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(54) Title: END POSITION DETECTING APPARATUS OF A MOBILE ELEMENT, AND A DISK APPARATUS USING THE SAME		
(57) Abstract In a moving position detecting apparatus of mobile element for detecting when the mobile element moving along a specified running path has reached a specified position, such as a pickup device of a disk apparatus, without applying reaction to the mobile element, move of the mobile element from the specified position is lessened and eliminated. The position detecting apparatus for detecting the moving position of a mobile element includes the mobile element moving reversibly along a specified running path, conductive electrode disposed along said running path, detecting electrode disposed on the mobile element, and detecting means for detecting contact or non-contact between the conductive electrode and detecting electrode. The detecting electrode is disposed so as to contact or not to contact with the conductive electrode by the move of the mobile element. The position of the mobile element is detected by the detecting means. This position detecting means further includes a guide shaft for guiding the move of the mobile element, and a drive shaft for driving the mobile element. The conductive electrode is disposed on the surface of the guide shaft or the surface of the drive shaft. The detecting electrode is disposed so as to contact electrically with the conductive electrode from the direction crossing with the moving direction of the detecting electrode.		

DESCRIPTION

End position detecting apparatus of a mobile element, and a disk apparatus using the same

TECHNICAL FIELD

The present invention relates to an information recording and reproducing apparatus, and more particularly to a moving position detecting apparatus of a mobile element used in a disk apparatus of the like.

BACKGROUND ART

In a conventional disk apparatus of magnetic disk or optical disk, a pickup device is moved to an innermost circumferential position or outermost circumferential position of a disk. A position detecting apparatus detects when the pickup apparatus is moved to a specified position. Thus, the specified operation of the pickup apparatus is done automatically.

As the position detecting means, hitherto, a push type switch has been used. In this case, when the pickup apparatus is moved to an innermost circumferential position or outermost circumferential position of a disk, the pickup apparatus pushes this push type switch from its moving direction, thereby detecting that the pickup apparatus has

reached the innermost circumferential position or outermost circumferential position.

In the push type switch, when a pressing work force larger than specified is applied to the pressing knob portion, the pressing knob portion is moved by overcoming the elastic force (reaction force) of the spring in the switch. When the pressing knob portion moves more than a specific distance, an electric contact is opened or closed. When the pressing force of the pressing knob portion is eliminated, it is restored to the initial state by the thrusting force of the spring.

Therefore, when the pressing work force and the reaction force are not mutually balanced, that is, when the reaction force by the push type switch and the pressing work force by the pickup apparatus are not adjusted properly, if the pickup apparatus is sent to the innermost circumferential position or outermost circumferential position of the disk along the radial direction of the disk, the push type switch cannot be driven. Moreover, if the pickup apparatus is driven, the pickup apparatus may be shifted from the specified position by the reaction force of the switch after driving.

SUMMARY OF THE INVENTION

According to a first aspect of the present invention, there is provided disk recording and reproducing apparatus comprising:

- a turntable for mounting a disk for recording information thereon; and

- a position detecting apparatus for detecting the relative positions of a mobile pickup element and a disk mounted on said turntable;

wherein said position detecting apparatus comprises:

said mobile element reversibly movable along a predetermined running path;

a conductive electrode disposed along a portion of said running path;

a detecting electrode disposed on said mobile element so as either to make contact with or not to make contact with said conductive electrode with movement of said mobile element; and

detecting means for detecting either contact or non-contact between said conductive electrode and said detecting electrode, to indicate the position of said mobile element with reference to a specified position.

Preferably, the position detecting apparatus further includes a guide shaft for guiding the movement of the mobile element, and the conductive electrode is disposed on the surface of the guide shaft.

Preferably too, the detecting electrode is disposed so as to make contact electrically with the conductive electrode from a direction at an angle to the direction of movement of the detecting electrode.

With the guide shaft above, the position detecting apparatus may further include a drive shaft for moving the mobile element.

Preferably, the conductive electrode is disposed on a first surface of the surfaces of at least a portion of said guide shaft;

said mobile element has a through-hole;

said guide shaft passes through said through-hole; and

said detecting electrode is disposed on said mobile element so as to make contact with said conductive electrode at a position proximate the centre of said through-hole.

Alternatively, the position detecting apparatus may further comprise:

a guide shaft for guiding the movement of said mobile element; and

a drive shaft for moving said mobile element; and

said conductive electrode may be disposed on the surface of a portion of said drive shaft.

Alternatively again, the position detecting apparatus may further comprises a drive shaft for moving said mobile element; with

said conductive electrode disposed on the surface of a portion of said drive shaft;

said detecting electrode disposed between said mobile element and said drive shaft; and

said detecting electrode operable to make contact with the surface of said drive shaft and said conductive electrode.

In another alternative, the position detecting apparatus further includes a drive shaft for moving the mobile element, and an elastic member disposed between the drive shaft and the mobile element, with the conductive electrode disposed on the surface of a portion of the drive shaft, the detecting electrode disposed between said elastic member and said drive shaft, and said detecting electrode operable to make contact with the surface of said drive shaft and said conductive electrode while being pressed by the pressing force of said elastic member.

In this constitution, application of reaction to the mobile element is prevented. Moreover, movement of the mobile element from the specified position is lessened and eliminated.

According to a second aspect of the present invention, there is provided position detecting apparatus for disk recording and reproducing apparatus, said position detecting apparatus comprising:

- a mobile pickup element reversibly movable along a predetermined running path;

- an electrode holder disposed along said running path;

- a conductive electrode disposed on the surface of a portion of said electrode holder;

- a detecting electrode disposed on said mobile element so as to make contact with said conductive electrode from a direction at an angle to the direction of movement of said mobile element; and

detecting means for detecting the presence or absence of electric connection between said conductive electrode and said detecting electrode, to determine when said mobile element is positioned at a predetermined position on said running path.

Preferably, the electrode holder includes a guide shaft disposed along said running path, so that said mobile element may slide and move; and

said conductive electrode is disposed on the surface of a portion of said guide shaft.

In this instance, the mobile element may have a through-hole;

said guide shaft may be disposed by penetrating through said through-hole; and

each one of said plurality of detecting electrodes may be operable to make contact with the surface of said guide shaft within said through-hole.

The detecting electrode may have a plurality of detecting electrodes;

said plurality of detecting electrodes may be disposed on

a portion of said mobile element; and

said detecting means may detect contact of each detecting electrode of said plurality of detecting electrodes with said conductive electrode.

The electrode holder may be disposed to be parallel with said running path.

Usefully, said electrode holder further may have a drive shaft for transmitting rotary motion from a motor; with

said conductive electrode disposed on the surface of a portion of said drive shaft.

In this case, the mobile element may include a motion converting device for converting the rotary motion from said drive shaft into a motion for moving said mobile element reversibly along said running path; with

said detecting electrode having a plurality of detecting electrodes;

said plurality of detecting electrodes disposed between said drive shaft and said mobile element;

said plurality of detecting electrodes disposed in said motion converting device; and

said detecting means operable to detect when said detecting electrode contacts with said conductive electrode.

Further a spring may be disposed between said drive shaft and mobile element; with

said motion converting device pressed to said drive shaft and mobile element by a spring force; and

said plurality of detecting electrodes disposed in said motion converting device so as to make contact with the surface of said electrode holder.

According to a third aspect of the present invention, there is provided position detecting apparatus for disk recording and reproducing apparatus, comprising:

a mobile element reversibly movable along a specified running path;

a conductive electrode disposed along said running path;

a detecting electrode disposed on said mobile element so as either to make contact with or not to make contact with said conductive electrode with movement of said mobile element; and

detecting means for detecting either contact or non-contact between said conductive electrode and said detecting electrode, to indicate the position of said mobile element with reference to a specified position;

wherein said mobile element has a pickup device for use in a disk apparatus for performing at least one of recording and reproducing information.

In the embodied invention, with the above aspects and preferred or other options, various results occur.

The detecting electrode disposed on the mobile element may contact the conductive electrode from a direction at an angle to the direction of movement of the mobile element. It hence prevents a reaction to the mobile element. Moreover, movement of the mobile element from the specified position is reduced or even eliminated.

The mobile element guide shaft for the movement of the mobile element and the electrode holder may be common, so that the structure is simplified.

Where there are a plurality of detecting means, more secure detection is realized.

The detecting electrodes can be disposed in the mobile element forming the through-hole directly by driving or other means, and the structure is simplified.

The drive shaft for the movement of the mobile element and the electrode holder may be common, so that the structure is simplified.

The motion converting device for the movement of the mobile element and the detecting electrode may be common, so that the structure is simplified.

Where a plurality of detecting means are provided and the drive shaft and mobile element are pressed in contact with each other by the spring, secure detection of the position of the mobile element is realized.

Where a lubricant is provided for moving the mobile element smoothly, disturbance of electric conduction by the lubricant is prevented, and the position of the mobile element can be detected accurately.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is an essential perspective view of a moving position detecting apparatus of mobile element in an embodiment of the invention.

Fig. 2 is a partially cut-away perspective view of the moving position detecting apparatus of mobile element in the embodiment of the invention.

Fig. 3 (a) and Fig. 3 (b) are side views schematically showing the operating state of the moving position detecting apparatus of mobile element in the embodiment of the invention.

Fig. 4 is an essential perspective view of a moving position detecting apparatus of mobile element in other embodiment of the invention.

Fig. 5 is a partially cut-away sectional view of the moving position detecting apparatus of mobile element shown in Fig. 4.

Fig. 6 (a) and Fig. 6 (b) are side views schematically showing the operating state of the moving position detecting apparatus of mobile element shown in Fig. 4.

SPECIFIC DESCRIPTION

Exemplary embodiments of the moving position detecting apparatus of mobile element of the invention are specifically described below.

Exemplary Embodiment 1

As an exemplary embodiment of the moving position detecting apparatus of mobile element of the invention, a pickup device of a disk apparatus is described below.

Fig. 1 is a perspective view of essential parts of a moving position detecting apparatus of mobile element in an exemplary embodiment of the invention. Fig. 2 is a partial magnified view of the moving position detecting apparatus shown in Fig. 1.

In Fig. 1 and Fig. 2, the moving position detecting

apparatus comprises a pickup device 3 as mobile element, electrode holders 4a, 4b, 7 detecting electrodes 5, 6, detecting means 11a, 11b, and a drive shaft 10. The electrode holders 4a, 4b, 7 including mobile element guide shafts 4a, 4b, and a conductive electrode 7, and the mobile element guide shafts 4a, 4b have a first mobile element guide shaft 4a and a second mobile element guide element 4b. The conductive electrode 7 is disposed at a specified position of the surface of the mobile element guide shaft 4a. The detecting electrodes 5, 6 have a first detecting electrode 5 and a second detecting electrode 6. The detecting means 11a, 11b have first detecting means 11a and second detecting means 11b. The mobile element has a motion converting device (not shown) for converting the rotary motion of the drive shaft into a linear motion. The mobile element itself has a function of motion converting device. The mobile element moves along the guide shaft while being driven by the driving force of the drive shaft.

The pickup device 3 is made of a non-conductive material. The pickup device has a relatively light weight. The pickup device 3 has a pickup 8, and the disk (not shown) is mounted on a turntable 2. The disk has a function of information medium for recording and reproducing information. Two through-holes 9 are formed in the pickup device 3. Two guide shafts 4a, 4b are disposed parallel to each other by

penetrating through the respective through-holes 9. These guide shafts 4a, 4b at least have a surface composed of a non-conductive material. The pickup device 3 can slide and move along these guide shafts 4a, 4b.

A feed screw rod 10 as drive shaft is disposed parallel to these guide shafts 4a, 4b, and the feed screw rod 10 is reversibly rotated by a gear 1 coupled to a motor (not shown). The pickup device 3 is always engaged with the feed screw rod 10. The pickup device 3 is reversibly slidable along the guide shafts 4a, 4b depending on the rotating direction of the feed screw rod 10.

On the surface at a specified position in the longitudinal direction of the first guide shaft 4a of the two guide shafts 4a, 4b, a conductive electrode 7 made of a conductive material is disposed. In this embodiment, the conductive electrode 7 is disposed on the surface at the end in the longitudinal direction of the first guide shaft 4a. This conductive electrode 7 is grounded. Near the end of the through-hole 9 penetrating through the first guide shaft 4a, the two detecting electrodes, that is, first detecting electrode 5 and second detecting electrode 6 are adjustably driven into the pickup device 3. Two detecting electrodes 5, 6 are disposed so that the leading ends of the two detecting electrodes 5, 6 may press the first guide shaft 4a to the inner wall of the through-hole 9 while abutting against the

surface of the first guide shaft 4a, from mutually different directions. That is, the pickup device 3 moves while the leading ends of the first detecting electrode 5 and second detecting electrode 6 are contacting with the surface of the first guide shaft 4a from the direction crossing with the moving direction of the pickup device 3 in the through-hole 9. The direction crossing with the moving direction of the pickup device 3 is, for example, a right-angle direction. In such constitution, with the disk mounted on the turntable 2, the pickup device 3 moves to the innermost circumference and outermost circumference of the disk. When the pickup device 3 has reaches a specified position, it is detected by the position detecting apparatus. That is, the relative positions of the pickup 8 and disk are detected.

In this constitution, when the pickup device 3 moves and the first detecting electrode 5 and second detecting electrode 6 are moved to the position contacting with the conductive electrode 7 as shown in Fig. 3 (a), an electric conductivity takes place between the first detecting electrode 5 and conductive electrode 7, and between the second detecting electrode 6 and conductive electrode 7. This electric conduction is detected by the first detecting means 11a and second detecting means 11b to detect conduction between the first detecting electrode 5 and conductive electrode 7, or between the second detecting electrode 6 and

conductive electrode 7, or both. By this detection, it is confirmed that the pickup device 3 has moved to a specified position. As the first detecting means 11a and second detecting means 11b, ammeters or the like may be used.

Similarly, as shown in Fig. 3 (b), at the positions where these detecting electrodes 5, 6 are remote from the conductive electrode 7, electric conduction is not obtained between the detecting electrodes 5, 6 and conductive electrode 7.

Accordingly, by detecting it with ammeters or other detecting means 11a, 11b, it is confirmed that the pickup device 3 is not moved to the specified position.

The embodiment is constituted so as to obtain an electric conduction between the detecting electrodes 5, 6 and conductive electrode 7 when the pickup device has moved to the specified position, but not limited to this constitution, to the contrary, it may be also effective to constitute so as to set in non-conducting state when reaching a specified position.

In the embodiment, the conductive electrode 7 is disposed on the guide shaft 4a as electrode holder, and the conductive electrode 7 and electrode holder 4a are shared, but not limited to this constitution, the electrode holder 4a and the conductive electrode 7 may be independently disposed mutually.

Also in the embodiment, the conductive electrode 7 is disposed on the first guide shaft 4a, but not limited to this

constitution, the conductive electrode 7 may be also disposed on the second guide shaft 4b.

Exemplary Embodiment 2

A moving position detecting apparatus of mobile element in other exemplary embodiment of the invention is described below while referring to the accompanying drawings. Same constituent elements as in the preceding embodiment are identified with same reference numerals, and the description of the same constituent elements is omitted.

Fig. 4 is an essential perspective view of the moving position detecting apparatus of mobile element in exemplary embodiment 2 of the invention. Fig. 5, Fig. 6 (a), and Fig. 6 (b) are partial magnified views of the moving position detecting apparatus shown in Fig. 4.

In Fig. 4 and Fig. 5, the moving position detecting apparatus comprises a pickup device 3 as mobile element, mobile element guide shafts 4a, 4b, a drive shaft 10, a conductive electrode 7, detecting electrodes 5, 6, and detecting means 11a. The conductive electrode 7 is disposed at a specified position on the surface of the feed screw rod 10 as drive shaft. A rack 12 and a spring 13 are disposed between the pickup device 3 and feed screw rod 10. The rack 12 has a function as motion converting device. The rack 12 is always pressed and engaged with the pickup device 3 and

feed screw rod 10 by the spring 13 as an elastic member. The rack 12 has a function of converting the rotary motion of the feed screw rod 10 into a sliding motion of the pickup device 3.

On the surface at a specified position of the feed screw rod 10, a conductive electrode 7 of a conductive material is formed, and this conductive electrode is grounded. The conductive electrode is disposed, for example, on the surface at the end of the feed screw rod 10. As shown in Fig. 5, the detecting electrodes 5, 6 are disposed in part of the rack 12. The feed screw rod 10 and detecting electrode 5 are pressed by the spring 13, and the detecting electrodes 5, 6 contact with the surface of the feed screw rod 10. The detecting electrode is composed of a plurality of electrodes of first detecting electrode 5 and second detecting electrode 6.

The first guide shaft 4a and second guide shaft 4b are disposed parallel to each other. The pickup device 3 is held by the first guide shaft 4a and second guide shaft 4b, and is reversibly movable along the first guide shaft 4a and second guide shaft 4b. A lubricant is applied on the surface of the guide shafts 4a, 4b, and this lubricant has a function of smoothing the move of the mobile element.

From the direction crossing with the moving direction of the pickup device 3, the pickup device 3 moves with the detecting electrode 5 kept in contact with the surface of the

feed screw rod 10. The direction crossing with the moving direction of the pickup device 3 is, for example, a right-angle direction.

In this constitution, as the pickup device 3 moves, and, as shown in Fig. 6 (a), when the detecting electrode 5 is moved to the position contacting with the conductive electrode 7, an electric conduction between the detecting electrode 5 and conductive electrode 7 is obtained. This electric conduction is detected by the detecting means 11a, and it is confirmed that the pickup device 3 has moved to the specified position.

Similarly, as shown in Fig. 6 (b), in the state of the detecting electrode 5 departing from the conductive electrode 7, electric conduction is not obtained between the detecting electrode 5 and conductive electrode 7. Accordingly, by detecting it by the detecting means 11a, it is confirmed that the pickup device 3 is not moved to the specified position.

This embodiment is constituted so that the electric conduction between the detecting electrode 5 and conductive electrode 7 is obtained when the pickup device is moved to the specified position, but not limited to this constitution, to the contrary, it may be constituted so that the detecting electrode 5 and conductive electrode 7 do not conduct when the pickup device has reached the specified position.

In the embodiment, it is constituted to obtain electric

conduction between one detecting electrode 5 and conductive electrode 7, but not limited to this constitution, it may be also effective to constitute so as to obtain electric conduction between a plurality of detecting electrodes and conductive electrode 7.

INDUSTRIAL APPLICABILITY

In the constitution of the moving position detecting apparatus of mobile element of the invention, the detecting electrode disposed on the mobile element contacts with the conductive electrode from the direction of crossing with the moving direction of the mobile element. In this constitution, application of reaction to the mobile element is prevented, and the move of the mobile element from the specified position is lessened and eliminated.

Since the mobile element guide shaft and electrode holder are shared, the structure of the moving position detecting apparatus is simplified.

As the feed screw shaft and mobile element are pressed to contact by the spring pressure, the position of the mobile element is detected accurately.

In the constitution of the lubricant disposed on the surface of the guide shaft, disturbance of electric conduction by the lubricant is prevented, and the position of the mobile element can be detected accurately.

CLAIMS

1. Disk recording and reproducing apparatus comprising:
 - a turntable for mounting a disk for recording information thereon; and
 - a position detecting apparatus for detecting the relative positions of a mobile pickup element and a disk mounted on said turntable;wherein said position detecting apparatus comprises:
 - said mobile element reversibly movable along a predetermined running path;
 - a conductive electrode disposed along a portion of said running path;
 - a detecting electrode disposed on said mobile element so as either to make contact with or not to make contact with said conductive electrode with movement of said mobile element; and
 - detecting means for detecting either contact or non-contact between said conductive electrode and said detecting electrode, to indicate the position of said mobile element with reference to a specified position.
2. The disk apparatus of claim 1, wherein
 - said position detecting apparatus further comprises a guide shaft for guiding the movement of said mobile element; and
 - said conductive electrode is disposed on the surface of a portion of said guide shaft.
3. The disk apparatus of claim 2, wherein said detecting electrode is disposed so as to make electrical contact with said conductive electrode from a direction at an angle to the direction of movement of the detecting electrode.
4. The disk apparatus of claim 2, wherein said position detecting apparatus further comprises a drive shaft for moving said mobile element.
5. The disk apparatus of claim 2, wherein
 - said conductive electrode is disposed on a first surface of the surfaces of

at least a portion of said guide shaft;

said mobile element has a through-hole;

said guide shaft passes through said through-hole; and

said detecting electrode is disposed on said mobile element so as to make contact with said conductive electrode at a position proximate the centre of said through-hole.

6. The disk apparatus of claim 1, wherein
said position detecting apparatus further comprises:
a guide shaft for guiding the movement of said mobile element; and
a drive shaft for moving said mobile element; and
said conductive electrode is disposed on the surface of a portion of said drive shaft.
7. The disk apparatus of claim 1, wherein
said position detecting apparatus further comprises a drive shaft for moving said mobile element;
said conductive electrode is disposed on the surface of a portion of said drive shaft;
said detecting electrode is disposed between said mobile element and said drive shaft; and
said detecting electrode is operable to make contact with the surface of said drive shaft and said conductive electrode.
8. The disk apparatus of claim 1, wherein
said position detecting apparatus further comprises:
a drive shaft for moving said mobile element; and
an elastic member disposed between said mobile element and drive shaft;
said conductive electrode is disposed on the surface of a portion of said drive shaft;
said detecting electrode is disposed between said elastic member and said drive shaft; and

said detecting electrode is operable to make contact with the surface of said drive shaft and said conductive electrode while being pressed by the pressing force of said elastic member.

9. Position detecting apparatus for disk recording and reproducing apparatus, said position detecting apparatus comprising:

- a mobile pickup element reversibly movable along a predetermined running path;

- an electrode holder disposed along said running path;

- a conductive electrode disposed on the surface of a portion of said electrode holder;

- a detecting electrode disposed on said mobile element so as to make contact with said conductive electrode from a direction at an angle to the direction of movement of said mobile element; and

detecting means for detecting the presence or absence of electric connection between said conductive electrode and said detecting electrode, to determine when said mobile element is positioned at a predetermined position on said running path.

10. The position detecting apparatus of claim 9, wherein

- said electrode holder includes a guide shaft disposed along said running path, so that said mobile element may slide and move; and

- said conductive electrode is disposed on the surface of a portion of said guide shaft.

11. The position detecting apparatus of claim 9, wherein

- said detecting electrode has a plurality of detecting electrodes;

- said plurality of detecting electrodes are disposed on a portion of said mobile element; and

- said detecting means detects contact of each detecting electrode of said plurality of detecting electrodes with said conductive electrode.

12. The position detecting apparatus of claim 10, wherein
said mobile element has a through-hole;
said guide shaft is disposed by penetrating through said through-hole; and
each one of said plurality of detecting electrodes is operable to make
contact with the surface of said guide shaft within said through-hole.
13. The position detecting apparatus of claim 9, wherein said electrode holder
is disposed to be parallel with said running path.
14. The position detecting apparatus of claim 13, wherein
said electrode holder further has a drive shaft for transmitting rotary motion
from a motor; and
said conductive electrode is disposed on the surface of a portion of said
drive shaft.
15. The position detecting apparatus of claim 14, wherein
said mobile element includes a motion converting device for converting the
rotary motion from said drive shaft into a motion for moving said mobile element
reversibly along said running path;
said detecting electrode has a plurality of detecting electrodes;
said plurality of detecting electrodes are disposed between said drive shaft
and said mobile element;
said plurality of detecting electrodes are disposed in said motion
converting device; and
said detecting means is operable to detect when said detecting electrode
contacts with said conductive electrode.
16. The position detecting apparatus of claim 15, further comprising a spring
disposed between said drive shaft and mobile element; wherein
said motion converting device is pressed to said drive shaft and mobile
element by a spring force; and
said plurality of detecting electrodes are disposed in said motion

converting device so as to make contact with the surface of said electrode holder.

17. Position detecting apparatus for disk recording and reproducing apparatus, comprising:

- a mobile element reversibly movable along a specified running path;

- a conductive electrode disposed along said running path;

- a detecting electrode disposed on said mobile element so as either to make contact with or not to make contact with said conductive electrode with movement of said mobile element; and

- detecting means for detecting either contact or non-contact between said conductive electrode and said detecting electrode, to indicate the position of said mobile element with reference to a specified position;

- wherein said mobile element has a pickup device for use in a disk apparatus for performing at least one of recording and reproducing information.

ABSTRACT

In a moving position detecting apparatus of mobile element for detecting when the mobile element moving along a specified running path has reached a specified position, such as a pickup device of a disk apparatus, without applying reaction to the mobile element, move of the mobile element from the specified position is lessened and eliminated. The position detecting apparatus for detecting the moving position of a mobile element includes the mobile element moving reversibly along a specified running path, conductive electrode disposed along said running path, detecting electrode disposed on the mobile element, and detecting means for detecting contact or non-contact between the conductive electrode and detecting electrode. The detecting electrode is disposed so as to contact or not to contact with the conductive electrode by the move of the mobile element. The position of the mobile element is detected by the detecting means. This position detecting means further includes a guide shaft for guiding the move of the mobile element, and a drive shaft for driving the mobile element. The conductive electrode is disposed on the surface of the guide shaft or the surface of the drive shaft. The detecting electrode is disposed so as to contact electrically with the conductive electrode from the direction crossing with the moving direction of the detecting electrode.