

NEAR-FIELD COMMUNICATION DATA CARRIER INSTALLED ON METAL OBJECT

BACKGROUND OF THE INVENTION

Technical Field

[0001] The present invention relates to an induction data carrier and, more particularly to a near-field communication data carrier adapted to be mounted in a metal object.

Description of Related Art

[0002] With the advancement of smart manufacturing, cyber-physical system has gradually replaced automation, and the industry has gradually applied induction data carriers to various products to confirm the specifications or safety regulation of products. Most of the induction data carriers used today use RFID data carriers (or RFID tags), in which the type, size, mechanical properties, manufacturer, manufacturing dates, critical loads, service life, maintenance processes, safety regulation certification data, etc. of the corresponding object which the RFID data carriers disposed in, or a link address to a database that stores the corresponding data can be stored. A user has to manipulate an RFID reader to write data in the RFID data carrier or read data from the RFID data carrier. However, the cost of the RFID reader is high, and if each employee needs an RFID reader, it would be a heavy burden to the employer.

[0003] Hence, the design of induction data carrier has gradually turned to NFC data carrier that can be read by a device such as a smartphone. However, most of the products, to which the data carriers are applied, are made of metal. When the NFC data carrier is applied to a metal object, the data transmission and the induction efficiency of the NFC data carrier would be interfered by the surrounding metal material, so that the efficiency of transmission and induction decreases. For example, when the user applies the NFC data carrier to the products mainly made of metal, such as a connecting ring, a

shackle, a pull ring, a rope socket, a snatch block, a hoist ring, a swivel, a swivel hoist ring, an eye bolt, a bearing swivels, a hook, a buckle, a carabiner, a connecting link, a double hook belt, a chain, a ratchet, a rope brake, a fall arrester, a snap hook, a hoist, etc., it would cause problem for the user in application and decrease the working efficiency of the user if the data transmission and the reading efficiency of the NFC data carrier is low. In view of the above, how to design an NFC data carrier, which could be read even it is mounted in the metal object, is one of the important problems to be solved.

BRIEF SUMMARY OF THE INVENTION

[0004] In view of the above, the purpose of the present invention is to provide a near-field communication data carrier, which has a good efficiency of data transmission and data reading even when being mounted in a metal object.

[0005] The present disclosure provides a near-field communication data carrier adapted to be disposed in a metal object having a receiving portion. The near-field communication data carrier includes a body and an electronic assembly. The body is adapted to be disposed in the receiving portion, wherein a maximum diameter of the body is less than or equal to 10 mm, and a maximum height of the body is less than or equal to 10 mm. The electronic assembly is disposed in the body and includes a circuit board, a near-field communication chip, and a coil set. The circuit board has a first side and a second side opposite to the first side. The near-field communication chip is disposed on the first side of the circuit board. The coil set is disposed on the second side of the circuit board and includes a magnetic core and a coil. The coil is wound around the magnetic core and is electrically connected to the near-field communication chip.

[0006] With the aforementioned design, the near-field communication data carrier could sense an external wireless signal through the coil set and could generate induced current to drive the near-field communication chip to send a wireless signal.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

[0007] The present invention will be best understood by referring to the following detailed description of some illustrative embodiments in conjunction with the accompanying drawings, in which

[0008] FIG. 1 is a perspective view showing the near-field communication data carrier and the metal object of an embodiment according to the present invention;

[0009] FIG. 2 is a perspective view showing the near-field communication data carrier of the embodiment shown in FIG. 1;

[0010] FIG. 3 is a cross-sectional simplified view showing the near-field communication data carrier is received in the receiving portion;

[0011] FIG. 4 is a perspective view showing the electronic assembly is disposed in the body of the near-field communication data carriers shown in FIG. 1;

[0012] FIG. 5 is a perspective view showing the electronic assembly is disposed in the body of the near-field communication data carriers in another way;

[0013] FIG. 6 is a perspective view showing the electronic assembly of the embodiment shown in FIG. 1;

[0014] FIG. 7 is a sectional view of FIG.6;

[0015] FIG. 8 is an exploded view showing the electronic assembly of the embodiment shown in FIG. 1; and

[0016] FIGs. 9 to 34 are perspective views showing the near-field communication data carriers applied to different metal objects.

DETAILED DESCRIPTION OF THE INVENTION

[0017] A near-field communication data carrier 100 of an embodiment is illustrated in FIG. 1 to FIG. 8, and is adapted to be disposed in a receiving portion of a metal object. In the current embodiment, the metal object is a side pull ring 1 for example. The side pull ring 1 includes a bolt 1a, an engaging member 1b, a hanging ring 1c, and a

receiving portion which is a blind hole 1d as an example, wherein the bolt 1a is engaged with the engaging member 1b. The hanging ring 1c is pivotally engaged with the engaging member 1b. The blind hole 1d is disposed on a side of the engaging member 1b.

[0018] The near-field communication data carrier 100 includes a body 110 and an electronic assembly 120. The body 110 is adapted to be mounted, embedded, or tucked into the blind hole 1d, wherein a maximum width of the body 110 is less than or equal to 10 mm, and a maximum height thereof is less than or equal to 10 mm. In the current embodiment, the body 110 is made of a plastic material, and has a first end 111 and a second end 112 which is opposite to the first end 111. The body 110 is tucked into the blind hole 1d with the second end 112 facing the blind hole 1d. In addition, in the current embodiment, the body 110 is designed as a cylinder shape, wherein a diameter of the body 110 is about 6 mm and a height thereof is about 4 mm. The width of the body 110 expands gradually from both the first end 111 and the second end 112 to a middle portion, thereby facilitating the body 110 to be fixed firmly in the blind hole 1d. The size design of the body 110 could not only facilitate miniaturization, but also have an advantage of not affecting or over-affecting a structural strength of the metal object. In addition, the body 110 still has enough volume for receiving the electronic assembly 120 and provides a better protection for the electronic assembly 120. Preferably, in an embodiment, the body 110 is mainly made of a plastic material and a permeability material (i.e., a magnetic material), or an ingredient of the body 110 includes a magnetic plastic or a plastic magnetic. For instance, the body 110 could be made of a plastic material containing magnetic powder, wherein the plastic material could be, but not limited to, nylon, engineering plastics, or other polymer plastics. The magnetic powder could be, but not limited to, ferrite, neodymium iron boron, samarium cobalt, or samarium iron nitride, etc., thereby to improve a permeability of the body 110.

[0019] As shown in FIG. 4 to FIG. 8, the electronic assembly 120 includes a

circuit board 121, a near-field communication chip 122, and a coil set 129, wherein the circuit board 121 has a first side 121a and a second side 121b which face opposite direction to each other. The near-field communication chip 122 is disposed on the first side 121a of the circuit board 121. The coil set 129 is disposed on the second side 121b of the circuit board 121 and includes a magnetic core 123 and a coil 124, wherein the coil 124 is wound around the magnetic core 123 and is electrically connected to the near-field communication chip 122. In the current embodiment, the near-field communication chip 122 is electrically connected to the circuit board 121. The coil 124 is electrically connected to the circuit board 121 and is electrically connected to the near-field communication chip 122 through a circuit on the circuit board 121, wherein the coil 124 is wound around the magnetic core 123 along a winding axial direction L2, and preferably, the winding axial direction L2 is different from a normal line direction L1 passing through the first end 111 and the second end 112 of the body 110. For example, an angle between the winding axial direction L2 and the normal line direction L1 ranges from 45 degrees to 90 degrees. In the current embodiment, the angle between the winding axial direction L2 and the normal line direction L1 is about 90 degrees (as shown in FIG. 5 and FIG. 8). Preferably, a number of turns of the coil 124 is between 20 and 40. For example, in the current embodiment, the number of turns ranges from 28 to 33. The magnetic core 123 could be made of, but not limited to, iron, cobalt, nickel, or an alloy thereof. For instance, using manganese zinc ferrite or nickel zinc ferrite to produce the magnetic core 123, so that the magnetic core 123 has a high permeability to guide a magnetic field radiating thereon to transmit along the magnetic core 123. In this way, the coil 124 wound around an outer peripheral of the core 123 generates an induced current which is then transmitted to the near-field communication chip 122 to supply an electrical power for the operation of the near-field communication chip 122 and sending a corresponding wireless signal. With the design of the magnetic core 123 and the coil 124, an induction efficiency and an

induction success rate of the near-field communication data carrier 100 and an efficiency of data transmission could be improved. In other applications, the core 123 could be made of other types of magnetically permeable materials.

[0020] Moreover, in the current embodiment, the near-field communication data carrier 100 further includes a protective frame 128 disposed on the second side 121b of the circuit board 121, and the coil set 129 is located between the protective frame and the circuit board 121. The protective frame 128 includes two side plates 125 and a rear plate 126, wherein the two side plates 125 are respectively located at a front side and a rear side of the coil set 129 and are connected to the second side 121b of the circuit board 121. The rear plate 126 is connected to the two side plates 125 and is located at a side of the coil set 129, so that the coil set 129 is located between the circuit board 121 and the rear plate 126. Preferably, the two side plates 125 are mainly made of permeability materials and are located on the winding axial direction L2 of the coil 124 for enhancing a permeability performance of the core 123. However, the side plate of the protective frame is not limited to be two, in an embodiment, the protective frame could include only one side plate 125 disposed on a side of the core 123. In practice, it is preferred that the protective frame 128 includes two side plates 125 having permeability performance and disposed at both the front side and the rear side of the core 123. Additionally, in an embodiment, the rear plate 126 could be, but not limited to, made of insulating material.

[0021] Referring to FIG. 4 and FIG. 6, in an embodiment, the electronic assembly 120 could be uprightly disposed in the body 110. Preferably, as shown in FIG. 5, in the current embodiment, the electronic assembly 120 is disposed in the body 110 in a tilted manner, and the first side 121a of the circuit board 121, on which the near-field communication chip 122 is disposed, faces the first end 111 of the body 110. Preferably, an angle θ between a surface of the first side 121a of the circuit board 121 and the normal line direction L1 is between 15 degrees and 45 degrees. In the current embodiment, the

angle θ is about 20 degrees to 30 degrees. With the aforementioned design, when the near-field communication chip 122 is triggered or turned on, it would facilitates the near-field communication chip 122 to successfully send a wireless signal out from the metal object, improving the success rate and efficiency of wireless signal transmission to an external device (e.g. a smartphone, a laptop, a tablet, etc.).

[0022] In an embodiment, the body 110 and the electronic assembly 120 of the near-field communication data carrier 100 could be, but not limited to, manufactured in the following manner: after assembling of components of the electronic assembly 120, the electronic assembly 120 is fixed on a support (not shown), wherein the electronic assembly 120 could be connected to the support through a solder 127 disposed on the circuit board 121, and then the electronic assembly 120 is encapsulated in the body 110. For example, a plastic material could be injected to encapsulate the electronic assembly 120 by using a plastic injection molding process, thereby to produce the near-field communication data carrier 100.

[0023] Additionally, in order to allow the near-field communication data carrier 100 to possess sufficient magnetic induction strength or induction efficiency, preferably, in an embodiment, the near-field communication data carrier 100 should meet at least one of the following requirements: (1) a volume ratio of the electronic assembly 120 to the body 110 is between 10% and 35%; (2) a volume ratio of the coil set 129 to the body 110 ranges from 2% to 10%; (3) a volume ratio of a total volume of the coil set 129 and the protective frame 128 to a volume of the body 110 is between 6% and 20%. More preferably, the near-field communication data carrier 100 should meet at least one of the following requirements: (1) the volume ratio of the electronic assembly 120 to the body 110 is between 15% and 25%; (2) the volume ratio of the coil set 129 to the body 110 is between 2% and 5%; (3) the volume ratio of the total volume of the coil set 129 and the protective frame 128 to the volume of the body 110 is between 10% and 15%.

[0024] For instance, in the current embodiment, the body 110 is cylindrical in shape, and has a diameter of 6 mm and a height of 4 mm. The volume of the body 110 is about 109.2 mm³; the volume of the electronic assembly 120 is about 19.6 mm³; a volume of the coil set 129 is about 2.86 mm³; a volume of the magnetic core 123 is about 2.33 mm³; a volume of the protective frame 128 is about 9.38 mm³. The volume ratio of the electronic assembly 120 to the body 110 is about 18%; the volume ratio of the coil set 129 to the body 110 is about 2.6%; the total volume of the coil set 129 and the protective frame 128 is about 12.24 mm³; and the volume ratio of the total volume of the coil set 129 and the protective frame 128 to the volume of the body 110 is about 11.2%.

[0025] However, the near-field communication data carrier 100 of the present invention is not limited to be applied to the metal object which is the side pull ring as an example, but could be applied to other types of metal object. For example, FIG. 9 to FIG. 34 are schematic views showing the near-field communication data carrier 100 of the present invention is applied to different metal objects.

[0026] As shown in FIG. 9, the metal object 2 is a snap hook as an example. The near-field communication data carrier 100 could be disposed in the receiving portion 2a or the receiving portion 2b of the snap hook.

[0027] As shown in FIG. 10, the metal object 3 is a swivel snap hook as an example. The near-field communication data carrier 100 could be disposed in the receiving portion 3a or the receiving portion 3b of the swivel snap hook.

[0028] As shown in FIG. 11, the metal object 4 is another snap hook as an example. The near-field communication data carrier 100 could be disposed in the receiving portion 4a or the receiving portion 4b of the snap hook.

[0029] As shown in FIG. 12, the metal object 5 is a hoist as an example. The near-field communication data carrier 100 could be disposed in the receiving portion 5a or the receiving portion 5b of the hoist.

[0030] As shown in FIG. 13, the metal object 6 is an eye bolt as an example. The near-field communication data carrier 100 could be disposed in the receiving portion 6a of the eye bolt.

[0031] As shown in FIG. 14, the metal object 7 is another swivel snap hook as an example. The near-field communication data carrier 100 could be disposed in the receiving portion 7a, the receiving portion 7b, or the receiving portion 7c of the swivel snap hook.

[0032] As shown in FIG. 15, the metal object 8 is still another snap hook as an example. The near-field communication data carrier 100 could be disposed in the receiving portion 8a or the receiving portion 8b of the snap hook.

[0033] As shown in FIG. 16, the metal object 9 is a snatch block as an example. The near-field communication data carrier 100 could be disposed in the receiving portion 9a, the receiving portion 9b, or the receiving portion 9c of the snatch block.

[0034] As shown in FIG. 17, the metal object 10 is still another type of snap hook as an example. The near-field communication data carrier 100 could be disposed in the receiving portion 10a or the receiving portion 10b of the snap hook.

[0035] As shown in FIG. 18, the metal object 11 is a shackle as an example. The near-field communication data carrier 100 could be disposed in the receiving portion 11a or the receiving portion 11b of the shackle.

[0036] As shown in FIG. 19, the metal object 12 is another type of shackle as an example. The near-field communication data carrier 100 could be disposed in the receiving portion 12a or the receiving portion 12b of the shackle.

[0037] As shown in FIG. 20, the metal object 13 is a rope socket as an example. The near-field communication data carrier 100 could be disposed in the receiving portion 13a of the rope socket.

[0038] As shown in FIG. 21, the metal object 14 is another type of rope socket as

an example. The near-field communication data carrier 100 could be disposed in the receiving portion 14a of the rope socket.

[0039] As shown in FIG. 22, the metal object 15 is still another type of rope socket as an example. The near-field communication data carrier 100 could be disposed in the receiving portion 15a of the rope socket.

[0040] As shown in FIG. 23, the metal object 16 is still another type of rope socket as an example. The near-field communication data carrier 100 could be disposed in the receiving portion 16a of the rope socket.

[0041] As shown in FIG. 24, the metal object 17 is still another snap hook as an example. The near-field communication data carrier 100 could be disposed in the receiving portion 17a or the receiving portion 17b of the snap hook.

[0042] As shown in FIG. 25, the metal object 18 is a carabiner hook ring as an example. The near-field communication data carrier 100 could be disposed in the receiving portion 18a or the receiving portion 18b of the carabiner hook ring.

[0043] As shown in FIG. 26, the metal object 19 is another type of carabiner hook ring as an example. The near-field communication data carrier 100 could be disposed in the receiving portion 19a or the receiving portion 19b of the carabiner hook ring.

[0044] As shown in FIG. 27, the metal object 20 is hoist ring as an example. The near-field communication data carrier 100 could be disposed in the receiving portion 20a of the hoist ring.

[0045] As shown in FIG. 28, the metal object 21 is a buckle as an example. The near-field communication data carrier 100 could be disposed in the receiving portion 21a of the buckle.

[0046] As shown in FIG. 29, the metal object 22 is a rope grab as an example. The near-field communication data carrier 100 could be disposed in the receiving portion 22a, the receiving portion 22b, or the receiving portion 22c of the rope grab.

[0047] As shown in FIG. 30, the metal object 23 is a squeeze buckle as an example. The near-field communication data carrier 100 could be disposed in the receiving portion 23a or the receiving portion 23b of the squeeze buckle.

[0048] As shown in FIG. 31, the metal object 24 is still another type of snap hook as an example. The near-field communication data carrier 100 could be disposed in the receiving portion 24a, the receiving portion 24b, or the receiving portion 24c of the snap hook.

[0049] As shown in FIG. 32, the metal object 25 is still another type of snap hook as an example. The near-field communication data carrier 100 could be disposed in the receiving portion 25a, the receiving portion 25b, the receiving portion 25c, or the receiving portion 25d of the snap hook.

[0050] As shown in FIG. 33, the metal object 26 is still another type of snap hook as an example. The near-field communication data carrier 100 could be disposed in the receiving portion 26a, the receiving portion 26b, or the receiving portion 26c of the snap hook.

[0051] As shown in FIG. 34, the metal object 27 is a fall arrester as an example. The near-field communication data carrier 100 could be disposed in the receiving portion 27a of the fall arrester.

[0052] The location of the receiving portion as described above is mainly selected at a position that does not affect a structural strength of the metal object or has less influence to the structural strength of the metal object. However, the position of the receiving portion is not limited to the examples given above. In other embodiments, the receiving portion could be disposed on other locations of the metal object.

[0053] Besides adapted in the metal object describing above, the near-field communication data carrier could also be adapted in any kinds of connecting ring, shackle, pull ring, rope socket, snatch block, hoist ring, swivel, swivel hoist ring, eye bolt, bearing

swivels, hook, buckle, carabiner, connecting link, double hook belt, chain, ratchet, rope brake, fall arrester, snap hook, hoist or other types of metal object. In addition, a size or a shape of the body 110 is not limited to the examples given above (i.e., a cylindrical body with 6 mm (diameter) times 4 mm (height)), but could be other sizes or shapes. For example, the body 110 could be manufactured in another size, such as 4 mm times 4 mm, 5 mm times 5 mm, or 10 mm times 10mm, etc., and could be manufactured in another shape, such as a prism, or pyramid, etc. Moreover, in an embodiment, a maximum diameter of the body 110 could be designed between 1 mm and 10 mm, 2 mm and 10 mm, or 3 mm and 10 mm; the maximum height of the body 110 could be designed between 1 mm and 10 mm, 2 mm and 10 mm, or 3 mm and 10 mm.

[0054] With the aforementioned design, when the user would like to know about an information of a metal object, the user could scan the near-field communication data carrier 100 installed on the metal object through an electronic device such as a smartphone, a laptop, etc., thereby to get the relevant information about the metal object, such as model number, size, mechanical properties, manufacturer, manufacturing date, critical load, service life, and maintenance process, etc.

[0055] It must be pointed out that the embodiments described above are only some embodiments of the present invention. All equivalent structures and material which employ the concepts disclosed in this specification and the appended claims should fall within the scope of the present invention

WHAT IS CLAIMED IS:

1. A near-field communication data carrier (100) adapted to be disposed in a metal object (2-27) having a receiving portion (2a-27a, 2b-5b, 7b-12b, 17b-19b, 22b-26b, 7c, 9c, 22c, 24c, 25c, 26c), comprising:

a body (110) adapted to be mounted in the receiving portion (2a-27a, 2b-5b, 7b-12b, 17b-19b, 22b-26b, 7c, 9c, 22c, 24c, 25c, 26c), wherein a maximum diameter of the body (110) is less than or equal to 10 mm, and a maximum height of the body (110) is less than or equal to 10 mm; and

an electronic assembly (120) disposed in the body (110) and including a circuit board (121), a near-field communication chip (122), and a coil set (129), wherein the circuit board (121) has a first side (121a) and a second side (121b) opposite to the first side (121a); the near-field communication chip (122) is disposed on the first side (121a) of the circuit board (121); the coil set (129) is disposed on the second side (121b) of the circuit board (121) and includes a magnetic core (123) and a coil (124); the coil (124) is wound around the magnetic core (123) and is electrically connected to the near-field communication chip (122).

2. The near-field communication data carrier (100) of claim 1, wherein the body (110) has a first end (111) and a second end (112) opposite to the first end (111), and is received in the receiving portion (2a-27a, 2b-5b, 7b-12b, 17b-19b, 22b-26b, 7c, 9c, 22c, 24c, 25c, 26c) with the second end (112) facing the receiving portion (2a-27a, 2b-5b, 7b-12b, 17b-19b, 22b-26b, 7c, 9c, 22c, 24c, 25c, 26c); the electronic assembly (120) is disposed in the body (110) in a tilted manner, and the first side (121a) of the circuit board (121) faces the first end (111).

3. The near-field communication data carrier (100) of claim 2, wherein the body (110) has a normal line direction (L1) passing through the first end (111) and the second end (112); an angle (θ) between a surface of the first side (121a) of the circuit board (121) and

the normal line direction (L1) is between 15 degrees and 45 degrees.

4. The near-field communication data carrier (100) of claim 1, wherein a volume ratio of the electronic assembly (120) to the body (110) is between 10% and 35%.

5. The near-field communication data carrier (100) of claim 1, wherein a volume ratio of the coil set (129) to the body (110) is between 2% and 10%.

6. The near-field communication data carrier (100) of claim 1, further comprising a protective frame (128) disposed on the second side (121b) of the circuit board (121), wherein the coil set (129) is located between the circuit board (121) and the protective frame (128).

7. The near-field communication data carrier (100) of claim 6, wherein a volume ratio of a total volume of the coil set (129) and the protective frame (128) to a volume of the body (110) is between 6% and 20%.

8. The near-field communication data carrier (100) of claim 6, wherein the protective frame (128) comprises at least one side plate (125), which is mainly made of a permeability material, and is disposed at a side of the magnetic core (123), and is located on a winding axial direction (L2) of the coil (124).

9. The near-field communication data carrier (100) of claim 1, wherein the body (110) has a first end (111) and a second end (112) opposite to the first end (111), and is received in the receiving portion (2a-27a, 2b-5b, 7b-12b, 17b-19b, 22b-26b, 7c, 9c, 22c, 24c, 25c, 26c) with the second end (112) facing the receiving portion (2a-27a, 2b-5b, 7b-12b, 17b-19b, 22b-26b, 7c, 9c, 22c, 24c, 25c, 26c); the body (110) has a normal line direction (L1) passing through the first end (111) and the second end (112); a winding axial direction (L2) of the coil (124) is different from the normal line direction (L1).

10. The near-field communication data carrier (100) of claim 1, wherein an angle between a winding axial direction (L2) of the coil (124) and a normal line direction (L1) of the body (110) is between 45 degrees and 90 degrees.

11. The near-field communication data carrier (100) of claim 1, wherein a number of turns of the coil (124) is between 20 and 40.

12. The near-field communication data carrier (100) of claim 1, wherein the body (110) is mainly made of a plastic material and a magnetic material.