

MAGNETIC LOCK DEVICE

The present invention relates to a magnetic lock device that makes use of the attracting action of the magnetism.

A conventional magnetic lock device includes a permanent magnet having a first side for providing one magnetic polarity to which a first ferromagnetic plate is attached and packaged in a nonmagnetic enclosure, and having a second side opposite the first side for providing the opposed magnetic polarity to which a second ferromagnetic plate may be detachably attached, the second ferromagnetic plate having a rod extending therefrom and adapted to be inserted through the respective bores in the permanent magnet and enclosure so that the rod can disengageably engage the first ferromagnetic plate or the rod extending therefrom. The conventional magnetic lock devices are used as attachments for handbags, baggage, and the like, or for clothes, belts, and the like.

According to the conventional magnetic lock device, the ferromagnetic rod on the second ferromagnetic plate is inserted through the respective bores in the permanent magnet and enclosure when the first and second ferromagnetic plates are to be coupled together. When this occurs, the sliding motion of the second ferromagnetic plate relative to the surface of the enclosure must be attempted in order to bring its rod into registry with the bore in the enclosure accurately. Usually, several attempts

must be made until the two parts are mated successfully. As those attempts are repeated each time they are to be coupled together, the surface of the enclosure will be damaged (such as scratches) by the sliding motion. There is another conventional magnetic lock device that is primarily designed to eliminate this problem (as disclosed in the Japanese patent applications Nos. 1-191404 and 2-105503). This magnetic lock device includes an enclosure which is formed to present a depressed surface on the side that engages the second ferromagnetic plate.

The last-mentioned conventional magnetic lock device has a construction that includes an enclosure having the depressed surface on the side engaging the second ferromagnetic plate. Thus, when the second ferromagnetic plate is slid relative to the depressed surface of the enclosure so that its rod can be brought into register with the bore in the enclosure, it may be appreciated that it can be moved along the depressed surface toward the bore at the center directly, without any effort to locate the bore randomly. This can reduce any possible damage that would occur if the sliding motion would be attempted in the same manner as for the earlier-mentioned prior art construction.

It is therefore understood that the provision of the depressed surface on the enclosure provides an effective means for protecting the enclosure against those possible damages. In this regard, it would be desirable to be able to provide a new and improved construction of the magnetic lock device that permits such a depressed surface to be formed on the enclosure, without affecting the functions of the device.

In its specific form, a magnetic lock device according to the

present invention comprises a first element comprising a permanent magnet having a central bore traversing it and having a first side for providing one polarity and a second side opposite to the first side for the opposite polarity, a first ferromagnetic plate rigidly attached to the said first side of the permanent magnet, and a non-ferromagnetic enclosure packaging the permanent magnet and the first ferromagnetic plate into one unit and having a central bore aligned with the central bore of the permanent magnet; and a second element comprising a second ferromagnetic plate detachably attached to the said second side of the permanent magnet; the second ferromagnetic plate having a ferromagnetic projection disengageably engaging the first ferromagnetic plate directly, or indirectly through a ferromagnetic projection extending from the first ferromagnetic plate, via the said bores; and the enclosure including a depressed surface inclining downwardly from a peripheral marginal edge toward the central bore of the enclosure; characterised in that a magnetic gap is defined, with or without an intervening non-magnetic member, between the depressed surface of the enclosure and the said second side of the permanent magnet.

The second ferromagnetic plate can be slid along the depressed surface of the non-magnetic enclosure, to ensure that its projection can be guided directly and accurately toward the bore at the center of the enclosure.

An advantage is provided by the spacing of the depressed surface away from the second side of the permanent magnet. Thus, the enclosure may be made of brass or any other non-magnetic material that can be machined to the desired shape. This

contributes to the reduced weight of the device as a whole. Furthermore, the manufacturing process may be simplified with less manufacturing costs.

The above and other objects, features, and advantages of the present invention will become apparent from the detailed description of the preferred embodiments of the invention that is provided with reference to the accompanying drawings, in which:

Fig. 1 is a sectional view of a first preferred embodiment of the present invention;

Fig. 2 illustrates the cross section of the part of the device according to a second preferred embodiment that provides the magnetically attracting action;

Fig. 3 illustrates the cross section of the magnetically attracting part according to a third preferred embodiment;

Fig. 4 illustrates the cross section of the magnetically attracting part according to a fourth preferred embodiment;

Fig. 5 illustrates the cross section of the magnetically attracting part according to a fifth preferred embodiment;

Fig. 6 illustrates the cross section of the magnetically attracting part having a depressed surface varying in the profile from those in the preceding embodiments;

Fig. 7 illustrates the cross section of the magnetically attracted part of the device according to another preferred embodiment;

Fig. 8 illustrates the cross section of the magnetically attracting part according to a sixth preferred embodiment; and

Fig. 9 illustrates the cross section of the magnetically attracting

part according to a seventh preferred embodiment.

Fig. 1 illustrates the cross section of the magnetic lock device according to the first preferred embodiment thereof. As seen from Fig. 1, the device comprises two parts, generally designated as A and B. The part A, which may be referred to as the "magnetically attracting part", attracts the part B magnetically, which may be referred to as the "magnetically attracted part". The part A includes a cylindrical permanent magnet 1 having a central bore 11 extending therethrough, a first ferromagnetic plate 2 rigidly attached to a first side of the permanent magnet 1 for providing one magnetic polarity, and an annular member 3 rigidly attached to a second or opposite side of the permanent magnet 1 for providing the opposed polarity. The permanent magnet 1, first ferromagnetic plate 2, and annular member 3 are packaged in a nonmagnetic enclosure 4 that may be made of any nonmagnetic material such as brass.

The enclosure 4 has the cylindrical shape closed at the top and open at the bottom, on its top end side, the enclosure 4 is formed to provide a depressed surface 8 like a funnel, having a peripheral flat portion 5 resting against the annular member 3, a slanted portion 7 extending downwardly and inwardly from the peripheral flat portion 5 toward the center, and a bore 6 at the center. The center bore 6 is formed to include an cylindrical extension 9 depending downwardly therefrom like a skirt. On the bottom end side, it includes nails 10, 10 extending inwardly radially for holding the permanent magnet 1 and first ferromagnetic plate 2 firmly.

The extension 9 depending downwardly from the center bore 6 forms a cylindrical shape which is fitted inside the center bore 11 through the permanent magnet 1. The first ferromagnetic plate 2 includes a rod 12 extending into half the depth of the bore 11. The rod 12 has a shaft 13 extending downwardly therefrom and which passes through the first ferromagnetic plate 2. The bottom end of the shaft 13 has a flange or rivet 15 formed by press, extending outwardly radially so that it can hold a pair of mounting legs 14 and secure it to the first ferromagnetic plate 2.

The part B, or the magnetically attracted part, includes a second ferromagnetic plate 16, a rod 17 made also of ferromagnetic material and extending from the second ferromagnetic plate 16 on the side thereof facing the part A, and a pair of mounting legs 18 secured to the second ferromagnetic plate 16 on the opposite side thereof. The second ferromagnetic plate 16 is made of iron, and is formed to include a peripheral marginal flat edge 19 whose shape conforms to the shape of the corresponding annular flat portion 5 of the enclosure 4, and a slanted portion 20 extending inwardly radially from the peripheral marginal flat edge 19, the slanted portion 20 forming the protruded surface 21 matching the shape of the corresponding depressed surface 8 on the enclosure 4. The protruded surface 21 is flat at the center thereof, as shown at 22, where a bore is provided for accepting the rod 17. The rod 17 has the diameter that allows the rod 17 to be inserted into the cylindrical part 9 on the enclosure 4, and the length or height that allows the rod 17 flatly to meet with the corresponding ferromagnetic rod 12 on the first ferromagnetic plate 2, when the second ferromagnetic plate 16 is placed on and magnetically attracted toward the enclosure 4. The rod 17 has a shaft 23 whose bottom end is formed by press to include a flange 24

for holding a pair of mounting legs 18 and securing it to the second ferromagnetic plate 16, in the same manner as described with reference to the part A.

According to the embodiment of the magnetic lock device described above, it may be appreciated that the second ferromagnetic plate 16 for the part B may be magnetically attracted toward the part A including the permanent magnet 1 when the plate 16 is placed on the enclosure 4, or may be detached from the part A by pulling it away from the part A. This may be accomplished by placing the second ferromagnetic plate 16 on the enclosure in such a way that the peripheral marginal flat edge 19 and protruded surface 21 of the plate 19 can engage the corresponding respective annular flat portion 5 and depressed surface 8 of the enclosure 4. When this occurs, the rod 17 from the second ferromagnetic plate 16 can meet the rod 12 from the first ferromagnetic plate 2 at their respective ends. When those rods meet, the magnetic lines of force from the permanent magnet 1 are centered onto the rods 12 and 17 through their respective ferromagnetic plates 2 and 16. Thus, the rods can attract each other under the action of the centered magnetic force.

More specifically, the operation may be performed in the following manner. When the part A and the part B are to be coupled together, the second ferromagnetic plate 16 is placed onto the enclosure 4, and its rod 17 may be inserted into the center bores 6, 11 by sliding it relative to the top surface of the enclosure 4. By doing this, the rod 17 can be guided along the slant 7 formed by the depressed surface 8 on the enclosure 4 toward the center bore 6. The minimum amount of effort may be required to direct the rod 17 toward the bore 6 by restricting its sliding motion to the shortest way to the bore 6. In this way, the damage such as scratches on the enclosure 4 that may be caused by the sliding motion can

be avoided, as it is the case with the prior art which provides improvement in this regard.

The annular member 3 is interposed between the permanent magnet 1 and the enclosure 4 so that a gap 25 can be defined between the top side of the enclosure 4 and the polar side of the permanent magnet 1 facing the top side. This gap is functionally equivalent to a magnetic gap in the magnetic circuit. The total weight of the device can be reduced by the amount of the gap 25. The annular member 3 has the simple configuration, and the fabrication process may be simplified by using this annular member 3. The annular member 3 may be made of either ferromagnetic materials or nonmagnetic materials. Preferably, the annular member should be made of brass or similar materials that can be cut to the desired shape. When the annular member is made, any nonmagnetic materials, brass, copper, or synthetic resins may be used. The annular member may consist of two split parts, each having the identical shape such as the semi-circular shape, which may be assembled together into one unit.

Figs. 2 through 5 show several respective variations of the preceding embodiment. In the variation shown in Fig. 2, the magnetic gap 25 in Fig. 1 is filled with another annular member 26 made of brass.

As seen from Fig. 2, the annular member 26 includes a bottom side 26a which engages the second polar side of the permanent magnet 1, and an upper side 26b whose shape conforms to the shape of the top surface of the enclosure 4. The annular member 26 may appear to have a slightly complicated profile, but it can be shaped to the desired profile by using brass, copper, or synthetic resin materials.

In the variation shown in Fig. 3, the permanent magnet 1 has a center bore 11 whose upper peripheral edge is cut to provide a slant 27,

and the enclosure 4 has a depressed surface 8 that presents a steeper slant 7 that matches the slant 27. In this variation, the annular member 3 may also be made of either ferromagnetic or nonmagnetic materials.

Fig. 4 shows the variation of the annular member, in which an annular member 28 has a cylindrical shape and is disposed on the second polar side of the permanent magnet 1, and the enclosure 4 has the depressed surface 6 on its top, beginning with the peripheral edge and slanting downwardly toward the center bore 6.

Fig. 5 shows a further variation of the annular member 28 in Fig. 4, in which the first ferromagnetic plate 2 has a slightly greater diameter than that of the permanent magnet 1, and an annular member 29 has a cylindrical shape which surrounds the permanent magnet 1.

The annular member 28 shown in Fig. 4 may be made of either ferromagnetic or nonmagnetic materials, whereas the annular member 29 in Fig. 5 should be made of nonmagnetic materials.

In each of those specific variations described above, a magnetic gap 25 may be provided between the permanent magnet 1 and the enclosure 4 on the top side thereof, or a magnetic gap may be provided by the annular member 26, 28, or 29. This gap reduces the weight, and makes the fabrication easy. When the annular member is made of nonmagnetic materials, brass, copper, or synthetic resin material may also be used. The annular member may also consist of two split pieces.

In the preceding embodiments and the variations thereof, the depressed surface 8 on the top of the enclosure 4 provides a linearly slanted surface 7. The depressed surface 8 may provide a curved slant surface 30 as shown in Fig. 6.

In each of the preceding embodiments, the second ferromagnetic plate 16 on the part B provides the protruded surface 21 whose shape matches

the shape of the depressed surface 8 on the enclosure 4. Alternatively, the shape may be flat as shown in Fig. 7. In this case, it is important to ensure that the rod 12 for the part A and the rod 17 for the part B can meet each other flatly, when the two parts A and B are coupled.

The variation shown in Fig. 5 may be varied as shown in Fig. 8 and Fig. 9, respectively.

In Fig. 8, the annular member 29 may be omitted, and instead an annular member 31 which may be made of ferromagnetic or nonmagnetic materials may be fitted inside the bore 11 through the permanent magnet 1. In this case, the peripheral bottom end 9 of the enclosure 4 that extends into the bore 11 may be supported by the peripheral upper end of the annular member 31.

In Fig. 9, the peripheral bottom end 9 of the enclosure 4 may be supported by the peripheral marginal edge of the rod 12.

In Figs. 8 and 9, the enclosure 4 can be also supported firmly, and the magnetic gap can be defined between the enclosure 4 and permanent magnet 1. The constructions in Figs. 8 and 9 may provide the same functional effects as those in the preceding embodiment and variations thereof.

According to the present invention, the rod for the magnetically attracted part can be directed toward the center bore by sliding it relative to the enclosure when that part is coupled with the magnetically attracting part, without causing any possible damage such as scratches on the enclosure during the sliding motion. The gap provided between the permanent magnet and enclosure reduces the weight and makes the fabrication easy.

Although the present invention has been described in full detail by referring to the preferred embodiments and variations thereof, it should

be understood that various changes and modifications may be made without departing from the scope of the invention as defined in the appended claims.

Claims:-

1. A magnetic lock device comprising:

a first element comprising a permanent magnet having a central bore traversing it and having a first side for providing one polarity and a second side opposite to the first side for the opposite polarity, a first ferromagnetic plate rigidly attached to the said first side of the permanent magnet, and a non-ferromagnetic enclosure packaging the permanent magnet and the first ferromagnetic plate into one unit and having a central bore aligned with the central bore of the permanent magnet; and

a second element comprising a second ferromagnetic plate detachably attached to the said second side of the permanent magnet;

the second ferromagnetic plate having a ferromagnetic projection disengageably engaging the first ferromagnetic plate directly, or indirectly through a ferromagnetic projection extending from the first ferromagnetic plate, via the said bores; and

the enclosure including a depressed surface inclining downwardly from a peripheral marginal edge toward the central bore of the enclosure;

characterised in that a magnetic gap is defined, with or without an intervening non-magnetic member, between the depressed surface of the enclosure and the said second side of the permanent magnet.

2. A magnetic lock device as claimed in claim 1, wherein the depressed surface of the enclosure is formed to provide a straight or curved surface inclining downwardly from the peripheral marginal edge of the enclosure toward its central bore.

3. A magnetic lock device as claimed in claim 1 or 2, wherein the depressed surface occupies the whole of the surface of the enclosure facing the second ferromagnetic plate, which



plate has a shape that matches the shape of the depressed surface.

4. A magnetic lock device as claimed in claim 1 or 2, wherein the surface of the enclosure facing the second ferromagnetic plate includes a flat portion around the peripheral marginal edge, the second ferromagnetic plate having a shape that matches the shape of the depressed surface and includes a flat portion corresponding to the flat portion of the enclosure.

5. A magnetic lock device as claimed in any preceding claim, wherein the intervening non-magnetic member is an annular non-magnetic member disposed between the permanent magnet and the enclosure, for backing up the depressed surface of the enclosure.

6. A magnetic lock device substantially as described with reference to any of the embodiments illustrated in the accompanying drawings.

