

MAGNETIC CLOSURE DEVICE

This invention relates to a magnetic, two-part closure device.

The closure device of this invention can function generally to releasably engage one member with another. Thus, for example, the closure device may be adapted to serve as a clasp, catch, buckle or stopper for such diverse articles as bags, boxes, bands, chains, hand-bags, ruck-sacks, trouser belts, shoulder bands, shoe bands and articles of jewelry such as necklaces and pendants.

The magnetic closure device of this invention has two parts adapted to be releasably magnetically engaged one with the other, one said part comprising a magnet having a through-hole extending from one magnetic pole surface to the other, a first ferromagnetic plate on one magnetic pole surface of the magnet, a magnetic shielding ferromagnetic plate on the other magnetic pole surface of the magnet and having an opening therethrough in substantial register with the hole through the magnet, and a casing for said magnet and said plates which is formed of non-magnetic material and which is open to permit access to said hole through said magnet; and the other said part of the closure device comprising a second ferromagnetic plate adapted to be brought into magnetic engagement with said first part on the side thereof adjacent the magnetic shielding ferromagnetic plate, at least one of said first and said second ferromagnetic plates carrying a _____

ferromagnetic contact member whereby when said two parts of the closure device are brought into engagement said ferromagnetic contact member or members complete a magnetic circuit connecting said first and second ferromagnetic plates through said hole in said magnet.

Embodiments of the closure device of this invention are constructed so that there is little or no leakage of lines of magnetic force from the magnet, so that not only is the magnetic engaging force of the closure device conserved but also problems which could arise if there was material leakage of the magnetic force, for example damage to magnetic tape or the like which comes into contact with the closure device, are minimized. Moreover, the lines of magnetic force are gathered into the edge of the engaging hole of the magnet to form an optimum magnetic field for magnetic adhesion.

Another advantage of the closure device of this invention is that in use any incidental deposition of magnetisable dirt e.g. iron sand will not adversely affect the magnetic characteristics.

Embodiments of the magnetic closure device of this invention will now be described with reference to the accompanying drawings, in which:

Fig. 1 is an exploded perspective view of one embodiment of closure device of this invention;

Fig. 2 is a cross-sectional view of one part of the closure device of Fig. 1, illustrating the gathered

state of lines of magnetic force within the device;

Fig. 3 is a cross-sectional view similar to Fig. 2 and illustrating the protection which the device affords against damage to a magnetic tape coming into contact with the device;

Fig. 4 is a cross-sectional view of the complete closure device shown in Fig. 1; and

Figs. 5-30 are cross-sectional views, similar to Fig. 4, of alternative embodiments of the closure device of this invention.

Referring first to Figures 1-4, there is shown a typical embodiment of the two-part closure device or stopper of the present invention, one part being generally designated by the reference letter A and the other by the reference letter B. The part A comprises a cylindrical permanent magnet 1 having an axial through-hole 1a, a ferromagnetic plate 2 attached to one magnetic pole surface of the magnet 1, a magnetic shielding ferromagnetic plate 3 attached to the other magnetic pole surface and provided with an opening 3a substantially registering with the hole 1a, and a generally cylindrical case 4 formed of a non-magnetic material.

It should be noted that the plate 3 is not necessarily composed of a single sheet or layer of magnetic shielding ferromagnetic material but instead may be composed of a plurality of such sheets or layers, and the surface of the plate 3 is sometimes formed with a suitable

hole. In any case, the magnetic shield effect can be achieved.

The case 4 serves not only to secure the plates 2 and 3 to the magnet 1, but also it serves the function of protecting the outer periphery of the magnet, and of preventing, for example, a magnetic tape x (Fig. 3) or the like from direct contact with the magnet 1 and the plate 3, which for certain applications may be desirable. In the embodiment shown in Figures 1-4, the cylindrical case 4 has an inner peripheral edge flange 4a which engages the upper surface of the plate 3, and engaging members or lugs 4b protruding from the open lower edge of the case 4 and which are bent around the lower surface of the plate 2 so as to hold the magnet 1 and plates 2 and 3 together.

The part A of the closure device also includes a ferromagnetic contact member in the form of a stud 5 which extends upwards from the upper surface of the plate into the hole 1a of the magnet 1. The stud 5 is of a diameter relative to that of the hole 1a so as to be magnetically spaced apart with respect to the wall of the hole, and is held in position by means of a shank portion of reduced diameter which passes down through the plate 2 and the base of a mounting washer 6, against the lower face of which the end of the shank portion is upset. The washer 6 is provided with downwardly extending legs 6a by means of which the part A of the closure device may be secured to a part of the article on which the closure member is to be used.

The second part of the closure member, part B, comprises a ferromagnetic plate 7 from which depends a ferromagnetic contact magnet in the form of a stud 8 carried by a mounting washer 6, similar to the mounting washer of the part A and to which it is secured in the same way as the stud 5. The plate 7 is dimensioned so that it can be received within the edge flange 4a of the case 4, whilst the stud 8 has a length such that it comes into intimate contact with the head of the stud 5 when the plate 7 is in intimate contact with and magnetically adhered to the plate 3. The heads of the studs 5 and 8 are rounded so as to reduce the actual contact surface between themselves.

Like stud 5, the stud 8 has a diameter such that, when received within the hole 1a, it does not directly contact the inner peripheral wall of the hole, such non-contacting state being maintained by engagement of the plate 7 with the edge flange 4a.

The legs 6a of the mounting washer 6 of the part B serve to provide means for securing that part to another part of the article on which the closure device is to be used.

As will be readily understood from the foregoing, the closure device shown in Figs. 1-4 is operated, to bring two parts of an article together for example, by relatively moving the parts A and B of the device together until the plate 7 and the stud 8 are in intimate contact with,

respectively, the plate 3 and the stud 5. The parts A and B then magnetically adhere together until the parts A and B are again moved apart.

The closure device shown in Figs. 1-4 has the following characteristics:

5 (1) The presence of the plate 3 causes all the lines of magnetic force of the magnet 1 to pass through the plate 3 without depicting a circle on the upper surface, and a magnetic path is formed at a position where resistance is minimum, as shown in Figure 2. As a
10 consequence, the lines of magnetic force basically pass between the inner edge of hole 3a of the plate 3 and the peripheral edge of the head of the stud 5, to substantially completely prevent external leakage of magnetism.

(2) Further, these lines of magnetic force between
15 the inner edge of hole 3a of the plate 3 and the peripheral edge of the head of stud 5 help to keep the head of the stud 5 free from any magnetisable dust e.g. iron sand, which may enter the hole 1a, since as indicated by y in Fig. 2 such dust is magnetically adhered along the thus produced
20 lines of magnetic force. Thus, intimate contact between the studs 5 and 8 can be assured.

(3) In addition, with this gathering of the lines of magnetic force, the lines of magnetic force peculiar to the magnet 1 are gathered at the edge of the plate 3 to
25 minimize leakage, thus enabling high magnetic adhesion to be maintained.

(4) Magnetic adhesion is further enhanced by spacing the studs 5 and 8 from the inner wall surface of the magnetic hole 1a by a distance not affected by the line of magnetic force to form a complete magnetic closed circuit in the studs 5 and 8.

(5) Magnetic adhesion is still further enhanced by rounding the heads of the studs 5 and 8 to reduce the contacting surfaces thereof, whereby the flux distribution passing through the contacting surfaces is of high density and hence most suitable for magnetic adhesion.

(6) Even if a magnetic tape x or the like should come into direct contact with the part A, as illustrated in Fig. 3, the magnetic recording portion thereof is positively protected from harm because of the small circle depicted by lines of magnetic force which leak outside and cover the magnet 1 and the case 4; and even in the area adjacent the magnetic pole surface, the presence of the edge flange 4a essentially prevents contact of the magnetic tape x with the magnetic pole surface.

In the following description of the embodiments of the invention shown in Figs. 5-30, like reference numerals will be used to designate parts having an equivalent function to parts shown in the embodiment of Figs. 1-4.

In the embodiment shown in Figure 5, the stud 5 is omitted and instead, the stud 8 is adapted to be placed in direct contact with the plate 2, thus achieving similar effects to those obtained in the embodiment shown in Figs. 1-4.

However, since the stud 5 is omitted, the peripheral edge 6b of the washer 6 is extended so that it may be integrally fixed to the magnet 1 together with the plate 2 by the lugs 4b of the case 4.

5 The embodiment shown in Figure 6 may be regarded as the converse to that shown in Figure 5, that is the stud 8 is omitted, and instead the stud 5 is lengthened so that its head lies in the plane of the upper surface of the plate 3. In this case, the plate 7 is magnetically adhered to the
10 upper end of the stud 5 when it is brought into engagement with the end flange 4a of the case 4. In this construction, the peripheral edge of the upper end of the stud 5 is positioned in proximity to the open edge of the plate 3 to further promote the effect of magnetic adhesion as described
15 above.

Figure 7 shows an embodiment wherein a recessed-stepped edge 3b is provided in the peripheral edge of the plate 3, to receive edge flange 4a of the case 4 so that the upper surface of the edge flange 4a is coplanar
20 with the upper surface of the plate 3. This arrangement permits the whole magnetic pole surface of the magnet to be covered with the plate 7, whose diameter is therefore enlarged for this purpose.

The embodiment shown in Figure 8 comprises a
25 combination of the mounting construction of the case 4 in the embodiment of Figure 7 with the single stud construction of the embodiment shown in Figure 5.

The embodiment shown in Figure 9 comprises a combination of the mounting construction of the case 4 in the embodiment of Figure 7 with the single stud construction of the embodiment shown in Figure 6. Additionally, the peripheral edge of the plate 7 is bent downwardly to form an engaging edge flange 7a.

Figures 10 to 12 show embodiments in which the plate 3 is totally covered by the case 4, so as to completely prevent direct contact of a magnetic tape x or the like with the plate 3.

Figures 13 to 15 show embodiments in which the outer peripheral edge of the plate 3 is extended downwardly to form an edge flange 3c, so that the circle depicted by the lines of magnetic force produced between the end flange 3c and the plate 2 is minimized to reduce problems resulting from the lines of magnetic force.

Figures 16 to 18 show embodiments wherein the inner peripheral edge of the plate 3 around the hole 3a is bent downwardly to form an edge flange 3d which projects into the hole 1a of the magnet. This expedient results in magnetic flux between the edge flange 3d and the outer peripheral edge of the upper end of the stud 5, thus helping to prevent magnetic leakage and increasing the magnetic adhesion effect.

Figures 19 to 21 show embodiments wherein the edge flange 3c of the plate 3 is extended so as to cover the edge of the plate 2, that is the peripheral surface where the magnet 1 is vacant, thus helping to prevent magnetic

leakage. In order to maintain a clearance between the magnet 1 and the plate 3, a cylindrical non-magnetic ring 9 formed of plastics or the like is fitted around the outer peripheral surface of the magnet 1.

Figures 22 to 24 show embodiments wherein the plate 7 is in the form of a convex spherical surface whilst the plate 3 and the upper surface of the case 4 are given a corresponding concave spherical surface. This expedient assists the insertion of the stud 8 into the hole 1a.

Figures 25 to 30 show embodiments especially adapted to serve as a catch for bands, chains or the like, in which the plate 2 is extended sideways to form an engaging portion 2a and the plate 7 is bent to form an engaging portion 7b. The engaging portion 2a and 7b are positioned in a common plane for the purpose of minimizing engagement between both the stoppers A and B against the pulling force. In Figures 26 to 29, both sides of the case 4 are stood upright to form an edge flange 4a thus positively preventing lateral displacement of the plate 7. In the drawings, reference numerals 2a' and 7b' designate mounting holes for attachment to chains, bands or the like.

In the embodiments shown in Figures 28 to 30, the other side edge of the plate 7 is also extended downwardly to form an engaging portion 7c against the pulling force in the mounting direction of the plate 7, namely in the direction of the engaging portion 7b.

It is to be understood that references above to a magnetic tape x are to be taken as referring not only to standard magnetic recording tape but also more generally to other articles having a magnetic recording part or strip, such as bank cash cards, credit cards, identity cards, train tickets etc.

CLAIMS:

1. A magnetic closure device having two parts adapted to be releasably magnetically engaged one with the other, one said part comprising a magnet having a through-hole extending from one magnetic pole surface to the other, a first ferromagnetic plate on one magnetic pole surface of the magnet, a magnetic shielding ferromagnetic plate on the other magnetic pole surface of the magnet and having an opening therethrough in substantial register with the hole through the magnet, and a casing for said magnet and said plates which is formed of non-magnetic material and which is open to permit access to said hole through said magnet; and the other said part of the closure device comprising a second ferromagnetic plate adapted to be brought into magnetic engagement with said first part on the side thereof adjacent the magnetic shielding ferromagnetic plate, at least one of said first and said second ferromagnetic plates carrying a ferromagnetic contact member whereby when said two parts of the closure device are brought into engagement said ferromagnetic contact member or members complete a magnetic circuit connection said first and second ferromagnetic plates through said hole in said magnet.
2. A closure device according to Claim 1, wherein said first ferromagnetic plate carries a magnetic contact member which projects through said hole through the magnet so as to directly magnetically contact said second ferromagnetic plate when said two parts of said device are brought into engagement.



3. A closure device according to Claim 1, wherein said second ferromagnetic plate carries a magnetic contact member adapted to enter said hole through said magnet so as to directly magnetically contact said first ferromagnetic plate when said two parts of said device are brought into engagement.

4. A closure device according to Claim 1, wherein both said first and second ferromagnetic plates carry magnetic contact members, the contact member carried by said first ferromagnetic plate projecting into the hole through the magnet, and the contact member carried by said second ferromagnetic plate being adapted to enter said hole through said magnet so as to magnetically contact the contact member carried by said first ferromagnetic plate when said two parts of said device are brought into engagement.

5. A closure device according to any preceding claim, wherein the or both said ferromagnetic contact members is in the form of a stud having a rounded head to reduce the area of contact with said other contact member or ferromagnetic plate, as the case may be, when said two parts of said device are brought into engagement.

6. A closure device according to any preceding claim, wherein the outer peripheral edge of said magnetic shield plate is bent towards said first ferromagnetic plate so as to form an edge flange about the adjacent edge of said magnet.



7. A closure device according to any preceding claim, wherein the edge of said magnetic shielding plate about the opening therethrough is bent towards said first ferromagnetic plate to form an edge flange about the adjacent edge of said hole through the magnet.

8. A closure device according to any preceding claim, wherein the casing is provided with an edge flange which protrudes from the outer peripheral surface of said magnetic shielding ferromagnetic plate.

9. A closure device according to any preceding claim, wherein the casing completely covers the outer surface of said magnetic shielding ferromagnetic plate.

10. A closure device according to any one of Claims 1-7, wherein the outer edge of said magnetic shielding ferromagnetic plate is recessed and an edge flange of said casing is received in said recess so that the outer surfaces of said magnetic shielding plate and said edge flange are substantially coplanar.

11. A closure device substantially as described hereinbefore with reference to Figs. 1-4 or any one of Figs. 5-30 of the accompanying drawings.

