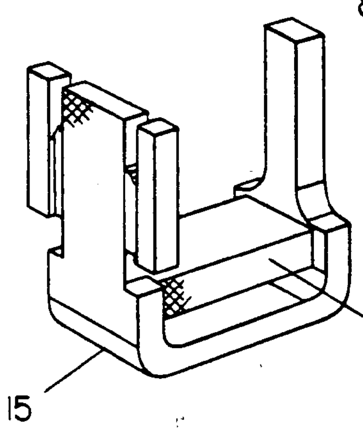

FIG. 2A

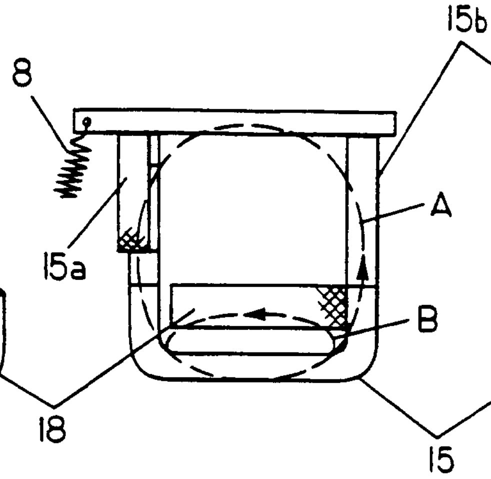

FIG. 2B

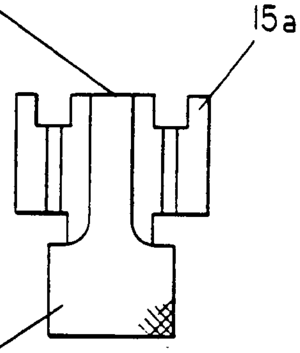

FIG. 2C

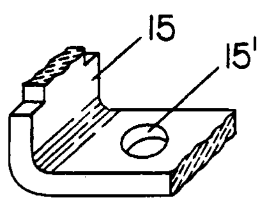

FIG. 3A

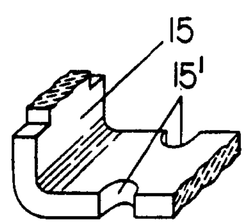

FIG. 3B

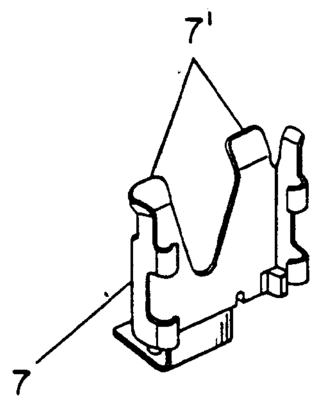

FIG.4A

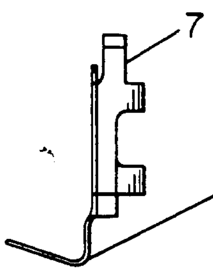

FIG.4B

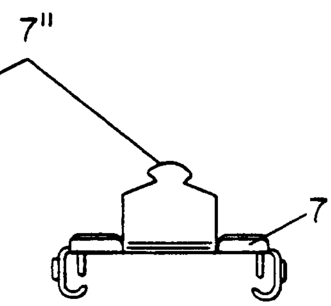

FIG.4C

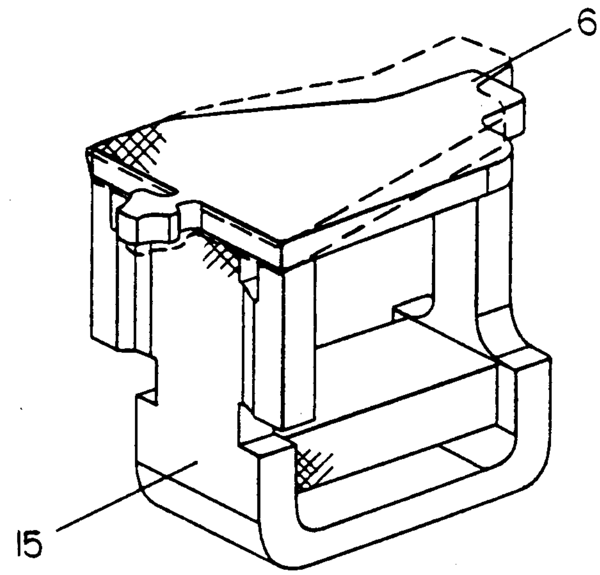

FIG. 5

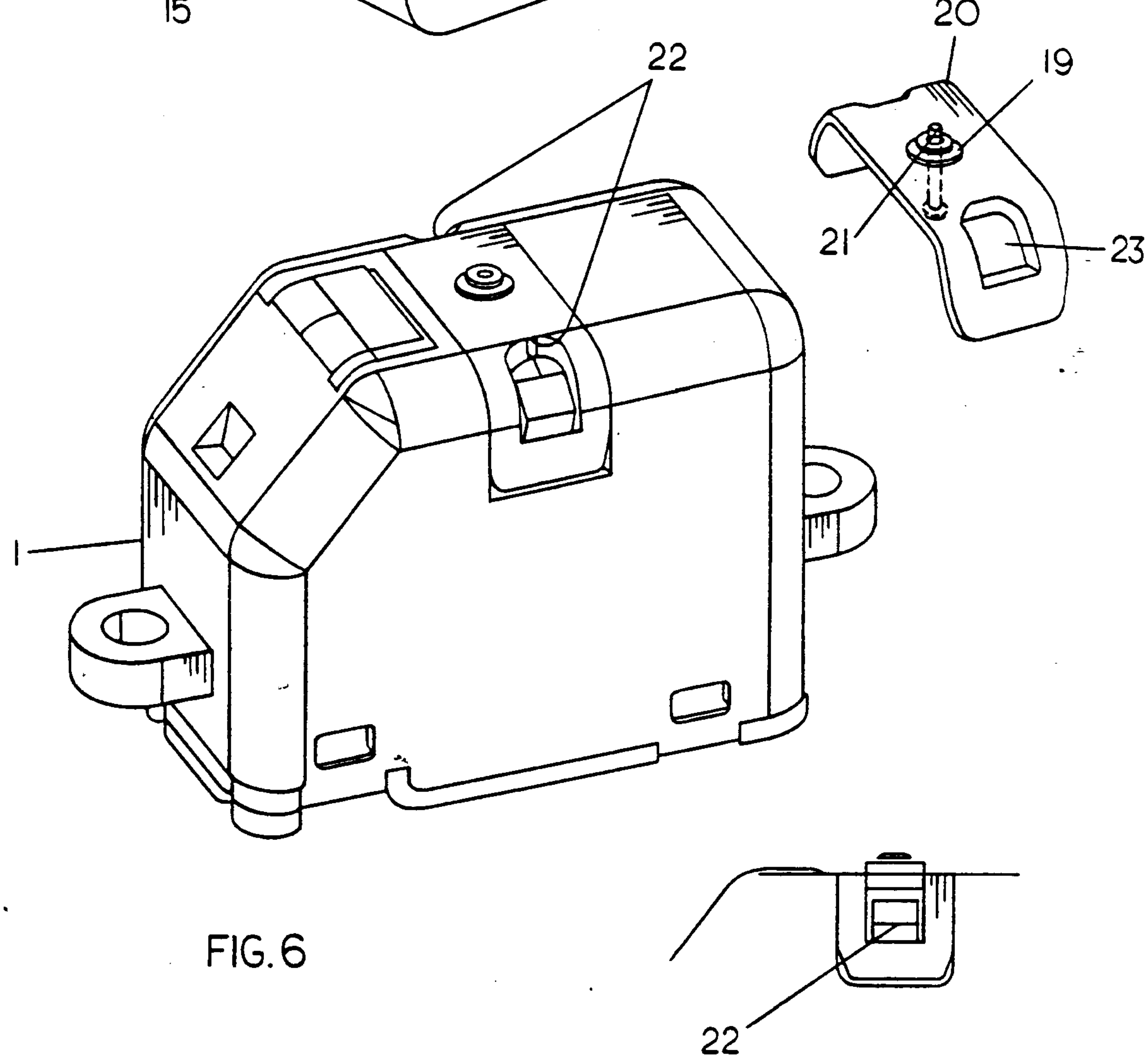

FIG. 6

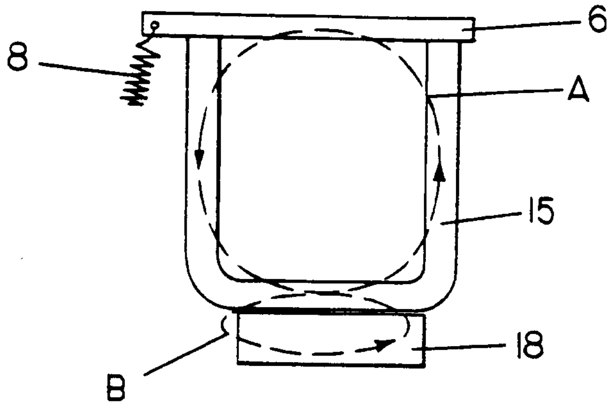

FIG. 7
(PRIOR ART)

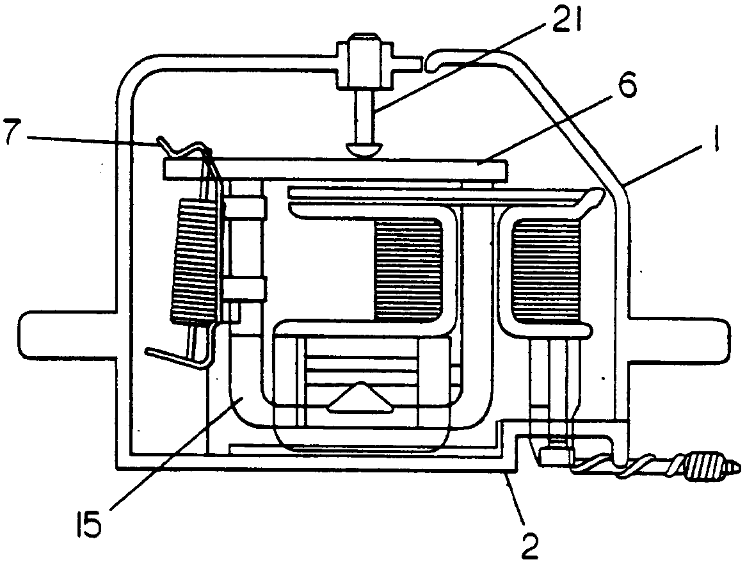

FIG. 8

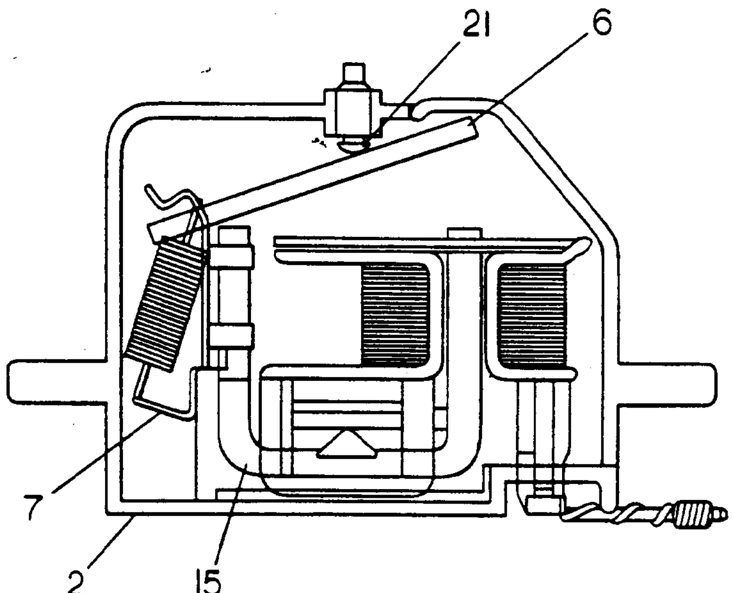

FIG. 9

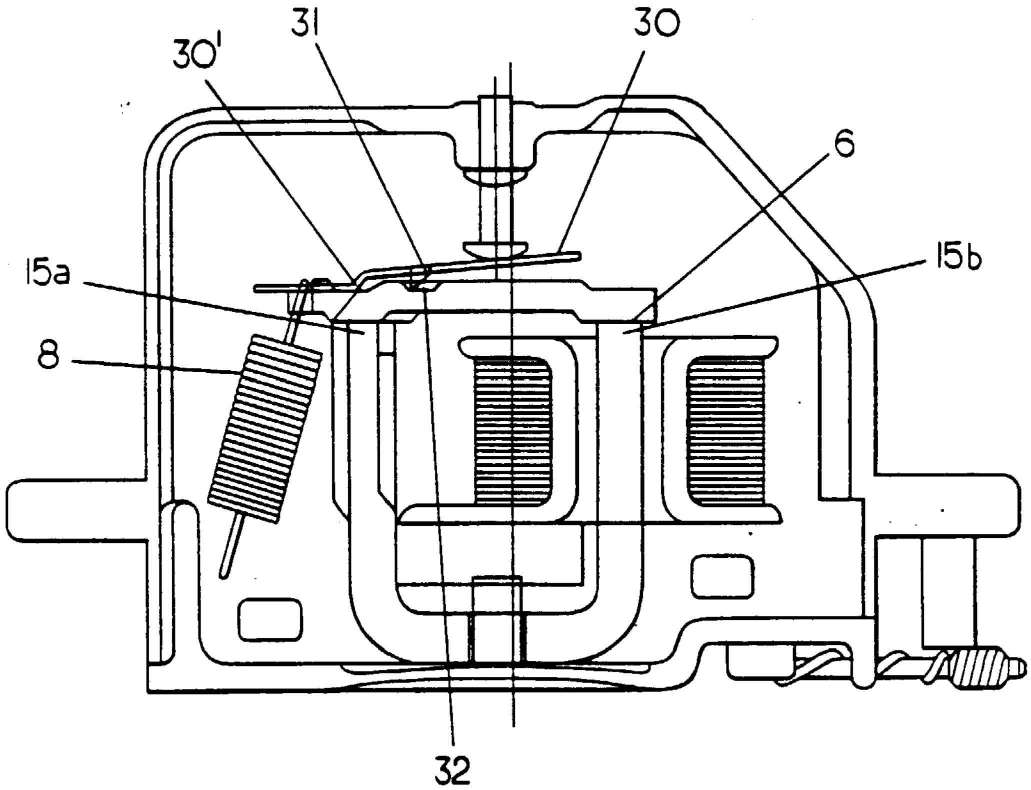

FIG. 10

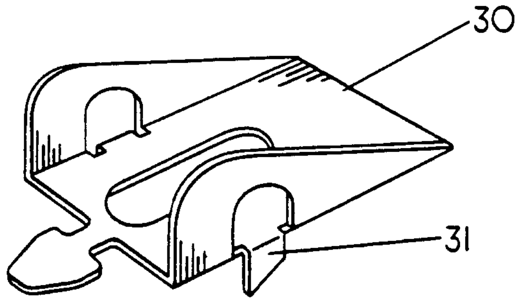

FIG. 11 A

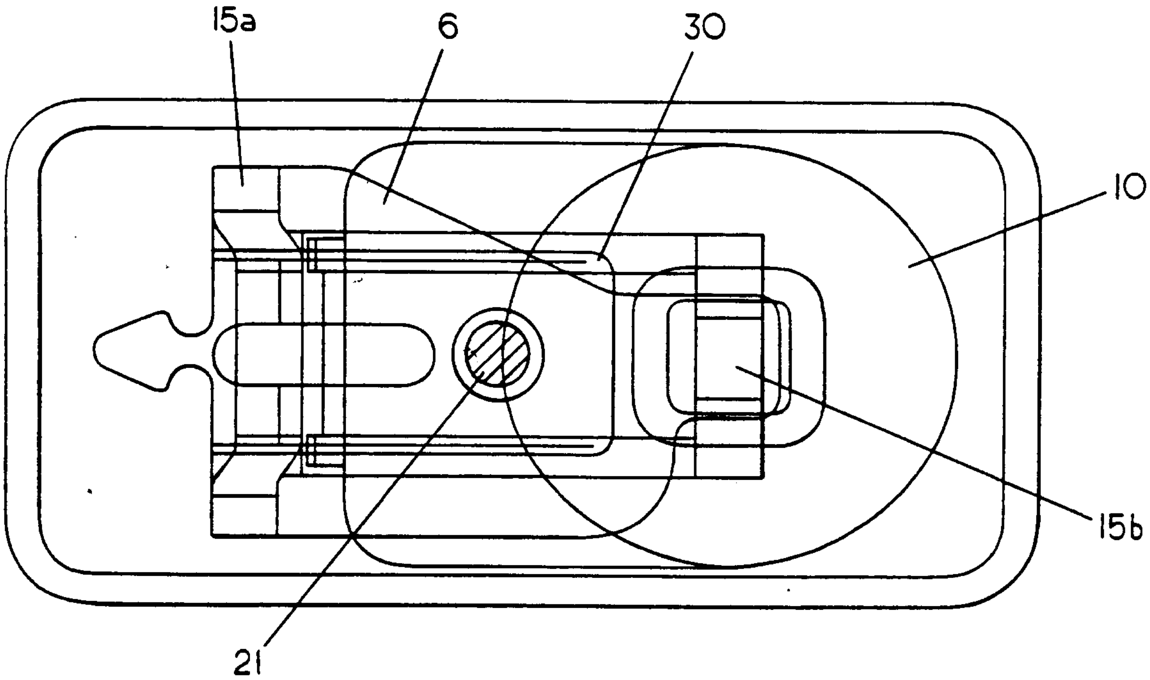

FIG. 11 B

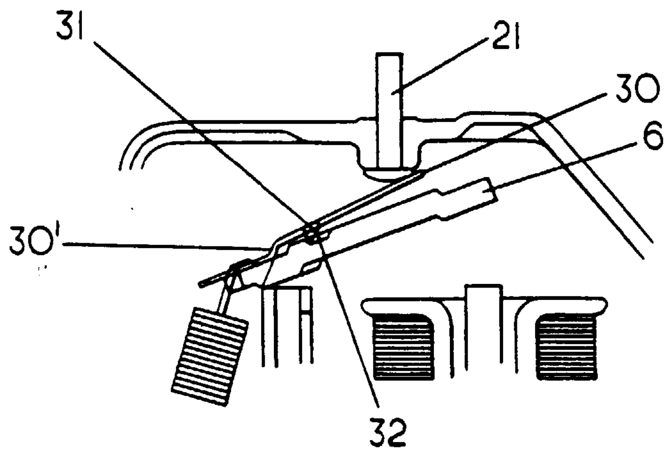

FIG. 12A

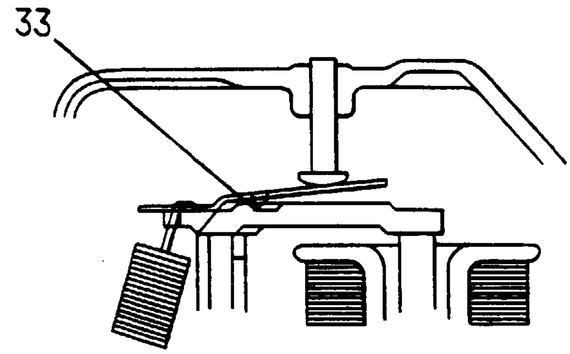

FIG. 12B

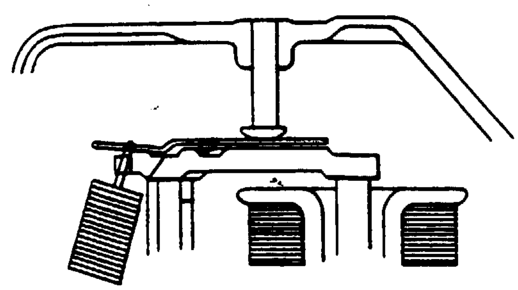

FIG. 12C

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 97 30 8470

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
Y A	DE 35 28 470 A (BBC BROWN BOVERI & CIE) * column 3, line 63 - column 4, line 15; figure 3 * ---	1,2 3	H01H71/32
Y	FR 2 596 577 A (SERD SOC ET REALISA DISJONCT) * page 6, line 1 - line 34; figure 3 * ---	1,2	
A	FR 2 410 353 A (MERLIN GERIN) * claims; figures * ---	1-3	
A	DE 36 43 510 A (FELTEN & GUILLEAUME ENERGIE) * page 3, line 53 - page 4, line 19 * -----	1	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)
H01H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	17 March 1998	Janssens De Vroom, P

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EPO FORM 1503 03.82 (P04C01)

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The members are as contained in the European Patent Office EDP file on
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17-03-1998

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82