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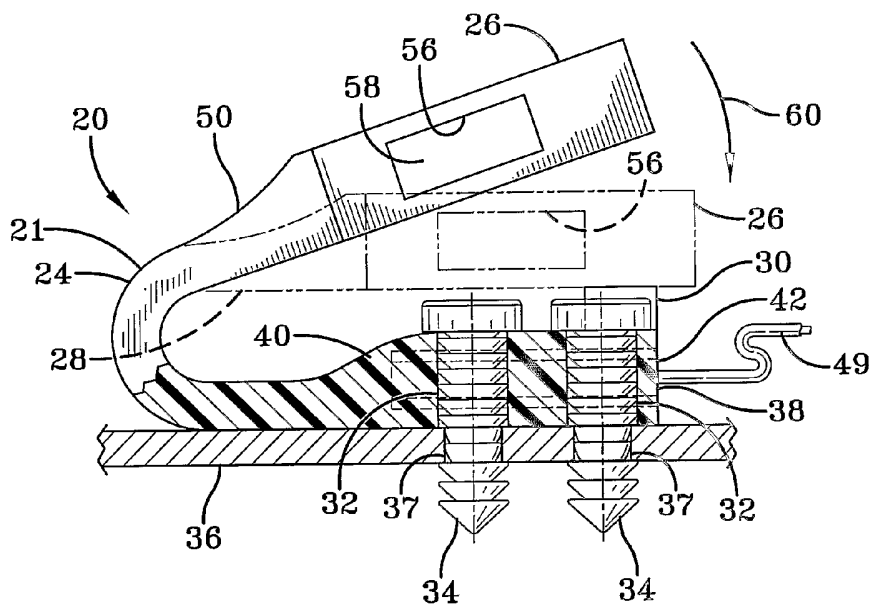
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(54) Title: MAGNETICALLY OPERATED HINGE SWITCH



(57) Abstract: A hinge switch (20) has a unitary plastic body (21) that can be formed by injection molding or extrusion. The body (21) has a base (22) that holds a magnetic field sensor (48). The base (22) is fastened to a support structure by a plurality of fasteners. The base (22) is connected to an arm by an elastic U-shaped portion (24) of the plastic body that acts as both a hinge and a biasing member. The arm positions an activation magnet (58) over the base (22) and the sensor. The arm does not block access to fasteners that mount the switch to the support structure.



For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

MAGNETICALLY OPERATED HINGE SWITCH

The present invention relates to switches used to detect the closing of a door or lid when two parts of a switch connected by a hinge are moved towards each other.

In many applications it is desirable to be able to positively detect that a certain action has taken place, for example that the hood of a car has been properly closed. Prior art devices usually comprise a base containing a sensor and an arm that is mounted by a hinge to the base, and the base contains a means for interacting with the sensor. These devices typically require three or more separate parts and a metal biasing means for keeping the sensor open. The metal biasing means can be exposed to corrosion depending on the environment of the use. What is needed is a hinge type switch of simpler and more robust construction.

The present invention is a hinge switch with a unitary plastic body that can be formed by injection molding or extrusion. The unitary plastic body has a base that can be fastened to a support structure by fasteners that pass through the base and the support structure. The base is connected to an arm by an elastic U-shaped portion of the plastic body that acts as both a hinge and a biasing member. The U-shaped portion is substantially thinner and thus more flexible than the base or the arm. The base has an end face in which a sensor-receiving cavity is formed. Positioned within the cavity is a sensor module that is connected by wire leads to a connector plug. The sensor module contains a magnetic field sensor such as a reed switch or Hall Effect sensor. The arm is narrower than the base so the arm does not block access to the fasteners that attach the base to the support structure. The arm has portions defining an opening into which an activation magnet is placed.

Further features and advantages of the invention will be apparent from the following detailed description when taken in conjunction with the accompanying drawings.

FIG. 1 is an exploded isometric view of the lever arm sensor of this invention.

FIG. 2 is a side elevational view partially cut away in section, of the lever arm sensor of FIG. 1.

In FIGS. 1 and 2 like reference numbers refer to similar parts. A hinge switch 20 is shown in FIGS. 1 and 2. The hinge switch of the present invention has a unitary construction. The hinge switch 20 comprises a unitary plastic body 21 that includes a base 22, a hinge 24, and a closure arm 26 that are integrally formed of plastic, for example polypropylene, as a single injection molded piece. The hinge elastically biases the switch to an open position. As illustrated in FIG. 2 the hinge 24 has a smooth U-shaped form 28 when the closure arm 26 is brought into engagement with a stop 30 that is integral with the base 22 and the entire switch 20.

The base 22 has two mounting holes 32 into which fasteners 34 are positioned to hold the base 22 fixed with respect to a mounting structure 36. The fasteners 34 pass through the holes 32 in the base and into corresponding holes 37 in the mounting structure. The base 22 has a thick section 38 that is joined by a smooth transitional section 40 to the hinge 24. The mounting holes 32 pass through the thick section 38 of the base. The base 22 has an overall rectangular shape with an end face 42 opposite the hinge 24 in which is formed a sensor cavity 44. A stop 30 is positioned above the sensor cavity 44. A sensor module 46 is positioned within the sensor cavity 44. The sensor module 46 contains a magnetic field sensor 48 such as a reed switch, a Hall Effect sensor, a GMR sensor, an induction coil or any other suitable means of detecting an electromagnetic field. The magnetic field sensor 48 is connected to a two or more wire leads 49 that terminate in a connector plug 52.

The closure arm 26 is connected to an upper transition section 50 but does not extend along the entire transition section 50 so that the arm 26 does not overlie the mounting holes 32 in the base 22 allowing access to install or remove the fasteners 34. The arm 26 and the transition section 50 define a rectangular open space 54 which allows vertical access to the mounting fasteners 34. Portions of the closure arm 26 define a cavity 56 into which an activation magnet 58 is bonded or insertion molded. The magnet 58 is

positioned to activate, or be detected by, the magnetic field sensor 48 within the sensor module 46 positioned within the sensor cavity 44 within the base 22. The stop 30 limits the motion of the closure arm 26, as shown in FIG. 2 and positions the activation magnet 58 to be detected by the magnetic field sensor 48 within the sensor module 46 mounted in the sensor cavity 44.

The closure arm 26 and the base 22 are about the same thickness. The closure arm 26 and the base 22 are connected by the lower transition section 40 and the upper transition section 50 to the hinge 24 which has about one-half the thickness of the closure arm 26 and the base 22. The greater thickness of the base 22 and the closure arm 26 means that substantially all elastic deformation caused by the motion of the closure arm downwardly, as indicated by arrow 60, occurs in the hinge 24. The smooth transition sections 40, 50 provide a gradual transition between the flexible hinge 24 and the substantially rigid base 22 and closure arm 26. The gradual transition prevents stress concentrations caused by the change in section between the base 22 and the arm 26 and the hinge 24. The minimization of stress concentrations results in a relatively low stressed hinge 24 with a flexure of about 30 degrees or less and the use of a suitable plastic, such as polypropylene, will produce a switch with a desirable long life.

While the hinge switch 20 is preferably formed as a single injection molded part it could be cut from a continuous extrusion. The activation magnet 58 and the sensor module 46 may be mounted to the hinge switch 20 by molding-in-place, bonding, or by being potted, heat staked or fastened to the switch body 21. If a reed switch is used as the magnetic field sensor, it could be of the type that is normally open, or the type which is normally closed. The hinge switch of the present invention is not subject to corrosion. As used herein and in the claims the term "without thickness discontinuity" means a gradual, smooth transition to avoid producing a stress concentration.

CLAIMS

1. A hinge switch (20) comprising:
 - a single piece plastic hinge body (21);
 - a base (22) forming a portion of the plastic hinge body (21), the base (22) being mounted to a support structure by a plurality of fasteners extending through the base (22);
 - a U-shaped hinge (24) integrally formed with the base (22);
 - an arm (26) integrally formed with the base (22) and the U-shaped hinge (24), wherein the U-shaped hinge extends between the base (22) and the arm, and wherein the arm (26) extends over at least a portion of the base (22);
 - a magnetic field sensor (48) mounted to the base (22); and
 - an activation magnet (58) mounted to the arm (26) the U-shaped hinge (24) elastically biasing the arm (26) and the activation magnet (58) away from the magnetic field sensor (48) mounted to the base (22) so that the magnetic field sensor is activated by elastically pushing the arm (26) towards the base (22).
2. The hinge switch (20) of claim 1 wherein the base (22) has portions forming a stop (30) that extends upwardly from the base (22), towards the arm (26), and which engages the arm when it is moved downwardly towards the base (22), the stop (30) limiting the travel on the arm (26) towards the base (22).
3. The hinge switch (20) of claim 1 wherein the base (22) transitions without thickness discontinuity into the U-shaped hinge (24) which is substantially less thick than the base (22), and the U-shaped hinge transitions without thickness discontinuity into the arm (26) which is about as thick as the base (22).

4. The hinge switch of claim 1 wherein the base (22) has portions defining at least one mounting hole (32), and wherein the arm does not extend over the at least one mounting hole (32).

4. The hinge switch (20) of claim 1 wherein the base (22) has an end face opposite the U-shaped hinge (24), and wherein portions of the base (22) form a sensor cavity (44) containing the magnetic field sensor (48).

5. The hinge switch (20) of any of claims 1 - 4 wherein the magnetic field sensor (48) is a Hall Effect sensor.

6. The hinge switch (20) of any of claims 1 – 4 wherein the magnetic field sensor (48) is a reed switch.

7. The hinge switch (20) of any of claims 1 – 6 wherein portions of the arm form a magnet receiving cavity in which the activation magnet (58) is positioned.

8. The hinge switch (20) of any of claims 1 – 7 wherein the extruded plastic hinge body (21) comprises polypropylene.

