

DESCRIPTION

ELECTROMAGNETIC DEVICE

Technical Field

- 5 [0001] The present invention relates to an electromagnetic device, and particularly to a magnet holder for holding a permanent magnet and a magnetic short-circuiting piece which are attached to an electromagnet.

Background of the Invention

- 10 [0002] In general, a switch includes a pair of electrodes inside, where one of the electrodes is a stationary electrode and the other electrode is a movable electrode. On-off control of the switch is implemented by control of an electromagnetic device. The electromagnetic device is
15 composed of an exciting coil, an iron core, a frame, etc. A mover is thrown to a stationary side by a magnetic attractive force that is caused by applying an exciting current to the exciting coil. Constantly excited mechanical latches and magnetic latches are known as a latch for
20 maintaining the thrown state.

- [0003] Conventionally, it is necessary to continue constant energization of the exciting coil for maintaining the thrown state. This results in wastage of power consumption. Patent document 1 is known to disclose a
25 method for preventing this. Patent document 1 discloses that a permanent magnet is provided in addition to an exciting coil so that a magnetic attractive force of the permanent magnet maintains a thrown state. When a

switch is shifted into the thrown state, then energization of the exciting coil is stopped so that the thrown state is maintained by the magnetic attractive force of the permanent magnet, for energy conservation.

5 **Prior Art Document**

Patent document

Patent document 1: JP 2002-008498 A (especially, FIG. 2)

Summary of the Invention

Problem(s) to be Solved by the Invention

10 [0005] The present applicant proposed an electromagnetic device having excellent usability, in which a relatively small permanent magnet is provided between a frame and a mover wherein the size of the electromagnetic device is suppressed from increasing, and which is usable
15 for both of a constant energization type and an electromagnetic latch type. In cases where an electromagnetic device is constructed with a permanent magnet, the permanent magnet is tightened and fixed by some means during assembling, in order to prevent the
20 permanent magnet from dropping due to vibration or the like. There is a problem that the magnetic force of the permanent magnet decreases sooner due to pressure of the tightening and displacement of the permanent magnet.

[0006] Accordingly, it is an object of the present
25 invention to provide an electromagnetic device in which a permanent magnet can be held without pressure applied to the permanent magnet, while preventing displacement of the permanent magnet due to vibration.

Means for Solving the Problem(s)

[0007] The present invention is an electromagnetic device wherein: an electromagnet is housed in a frame, wherein the electromagnet includes an exciting coil, a stator and a mover, and the mover is fixed to a moving
5 shaft; and a permanent magnet is arranged in a magnetic circuit formed by energizing the exciting coil, characterized in that: each of left and right sides of the electromagnetic device is provided with a magnet holder between the frame and the exciting coil, wherein the magnet holder is formed
10 of a nonmagnetic material, and has a frame-shape having a thickness equivalent to or slightly greater than thickness of the permanent magnet; and the magnet holder includes: a fixing arm connected to an edge of the frame-shape, wherein the fixing arm extends along a center line of the
15 frame-shape and includes a fixing hole; supporting pieces arranged on upper and lower sides of the fixing arm respectively, wherein each supporting piece faces the fixing arm with a hollow section therebetween, and has one end connected to the edge of the frame-shape and another free
20 end; and spaces each of which is defined between a surface of a corresponding one of the supporting pieces and a surface of the edge of the frame-shape, wherein the surfaces face each other, wherein one of the permanent magnet and a magnetic short-circuiting piece is fitted in
25 each space.

[0008] The present invention is characterized in that the frame is formed with a cutout whose opening is located so that the free end of each supporting piece is exposed to outside through the opening.

[0009] The present invention is characterized in that a free end side of each supporting piece is provided with a stopper.

Effect(s) of the Invention

5 [0010] As described above, according to the present invention, the permanent magnet or magnetic short-circuiting piece is fitted and held in the space defined in the magnet holder. This serves to allow the permanent magnet to be attached without tightening, and thereby
10 prevent the magnetic force from falling due to tightening. Moreover, it is possible to prevent the displacement of the permanent magnet due to vibration, because the permanent magnet is fitted in the space of the magnet holder. Moreover, the feature that the frame is formed
15 with a cutout whose opening is located so that the free end of each supporting piece is exposed to outside through the opening, serves to make it easy to replace the permanent magnet or magnetic short-circuiting piece after assembling of the electromagnetic device.

Brief Description of the Drawings

[0011]

FIG. 1 is a front view of an electromagnetic device according to an embodiment of the present invention;

FIG. 2 is a partly transparent side view of the
25 electromagnetic device according to the embodiment of the present invention;

FIG. 3 is a sectional view of the electromagnetic device according to the embodiment of the present invention; and

FIG. 4 is a configuration diagram of a magnet holder employed in the present invention.

Mode(s) for Carrying Out the Invention

[0012] FIGS. 1 to 3 are configuration diagrams of the present invention, wherein FIG. 1 is a front view, FIG. 2 is a partly transparent view of a side face of FIG. 1, and FIG. 3 is a sectional view of a side face. In these views, 1 represents a moving shaft having threaded ends, and 2 represents a cylindrically formed stator having a hole through which an end of moving shaft 1 passes. 3 represents a mover fixed to moving shaft 1. A breaking spring 4 is pressed and inserted between stator 2 and mover 3 so as to constantly separate stator 2 and mover 3 from each other. 5 represents a coil frame which surrounds stator 2, mover 3 and breaking spring 4, and in which an exciting coil 6 is mounted. 7 represents a frame which is U-shaped with a bottomed end. A central portion of the bottom is formed with a hole 7a through which the end of moving shaft 1 passes.

[0013] 8 represents an end plate which is U-shaped with a bottom, a central portion of which is formed with a hole similar to the frame. 9 represents a frame face plate (frame) through which another end of moving shaft 1 passes. Frame face plate 9 covers an opposite side of frame 7, and is fixed solidly to frame 7 with a bolt 21 through end plate 8 and a magnet holder 10 described below. Frame face plate 9 is formed with a cutout whose opening is located so that supporting pieces of magnet holder 10 and places for holding permanent magnets can be

viewed from outside. 22 represents a supporting tube, where an edge surface of the hole of end plate 8 is fitted on one end of supporting tube 22. Mover 3 is inserted movably in supporting tube 22. 23 represents a stop plate. 5 Stop plate 23 is fixed to moving shaft 1 with a nut 24 so as to define a moving length L between stop plate 23 and an internal surface of frame face plate 9. 25 represents a state indicator. 26 represents the permanent magnet which is held by magnet holder 10, and is inserted in a 10 magnetic circuit of an electromagnet to generate a magnetic force for maintaining the stator 2 and mover 3 in contact with each other.

[0014] FIG. 4 shows magnet holder 10 which is formed in a frame-shape. Magnet holder 10 is formed of a resin 15 (plastic) for holding a permanent magnet and a magnetic short-circuiting piece. An edge of frame 11 of magnet holder 10 is connected to a fixing arm 12 which extends along a center line of frame 11. A tip portion of fixing arm 12 is formed with a hole 12a. 14 (14a, 14b) represents a 20 supporting piece which is formed to project and located at a position facing the fixing arm 12 with a hollow section 13 therebetween. The free tip of supporting piece 14 is provided with a stopper 15. Each supporting piece 14 is provided with a space 16 (16a, 16b) between supporting 25 piece 14 and one of upper and lower edges constituting the frame 11, wherein space 16 (16a, 16b) has heights h1 and h2. Accordingly, supporting piece 14 has a spring property toward the center line with a fulcrum being a point at which supporting piece 14 is connected to frame 11. Permanent

magnet 26 is fitted in the place of height h1 of space 16. Magnetic short-circuiting piece 27 is fitted in the place from height h1 to height h2. Although permanent magnet 26 is fitted in space 16a, and magnetic short-circuiting piece 27 is fitted in space 16b, the space where permanent magnet 26 or magnetic short-circuiting piece 27 is fitted may be selected arbitrarily depending on applications. Magnet holder 10 is formed symmetrical with respect to the center line, so that permanent magnet 26 or magnetic short-circuiting piece 27 is fitted in space 16. Magnet holder 10 has a thickness equivalent to or slightly greater than thickness of permanent magnet 26 so that permanent magnet 26 is free from pressure due to attachment. This prevents characteristics of permanent magnet 26 from changing due to pressure. Frame 11 includes recesses 11a, 11b through which fixing bolts pass.

[0015] As shown in FIG. 1, each of left and right sides of the electromagnet is provided with magnet holder 10, wherein a bolt 21 passes through hole 12a of fixing arm 12, and is fixed to end plate 8 by engaging with the thread formed in end plate 8. Other fixing bolts pass through recesses 11a, 11b of the magnet holder. When magnet holder 10 is attached to the electromagnet, the tip of supporting piece 14a, 14b can be seen from the front side of the electromagnet. By bending the tip of supporting piece 14a, 14b toward the center line, it is possible to make it easy to attach permanent magnet 26 or magnetic short-circuiting piece 27 from outside to space 16a, 16b or detach same from space 16a, 16b to outside. The magnetic

attractive force can be adjusted by replacement of permanent magnet 26 or magnetic short-circuiting piece 27. Accordingly, this electromagnetic device can be adapted in two ways, i.e. to the constant energization type and magnetic latch type. The attached permanent magnet 26 and magnetic short-circuiting piece 27 are prevented from dropping, by the restoring force of supporting piece 14a, 14b and stopper 15.

[0016] In the electromagnetic device constructed as described above, when no current is flowing through exciting coil 6, the reaction force of breaking spring 4 serves to bring stop plate 23, which is fixed to moving shaft 1, into contact with the inner wall of frame face plate 9 as indicated by a dotted line, so that stator 2 and mover 3 are separated from each other, and thereby the switch coupled to moving shaft 1 is in breaking state. In the breaking state, the magnetic flux from permanent magnet 26 flows in a magnetic circuit passing from permanent magnet 26 through end plate 8, supporting tube 22, stop plate 23, frame face plate 9, and frame 7 in this order to permanent magnet 26.

[0017] Then, when a current flows through exciting coil 6, magnetic flux ϕ occurs and flows in a magnetic circuit passing through frame 7, permanent magnet 26, end plate 8, supporting tube 22, mover 3, and stator 2. At this moment, the magnetic flux is a sum of the magnetic flux generated by exciting coil 6 and the magnetic flux generated by permanent magnet 26, by which the magnetic attractive force serves to bias and hold mover 3 to stator 2

against breaking spring 4. Moving shaft 1 moves along with mover 3, and brings the switch into thrown state.

[0018] According to the embodiment of the present invention constructed as described above, the permanent magnet and magnetic short-circuiting piece are fitted and held in the spaces of the magnet holder so that the permanent magnet and magnetic short-circuiting piece are prevented from displacing due to vibration, and are free from the pressure for fixing the permanent magnet. This prevents magnetic characteristics from changing. The feature that the movable ends of the supporting pieces supporting the permanent magnet and magnetic short-circuiting piece can be accessed from the front side of the electromagnetic device, makes it easy to adjust the magnetic attractive force by access from outside and replacement of the permanent magnet and magnetic short-circuiting piece. Moreover, it is easy to attach the permanent magnet or magnetic short-circuiting piece to the magnet holder or detach same from the magnet holder, because such operation is free except from the attractive force of the permanent magnet.

Description of Reference Signs

[0019]

- 1... Moving Shaft
- 25 2... Stator
- 3... Mover
- 4... Breaking Spring
- 5... Coil Frame
- 6... Exciting Coil

- 7... Frame
- 8... End Plate
- 9... Frame (Frame Face Plate)
- 10... Magnet Holder
- 5 11... Frame
- 12... Fixing Arm
- 14... Supporting Piece
- 26... Permanent Magnet
- 27... Magnetic Short-Circuiting Piece

CLAIMS

1. An electromagnetic device wherein:

an electromagnet is housed in a frame, wherein the
5 electromagnet includes an exciting coil, a stator and a
mover, and the mover is fixed to a moving shaft; and

a permanent magnet is arranged in a magnetic circuit
formed by energizing the exciting coil,

characterized in that:

10 each of left and right sides of the electromagnetic
device is provided with a magnet holder between the frame
and the exciting coil, wherein the magnet holder is formed
of a nonmagnetic material, and has a frame-shape having a
thickness equivalent to or slightly greater than thickness of
15 the permanent magnet; and

the magnet holder includes:

a fixing arm connected to an edge of the frame-
shape, wherein the fixing arm extends along a center line
of the frame-shape and includes a fixing hole;

20 supporting pieces arranged on upper and lower
sides of the fixing arm respectively, wherein each
supporting piece faces the fixing arm with a hollow section
therebetween, and has one end connected to the edge of
the frame-shape and another free end; and

25 spaces each of which is defined between a
surface of a corresponding one of the supporting pieces and
a surface of the edge of the frame-shape, wherein the
surfaces face each other, wherein one of the permanent
magnet and a magnetic short-circuiting piece is fitted in
30 each space.

2. The electromagnetic device as claimed in Claim 1,
characterized in that the frame is formed with a cutout
whose opening is located so that the free end of each
5 supporting piece is exposed to outside through the opening.

3. The electromagnetic device as claimed in Claim 1 or 2,
characterized in that a free end side of each supporting
piece is provided with a stopper.