US 20240339279A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2024/0339279 A1**

Huang et al. (43) **Pub. Date: Oct. 10, 2024**

(54) **BUTTON AND ELECTRONIC DEVICE**

(71) Applicant: **AAC Technologies (Nanjing) Co., Ltd.**, Nanjing (CN)

(72) Inventors: **Xingzhi Huang**, Nanjing (CN); **Wei Song**, Nanjing (CN); **Xiaofeng Pu**, Nanjing (CN); **Lubin Mao**, Nanjing (CN); **Yun Tang**, Nanjing (CN); **Jie Ma**, Nanjing (CN)

(21) Appl. No.: **18/395,659**

(22) Filed: **Dec. 25, 2023**

Related U.S. Application Data

(63) Continuation of application No. PCT/CN2023/087006, filed on Apr. 7, 2023.

Publication Classification

(51) **Int. Cl.**

H01H 71/24 (2006.01)

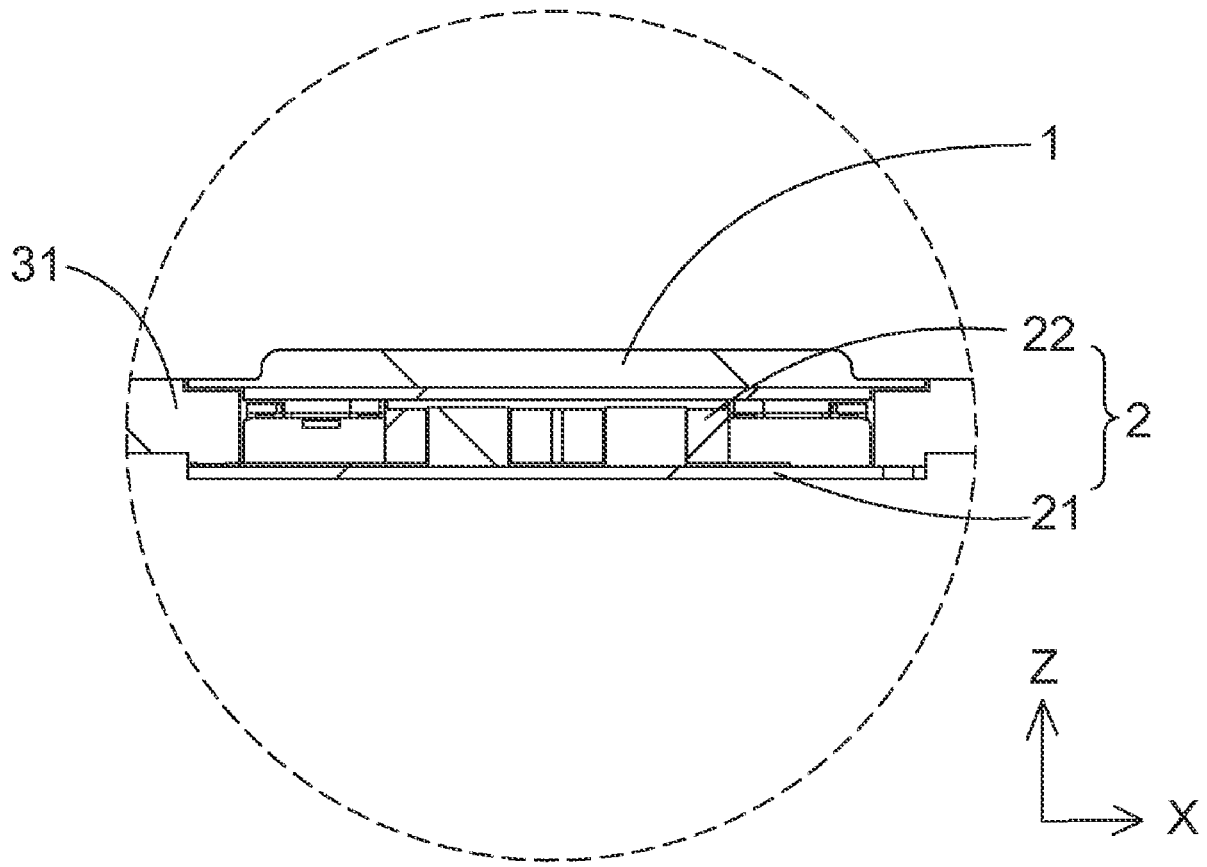
G06F 3/01 (2006.01)

(52) **U.S. Cl.**

CPC ***H01H 71/2454*** (2013.01); ***G06F 3/016*** (2013.01); ***H01H 71/2481*** (2013.01)

(57) **ABSTRACT**

A button and electronic device, including shell and motor connected to the shell, the motor includes base and magnetic circuit, accommodating space is formed in the base, at least part of the magnetic circuit is accommodated in the accommodating space. The magnetic circuit at least includes magnetic conductive cover plate, voice coil and iron core, the magnetic conductive cover plate is fixedly connected to the shell and movably connected to the base. The voice coil and the iron core are accommodated in the accommodating space and are fixedly connected to the base, the voice coil is sleeved on the iron core, preset gap is formed between the iron core and the magnetic conductive cover plate. The voice coil and the iron core drive the magnetic conductive cover plate to drive the shell to move. The button can achieve feedback function to the user, thereby improving accuracy of user operation.



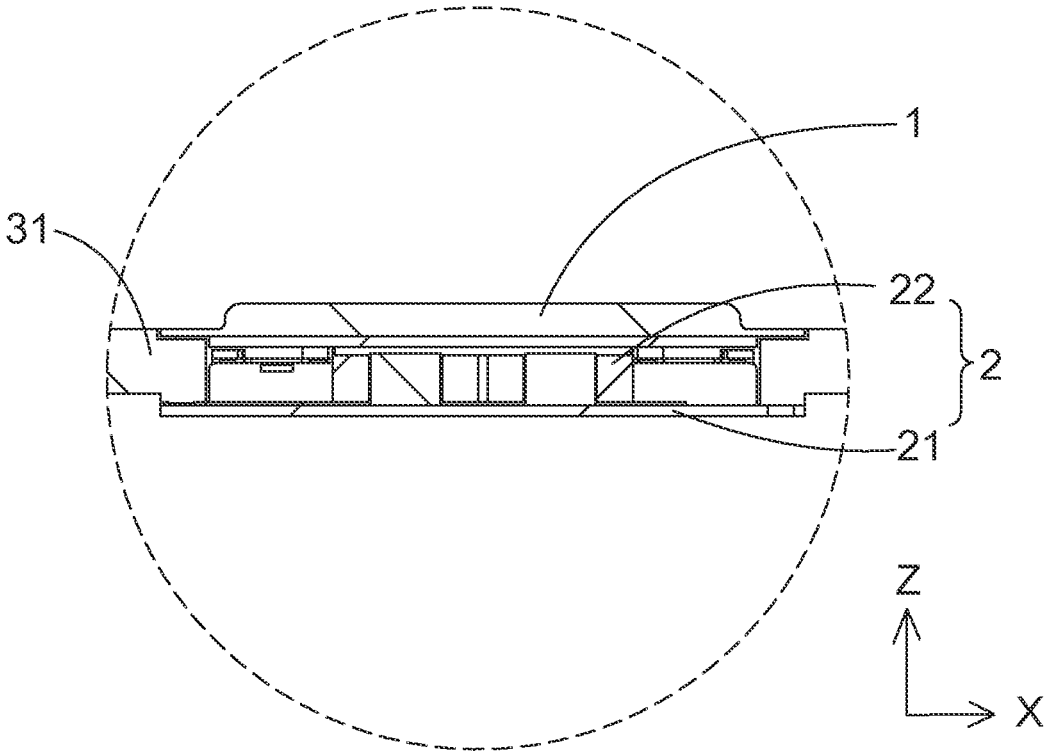


FIG. 1

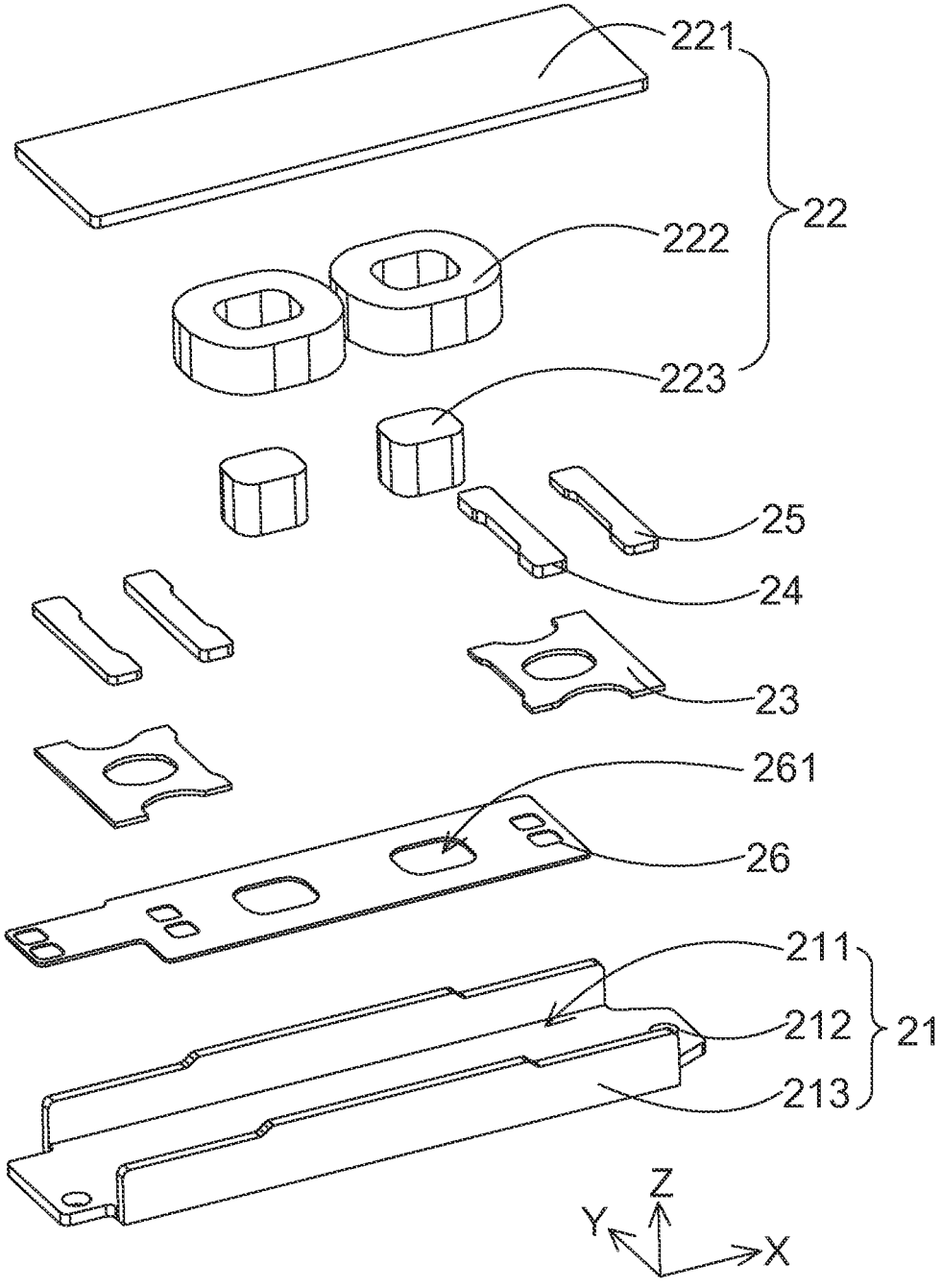


FIG. 2

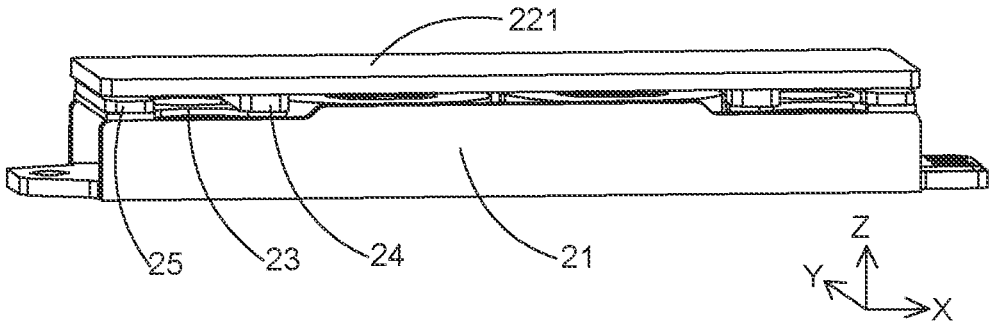


FIG. 3

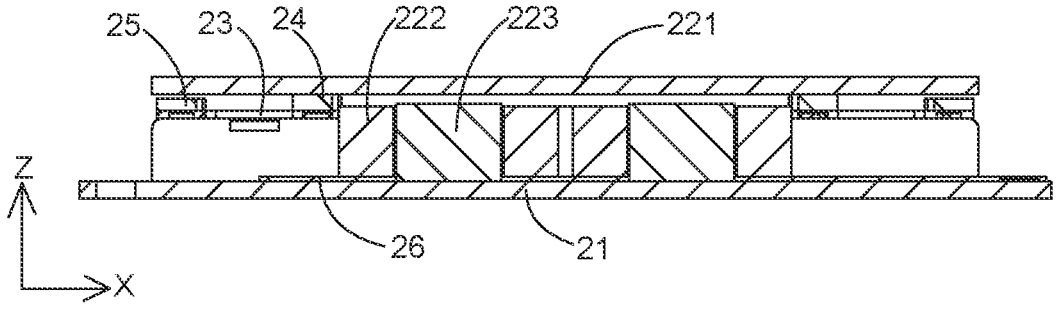


FIG. 4

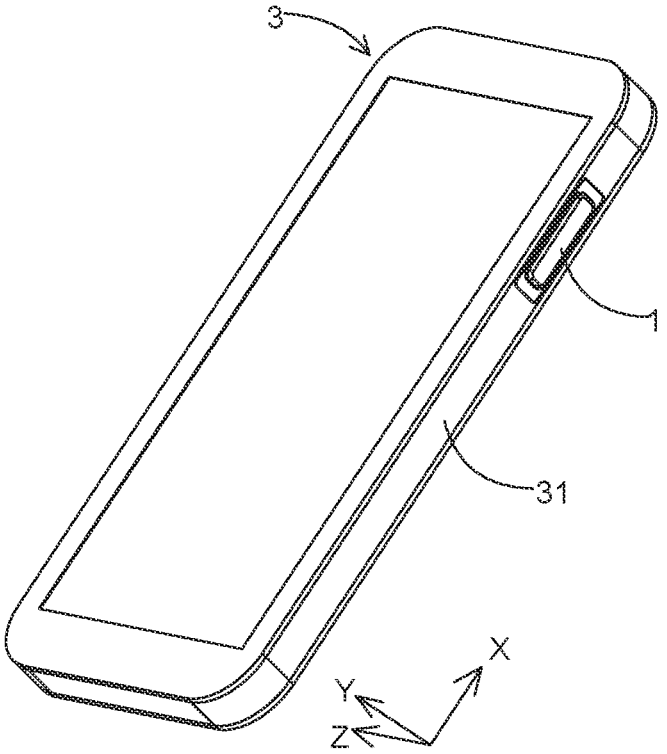


FIG. 5

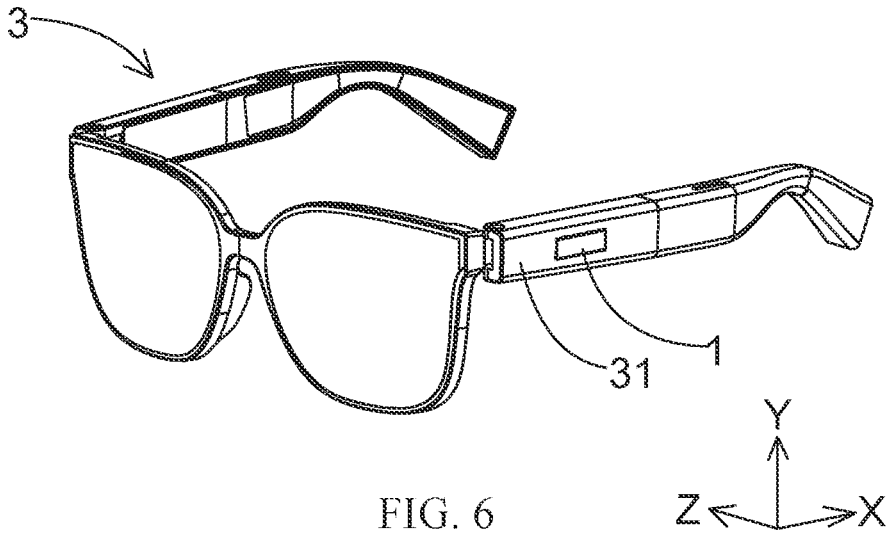


FIG. 6

BUTTON AND ELECTRONIC DEVICE

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] The present disclosure is a continuation of International Application No. PCT/CN2023/087006, filed on Apr. 7, 2023, the content of which is incorporated herein by reference in its entirety.

TECHNICAL FIELD

[0002] The invention relates to the technical field of mobile terminals, in particular to a button and electronic device.

BACKGROUND

[0003] With the development of science and technology, electronic devices such as smart phones, earphones, glasses and the like gradually incorporate into peoples' daily life and working environment. Users can operate the electronic device through a button on the electronic device, so that the electronic device implements different functions and achieves different effects. However, the button on conventional electronic devices has poor feedback effects to the users, it is difficult for the users to confirm whether the user effectively operates the button, which results in low accuracy of the users' operations and thus poor user experience.

[0004] Therefore, it is necessary to provide a button and an electronic device to solve the above problems.

SUMMARY

[0005] The invention aims to provide a button and an electronic device that can provide force feedback to the user.

[0006] The technical solution of the present disclosure is as follows.

[0007] A first aspect of the present disclosure provides a button, including a shell and a motor, the motor is connected to the shell. The motor includes a base and a magnetic circuit, an accommodating space is formed in the base, and at least part of the magnetic circuit is accommodated in the accommodating space. The magnetic circuit at least includes a magnetic conductive cover plate, a voice coil, and an iron core. The magnetic conductive cover plate is located on one side of the base. The magnetic conductive cover plate is fixedly connected to the shell and is movably connected to the base. The voice coil and the iron core are accommodated in the accommodating space and both fixedly connected to the base. The voice coil is sleeved on the iron core. Along a thickness direction of the motor, a preset gap is provided between the iron core and the magnetic conductive cover plate. The voice coil and the iron core are configured to drive the magnetic conductive cover plate to drive the shell to move in the thickness direction of the motor.

[0008] As an improvement, the magnetic circuit includes two iron cores and two voice coils. The two iron cores are arranged along a length direction of the motor. The two voice coils are respectively sleeved on the corresponding iron cores, and directions of current in the two voice coils are opposite to each other.

[0009] As an improvement, the motor further includes at least one elastic member, in the thickness direction of the motor, the elastic member is located between the magnetic conductive cover plate and the base, one end of the elastic member is connected to the magnetic conductive cover plate, and the other end of the elastic member is connected to the base.

[0010] As an improvement, the elastic member is a flat spring.

[0011] As an improvement, the motor further includes a first welding tab and a second welding tab, in a length direction of the motor, the first welding tab and the second welding tab are located on two sides of the elastic member and connected to the elastic member. In a thickness direction of the motor, the first welding tab and the second welding tab are located between the magnetic conductive cover plate and the elastic member, the first welding tab is connected to the magnetic conductive cover plate, and a gap is formed between the second welding tab and the magnetic conductive cover plate.

[0012] As an improvement, the motor includes two elastic members, in a length direction of the motor, the two elastic members are located on two sides of the base, and the voice coil and the iron core are located between the two elastic members.

[0013] As an improvement, the motor further includes a circuit board located in the accommodating space and connected to the base; the voice coil is located on a side of the circuit board away from the base, and is electrically connected to the circuit board; the circuit board is provided with at least one through hole along the thickness direction of the motor, and the iron core is located in the corresponding through hole.

[0014] As an improvement, the base is a magnetic conductor, the base includes a bottom plate and two side plates, the bottom plate and the two side plates enclose to form the accommodating space. The two side plates are located on two sides of the bottom plate and fixedly connected to the bottom plate, and the two side plates both extend in the thickness direction of the motor.

[0015] As an improvement, the button further includes a sensor configured to detect operation of the button, and the sensor is electrically connected to the motor.

[0016] A second aspect of the present disclosure provides an electronic device, including a body and a button mounted on the body, and the button is the button as described above.

[0017] The present disclosure has the following beneficial effects: the button can perform force feedback to the user through the motor after the user operates the button, which serves as a prompt for the user to confirm their operation. This design is beneficial to improving the accuracy of the user's button operation and thus enhancing the user's experience.

BRIEF DESCRIPTION OF DRAWINGS

[0018] FIG. **1** is a cross-sectional view of a button according to the present disclosure;

[0019] FIG. **2** is an exploded schematic diagram of a motor of a button according to the present disclosure;

[0020] FIG. **3** is a schematic diagram of an appearance of a motor of a button according to the present disclosure;

[0021] FIG. **4** is a cross-sectional view of a motor of a button according to the present disclosure;

[0022] FIG. **5** is a schematic diagram of an electronic device according to a first embodiment of the present disclosure;

[0023] FIG. **6** is a schematic diagram of an electronic device according to a second embodiment of the present disclosure.

REFERENCE SIGNS

[0024] **1**-shell;
[0025] **2**-motor;
[0026] **21**-base;
[0027] **211**-accommodating space
[0028] **212**-bottom plate;
[0029] **213**-side plate;
[0030] **22**-magnetic circuit;
[0031] **221**-magnetic conductive cover plate;
[0032] **222**-voice coil;
[0033] **223**-iron core;
[0034] **23**-elastic member;
[0035] **24**-first welding tab;
[0036] **25**-second welding tab;
[0037] **26**-circuit board;
[0038] **261**-through hole;
[0039] **3**-electronic device;
[0040] **31**-body.

DESCRIPTION OF EMBODIMENTS

[0041] The present disclosure is further described below with reference to the accompanying drawings and embodiments.

[0042] As shown in FIG. **1** to FIG. **4**, the present disclosure provides a button, the button includes a shell **1** and a motor **2**, and the motor **2** is connected to the shell **1**. The motor **2** includes a base **21** and a magnetic circuit **22**. An accommodating space **211** is formed in the base **21**, and at least part of the magnetic circuit **22** is accommodated in the accommodating space **211**. The magnetic circuit **22** at least includes a magnetic conductive cover plate **221**, a voice coil **222**, and an iron core **223**. The magnetic conductive cover plate **221** is located on one side of the base **21**. The magnetic conductive cover plate **221** is fixedly connected to the shell **1** and movably connected to the base **21**. The voice coil **222** and the iron core **223** are accommodated in the accommodating space **211** and are both fixedly connected to the base **21**. The voice coil **222** is sleeved on the iron core **223**. Along a thickness direction Z of the motor **2**, a preset gap is provided between the iron core **223** and the magnetic conductive cover plate **221**, and the voice coil **222** and the iron core **223** are configured to drive the magnetic conductive cover plate **221** to drive the shell **1** to move in the thickness direction Z of the motor **2**.

[0043] The shell **1** can be a button cap of a button, and the magnetic conductive cover plate **211** is fixed to the shell **1** and covers the base **21**. The material of the magnetic conductive cover plate **221** and the iron core **223** can be iron cobalt alloy, or the material of the magnetic conductive cover plate **221** can also be other suitable magnetically conductive materials according to actual use requirements for the button, which is not limited herein. When the user presses the button, the motor **2** drives the shell **1** to move by the magnetic conductive cover plate **211**, so as to perform force feedback to the user. After the user presses the button, the shell **1** drives the magnetic conductive cover plate **221** to move in a direction close to the base **21** under the action of an external force. The voice coil **222** is energized, so that the iron core **223** in the voice coil **222** is magnetized. A magnetic gap is formed between the iron core **223** and the magnetic conductive cover plate **221**, so that a corresponding force is generated between the iron core **223** and the magnetic conductive cover plate **221**. The direction of the force can be changed by changing the direction of the current in the voice coil **222**, and the magnetic conductive cover plate **221** is driven by this force to move the shell **1** up and down, thereby achieving force feedback to the user, i.e., generating a simulated vibration for the user.

[0044] The present disclosure provides a motor **2** in the button, so that after the user operates the button, the button can perform force feedback to the user through the motor **2**, and the feedback plays a role of prompting the user, thereby facilitating confirmation of their operation. This design is beneficial to improving the accuracy of the user's button operation, and is beneficial to improving the user's experience. On the other hand, the motor **2** in the present disclosure has a relatively simple structure. It is beneficial to reduce the overall volume of the motor **2** by simplifying the internal structure of the motor **2**, thereby facilitating miniaturization of the button, and facilitating the user to perform accurate pressing operations, and thereby improving the user's experience.

[0045] As shown in FIG. **2** to FIG. **4**, in an embodiment, the magnetic circuit **22** includes two iron cores **223** and two voice coils **222**. The two iron cores **223** are arranged in the length direction X of the motor **2**. The two voice coils **222** are respectively sleeved on corresponding iron cores **223**, and directions of current in the two voice coils **222** are opposite to each other.

[0046] After the two voice coils **222** are energized, the directions of current in the two voice coils **222** are opposite to each other. This arrangement enables a closed magnetic circuit to be formed in the motor **2**, thereby increasing the force between the iron core **223** and the magnetic conductive cover plate **221**, that is, increasing the driving force of the motor **2**, and thus enabling the motor **2** to provide the user with more obvious force feedback.

[0047] As shown in FIG. **2** to FIG. **4**, in an embodiment, the motor **2** further includes at least one elastic member **23**. In the thickness direction Z of the motor **2**, the elastic member **23** is located between the magnetic conductive cover plate **221** and the base **21**. One end of the elastic member **23** is connected to the magnetic conductive cover plate **221**, and the other end is connected to the base **21**.

[0048] After the user presses the button, the elastic member **23** is compressed by an external force. After the voice coil **222** is de-energized, the force between the iron core **223** and the magnetic conductive cover plate **221** disappears, and the magnetic conductive cover plate **221** and the shell **1** can be reset under the action of the elastic member **23**.

[0049] By providing the elastic member **23** between the magnetic conductive cover plate **221** and the base **21**, it is beneficial to achieve automatic reset of the magnetic conductive cover plate **221** and the shell **1**, thereby facilitating repeated use of the button by the user. In addition, the elastic member **23** also supports the magnetic conductive cover plate **221** and the shell **1**, thereby improving the stability of the magnetic conductive cover plate **221** on the shell **1**, and further facilitating the operation of the user.

[0050] In an embodiment, the elastic member **23** is a flat spring.

[0051] The flat spring is relatively simple to process and convenient to assemble. In addition, the use of the flat spring

is also beneficial to saving the space inside the motor **2**, thereby realizing the miniaturization design of the motor **2**, and saving the volume of the entire button.

[0052] As shown in FIG. **2** to FIG. **4**, in an embodiment, the motor **2** further includes a first welding tab **24** and a second welding tab **25**. In the length direction X of the motor **2**, the first welding tab **24** and the second welding tab **25** are respectively located on two sides of the elastic member **23** and connected to the elastic member **23**. In the thickness direction Z of the motor **2**, the first welding tab **24** and the second welding tab **25** are located between the magnetic conductive cover plate **221** and the elastic member **23**. The first welding tab **24** is connected to the magnetic conductive cover plate **221**, and a gap is formed between the second welding tab **25** and the magnetic conductive cover plate **221**.

[0053] One end of the elastic element **23** having the first welding tab **24** is a free end that can move up and down, while the other end of the elastic element **23** having the second welding tab **25** is a fixed end that is fixed to the base **21**. The elastic member **23** is fixed to the magnetic conductive cover plate **221** through the first welding tab **24**, and there is a certain gap between the second welding tab **25** and the magnetic conductive cover plate **221**, thereby providing a space for the movement of the magnetic conductive cover plate **221**. When the user presses the button down until the magnetic cover plate **221** abuts against the second welding plate **25**, the button is pressed in place and cannot move further. For example, the first solder tab **24** and the second solder tab **25** can be made of stainless steel.

[0054] By providing the first welding tab **24**, the stability of the connection between the elastic member **23** and the magnetic conductive cover plate **221** can be improved, thereby facilitating the automatic reset of the magnetic conductive cover plate **211** through the elastic member **23**. The movement range of the magnetic conductive cover plate **221** can be limited by providing the second welding tab **25**, making it easier for the user to operate the button.

[0055] As shown in FIG. **2** to FIG. **4**, in an embodiment, the motor **2** includes two elastic members **23**. In the length direction X of the motor **2**, the two elastic members **23** are located on two sides of the base **21**, and the voice coil **222** and the iron core **223** are located between the two elastic members **23**.

[0056] By providing the two elastic members **23**, a more stable and uniform restoring force can be obtained for the magnetic conductive cover plate **221**, further facilitating the automatic reset of the magnetic conductive cover plate **221**. In addition, by this design, both ends of the magnetic conductive cover plate **221** are supported by the elastic members **23**, which is beneficial to further improving the stability of the magnetic conductive cover plate **221**.

[0057] As shown in FIG. **2** and FIG. **4**, in an embodiment, the motor **2** further includes a circuit board **26**. The circuit board **26** is located in the accommodating space **211** and connected to the base **21**. The voice coil **222** is located on one side of the circuit board **26** away from the base **21**, and is electrically connected to the circuit board **26**. The circuit board **26** is provided with at least one through hole **261** in a thickness direction Z of the motor **2**, and the iron core **223** is located in the corresponding through hole **261**.

[0058] The circuit board **26** can be a flexible circuit board fixed at the bottom of the base **21**. The circuit board **26** can be connected to an external power source to supply power to the voice coil **222** to drive the magnetic conductive cover plate **221** to move. The iron core **223** can be located in the through hole **261**, so that the iron core **223** directly abuts against the base **21**. Providing the through hole **261** can reduce the possibility of interference between the circuit board **26** and the iron core **223**.

[0059] As shown in FIG. **2**, in an embodiment, the base **21** is a magnetic conductor. The base **21** includes a bottom plate **212** and two side plates **213**. The bottom plate **212** and the two side plates **213** enclose to form the accommodating space **211**. The two side plates **213** are respectively located on two sides of the bottom plate **212** and fixedly connected to the bottom plate **212**, and the two side plates **213** both extend in the thickness direction Z of the motor **2**.

[0060] The base **21** can be made of an iron-cobalt alloy, or other magnetic conductive materials selected according to actual use requirements for the button. The side plate **213** can be perpendicularly disposed on the bottom plate **212**, thereby protecting and limiting the elements inside the accommodating space **211**.

[0061] By providing the base **21** as a magnetic conductor, it is further beneficial to form a closed magnetic circuit in the motor **2**, thereby providing a greater driving force for the magnetic conductive cover plate **221**, and further enhancing the effect of button force feedback, so as to improve the user's experience and accuracy of user's operation.

[0062] In an embodiment, the button further includes a sensor (not shown in the figures), which is configured to detect operations to the button, and electrically connected to the motor **2**.

[0063] The sensor can be configured to detect information such as a pressing position and a pressing force of the user on the button. Based on this information, the user's specific operating methods can be determined, such as whether the button is being pressed or slid. After the user operates the button, the sensor can detect that the magnetic conductive cover plate **221** has moved. At this time, the voice coil **222** can be energized, so that a force is generated between the iron core **223** and the magnetic conductive cover plate **221**, thereby realizing force feedback to the user.

[0064] By arranging the sensor, the button detection function can be realized, so that the user can use the button conveniently, and the user's experience is improved.

[0065] As shown in FIG. **1**, FIG. **5** and FIG. **6**, the present disclosure further provides an electronic device **3**, including a body **31** and a button. The button is installed on the body **31**, which is any one of the above buttons.

[0066] The electronic device **3** can be a mobile phone, an earphone, a handle, a steering wheel, a VR device, an AR device, or the like, which is not limited herein. The body **31** can be a middle frame of the electronic device **3**, and the button can be a side button of the electronic device **3**. The base **21** of the motor **2** can be fixed on the body **31**. The user can perform operations such as clicking and sliding the button on the body **31** to control the electronic device **3**. The sensor in the button can feed back the detected pressing position, pressing force and other information to the electronic device **3**. The electronic device **3** can identify the action of the user according to the feedback result of the sensor, thereby enabling the electronic device **3** to perform corresponding operations. The specific process may be as follows: the user operates the button by applying an external force to the button. Under the action of the external force, the magnetic conductive cover plate **221** can move to a side close to the base **21**. At this time, the elastic member **23** is

compressed. The sensor detects that the magnetic conductive cover plate **221** has moved. The voice coil **222** is energized to magnetize the iron core **223**. A force is generated between the iron core **223** and the magnetic conductive cover plate **221**. The magnetic conductive cover plate **221** can provide force feedback to the user after receiving the force. The sensor also detects information such as a pressing position and a pressing force. The electronic device **3** uses the detection result of the sensor to operate the entire device, and can call an effect library according to the detection result of the sensor to achieve the effect of pressing or sliding the button.

[0067] By providing the above button as described in the above embodiments, it is beneficial to implement timely interaction between the electronic device **3** and the user, and can provide rich control experience for the user, so that the user can perform different operations on the button to implement different functions and effects of the electronic device **3**, thereby improving the convenience of use of the electronic device **3**. Moreover, the electronic device **3** can provide corresponding force feedback for the user after the user operates the button to prompt the user, thereby improving the accuracy of the user operation and further improving the user experience.

[0068] The above are only embodiments of the present disclosure, and it should be noted herein that those skilled in the art can also make modifications or improvements without departing from the concept of the present disclosure, but these modifications or improvements are all within the protection scope of the present disclosure.

What is claimed is:

1. A button, comprising:

a shell;

a motor connected to the shell;

wherein the motor includes a base and a magnetic circuit, an accommodating space is formed in the base, and at least part of the magnetic circuit is accommodated in the accommodating space;

the magnetic circuit at least comprises a magnetic conductive cover plate, a voice coil and an iron core, the magnetic conductive cover plate is located on one side of a base; the magnetic conductive cover plate is fixedly connected to the shell and is movably connected to the base; the voice coil and the iron core are accommodated in the accommodating space and fixedly connected to the base; the voice coil is sleeved on the iron core; along a thickness direction of the motor, a preset gap is formed between the iron core and the magnetic conductive cover plate; and the voice coil and the iron core are configured to drive the magnetic conductive cover plate to drive the shell to move in the thickness direction of the motor.

2. The button as described in claim **1**, wherein the magnetic circuit comprises two iron cores and two voice coils, the two iron cores are arranged along a length direction of the motor, the two voice coils are respectively sleeved on the corresponding iron cores, and directions of current in the two voice coils are opposite to each other.

3. The button as described in claim **1**, wherein the motor further comprises at least one elastic member, in the thickness direction of the motor, the elastic member is located between the magnetic conductive cover plate and the base, one end of the elastic member is connected to the magnetic conductive cover plate, and the other end of the elastic member is connected to the base.

4. The button as described in claim **3**, wherein the elastic member is a flat spring.

5. The button as described in claim **4**, wherein the motor further comprises a first welding tab and a second welding tab, in a length direction of the motor, the first welding tab and the second welding tab are located on two sides of the elastic member and connected to the elastic member; in a thickness direction of the motor, the first welding tab and the second welding tab are located between the magnetic conductive cover plate and the elastic member, the first welding tab is connected to the magnetic conductive cover plate, and a gap is formed between the second welding tab and the magnetic conductive cover plate.

6. The button as described in claim **4**, wherein the motor comprises two elastic members, in a length direction of the motor, the two elastic members are located on two sides of the base, and the voice coil and the iron core are located between the two elastic members.

7. The button as described in claim **1**, wherein the motor further comprises a circuit board located in the accommodating space and connected to the base; the voice coil is located on a side of the circuit board away from the base, and is electrically connected to the circuit board; the circuit board is provided with at least one through hole along the thickness direction of the motor, and the iron core is located in the corresponding through hole.

8. The button as described in claim **1**, wherein the base is a magnetic conductor, the base comprises a bottom plate and two side plates, the bottom plate and the two side plates enclose to form the accommodating space; the two side plates are located on two sides of the bottom plate and fixedly connected to the bottom plate, and the two side plates both extend in the thickness direction of the motor.

9. The button as described in claim **1**, wherein the button further comprises a sensor configured to detect operation of the button, and the sensor is electrically connected to the motor.

10. An electronic device, comprising:

a body;

a button mounted on the body, wherein the button comprises:

a shell;

a motor connected to the shell;

wherein the motor includes a base and a magnetic circuit, an accommodating space is formed in the base, and at least part of the magnetic circuit is accommodated in the accommodating space;

the magnetic circuit at least comprises a magnetic conductive cover plate, a voice coil and an iron core, the magnetic conductive cover plate is located on one side of a base; the magnetic conductive cover plate is fixedly connected to the shell and is movably connected to the base; the voice coil and the iron core are accommodated in the accommodating space and fixedly connected to the base; the voice coil is sleeved on the iron core; along a thickness direction of the motor, a preset gap is formed between the iron core and the magnetic conductive cover plate; and the voice coil and the iron core are configured to

drive the magnetic conductive cover plate to drive the shell to move in the thickness direction of the motor.

* * * * *