United States Patent [19]

Kashio

[11] **3,859,612**

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[54] **SWITCHING DEVICE**

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[73] Assignee: **Casio Computer Co., Ltd.,** Tokyo, Japan

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[30] **Foreign Application Priority Data**

Apr. 3, 1973 Japan 48-37985

[52] **U.S. Cl.** **335/205,** 335/207

[51] **Int. Cl.** **H01h 9/00**

[58] **Field of Search** 335/205, 206, 207

[56] **References Cited**

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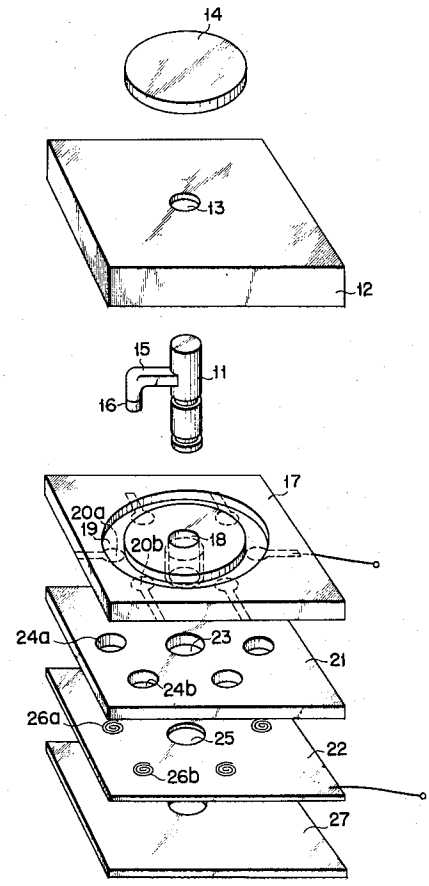
Primary Examiner—G. Harris

Attorney, Agent, or Firm—Flynn & Frishauf

[57] **ABSTRACT**

A switching device includes a plurality of fixed contacts supported on a print board having an annular guide opening and arranged along the annular opening; a plurality of movable contacts formed integral with a magnetic plate and arranged to oppositely face the plurality of fixed contacts, respectively, with a clearance left therebetween; and an operating handle disposed, through the print board, on a side opposite to the side on which the magnetic plate is arranged. The handle is provided with a permanent magnet. When any one of the fixed contacts is selected by operating the handle, the corresponding movable contact is attracted, under the magnetic attraction of the permanent magnet, into contact with the fixed contact.

4 Claims, 3 Drawing Figures



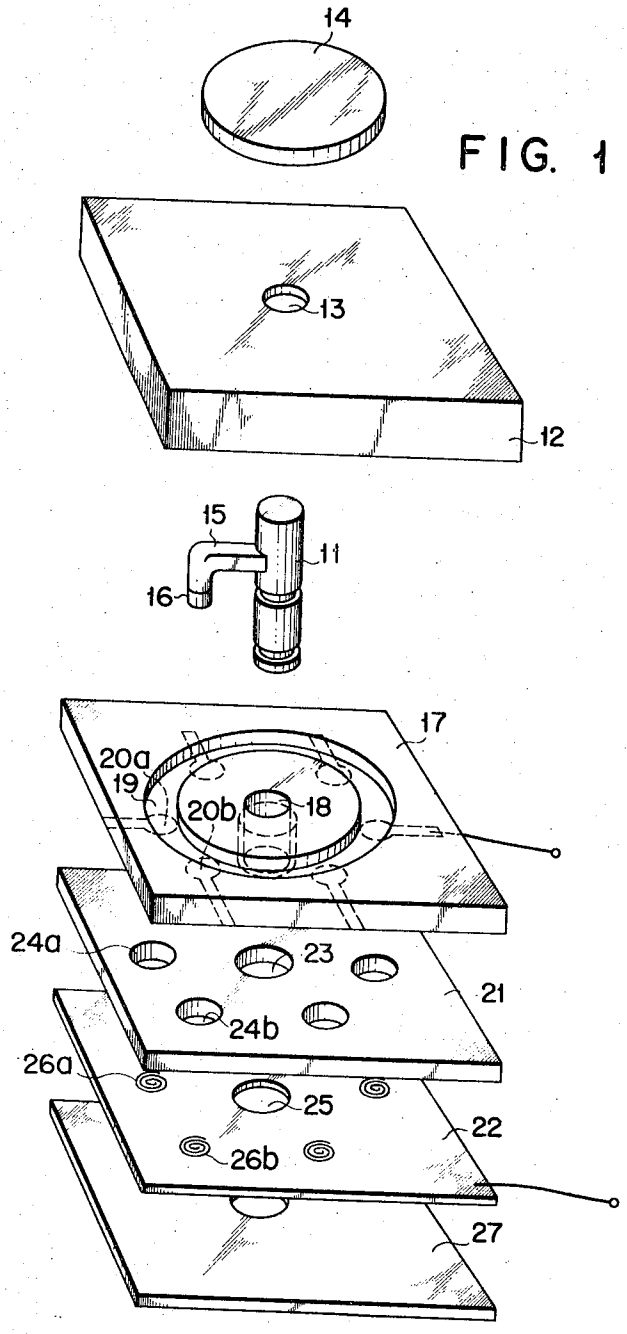


FIG. 1

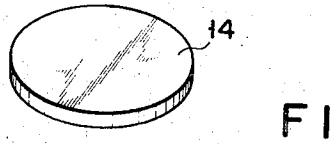

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FIG. 3

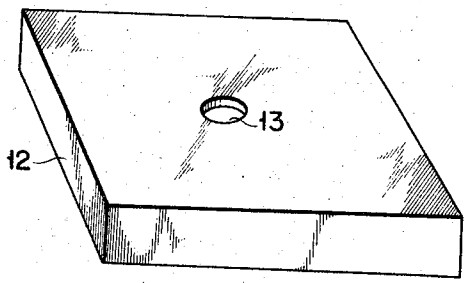
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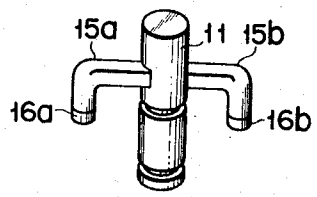
FIG. 2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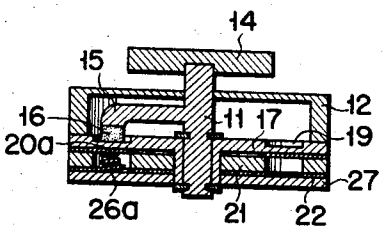
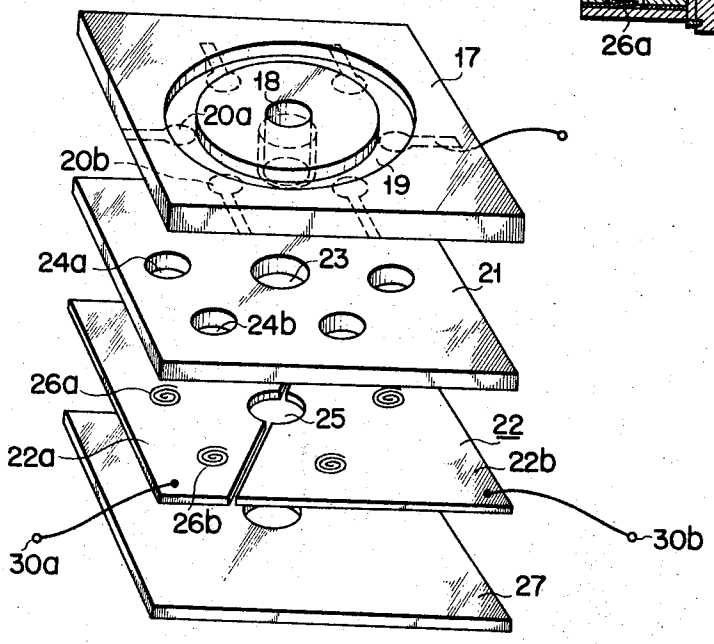
11
15b
16a
16b


14
15
16
11
17
12
19
20a
27
26a
21
22


17
18
20a
20b
19
24a
23
21
24b
26a
25
22
22a
22b
26b
30a
30b
27

SWITCHING DEVICE

BACKGROUND OF THE INVENTION

This invention relates to an improved switching device capable of effecting the on-off operation of contacts under the influence of magnetic attraction.

A conventional switching device is provided with fixed contacts and movable contacts supported on corresponding elastic members. With this device, the operation of a switch actuator causes the elastic member supporting the movable contact to be driven to permit the movable contact to be brought into contact with the fixed contact under resilient force of the elastic member. When the movable contact is moved toward and away from the fixed contact under the resilient force of the elastic member, the elastic member is liable to be vibrated. As a result, chattering is liable to occur between the fixed contact and the movable contact. Where any electrical signals for various instructions are obtained upon movement of the movable contact toward and away from the fixed contact, noise signals are liable to be introduced at the rise of the electrical signal. In this case, the signal is not suitable for the instruction purpose and there arises a case where it is impossible to effect control on a one operation-one instruction basis. Furthermore, the chattering causes spark discharges upon movement of the movable contact toward and away from the fixed contact with the resultant damage to the surfaces of the contacts.

With a rotary- or slide-type switching device the movable contact is vibratingly moved toward and away from the fixed contact and mechanical vibrations are liable to occur particularly when the movable contact is brought into sliding engagement with the fixed contact. Consequently, chattering is very liable to occur. Since the speed at which the movable contact is moved toward and away from the fixed contact corresponds to the operating speed of an actuator for effecting a rotary or sliding movement, the surfaces of the contacts are damaged to a considerable extent and greater noise signals are liable to be introduced into electrical signals derived upon movement of the movable contact toward and away from the fixed contact.

SUMMARY OF THE INVENTION

It is accordingly the object of this invention to provide a compact, dust-proof rotary- or slide-type switching device having a simple construction and capable of preventing any chattering from occurring between movable and fixed contacts, capable of effectively deriving electrical signals from various circuits or for various instructions, and capable of minimizing any damage to the surfaces of the contacts.

According to this invention a plurality of fixed contacts are easily provided, by printing etc., on a print board and a plurality of movable contacts are easily provided by etching a magnetic plate in places to form cuts integral with the magnetic plate. The switching device so constructed can be applied to a slide-type switching device as well as a rotary-type switching device.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an exploded view of a switching device according to one embodiment of this invention;

FIG. **2** is a sectional view showing the switching device of FIG. **1**; and

FIG. **3** is an exploded view showing another embodiment of this invention.

This invention will be further explained by reference to the accompanying drawings.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIGS. **1** and **2**, there is shown a rotary switching device. An operating shaft **11** extends through a hole **13** of a supporting case **12** and an actuator **14** is capped on the top end of the operating shaft. The operating shaft **11** is rotated by the operation of the actuator **14.** On the side surface of the operating shaft is integrally provided a downturned arm **15** which is located below the support case **12.** A permanent magnet **16** is integrally mounted to the forward end of the downturned arm. The lower end portion of the operating shaft extends through a hole **18** of a print board **17.** In the print board an annular guide opening **19** is provided along a locus described when the permanent magnet **16** is rotated as a result of the rotation of the operating shaft. Consequently, when the operating shaft **11** is rotated, the permanent magnet **16** is driven along the guide opening **19.** On the reverse surface of the print board a plurality of fixed contacts **20***a*, **20***b* . . . are provided, by printing, etc., at certain intervals so as to correspond to the guide opening. The guide opening **19** may be provided as required. If the magnetic attraction of the permanent magnet imparts any adverse influence to the reverse side of the print board **17** the guide opening may be omitted. Under the print board a magnetic plate **22** is disposed through a spacer. In the spacer **21** are provided a hole **23** through which the operating shaft **11** extends and a plurality of apertures **24***a*, **24***b*, . . . corresponding to the plurality of fixed contacts **20***a*, **20***b* . . . respectively. In the magnetic plate **22** are provided a hole **25** through which the operating shaft **11** extends and a plurality of spiral cuts **26***a*, **26***b* . . . oppositely facing, through the respective apertures of the spacer, the plurality of fixed contacts **20***a*, **20***b* . . . respectively. The spiral cuts constitute a movable contact. Though the movable contact is shown as being spiral in shape, it may take any form, provided that it can be attracted under the magnetic attraction of the permanent magnet **16.** For example, the movable contact may be rectangular, lip-like, etc., in shape. These cuts may be easily formed by etching. Under the magnetic plate **22** a protective plate **27** is disposed. The rotary switching device is so fabricated integral with the supporting case.

When the actuator **14** is operated, the operating shaft **11** is rotated to permit the permanent magnet **16** to be set at a position corresponding to any one of the fixed contacts **20***a*, **20***b* . . . When the permanent magnet **16** is set at a position, for example, corresponding to the fixed contact **20***a*, the movable contact **26***a* constituted of the magnetic material is attracted, under the attractive force of the permanent magnet, toward the permanent magnet and thus the fixed contact **20** as shown in FIG. **2** so that the movable contact **26***a* is kept into electric contact with the fixed contact **20***a*. In other words, any contact circuit is selectively created by rotating the actuator **14** and thus the operating shaft **11.** In this case, the movable contacts **26***a*, **26***b* . . . are driven under the magnetic attraction of the permanent

magnet and any one of the movable contacts is, when magnetically attracted toward any one of the fixed contacts **20***a*, **20***b* . . . , kept in contact with the latter under a strong attractive force of the permanent magnet. Since no mechanically driven elastic support member for supporting the movable contact is used in this case, any mechanical vibration as occurring between the movable and fixed contacts can be prevented. As a result, any chattering can be prevented. This permits transmission of elastic signals, generation of instruction signals, and so on to be effectively controlled without introduction of any noise signals. Furthermore, since in a contact throw-in state a distance between the permanent magnet and the movable contact is sufficiently reduced, the movable contact is kept, under a sufficiently strong magnetic force, into electric contact with the fixed contact.

There will be explained another embodiment of this invention by reference to FIG. **3**.

In this embodiment, the same reference numerals are employed to indicate parts or elements corresponding to those shown in FIGS. **1** and **2** and any further explanation is therefore omitted. With this embodiment, a magnetic plate **22** is formed by a pair of complementary plate halves **22***a* and **22***b* with an insulation space left therebetween. To the plate halves **22***a* and **22***b*, input terminals **30***a* and **30***b* are respectively connected. A pair of downturned arms **15***a* and **15***b* are mounted on the opposite side surfaces of an operating shaft **11**. When any one of movable contacts of a magnetic plate **22***a* is selected through a permanent magnet **16***a* by operating an actuator **14**, a corresponding contact of the magnetic plate **22***b* is simultaneously selected through a permanent magnet **16***b*. Consequently, two contact circuits are simultaneously created by operating an actuator **14** once.

Though with the above-mentioned embodiments the movable contact is formed by suitably cutting in places the magnetic plate by a suitable means, magnetic pieces can be attached to the places in which the movable contacts are positioned. In this case, larger magnetic pieces may be used so that magnetic attraction can be effectively acted on the magnetic piece.

The contact is subjected, as required, to a plating treatment etc. Any specific contact material may be attached to the place in which the fixed contact is positioned. The fixed contact is not restricted to such a type as printed on a print board and it may be separately and independently formed using any suitable contact means.

What is claimed is:

1. A switching device comprising an operating handle having a permanent magnet driven to describe a predetermined locus; a plurality of fixed contacts supported on a plate and in proximity to the locus of the permanent magnet with an insulating space left therebetween; and a plurality of movable contacts formed integral with a magnetic plate and disposed, through the first-mentioned plate, on a side opposite to the side on which the operating handle is disposed, said plurality of movable contacts correspondingly facing said plurality of fixed contacts, respectively, so that when any one of the fixed contacts is selected by operating the handle, the corresponding movable contact is attracted, under the magnetic attraction of the permanent magnet, into contact with the fixed contact.

2. The switching device according to claim **1** in which the permanent magnet is mounted in plural numbers to the operating handle.

3. The switching device according to claim **1** in which said magnetic plate comprises a plurality of magnetic sections, with an insulating space left therebetween, on which the movable contact is formed.

4. The switching device according to claim **1** in which said magnetic plate comprises an electroconductive plate on which magnetic pieces are attached as movable contacts.

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