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Igata

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[54] **RECORD-CHANGER SPINDLE**

[75] Inventor: **Toyonori Igata,** Iwata, Japan

[73] Assignee: **Pioneer Electronic Corporation,** Tokyo, Japan

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[51] **Int. Cl.** **G11b 17/04**

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Primary Examiner—Leonard Forman
Assistant Examiner—Charles E. Phillips
Attorney—Richard C. Sughrue et al.

[57] **ABSTRACT**

A record-changer spindle has a drive shaft which, when moved downward, opens a set of upper pawls to support a plurality of record disks, and when rotated in one direction closes a set of normally open, lower pawls to thereby allow one disk to move downwardly.

8 Claims, 2 Drawing Figures

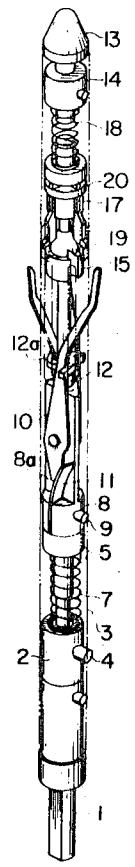


FIG. 1

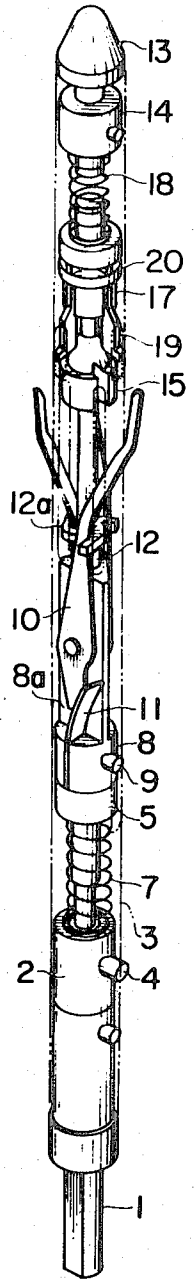
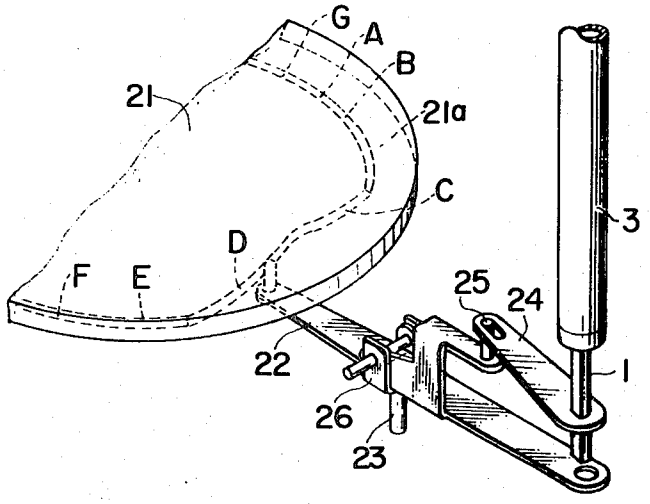

13
14
18
20
17
19
15
12a
12
10
8a
11
8
9
5
7
3
2
4
1

FIG. 2


G
A
B
21
21a
C
3
D
F
E
25
24
22
1
26
23

RECORD-CHANGER SPINDLE

BACKGROUND AND SUMMARY OF THE INVENTION

This invention relates to a record-changer spindle incorporated in a record player of the type which is adapted to play a plurality of disks automatically and sequentially.

It is an object of the invention to provide a record-changer spindle.

It is a more detailed object of the invention to provide a record-changer spindle which has lower pawls permitting the record disks to move downwardly one at a time in response to rotation of a drive shaft.

According to the invention there is provided a record-changer spindle incorporated in an auto record player, which includes upper pawls for supporting record disks which are adapted to open and shut in response to upward and downward movement of a drive shaft, and lower pawls for supporting disks which are adapted to open and shut in response to clockwise and counterclockwise rotation of the drive shaft, whereby the disks are allowed to move down smoothly and reliably onto a turntable one at a time.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a perspective view of a record-changer spindle constructed according to the present invention; and

FIG. 2 is also a perspective view showing a portion of a control mechanism of a record player including the spindle of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawing, particularly, FIG. 1, a drive shaft 1 is shown which is constructed so as to rotate in either direction and move vertically in response to operation of the control mechanism of FIG. 2 which is described hereinafter. A bearing 2 for the drive shaft 1 is secured by a pin 4 to a spindle shell 3 functioning also as a turntable shaft. About the drive shaft 1, a collar 5 is fitted and a lower spring 7 is interposed between the collar 5 and the bearing 2.

A lower pawl support 8 is backed up by the collar 5 and prevented from rotating by a vertically movable pin 9 which is slidable in a vertical slot in the spindle shell 3. Three lower pawls 10 are pivotally connected to the shaped portion 8*a* of the lower pawl support 8, and are biased, by respective leaf springs 11 secured to the lower pawl support 8, in an open direction wherein the upper ends of the lower pawls 10 project outwardly through windows formed in the spindle shell 3.

A pawl open-shut cam 12 is fixed to the drive shaft 1 and is provided with hooks 12*a* which act to close the lower pawls 10 when the cam 12 rotates in one direction, i.e., in the clockwise direction as viewed in FIG. 1.

At its upper portion, the spindle shell 3 has a head plug 13, a spring stop 14, and a conical cam 15 secured thereto. An upper pawl support 17 is vertically movable between the spring stop 14 and the conical cam 15, and is biased downwardly by an upper spring 18. The pawl support 17 is supported by the upper end of the drive shaft 1 which slidably extends through the conical cam 15.

Three upper pawls 19 are supported by the upper pawl support 17 and guided by a support ring 20 to open and closed positions. These pawls 19 are normally held in the open position by the conical cam 15 wherein they project outwardly through other windows also formed in the spindle shell 3.

FIG. 2 shows a portion of a control mechanism of a record player wherein a control cam 21 is constructed so as to rotate only in one direction, i.e., in the counterclockwise direction as viewed in FIG. 2. A cam follower 22 has one end with a projection that is in engagement with the cam face, or engaged in a grove 21*a* of the control cam 21. The other end of the cam follower 22 engages the lower end of the drive shaft 1 to move it vertically.

A rotary shaft 23 supports a rotary plate 26 which in turn carries the cam follower 22 and allows rotation of the cam follower in either direction. A pivot arm 24 has one end coupled to an angular shaft portion of the drive shaft 1 for rotating the same in either direction, and the other end formed with an elongated hole in which a coupling pin 25 fixed on the cam follower 22 is slidably disposed. Between the drive shaft 1 and the cam follower 22, a movable sensing mechanism (not shown) may be provided to detect the existence of a record disk.

The operation of the afore-described record-changer spindle will now be explained in conjunction with the control mechanism.

In the initial position wherein the spindle is mounted in the record player, the drive shaft 1, the collar 5, the lower pawl support 8 and the upper pawl support 17 are in their positions shown in FIG. 1, and the lower pawls 10 are open and project outwardly of the spindle shell 3. Since the upper pawls 19 are not backed up by the conical cam 15, they are retracted inside the spindle shell 3 and shut, as also shown in FIG. 1.

In the above initial position, the one end of the cam follower 22 of the control mechanism shown in FIG. 2 rides on portion A of the groove 21a formed on the underside of the control cam 21, and the portion A is downwardly convex. The other end of the cam follower 22 assumes a high position to thereby elevate the drive shaft 1.

In the above state, if a plurality of record disks are put on the spindle from above with their centers aligned about the axis of the spindle, they will be supported by the open lower pawls 10. It will be noted that the gap between the upper pawls 19 and the lower pawls 10 is set to be equal substantially to one and a half of the thickness of one disk.

Upon the feeding of electric power to the record player to place the same in an energized state, the control cam 21 starts to rotate in the counterclockwise direction as viewed in FIG. 2. In response to rotation of the control cam 21, the one end of the cam follower 22 moves from the downwardly convex portion A to a downwardly concave portion B of the groove 21a while in contact with the groove face, so that the other end of the cam follower 22 on the spindle side moves downwardly. Then, owing to the weight of the record disks, the lower pawls 10 and the support 8 move downwardly, and the drive shaft 1 is also lowered. Further, since the upper pawl support 17 is normally pushed downwardly by the upper spring 18, the upper

pawl support **17** moves downwardly to cause the upper pawls **19** to open, owing to their engagement with the cam face of the conical cam **15** secured to the spindle shell **3**. Accordingly, the record disks, except the lowermost disk being received by the lower pawls **10**, are supported by the open upper pawls **19**.

In this state, he drive shaft **1** assumes a position lower than the position before energization when there is no disk on the shaft, because the collar **5** normally held at an upper position by the lower spring **7** is moved downwardly by the weight of the disk, thereby compressing the spring **7**.

As the control cam **21** rotates further in a counterclockwise direction, the one end of the cam follower **22** moves towards a zone of the groove **21a** where the line of the groove curves radially inwardly towards the center of the cam **21** rather than following a regular concentric circle, so that the cam follower **22** pivots about the rotary shaft **23** in the normal direction to thereby rotate the drive shaft **1** in the normal direction by means of the pivot arm **24** through the pin **25**, that is, the drive shaft **1** rotates in the clockwise direction as viewed in FIG. **1**.

Upon this clockwise rotation of the drive shaft **1**, the pawl open-shut cam **12** is rotated in the same direction to shut the lower pawls **10** through the action of the hooks **12***a*, while resisting the force of the leaf springs **11**, so that the record disk supported by the lower pawls **10** is allowed to fall down onto the turntable (not shown).

Thereafter, as the control cam **21** rotates further in the counterclockwise direction, the one end of the cam follower **22** moves to a portion D of the groove **21**a, whereby the rotary shaft **23** rotates reversely to thereby rotate the drive shaft **1** in the counterclockwise direction through the pivot arm **24**, so that the lower pawls **10** are released from the hooks **12**a and caused to open by the force of the leaf springs **11**.

As the control cam **21** rotates even further, the one end of the cam follower **22** moves from the portion D to the portion E, and then to a portion F which is a downwardly convex portion. As the one end of the cam follower **22** reaches the downwardly convex position F, the other end thereof moves upwardly to thereby cause the drive shaft **1** to move upwardly, so that the record disks supported by the upper pawls **19** are now supported by the lower pawls **10**.

Thereafter, the control cam **21** rotates further through about 180° and then stops, during which a tone arm (not shown) moves towards the record disk on the turntable and engages it.

Upon completion of playing of the disk on the turntable, the tone arm is returned onto a rest member, and the control cam **21** rotates through the last half rotation and then again assumes its initial position.

Now it should be noted that the groove **21***a* of the control cam **21** has further a downwardly concave portion G leading to the first downwardly convex position A. Thus, the cam follower **22** is moved or swung at the end of the one cycle before the control cam **21** finishes its one rotation completely to thereby move its other end downwardly on the spindle side, so that the lower end of the drive shaft **1** is free.

In case there are one or more record disks supported by the lower pawls **10**, the drive shaft **1** is caused to move downwardly by the disks through the lower pawls **10** and the collar **5**. In response to this downward movement, the sensing mechanism (not shown) operates to cause the control cam **21** to rotate again, whereby one record disk is allowed to fall downwardly onto the turntable so as to be played, as described hereinabove.

If there is no disk on the spindle, the drive shaft **1** does not move downwardly so that the record player is stopped.

The disks whose playing has completed can be easily removed from the player by pushing the lower pawls **10** into the inside of the spindle shell **3** against the force of the leaf springs **11**.

According to the instant invention, as described hereinabove, which is different from a system where lower pawls open and shut in response to up and down movement, the lower pawls allowing the record disks to fall down one at a time are closed by the hooks of a cam secured to the drive shaft in response to rotation of the drive shaft, so that each disk falls down onto the turntable smoothly and reliably.

In another embodiment of the present invention, the pawl open-shut cam **12** is held rotatably on the spindle shell **3** and is engaged with the drive shaft **1** slidably in the vertical direction. The lower spring **7** is eliminated, so that the drive shaft **1** and lower pawls **10** are maintained in the upward position by the cam follower **22**.

What is claimed is:

1. A spindle for a record changer having a control mechanism, said spindle comprising: a drive shaft, a spindle shell surrounding said drive shaft, said spindle shell being formed with windows,

said drive shaft adapted to move vertically in said shell and rotate in either direction in response to operation of the control mechanism of the record player,

a lower pawl support mounted on said drive shaft, said lower pawl support being keyed to said spindle shell to allow vertical movement relative thereto, but prevent rotational movement relative thereto,

lower pawls for supporting records, said pawls being pivotally connected to said lower pawl support and being movable to open and closed positions,

means cooperating with said lower pawl support for biasing each of said lower pawls to an open position,

a first cam engaged with said drive shaft and engageable with said lower pawls to move them to a closed position in response to rotation of said drive shaft,

an upper pawl support mounted on said drive shaft,

means for biasing said upper pawl support in a downward direction,

a spindle shell surrounding said drive shaft,

a second cam fixed to said spindle shell below said upper pawl support, and

upper pawls for supporting records, said upper pawls being mounted on said upper pawl support and being movable to an open position by engagement with said second cam when said drive shaft moves downwardly and said upper pawl support is in its lower position, said upper pawls being movable to a closed position by engagement with said spindle

shell when said drive shaft is moved upwardly and said upper pawl support is in its upper position said upper and lower pawls are projected through said windows in said open position and retracted through said windows in a closed position.

2. A record-changer spindle as recited in claim 1 wherein there are three lower pawls and three upper pawls.

3. A record-changer spindle as recited in claim 1 wherein said drive shaft is adapted to move downwardly relative to said spindle shell when said lower pawls support at least one record and the lower end of said drive shaft is unsupported.

4. A record-changer spindle as recited in claim 1, further comprising a bearing interposed between said drive shaft and said spindle shell to enable said drive shaft to move vertically and to rotate relative to said spindle shell.

5. A record-changer spindle as recited in claim 1 wherein the lower ends of said upper pawls and the upper ends of said lower pawls are spaced a distance that is substantially equal to one and a half times the thickness of a record.

6. A record-changer spindle as recited in claim 1 wherein said biasing means for said lower pawls and said upper pawl support are springs.

7. A record-changer spindle as recited in claim 1 wherein said first cam has hooks for engaging said lower pawls.

8. A record-changer spindle as recited in claim 1 wherein said second cam is conical in shape.

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