

SPECIFICATION

DISK DRIVE DEVICE**Technical Field**

[0001] The present invention relates to a disk drive device in which a disk such as a CD (Compact Disk) and MD (Mini Disk) is set in a tray, and the tray is pulled out to take out the disk.

Background Art

[0002] For mechanisms for storing and feeding disks as conventional changer mechanisms, a calocell system in which a plurality of disks are put on a circular plate, and are rotated to change the disk, and types of systems in which a plurality of trays are stacked in vertical direction, and are moved horizontally are known. The latter types include a magazine system, bank system and independent tray system, but in those systems, disks are stored and fed through rotation of the tray, horizontal movement of the tray, or a combination thereof.

[0003] Also, a conventional disk drive device, especially a changer mechanism having a plurality of trays usually has three positions: the ejection position, storage position and playing position. For example, a disk drive device 501 in which a stacker 502 and a disk drive device unit 503 are provided, and in whose tip a fixed tray guide 504 is provided as shown in FIG. 27 is known. A plurality of trays 505 are placed in the stacker 502, and the stacker 502 itself can be moved in vertical direction.

[0004] For the above-mentioned calocell system, the area of the tray is large, and thus limitation is imposed in terms of engineering and design of the main body. Also, for the magazine system, the disk is once put in a cartridge, and is then placed in the mechanism, and thus the system is inferior of operability. In

addition, for the bank system, the above-mentioned problems are alleviated, but it is not possible to know directly which tray is opened (in playing state), and therefore the system is inferior of operability and visual recognizability. Also, for the independent tray system, the thickness of one tray is large, and independent trays are stacked in vertical, thus increasing the thickness of the mechanism.

[0005] The present invention has been made to solve the above-mentioned problems, and has as its object the provision of a disk drive device capable of reducing the entire size and thickness.

[0006] In addition, for the conventional disk drive device 501, since the engagement of gears for driving the tray 505 and the like should be maintained and the position of the tray 505 should be fixed when the tray 505 is brought to the ejection position (open position), the length of the line in which the tray 505 is moved is much larger than the diameter of the disk. That is, the distance 506 between the ejection position and storage position in FIG. 27 is increased, and thus the depth dimension of the disk drive device 501 is enlarged.

[0007] Also, for this type of disk drive device 501, the disk is made to pop up toward the front at the ejection position in order that the disk can easily be taken out at the time of opening. Therefore, the depth dimension tends to increase still further. Furthermore, there are also disk drive devices with reduced depth dimensions, but they have the disadvantage that the disk cannot be taken out easily, fixation of the tray 505 is not sufficiently fixed, and engagement of gears is not stable.

[0008] The present invention has been made to solve the above-mentioned problems, and also has as its object the provision of a disk drive device capable of reducing the depth dimension, and providing a quality and function equivalent to those of a device having a large depth dimension.

Disclosure of the Invention

[0009] According to the first aspect of the present invention, for achieving the above-mentioned objects, the invention provides a disk drive device having a mechanism for feeding a tray having a disk thereon to a disk drive part, wherein the tray is formed so as to be separable into two parts: a main tray and a subtray so that the disk can be put on the subtray and the subtray can be moved relative to the main tray, and the plurality of trays are so disposed as to be stacked in vertical direction and the tip of each subtray on the disk drive part side can be converged when the disk is stored in the tray.

[0010] Therefore, only the subtray having the disk thereon can be moved to the disk drive part. As a result, an area required for the movement can be reduced, and thus the disk drive device can be downsized. Particularly, in the case where a plurality of trays are used, an area where the subtray that is moved is driven can be set at an appropriate location, and the degree of freedom for design is enhanced. Furthermore, an area to which each subtray is moved is collectively set at a predetermined location, thereby making it possible to significantly reduce the rate of space occupation by mechanism movable components, and thus the size and thickness of the device can be further reduced. In addition, if it is so called a changer mechanism having a plurality of trays, it is possible to significantly reduce the rate of space occupation by mechanism movable components, and thus the size and thickness of the device can be further reduced.

[0011] Furthermore, in another embodiment of the invention, in addition to the configuration of the disk drive device of the above-mentioned embodiment of the invention, the main tray and the subtray are so disposed as to overlap each other in vertical direction at the disk eject position, and the subtray having the disk

thereon is separated from the main tray and moved to the disk drive part when the disk is driven in the disk drive part.

[0012] In this way, at the disk ejection position, the main tray and the subtray overlap each other in vertical direction, and therefore the disk can be securely set on the subtray. Also, the subtray is separated from the main tray at the time when the disk is driven, thus making it possible to keep the movement of the main tray small even the disk drive part is placed deep in the recess. Therefore, the size and thickness of the device can be further reduced, and the degree of freedom for design can be enhanced.

[0013] Furthermore, in another embodiment of the invention, in addition to the configuration of the disk drive device of the above-mentioned embodiment of the invention, subtrays are arranged in parallel with one another at the disk ejection position. Therefore, when the disk is set and ejected with human involvement, natural sense can be provided as ever, and the operability of disks is enhanced.

[0014] Also, in another embodiment of the invention, in addition to the above-mentioned each embodiment of the invention, the disk drive part has a holder that receives the subtray, and is moved to the position of rotation together with the disk on this subtray. Therefore, the subtray separated from the main tray is held by the holder, and is guided to the position at which the disk is rotated.

[0015] Furthermore, in another embodiment of the invention, in addition to the configuration of the disk drive device of the above-mentioned each embodiment of the invention, the holder is formed so as to be rotatable in keeping with the gradient of the subtray. In this way, since the holder is rotatable in keeping with the gradient of the subtray, the subtray is reliably guided to the holder and held by the holder.

[0016] Then, according to the second aspect of the present invention, in a disk drive device in which the tray on which the disk is to be put can be pulled out, a guiding portion for guiding and holding the tray is formed so as to be expandable and contractible so that the length of the guide part gets larger when the tray is in the ejection position than when it is in the storage position. Therefore, the length of the guiding portion can be reduced and the device can thus be downsized when the tray is in the storage position, and when the tray moves to the ejection position, the length of the guiding portion is increased and the tray can be held sufficiently. As a result, the depth dimension of the device can be reduced, and a quality and function equivalent to those of a device having a large depth dimension can be provided.

[0017] Also, in another embodiment of the invention, in addition to the configuration of the disk drive device of the above-mentioned embodiment of the invention, the guiding portion comprises a fixed guiding guide and a sliding arm capable of being slid relative to this guiding guide.

[0018] Therefore, at the storage position, the tray is reliably guided and held by the fixed guiding guide. And, at the ejection position, the sliding arm is further extended from the guiding guide toward the front, and the guiding portion is made to be substantially long to hold the tray reliably.

[0019] Furthermore, in another embodiment of the invention, in addition to the configuration of the disk drive device of the above-mentioned embodiment of the invention, the tray comprises two members that are separated into a main tray and a subtray at the playing position, and when the tray is driven in the direction of ejection, the main tray hits against the sliding arm to push the sliding arm in the direction of pullout, and the rear end of the subtray is placed on the sliding arm, so that the main tray, subtray and sliding arm are pulled out in one united body.

[0020] In this way, since the tray is separated into the main tray and the subtray, and the sliding arm is pushed by the main tray, and the rear end of the subtray is placed in the sliding arm, the length of the guiding portion can be increased with a simple structure, and the subtray is securely held.

[0021] In addition, in another embodiment of the invention, in addition to the above-mentioned each embodiment of the invention, the tip of the guiding portion extends off the front face of the tray in the storage position when the length of the guiding portion is increased. In this way, since the guiding portion when its length is increased extends off the tip of the tray in the storage position, the depth dimension and space of the device can be considerably reduced.

[0022] Also, in another embodiment of the invention, in a disk drive device in which the tray on which the disk is to be put can be pulled out, the tray is formed so as to be separable into two parts: a main tray and a subtray, and the main tray is made to be long enough to reach the playing position, and only the subtray is moved from the storage position to the playing position, and the main tray and the subtray are guided by the guiding portion and moved in one united body to the eject position.

[0023] In this way, since the separable main tray is made to be long enough to reach the playing position, the rear end of the main tray can be well situated within the device even when the tray is in the ejection position. Therefore, engagement and positioning of excessive gears are not required, and thus the depth dimension of the device can be reduced.

[0024] Furthermore, in another embodiment of the invention, in addition to the disk drive device of the above-mentioned embodiment of the invention, the guiding portion comprises a fixed guiding guide and a sliding arm capable of being slid relative to this guiding guide.

[0025] Therefore, the length of the guiding portion can be reduced and the size of the device can be reduced when the tray is in the storage position, and when the tray moves to the ejection position, the length of the guiding portion is increased and the tray can be held sufficiently. As a result, the depth dimension of the device can be reduced and a quality and function equivalent to those of a disk drive device having a large depth dimension can be provided. Furthermore, at the storage position, the tray is securely guided and held by the fixed guiding guide.

[0026] Furthermore, in another embodiment of the invention, in addition to the above-mentioned each embodiment of the invention, a plurality of trays can be stacked in vertical direction. Therefore, the depth dimension can be reduced without compromising the quality and function of so called a changer mechanism.

Brief Description of the Drawings

[0027] FIG. 1 is an illustrative view for illustrating the basic configuration and function of a disk drive device of the embodiment of the present invention, and shows a situation in which a subtray in the lowermost stage is captured in a holder.

[0028] FIG. 2 is a functional illustrative view for illustrating the basic configuration and function of the disk drive device of the embodiment of the present invention, and shows a situation in which the subtray in the lowermost stage is captured in the holder to provide a playing state.

[0029] FIG. 3 is a plan view of the situation in FIG. 1 seen from above.

[0030] FIG. 4 is a functional illustrative view for illustrating the basic configuration and function of the disk drive device of the embodiment of the

present invention, and shows different trays being moved from an ejection position to a storage position, and then captured in the holder.

[0031] FIG. 5 is a plan view of the situation in FIG. 4 (A) seen from above.

[0032] FIG. 6 is an exploded perspective view, seen from the top side, of a tray unit (main tray and subtray), which is used for the disk drive device of the embodiment of the present invention.

[0033] FIG. 7 is an exploded perspective view, seen from the bottom side, of the tray unit (main tray and subtray), which is used for the disk drive device of the embodiment of the present invention.

[0034] FIG. 8 illustrates engagement in the tip of the main tray and subtray, which are used for the disk drive device of the embodiment of the present invention.

[0035] FIG. 9 illustrates a structure in which a slider that is used for the disk drive device of the embodiment of the present invention is combined with and separated from the main tray.

[0036] FIG. 10 illustrates the structure and function of a guiding guide that is used for the disk drive device of the embodiment of the present invention.

[0037] FIG. 11 is an exploded perspective view showing a guide unit, a guiding guide, a sliding arm and a gear support, which are used for the disk drive device of the embodiment of the present invention, and structures of their surroundings, and shows main components in the right of the front part of the device.

[0038] FIG. 12 is an exploded perspective view showing a chassis body constituting a part of a chassis, which is used for the disk drive device of the embodiment of the present invention, and structures of its surroundings.

[0039] FIG. 13 is an exploded perspective view showing the chassis body, guiding portion, gear support and guiding guide, which are used for the disk

drive device of the embodiment of the present invention, and structures of their surroundings.

[0040] FIG. 14 is an exploded perspective view showing the holder and members (the guiding portion, the gear support, a main tray slider, a subtray slider, a guide cam, a lift slider and a rotating cam) placed on the right side when seen from the front of the device, which are used for the disk drive device of the embodiment of the present invention.

[0041] FIG. 15 is an exploded perspective view of the same components as those in FIG. 14 seen from a different angle.

[0042] FIG. 16 is an exploded perspective view of the components seen from an opposite side compared to the case of FIG. 14.

[0043] FIG. 17 illustrates an engagement structure when the subtray that is used for the disk drive device of the embodiment of the present invention is pulled into the holder.

[0044] FIG. 18 illustrates position detecting operations of the main tray slider that is used for the disk drive device of the embodiment of the present invention.

[0045] FIG. 19 is a perspective view showing a first drive unit portion that is used for the disk drive device of the embodiment of the present invention.

[0046] FIG. 20 is a perspective view showing a second drive unit portion that is used for the disk drive device of the embodiment of the present invention.

[0047] FIG. 21 illustrates the relation of a gear holder, a second cam hole of the lift slider and third reinforcement fittings that are used for the disk drive device of the embodiment of the present invention.

[0048] FIG. 22 is a sectional view of a planetary mechanism for illustrating operations of the planetary mechanism in the first drive unit portion shown in FIG. 19.

[0049] FIG. 23 illustrates the situation in which a second output gear of the planetary mechanism in the first drive unit portion shown in FIG. 19 is prevented from rotating.

[0050] FIG. 24 illustrates the situation in which a first output gear of the planetary mechanism in the first drive unit portion shown in FIG. 19 is prevented from rotating.

[0051] FIG. 25 illustrates attachment of a light-emitting device used to detect ejection conditions of the tray that is used for the disk drive device of the embodiment of the present invention.

[0052] FIG. 26 illustrates attachment of the light-receiving device used to detect ejection conditions of the tray that is used for the disk drive device of the embodiment of the present invention.

[0053] FIG. 27 is a schematic sectional view showing a conventional disk drive device.

Best Mode for Carrying Out the Invention

[0054] A disk drive device of the embodiment of the present invention will be described below. Furthermore, this disk drive device 1 is so called a changer mechanism that can store a plurality of magneto-optic disks, and enables playing of a predetermined magneto-optic disk of the stored magneto-optic disks.

[0055] First, the basic structure and function of this disk drive device will be described, based on functional illustrative views of FIGS. 1 to 5. This disk drive device 1 comprises a disk ejection and storage unit 2 and a disk drive part 3. Also, as shown in FIG. 3, this disk drive device 1 operates such that it has broadly classified three positions, namely an ejection position in which a disk 5 is set and ejected, a storage position in which the disk is in storage conditions, and a playing condition in which the disk is played.

[0056] The disk drive device 1 has a plurality of trays 10 arranged in vertical direction like a drawer. Each tray 10 is constituted by a main tray 11 and a subtray 12, and they can be separated. The main tray 11 is so disposed as to surround the subtray 12, and the end on the ejection side of the subtray 12 is detachably supported by the main tray 11. Furthermore, the disk 5 is placed on the subtray 12.

[0057] The subtray 12 is combined with the main tray 11 at the ejection position, and moves with the main tray 11 from the ejection position to the storage position. When moving from the ejection position to the storage position, the main trays 11 moves while keeping a level arrangement, but the subtray 12 moves with the tip on the playing position side being guided by a chassis 13 that is a fixed member. Since the chassis 13 is provided with a guiding groove extending upward in slanting direction, the subtrays 12 form a converged structure with the distance between them at the end in the playing position reduced, as shown in FIG. 1.

[0058] Therefore, at the storage position, the main tray 11 keeps a level arrangement, but the subtrays 12 having the disk 5 thereon are stored in such a manner that they are not arranged in parallel with one another. In this embodiment, as shown in FIG. 1, the subtrays 12 are stored in such a manner that they are bound upward in slanting direction so that they gather at the position of the uppermost subtray 12. That is, at the ejection position, the main tray 11 and the subtray 12 are combined with each other, and keep level arrangements, as shown in FIG. 4. Here, FIG. 4 (A) shows the uppermost tray 10 being pulled out, FIG. 4 (B) shows the middle tray 10 being pulled out, and FIG. 4 (C) shows the lowermost tray 10 being pulled out. In this way, the main trays 11 and the subtrays 12 both keep level arrangements at the ejection position. Furthermore, in FIG. 4, a part of the disk 5 is not shown. Also, FIG. 5 is a plan view of the situation in FIG. 4 (A) seen from above.

[0059] The main tray 11 keeps a level arrangement at the storage position, as well as at the ejection position, while all of the subtrays 12 keep level arrangements at the ejection position as shown in FIG. 4, but at the storage position, the subtrays 12 other than the uppermost subtray 12 are stored slantingly in such a manner that the tip on the playing side is converged. Therefore, the distance between the subtrays 12 on the ejection side is determined by the distance between the main trays 11, and is thus significantly large, but the distance between the ends of the subtrays 12 on the playing side can be reduced to a level equal or close to zero. Also, the subtray 12 is formed slimly, whereby the entire thickness in the converged portion can be reduced.

[0060] The subtray 12 in the storage position is moved to the disk drive part 3 by movement means (not shown) for moving the subtray 12. At this time, the subtray 12 is released from engagement with the main tray 11 at the end on the ejection side, and is pulled out from the main tray 11 while being guided by the guiding groove of the chassis 13.

[0061] The subtray 12, which is pulled out, is inserted in the holder 14 placed in the disk drive part 3. This holder 14 is supported in such a manner that it can be rotated with a rocking lever shaft 15 at the center of rotation in the directions shown by arrows g and h in FIG. 1. Therefore, when the subtray 12 in the lowermost tray 10 of the three trays 10 is conveyed to the holder 14, for example, the holder is rotated in the direction shown by the arrow c so that it slopes at an angle almost same as that of the lowermost subtray 12, as shown in FIG. 1. Depending on the subtray 12 to be conveyed, a setting is made so that the angle of slope of the holder 14 is consistent with the angle of slope of the subtray 12.

[0062] Furthermore, when the subtray 12 having the disk 5 thereon is returned back to the original main tray 11 after playing is completed, the holder 14 is rotated in a similar way with the rocking lever shaft 15 at the center of rotation,

and the subtray 12 in the holder 14 is guided through the guiding groove of the chassis 13 and returned back to the main tray 11.

[0063] When the subtray 12 is conveyed into the holder 14, the rocking lever shaft 15 moves down, and the end in the storage position of the holder 14 also moves down. The part of holder 14 in the storage position moves down slightly while the rocking lever shaft 15 moves down significantly, and the holder 14 in general is parallel to a disk drive part 16, and the disk 5 is mounted on a rotating table 18 of the disk drive part 16 (See FIG. 2).

[0064] The disk 5 is placed on the subtray 12 unless it is in playing conditions. When it is in playing conditions, the disk 5 is fixed between a magnet of a clasper 17 in the holder 14 and the rotating table 18 of the disk drive part 16, and is rotated with the rotating table 18.

[0065] If the stop button is pressed after completion of playing or at some mid point of playing, driving of the disk drive part 16 is stopped, and thereafter the holder 14 in general moves upward and slopes so that it is consistent with a predetermined main tray 11. Thereafter, the subtray 12 is engaged and combined with the main tray 11. On the other hand, as shown in FIG. 2, the holder 14 has the rotating table 18 of the disk drive part 16 engaging with the clasper 17, and waits for next instructions.

[0066] Furthermore, in this embodiment, the guiding portion 13 for guiding and holding the tray 10 (specifically, fixed guiding guides 61 and 62 described later, and sliding arms 222 and 223 capable of being slid relative to these guiding guides) is formed so as to be expandable and contractible, and the guiding portion is made to be longer when the tray 10 is in the ejection position than it is in the storage position (See FIGS. 3 and 5). That is, when the tray 10 is driven in the direction of ejection, the main tray 11 hits against the sliding arms 222 and 223 to push the sliding arms 222 and 223 in the direction of pullout, the rear end

portion of the subtray 12 is placed on the these sliding arms 222 and 223, and the main tray 11, the subtray 12 and the sliding arms 222 and 223 are pulled out in one united body.

[0067] The main configuration and main operations of this disk drive device 1 have been described above. Now, the specific configuration of the disk drive device 1 having such a configuration will be described.

[0068] The structure of this disk drive device 1 is divided into the disk ejection and storage unit 2 and the disk drive part 3 in terms of their positions. On the other hand, the disk drive device 1 mainly comprises, from a viewpoint of functionality, a tray unit portion comprising a plurality of trays 10, a first drive unit portion for operating each tray 10, a second drive unit portion for changing each tray 10, a mechanism unit operating in the both unit portions and giving various kinds of motions to the tray 10 and the like, the chassis 13 and the disk drive part 16.

[0069] In this embodiment, the tray unit portion comprises the three trays 10, and a part of the chassis 13 holding each tray 10 in such a manner that the tray can be slid. A member fixed at the both front sides of a chassis body 190 made of resin constituting the chassis 13, which will be described later, corresponds to the chassis 13 in the tray unit. Each tray 10 has the main tray 11 and the subtray 12 as shown in FIG. 6.

[0070] The main tray 11 each has a main tray body 20 made of resin, a slider 21, a locking arm 22 mounted rotatably on the main tray 11, and an arm 23 that is mounted on the main tray 11 in such a manner that it can be slid to combine the subtray 12 with the main tray 11. The main tray 11 further comprises first reinforcement fittings 24 that is laterally attached to the lower front part of the main tray body 20 to reinforce the main tray body 20, second reinforcement fittings 25 that has length slightly larger than that of the slider 21 to catch hold of

the slider 21 in cooperation with the main tray body 20 and reinforce the main tray body 20, and an extension spring 26 for pulling the arm 23 toward the center. Members constituting the main tray 11 are combined with a plurality of screws 27.

[0071] The part located at the right if seen from the front of the main tray 11 is long enough for its rear end to reach the vicinity of the back face of the chassis main body 190 when the tray is in the storage position. This rear end position reaches a position beyond a large hole portion 198 of the chassis body 190. On the other hand, the part located at the left if seen from the front of the main tray 11 has its rear end extending to almost center of the large hole portion 198 when the tray is in the storage position. Thereby, even when the main tray 11 is in the ejection position, the main tray 11 can be fully inserted in the device body to perform a function as a tray 10.

[0072] The subtray 12 is provided with four bosses 31, 32, 33 and 34 fitting in the guiding groove of the chassis 13 in such a manner that they can be slid, two grooves 35 and 36, a front notch 37, a rear notch 38, and a large notched portion 39 significantly notched to prevent contact with the disk drive part 16.

[0073] The structures of the tray unit portion and related mechanisms will be described below, along with their operations. First, open/close operations of the tray 10 will be described.

[0074] The slider 21 is caught between the main tray body 20 and the second reinforcement fittings 25 as described above, and a rib 40 (See FIG. 7) is guided through a groove 41 of the second reinforcement fittings 25 (see FIG. 6), and is held in such a manner as to be capable of reciprocating motion in the directions shown by arrows a and b in FIG. 6.

[0075] The locking arm 22 has its hole 42 bore rotatably by the boss 43 of the main tray body 20.

[0076] The boss 20a protruded from the main tray body 20 (See FIG. 7) is inserted in the hole 44 located at the center, whereby the arm 23 is guided by the boss 20a and a guiding wall 20b, and is held by the main tray body 20 and the second reinforcement plate 25 in such a manner that the arm 23 is capable of reciprocating motion in the directions shown by arrows c and d in FIG. 6. Furthermore, this arm 23 is always inclined in the direction shown by the arrow c, by the extension spring 26 with one end thereof attached to the main tray body 20, and the other end fixed in the hole provided in an arm 45 protruding from the side of the arm 23.

[0077] The ribs 20c and 20c formed in the end portion of the main tray body 20 (See FIG. 7) are fitted in the grooves 35 and 36, whereby the subtray 12 is made to be combined with the main tray 11 and positioned, in the ejection and storage positions.

[0078] Also, as shown in FIG. 8, the subtray 12 has its tip portion caught between the main tray body 20 and the first reinforcement fittings 24, in the ejection and storage positions. And, tip portions 51 and 51 provided in the subtray 12 hit against the ribs 52 and 52 provided in the main tray body 20, and are capable of rotating in the directions shown by arrows e and f in FIG. 8. The smoothness of this rotation is further enhanced due to the fact that the both sides of the entire tip of the subtray 12 including the tip portions 51 and 51 are provided with taper surfaces 53 and 53 that taper down to tips.

[0079] At the ejection and storage positions, a triangular portion in the tip of the arm 23 is inserted in a notch 37 in front of the subtray 12, and the slider 21 is located in such a manner as to abut against the rear end of the arm 23. Therefore, the arm 23 cannot escape from the notch 37, and thus the main tray 11 is combined with the subtray 12.

[0080] Also, when the slider 21 moves in the direction shown by the arrow b to change its state from the state shown in FIG. 9 (A) to the state shown in FIG. 9 (B), the locking arm 22 rotates with the boss 43 at the center of rotation, and a boss portion 54 on one side is inserted in a notch groove 55 provided in the slider 21. Thus, the slider 21 is combined with the main tray body 20 through the locking arm 22. This combination occurs when the subtray 12 comes to the storage position. Furthermore, the movement of the slider 21 in the direction shown by the arrow b causes a protruded portion 56 at the rear end of the arm 23 to abut against the slider 21.

[0081] In this way, the main tray 11 and the subtray 12 and the slider 21 are combined together at the storage and ejection positions. Furthermore, a groove 57 at the lower side of the second reinforcement plate 25 is guided and held by a rib 59 provided in a guide portion 58 constituting a part of the chassis 13 (See FIG. 11).

[0082] As described previously, the rib 40 of the slider 21 combined with the subtray 12 is inserted in the groove 41 at the storage position, the tip of the subtray 12 is caught between the main tray body 20 and the first reinforcement plate 24, and the arm 23 is inserted in the notch 37, whereby the subtray 12 is combined with the main tray 11 and held. At this storage position, for each subtray 12, the bosses 32 and 34 behind the subtray 12 move upward along guiding grooves 61a, 61b and 61c and 62a, 62b and 62c of left and right guiding guides 61 and 62 (described in detail later), respectively, as shown in FIG. 10, and the degree of slope of the subtray 12 is determined by the degrees of slope of the guiding guides 61a to 62c. Furthermore, at the storage position, the bosses 31 and 33 in the front part are held by the guiding guides 61 and 62, but they may be made extend slightly off the guiding guides 61 and 62 and held by other holding portion of the tray unit portion.

[0083] A bending portion 63 provided in the second reinforcement plate 25 that is fixed in the main tray body 20 is to detect that the tray 10 comes to the ejection position. That is, this bending portion 63 abuts against a protrusion 65 of a first switch body 64 placed rotatably in the guide portion 58 (See FIG. 11) to rotate this first switch body 64 in the direction shown by the arrow W in FIG. 11. This rotation actuates the first switch 66 to ensure that the tray 10 has come to the ejection position.

[0084] It is detected that the tray 10 is in the storage position, using a second switch body 67 placed rotatably in the guide portion 58. That is, first, the slider 21 moves in the direction shown by the arrow a in FIG. 6 by driving force from a first motor 110 described later to bring the tray 10 from the ejection position to the storage position. This movement occurs due to engagement of the locking arm 22 with the notch groove 55 of the slider 21. Also, this movement is made along a guiding groove 68 of the guide portion 58. A point groove 69 bended downward is formed at the rear end of the guiding groove 68 (See the partially magnified view in FIG. 11), and a boss portion 70 at the other end of the locking arm 22 is guided therethrough, whereby the locking arm 22 rotates downward. Therefore, the slider 21 is separated from the combined main tray body 20. Consequently, the tray 10 stops moving apparently.

[0085] On the other hand, the slider 21 further moves in the direction shown by the arrow a by the first motor 110 described later. This movement causes a protrusion 71 of the second switch body 67 to abut against the slider 21, and the second switch body 67 is rotated in the direction shown by the arrow Y in FIG. 11. Furthermore, the second switch body 67 is always inclined in a direction opposite to the direction Y by a torsion spring 72. This rotation of the second switch body 67 causes the protrusion 71 to be inserted in the notch groove 55 of the

slider 21, and a second switch 73 goes into the OFF position. It is detected that the tray 10 comes to the storage position, by ON/OFF of this second switch 73.

[0086] Also, the slider 21 moves in the direction shown by the arrow a after the main tray 11 stops, whereby the arm 23 can move in the direction shown by the arrow d in FIG. 6, and the subtray 12 becomes detachable to the main tray 11. Furthermore, the first switch body 64 and the second switch body 67 have the three protrusions 65 and 71, respectively, so that they can be actuated equally for the three trays 10.

[0087] Operations for moving the tray 10 between the storage position and the playing position will now be described, along with each configuration.

[0088] The following members are used for guiding the tray 10 from the storage position to the playing position. That is, the holder 14, a holder tray 81 working as support means when the holder 14 is moved in vertical direction, a subtray slider 82, a main tray slider 83, a third switch body 86 that is rotatably placed in a boss portion 85 situated behind a gear supporting portion 84 placed inside the guide portion 58, a fourth switch body 87 caught between the chassis 13 and the gear supporting portion 84, and rotatably placed in a boss portion (not shown) in front of the chassis 13, a third switch 88 that is operated with the third switch body 86, a fourth switch 89 that is operated with the fourth switch body 87 and the like are used. Furthermore, the third switch body 86 is inclined to the main tray slider 83 by a spring 86a.

[0089] The holder tray 81 is located at the right if it is seen from the front of the holder 14. A point rib 92 of the holder tray 81 fits in a groove 91 of the subtray slider 82 (See FIG. 15), whereby the subtray slider 82 is guided and held in the directions shown by the arrows a and b in FIG. 14. In addition, a boss 94 bended at the right angle that is situated at the rear end of the main tray slider 83 is inserted and engaged in a hole 93 of the subtray slider 82 (See FIG. 16). On

the other hand, the main tray slider 83 is guided and held by a rib 95 of the gear supporting portion 84 in such a manner that it is capable of reciprocating motion in the directions shown by the arrows a and b.

[0090] The subtray slider 82 that can be moved with the main tray slider 83 as one united body in the directions shown by the arrows a and b slides to move on the lower part of the holder tray 81. Furthermore, the rotation of the holder 14 causes the holder tray 81 to be rotated. By this rotation, the engaged subtray slider 82 moves the boss 94 in vertical direction, and faces the subtray 12 that is pulled out.

[0091] A rib 96 of the subtray slider 82 is placed in the notch 38 situated behind the subtray 12 as shown in FIG. 17. As described above, the rotation of the holder tray 81 causes the subtray slider 82 to move in vertical direction, whereby the rib 96 fits in the notch 38 of the subtray 12 to be pulled out. When the main tray slider 83 moves in the direction shown by the arrow a, the subtray slider 82 moves at the same time, and the subtray 12 also moves through this subtray slider 82. At this time, the four bosses 31, 32, 33 and 34 of the subtray 12 are guided and held by a groove 97 of the holder 14 (See FIG. 15) and a groove 98 of the holder tray 81 (See FIG. 15).

[0092] When the subtray 12 is moved from the storage position to the playing position, the main tray slider 83 moves in the direction shown by the arrow a, whereby a rib 99 of the main tray slider 83 abuts against an operation portion 101 of the third switch body 86 provided in the rear part of the device to turn the third switch 88 to the ON position. The main tray slider 83 further moves in the direction shown by the arrow a, whereby the rib 99 of the main tray slider 83 passes through the operation portion 101, and the third switch 88 is turned to the OFF position (See FIG. 18). It is detected by this ON/OFF operation that the subtray 12 has come to the playing position, and then movement is stopped.

[0093] On the other hand, when the subtray 12 is returned from the playing position to the storage position, a rib 102 on the tip side of the main tray slider 83 abuts against an operation portion 103 of the fourth switch body 87 situated in the front part of the device, and the fourth switch 89 is thereby turned to the ON position, and thereafter is turned to the OFF position (See FIG. 18). It is detected by this ON/OFF operation that the subtray 12 has returned from the playing position to the storage position, and then the return operation is stopped.

[0094] Selection and switching of the tray 10 and disk clamping will now be described, but before they are described, first and second drive unit portions will be described. The both drive unit portions are placed in a chassis body 190 constituting the chassis 13, and is located in the lower part of the device in general. Approximate locations W1 and W2 of the both drive unit portions are shown. Furthermore, the location W1 is a location on the chassis body 190, and the location W2 is a location on the gear supporting portion 84 fixed to the chassis body 190.

[0095] First, the first drive unit portion for carrying out the operations that have been described above will be described.

[0096] As shown in FIG. 19, the first drive unit portion comprises the first motor 110, a pulley 111 fixed to the output axis of the first motor 110, a first belt 112 wound around the pulley 111, a pulley-coupled gear 113 having a pulley around which the first belt 112 is wound, a gear 114 engaging with the pulley-coupled gear 113, a large gear 115 engaging with the gear 114, a planetary mechanism 116 engaging with the large gear 115, a first gear 118 engaging with an output gear 117 in the planetary mechanism 116, a second gear 119 engaging with the first gear 118, a third gear 120 engaging with the second gear 119, a fourth gear 121 engaging with the third gear 120, a fifth gear 122 engaging with the fourth gear 121, a sixth gear 123 engaging with the fifth gear 122, a seventh gear 124

engaging with the sixth gear 123, and two engagement gears 126 and 126 engaging with a second output gear 125 of the planetary mechanism 116.

[0097] The planetary mechanism 116 comprises an input gear 133 having an input portion 131 and an output portion 132, the first output gear 117, the second output gear 125 having an internal gear 134 and an external gear 135, two planetary gears 136 and 136 engaging with the output portion 132 and the internal gear 134 at a time, two bosses 137 and 137 provided in the first output gear 117 to support the planetary gears 136 and 136, and a rotation center axis 138 that is provided in the first output gear 117, fits in the central hole of the input gear 133, and forms the center of rotation of the input gear 133 and the first output gear 117.

[0098] Operations of the tray 10 between the ejection position and the storage position are carried out by the driving force of the first motor 110 being transferred to the slider 21. That is, the driving force of the first motor 110 is transferred to the seventh gear 124 in the lowest stage, and thereafter the driving force is transferred to a long longitudinal gear 141 exposed at the side face of the mechanism device shown in FIG. 11, and is further transferred to a transfer gear 142. The transfer gear 142, which engages with a rack 143 of the slider 21 (See FIGS. 6 and 7), moves this slider 21 in the directions shown by the arrows a and b.

[0099] Operations of the tray 10 between the storage position and the playing position are carried out by the driving force of the first motor 110 being transferred to the main tray slider 83. That is, the driving force of the first motor 110 is transferred through the second output gear 125 of the planetary mechanism to the engagement gears 126 and 126. The engagement gears 126 and 126, which engage with a rack 144 provided in the lower part of the main tray

slider 83 (See FIGS. 14 and 15), move this main tray slider 83 in the directions shown by the arrows a and b.

[0100] Selection and switching of the tray 10 and disk clamping will now be described, but before the operations are described, the configuration of the second drive unit portion will be described.

[0101] As shown in FIG. 20, the second drive unit portion comprises a second motor located before the first motor 110, a pulley 151 fixed to the output axis of the second motor 150, a second belt 152 wound around the pulley 151, a pulley-coupled gear 153 with a pulley around which the second belt 152 is wound, a gear 154 engaging with the pulley-coupled gear 153, a gear 155 engaging with the gear 154, a gear 156 in the same form as that of the gear 155 and engaging with the gear 155, a gear 157 engaging with the gear 156, a gear 158 engaging with the gear 157, and a lift idler 159 having a gear engaging with the gear 158.

[0102] The lift idler 159 engages with a rack 162 of a guide cam 161 (See FIG. 16). Therefore, rotation of the second motor 150 allows the guide cam 161 to make a reciprocating motion in the directions shown by the arrows a and b. Two bosses 163 and 163 of the guide cam 161 are inserted in a groove 164 of the guide portion 58 (See FIG. 11), and are guided. Also, a lift slider 167 having a first cam hole 165 and a second cam hole 166 is fixed to the guide cam 161, and they move in one united body.

[0103] A first boss 172 of a gear holder 171 (See FIG. 15) is inserted in the second cam hole 166. Also, the gear holder 171 is inserted in a vertically oriented hole 175 of reinforcement fittings 173 provided in such a manner that the first boss 172 and a second boss 173 are both exposed at the side face of the mechanism device and fixed thereto as shown in FIG. 21, and guided and held so that only vertical motions can be made.

[0104] A shaft 177 is inserted in two holes 176 in the upper part on the tip side of the gear holder 171, and the transfer gear 142 is placed between those two holes 176 and 176. This transfer gear 142 moves in vertical direction in association with vertical movement of the gear holder 171, and engages with the slider 21 of a predetermined tray 10. That is, the g section of the second cam hole 166 shown in FIG. 16 is stepped, and the gear holder 171 and the transfer gear 142 moves in vertical direction along the stepped second cam hole 166 in one united body to select and switch the tray 10 for which operations should be carried out.

[0105] On the other hand, for the f section of the second cam hole 166 in FIG. 16, the height of the gear holder 171 remains unchanged. Furthermore, a first boss 181 of the holder 14 (See FIG. 15) is inserted in the first cam hole 165 of the lift slider 167, and this first boss 181 is further inserted in a guiding groove 182 of the guide portion 58 (See FIG. 11), and is guided.

[0106] Furthermore, a second boss 183 forming the previously shown rocking lever shaft 15 of the holder 14, and a third boss (not shown) situated at the opposite side are supported by grooves 185 and 186 of a lift holder 184 (See FIG. 15), respectively. A groove 187 engages with a rib 191 in the back face of a chassis body 190 (See FIG. 12), whereby the lift holder 184 receives the guide by the vertical motion, and a rib 188 at the right end of the lift holder 184 is inserted in a groove 192 of the chassis body 190 (See FIG. 12) to receive the guide by the vertical motion. Also, a rear boss 189a of the lift holder 184 passes through a longitudinal hole 193 in the back face of the chassis 190 to receive the guide by the vertical motion.

[0107] A boss 194 of the chassis body 190 is inserted in a rotation center hole 201, whereby a rotating cam portion 200 can rotate in the directions shown by the arrows r and s with this boss 194g at the center of rotation. Also, the

rotating cam portion 200 is provided with a groove 202 of which location is gradually changed in a vertical direction with rotation (See FIG. 16), and a front boss 189b of the lift holder 184 (See FIG. 15) is inserted in this groove 202. Therefore, when the rotating cam portion 200 rotates in the direction shown by the arrow r, the front boss 189b is guided by the groove 202 to move downward, and thus the lift holder 184 moves down. On the other hand, when the rotating cam portion 200 rotates in the direction shown by the arrow s, the lift holder 184 moves upward.

[0108] When the tray 10 is in the storage position, the lift slider 167 is located in the rear part in general. When instructions for playing are provided, the lift slider 167 is driven toward the front. Consequently, the holder 14 moves upward, the lift holder 184 also moves upward in association with that movement, and the rotating cam portion 200 rotates completely in the direction shown by the arrow s. In this way, the first boss 181 of the holder 14 is located in the uppermost part of the first cam hole 165 of the lift slider 167.

[0109] At this time, when the guide cam 161 moves in the direction shown by the arrow a, the lift slider 167 also moves in the direction shown by the arrow a. Then, the first boss 181 of the holder 14 moves downward along the first cam hole 165 of the lift slider 167. Consequently, the holder 14 rotates in the direction shown by the arrow h in FIG. 15 with the second boss 183 and a third boss at the opposite side being a rocking lever shaft. For the angle of this rotation, the step height 204 of the guide cam 161 (See FIG. 15) is detected by a fifth switch 205 (See FIG. 14), and a photo interrupter 206 detects five slits 207 of the guide cam 161, whereby a relative location therefrom is detected, and thus the rotation is stopped at a predetermined angle.

[0110] This rotation occurring only in the tip side of the holder 14 causes the holder 14 to be in a position of facing the subtray 12 to be brought to the playing

position. The tray 10 to be submitted for play is selected in this standby position. Also, similar operations carried out to provide the standby position consistent with the tray 10 when the play is completed, whereby the disk 5 that has been played and its subtray 12 are given back to the empty main tray 11.

[0111] The guide cam 161 moves in the direction shown by the arrow a, even after the subtray 12 holding the disk 5 is captured in the holder 14. With this movement, a boss 208 of the rotating cam portion 200 is engaged in a bended groove 209 of the guide cam 161 and receives the guide to rotate in the direction shown by the arrow r in FIG. 15. Consequently, the lift holder 184 moves down, and the first boss 181 of the holder 14 is guided to the first cam hole 165 of the lift slider 167 and moves down. Their moving down causes the holder 14 to move altogether from the position in which the subtray 12 is captured to the disk drive part 16 to place the disk 5 on the rotating table 18.

[0112] The operation of the tray 10 between the ejection position and the storage position, the operation of the subtray 12 between the storage position and the playing position, and the configurations related to those operations have been described above, but those operations are both carried out by the first drive unit portion. And, these operations are switched using the planetary mechanism 116 of the first drive unit portion.

[0113] Operations of the planetary mechanism 116 of the first drive unit portion will be described below, using FIGS. 19 and 22.

[0114] The rotation of the first motor 110 is transferred to the large gear 115, and is then transferred from the large gear 115 to the input gear 133 of the planetary mechanism 116. The rotation of the input gear 133 is transferred from the output portion 132 to the planetary gears 136 and 136. At this time, when the second output gear 125 is prevented from rotating, the planetary gears 136 and 136 engaging with the internal gear 134 of the second output gear 125 rotate

on their own axis, and revolves along the internal gear 134 of the second output gear 125 with the rotation center axis 138 as the center of revolution.

[0115] The planetary gears 136 and 136 are bore by the bosses 137 and 137 of the first output gear 117, and therefore the first output gear 117 rotates in synchronization with the revolution of planetary gears 136 and 136. The rotation of the first output gear 117 is transferred to the seventh gear 124, and thereafter the slider 21 is moved through the transfer gear 142. Thereby, operations between the ejection position and the storage position are carried out.

[0116] On the other hand, when the first output gear 117 is prevented from rotating, the planetary gears 136 and 136 are prevented from revolving and can only rotate. Therefore, the rotation of the input gear 133 is transferred to the second output gear 124 through the planetary gears 136 and 136 to cause the second output gear 125 to rotate. The rotation of the second output gear 125 is transferred to two engagement gears 126 and 126 to drive the main tray slider 83 engaging with these engagement gears 126 and 126 and guide the subtray 12 to the holder 14.

[0117] As described above, two outputs gears 117 and 125 are provided for one input gear 133, and one of the output gears is prevented from rotating to output the driving force of the first motor 110 from the other output gear, thereby transferring the rotation of the first motor 110 to two systems.

[0118] The operation will now be described, in relation with the location of the lift slider 167.

[0119] When the first boss 172 of the gear holder 171 is located in the g section of the list slider 167 shown in FIG. 16, the holder 14 is in the playing position. On the other hand, in this g section, the tray 10 moving between the ejection position and the storage position is switched. First, the guide cam 161 and the lift slider 167 combined therewith are driven by the second motor 150 so that the

first boss 172 is situated at a predetermined location in the g section. When the second output gear 125 in the planetary mechanism 116 is prevented from rotating in this g section, the first output gear 117 rotates to move the slider 21. Thereby, ejection and storage of the tray 10 is carried out.

[0120] The second output gear 125 is prevented from rotating in the following manner. The second output gear 125 engages with the engagement gears 126 and 126, and the engagement gears 126 and 126 engage with the main tray slider 83. When the disk 5 is in the storage position, the main tray slider 83 is in an unload position, and its tip abuts against the chassis main body 190 as shown in FIG. 23. On the other hand, the front face 14a of the empty holder 14 (shown by a two-point chain line) situated in the playing position (dropped position) faces the back face 94b of the boss 94 at the rear end, and is caught between the chassis body 190 and the holder 14. Therefore, the second output gear 125 is prevented from rotating.

[0121] Also, the subtray 12 is captured in the holder 14, and the holder 14 moves down, and when the disk 5 is in the playing position (shown by the two-point chain line), the main tray slider 83 is in a position shown by the one-point chain line in FIG. 23 (load position), and is caught between the holder 14 and the chassis body 190 in such a manner that the back face 94b of its boss 94 faces the chassis body 190, and the front face 94a of the boss 94 faces the back face of the holder 14. Therefore, the second output gear 125 is prevented from rotating.

[0122] In this way, the tray 10 can be moved between the ejection position and the storage position either when the disk is played or when the disk is not played. Furthermore, in any case, the holder 14 should be in the playing position (dropped position).

[0123] The case will now be described where the lift slider 167 moves toward the front, and the first boss 172 of the gear holder 171 moves to the f section of the second cam hole 166 of the lift slider 167, while the first boss 181 of the holder 14 exist in the h section of the first cam hole 165 shown in FIG. 16.

[0124] In this h section, the subtray 12 to be loaded and unloaded is switched. In this h section, the first boss 181 of the holder 14 is shifted upward, and the tip of the holder 14 is situated above the line L as shown in FIG. 23. Therefore, there is no possibility that movement of the main tray slider 83 is hindered. That is, the second output gear 125 is capable of rotating and the main tray slider 83 is capable of moving. However, to meet this need, the first output gear 117 should be prevented from rotating.

[0125] The configuration in which the first output gear 117 is prevented from rotating in this case will now be described referring to FIG. 24 and the like.

[0126] A rotation center hole 212 of a rack gear 211 (See FIGS. 15 and 16) is bore rotatably by a boss 213 of the guide portion 58 (See FIG. 11), and is inclined in the direction shown by the arrow j in FIG. 16 by a torsion spring 214. As long as the first boss 181 of the holder 14 exists in the h section, a boss 215 of the rack gear 211 contacts the innermost face 167a of the lift slider 167, and is prevented from rotating in the direction shown by the arrow j, and the rack gear 21 is rotated in the direction shown by the arrow k.

[0127] When the rack gear 211 is rotated in the direction shown by the arrow k, a lug 216 of the rack gear 211 is caught between teeth of the third gear 120 (placed in the gear supporting portion 84) in the first drive unit portion as shown in FIG. 24 (A), resulting in prevention of rotation of the first output gear 117. Therefore, when the lift slider 167 is driven toward the front part of the device, operations of the tray 10 between the ejection position and the storage position

(open/close operations of the tray 10) are not carried out, but the subtray 12 is guided from the storage to the holder 14, and vice versa.

[0128] When the lift slider 167 moves toward the rear, and the first boss 181 of the holder 14 comes to the i section in FIG. 16, the inner face 167a of the lift slider 167 against which the boss 215 of the rack gear 211 abuts disappears. Therefore, the rack gear 211 is rotated in the direction shown by the arrow j as shown in FIG. 24 (B) with momentum provided by the torsion spring 214, and the third gear 120 is capable of rotating again. On the other hand, because the holder 14 comes to the playing position, and the main tray slider 83 is prevented from moving, the second output gear 125 is prevented from rotating, and the open operation and close operation of the tray 10 can be carried out again.

[0129] The specific configurations and main operations of this disk drive device 1 have been described above, and configurations and operations that have not mentioned above will now be described.

[0130] For the outer faces of the guiding guides 61 and 62 shown in FIGS. 10 and 13 and the like, bosses 221 two of which constitute a pair (See FIG. 13) are provided in such a manner that six bosses 221 are provided on each side face, and thus twelve bosses 221 in total are provided on both side faces. These bosses 221 guide and hold three sliding arms 222 placed on the left side face of the guiding guide 61, and three sliding arms 223 placed on the right side face of the guiding guide 62.

[0131] Specifically, the sliding arms 222 and 223 are provided with two longitudinal fitting holes 224, respectively, and the boss 221 is fitted in the fitting holes 224. In this way, three sliding arms are provided for the left sliding arm 222, and three sliding arms are provided for the right sliding arm 223, two longitudinal fitting holes 224 are provided in each of the sliding arms, and one of the bosses 221 is fitted in each longitudinal fitting hole 224. Also, the sliding

arms 222 and 223 have U-shaped sections so that they fit in lateral grooves provided in the upper and lower parts of the bosses 221 of the guiding guides 61 and 62. As a result, the sliding arms 222 and 223 are guided and supported by the bosses 221 and the lateral grooves of the guiding guides 61 and 62 so as to be capable of reciprocating motion.

[0132] The functions and operations of the sliding arms 222 and 223 are as follows. Furthermore, the sliding arm 222 and the guiding guide 61 form one guiding portion that is expandable and contractible, and the sliding arm 223 and the guiding guide 62 form the other guiding portion that is expandable and contractible.

[0133] When the main tray 11 moves toward the ejection position (open), two bosses 32 and 34 at the rear end of the subtray 12 are inclined to disengage from the guiding grooves 61a to 62c of the guiding guides 61 and 62. However, just before their disengagement, a left step height 232 protruded inward from the main tray 11 and a right step height 233 inward and downward from the main tray 11 (See FIG. 7) abut against ribs 234 and 235 protruded outward from the sliding arms 222 and 223, respectively (See FIG. 13), and the sliding arms 222 and 223 start moving with the main tray 11 in the open direction.

[0134] Consequently, the bosses 32 and 34 of the subtray 12 move from the guiding grooves 61a to 62c of the guiding guides 61 and 62 to guiding grooves 236 of the sliding arms 222 and 223. That is, after the bosses 32 and 34 of the subtray 12 disengage from the guiding grooves 61a to 61c, the main tray 11, the subtray 12 and the sliding arms 222 and 223 move toward the front in one united body. At this time, the subtray 12 has its tip engaged in the main tray 11 and its rear end engaged in the sliding arms 222 and 223 to keep a level arrangement. When the tray 10 comes to the ejection position completely, the tips of the sliding

arms 222 and 223 are made to extend off the front face of the other tray 10 in the storage position. Thereby the depth dimension can be significantly reduced.

[0135] Also, when the disk 5 is placed on the disk drive part 16 to provide playing conditions, two protrusions 241 and 242 provided on the undersurface of the subtray 12 (See FIG. 7) abut against two determination switches 243 and 244 (See FIG. 13), respectively. The switches 243 and 244 are placed on a circuit board 246 mounted on a bedplate 245 at the rear end of the chassis body 190.

[0136] For these two determination switches 243 and 244, any one of two protrusions 241 and 242 of the subtray 12 is removed, and none of them is removed, whereby various ON/OFF combinations can be obtained. With those ON/OFF combinations, which subtray 12 the disk 5 in the playing position belongs to is determined, and which main tray 11 it is given back to is determined. That is, address information of the subtray 12 is obtained by using combinations of two determination switches 243 and 244 and two protrusions 241 and 242.

[0137] In this embodiment, three trays 10 are used, and the address information is set as follows. A determination for the uppermost tray 10 (=subtray 12) is made by obtaining ON signals from the both determination switches 243 and 244 with none of the protrusions 241 and 242 removed. For the middle tray 10 (subtray 12), the protrusion 242 is removed. As a result, only the signal of the first determination switch 243 is turned ON, and the second determination switch 244 is turned to the OFF position to determine that the tray is the middle tray 10. Also, in the case of the lowermost tray 10 (subtray 12), the protrusion 241 is removed to obtain an ON signal only from the second determination switch 244. Furthermore, if four trays 10 in four stages are used, the both protrusions 241 and 242 are removed, thereby making it possible to discriminate four kinds of subtrays 12 easily.

[0138] The clasper 17 comprises a clasper body 247 made of resin and a doughnut-shaped magnet 248 as shown in FIG. 14. Also, a partial guiding guide 249 (See FIG. 13) is provided on the left side of the front end of the chassis body 190 in such a manner that the guiding guide 61 faces approximately 2/3 parts of the rear end. The surface of this partial guiding guide 249 is on a level with the outer surface of the left face 195 of the chassis body 190, and is provided on its inner surface with three laterally extending ribs 250 for guiding the main tray 11. Also, six ribs 196 in total, two for each stage, for guiding the main tray 11 are provided on the inner surface of the left face 195 of the chassis body 190.

[0139] A partial guide 251 to be fitted in the guide portion 58 (See FIG. 11) is provided on the right side of the front end of the chassis body 190. This partial guide 251 has a rib 252 for the middle stage corresponding to the rib 59. In addition, in order to switch smoothly the direction of the rotation cam portion 200 to the directions shown by the arrows r and s, a clip spring 253 for making the rotation cam portion 200 inclined in the direction shown by the arrow s is provided in the lower part of the rotation cam portion 200 and between the rotation cam portion 200 and the chassis body 190.

[0140] Also, fittings 254 for preventing friction with the metallic lift slider 167 and ensure smooth movement are fitted in the first boss 172 of the gear holder 171. Similarly, fittings 255 are fitted in the first boss 181 of the holder 14. In addition, headed screw fittings 256 are attached to the rear boss 189a of the lift holder 184 to ensure the exit and smooth vertical movement of the rear boss 189a passing through the longitudinal hole 193.

[0141] Also, a fourth reinforcement fittings 261 are attached to the front part of the upper part of the chassis body 190 in such a manner as to cover the tray unit portion. A light-emitting device 262 is attached to the tip of the fourth

reinforcement fittings 261 through a circuit board 263 as shown in FIG. 25. Also, a light-receiving device 264 is attached to the front end of the lower part of the chassis body 190 through a circuit board 265. The light-receiving device 264 is so disposed as to be surrounded by a cylindrical boss 197 provided on the face of the bottom end of the chassis body 190.

[0142] Furthermore, a control IC 266 for controlling the first motor 110, the second motor 150 and the like with signals of various kinds of switches is attached to the front part of the bottom end of chassis body 190 through a controlling circuit board 267.

[0143] The light-emitting device 262 and the light-receiving device 264 are so disposed as to face a left through-hole 271 provided in the front part of the main tray 11. And, when light from the light-emitting device 262 reaches the light-receiving device 264, it is determined that trays 10 are all in the storage position. On the other hand, when light is cut off and thus cannot reach the light-receiving device 264, instructions are given by the control IC 266 to recognize that the tray 10 that is moving to the ejection position, or is returning back to the storage position, or is in the ejection is surely in a state consistent with the instructions. Furthermore, a right through-hole 272 is provided on the right side of the front part of the main tray 11 in preparation for other controls and for maintaining symmetry in molding.

[0144] Also, one boss 275 of a movement preventing member 274 for preventing the tray 10 from moving is movably inserted in a groove 273 in the front part of the holder 14. The other boss 276 is fitted in an engagement hole 277 provided at the rear end of the fourth reinforcement fittings 261 (See FIG. 16). When the holder 14 is in the playing position (dropped position), this movement preventing member 274 is so disposed as to traverse the rear end of the subtray

12 in slanting direction, and plays a role to surely prevent the tray 10 from moving to the rear.

[0145] The disk drive part 16 is screwed fixedly on the position of the rectangular large hole portion 198 located leftward from the center of the chassis body 190 through a buffer material such as rubber. A spindle motor for driving the rotating table 18, gear portion for transferring rotation of this spindle motor, optical pickup retaining means for retaining optical pickups to read information of the disk 5, and the like are attached to the disk drive part 16. This configuration is similar to a conventional configuration, and thus detailed description and illustrative views thereof are not presented here.

[0146] Finally, the configuration of the area in which the gears of the first and second drive unit portions are placed will be described.

[0147] The first motor 110 is fitted to a first motor fitting portion 281 like an inversed cup of the chassis body 190 from underneath the chassis body 190. The pulley 111 is attached to a motor output axis protruded from the chassis body 190. The pulley-coupled gear 113 is supported by a first supporting column 282, the gear 114 is supported by a second supporting column 283 of the chassis body 190, the large gear 115 is supported by a third supporting column 284, and the input gear 133 (part of the planetary mechanism 116) is supported by the rotation center axis 138 fixed to the chassis body 190. These gears (except for the pulley-coupled gear 113) are placed in a gap between the chassis body 190 and the gear supporting portion 84.

[0148] The first gear 118 and the second gear 119 are rotatably attached to the lower part of the gear supporting portion 84. The third gear 120 is rotatably attached to a top-down boss 285 protruded downward from the gear supporting portion 84 (See FIG. 13) and the fourth gear 121, fifth gear 122 and sixth gear 123 are attached to bottom-up bosses 286, 287 and 288 protruded upward from

the gear supporting portion 84 (See FIG. 13). Also, the seventh gear 124 is placed on and supported by a bottom-up boss 289 of the chassis body 190. The longitudinal gear 141 engaging with this seventh gear 124 is supported in such a manner that a shaft 292 fixedly inserted in an angular boss 291 provided in the chassis body 190 (See FIGS. 12 and 13) is passed through its center hole.

[0149] The engagement gears 126 and 126 are attached to the bottom faces of protruding portions 293 and 294 of the gear supporting portion 84 (See FIG. 11), respectively, and are exposed from protrusions 293a and 294a toward the front in FIG. 11. The rack 144 of the main tray slider 83 engages with this exposed area of the engagement gears 126 and 126, and the main tray slider 83 moves in the directions shown by the arrows a and b.

[0150] The second motor 150 is fixedly fitted in a second motor fitting portion 301 of the chassis body 190 from underneath. The pulley 151 is attached to a motor output axis protruded from the chassis body 190. The pulley-coupled gear 153 is attached to a fourth supporting column 302 of the chassis body 190, and the gear 154 is attached to a fifth supporting column 303. A large diameter portion in the upper part of the gear 154 protrudes upward from the gear supporting portion 84, and a small diameter portion in the lower part engages the gear 155 located at the lower side of the gear supporting portion 84.

[0151] The gears 155, 156 and 157 are supported, respectively, by a sixth supporting column 304, a seventh supporting column 305 and a eighth supporting column 306 that are placed on the bottom face of the chassis body 190 in such a manner as to face upward. Also, the gear 158 and the lift idler 159 are supported, respectively, by a ninth supporting column 307 and a tenth supporting column 308 that are also placed on the bottom face of the chassis body 190 in such a manner as to face upward. These gears 155, 156, 157 and

158, and the lift idler 159 are located in the lower part of the gear indicating portion 84, and the lift idler 159 engages with the rack 162 of the guide cam 161.

[0152] Furthermore, the guide cam 161 is integrated, with its flat surface 311 being inserted in an insertion hole 312 of the lift slider 167 (See FIG. 14) and fixed by a screw 313. And, the first cam hole 165 is completed with the first cam hole 165 provided in the lift slider 167, and a step height forming portion 314 for forming the step height 204 of the guide cam 161. Also, the first cam hole 165 is placed on the inner surface of the guide portion 58, and the second cam hole 166 is placed on the outer surface of the guide portion 58, and the both cam holes 165 and 166 can move relative to the guide portion 58 with the guide portion 58 therebetween.

[0153] Operations of the disk drive device 1 configured as described above will now be described in brief, although some of them have been already described.

[0154] First, operations for storing the disk 5 in the tray 10 will be described.

[0155] Instructions to take out a predetermined tray 10 to the open position are given using a bottom, a remote control or the like. Receiving the instructions, the control IC 266 operates the second motor 150 to move the lift slider 167 slightly toward the front. Its movement depends on a selected tray 10. That is, the movement of the lift slider 167 is almost zero if the tray 10 in the lowermost stage is selected, and the lift slider 167 moves toward the front until the boss 172 of the gear holder 171 comes to the middle position of the second cam hole 166 if the tray 10 in the middle stage is selected. Also, the lift slider 167 significantly moves so that the boss 172 comes to the top of the second cam hole 166 if the tray 10 in the uppermost stage is selected.

[0156] After the tray 10 is selected, the second motor 150 stops, and the control IC 266 drives the first motor 110. At this time, the holder 14 is in the playing position, and therefore the main tray slider 83 is prevented from moving.

As a result, the second output gear 125 is prevented from rotating, and therefore the slider 21 is moved in the direction shown by the arrow b. Thereby, the tray 10 (main tray 11 and subtray 12) moves toward the ejection position.

[0157] When the tray 10 reaches the ejection position, the first switch body 64 is operated to ensure that the tray 10 is in the ejection (storage) position, and the control IC 266 stops the first motor 110. In this operation of ejecting the tray 10, by using the sliding arms 222 and 223, the tray 10 can be sufficiently guided and held even though the guiding guides 61 and 62 are short. That is, at some midpoint of the ejection operation, the sliding arms 222 and 233 start sliding toward the front to keep the tray 10 held.

[0158] Thereafter, when the disk 5 is placed on the tray 10, and instructions to store the tray 10 are given, the first motor 110 rotates in the direction reverse to that described above, and the slider 21 moves in the direction shown by the arrow a to bring the tray 10 to the storage position. At this storage position, the subtray 12 is in the state shown in FIG. 1 with its tip converged. And, the second motor 150 is rotated in the reverse direction, and the lift slider 167 is turned back to the original position to provide a standby state. Furthermore, the lift slider 167 may be kept in the previous position without rotating the second motor 150 in the reverse direction.

[0159] Operations with the disk 5 in the playing position will now be described.

[0160] When instructions to play a disk 5 (tray 10) to be played are selected using a button, a remote control or the like, the control IC 266 first operates the second motor 150, and moves the lift slider 167 toward the front as previously described. This movement triggers momentum of the clip spring 253, causing the rotation cam portion 200 to rotate in the direction shown by the arrow s. Thereby, the lift holder 184 moves upward, and the rear end of the holder 14 moves to the uppermost part. However, since the first boss 181 of the holder 14

exists in the i section of the first cam hole 165 at the position in which the first boss 172 of the gear holder 171 exists in the leading part of the f section of the second cam hole 166 of the lift slider 167, the tip of the holder 14 exists in the lower part, and thus the holder 14 is considerably slanted.

[0161] When the lift slider 167 further moves toward the front, the first boss 181 comes to the h section of the first cam hole 165, and moves upward in three steps. The position higher by one step than the lowest position corresponds to the tray 10 in the lowermost stage, the next step corresponds to the tray 10 in the middle stage, and the uppermost step corresponds to the tray 10 in the uppermost stage.

[0162] This position detection is carried out in such a way that the photo interrupter 206 detects the slit 207 of the guide cam 161. By this detection, the lift slider 167 is stopped at a predetermined position, and the tray 10 (disk 5) to be submitted for playing is selected. At this time, the holder 14 is leveled or slanted depending on the selected tray 10 as shown in FIG. 4.

[0163] At this time, the subtray slider 82 engaged in the main tray slider 83 moves with the holder 14 in vertical direction. By this vertical movement, the subtray 12 to be pulled out is selected.

[0164] Then the first motor 110 starts to be driven. At this time, the first output gear 117 is prevented from rotating. That is, the first boss 181 of the holder 14 exists in the h section of the first cam hole 165, and therefore the boss 215 of the rack gear 211 contacts the inner face 167a of the lift slider 167. The lug 216 of the rack gear 211 fits in the third gear 120 to prevent the first output gear 117 from rotating.

[0165] Since the first output gear 117 is prevented from rotating, the main tray slider 83 is influenced by the rotation of the second output gear 125 to move toward the rear (in the direction shown by the arrow a). As a result, the subtray

12 engaging with the subtray slider 82 is pulled out and captured in the holder 14. When the main tray slider 83 moves to the rearmost position, the third switch body 86 is operated to turn the third switch 88 to the ON or OFF position. Thereby, the control IC 266 stops the first motor 110.

[0166] Thereafter, the second motor 150 starts to be driven to move the lift slider 147 toward to the rear (in the direction shown by the arrow a). Then, the guide cam 161 combined with this lift slider 167 rotates the rotation cam portion 200 in the direction shown by the arrow r. Thereby, the holder 14 in general moves down, and the disk 5 is placed on the rotating table 18.

[0167] As the holder 14 moves down, the subtray 12 moves down at the same time. At this time, both or any one of the determination switches 243 and 244 are turned to the ON position depending on existence/non-existence of two protrusions 241 and 242 provided at the rear end of the subtray 12. The control IC 266 recognizes by this signal that the disk 5 to be played is a correct disk 5, and uses this signal as address information for selecting the tray 10 (main tray 11) to be returned back after playing.

[0168] When the signals of the determination switches 243 and 244 are generated, the control IC 266 stops the second motor 150 and drives the spindle motor for the rotating table 18 to read information from the disk 5 to start playing.

[0169] If the disk 5 is returned back after playing or at some midpoint of playing, it is accomplished by carrying out operations opposite to the above-mentioned operations. Furthermore, a new disk 5 can be set in the tray 10 in the playing state. This can be done because it is possible to drive the first motor 110 to move the slider 21 toward the front (in the direction shown by the arrow b) while driving the spindle motor for driving the disk.

[0170] Also, other disks 5 can be played in succession in course of playing of one disk 5 or after playing of it. The operations in this case are basically

identical to the above-mentioned operations, but are different in the sense that after the subtray 12 having the disk 5 is given back to the main tray 11, the lift slider 167 is not returned to the original position, but is slightly moved so that it comes to the position in which it faces the tray 10. Thereby, the next subtray 12 can be immediately captured in the holder 14. However, same operations may be repeated instead of omitting operations.

[0171] The above-mentioned embodiment is a preferred embodiment in the first aspect of the present invention, but various changes can be made without departing the spirit of the present invention. For example, the back part of the subtray 12 is converged upward, but it may be converged downward or toward the center. Also, the rear end (back part) of the tray 10 in general as well as the subtray 12 may be converged. In this case, the tray 10 is not formed so as to be separable, but the thickness of the device can be reduced.

[0172] Also, the disk drive part 16 is a fixed unit, but the disk drive part 16 may be a movable unit. Furthermore, in stead of moving the holder 14 in vertical direction, it may be moved in a horizontal direction as a longitudinal type. In this case, the vertical movement, upward movement and downward movement described in the specification are reinterpreted as movements in horizontal directions.

[0173] In the above described embodiment, the device is a changer mechanism having a plurality of trays 10, but the structure of the separable tray 10 and other structures may also be applied to a usual disk drive device allowing only one disk to be inserted. Furthermore, the present invention may be applied to various kinds of disk devices for compact disks, laser disks, minidisks, digital video disks and the like, in addition to a disk drive device for magneto-optical disks.

[0174] Also, in the second aspect of the present invention, various changes can be made without departing the spirit of the present invention. For example, in the above described embodiment, the guiding portion comprises the fixed guiding guides 61 and 62, and the sliding arms 222 and 223 capable of being slid relative to these guiding guides 61 and 62, but it may be a wholly-movable type allowing the guiding portion in general to make a back-and-forth motion, or it may be formed so as to be expandable and contractible by changing a part thereof to a bellows structure.

[0175] Also, the main tray 11 is made to be long enough to reach at least the playing position, thereby making it possible to downsize the device and hold the tray with high stability. Furthermore, from a viewpoint of dimension, the distance from the rear end of the storage position is preferably increased in length by 50% or more (ratio to the diameter of the disk 5), in terms of downsizing the device and holding the tray with stability. Also, when the tray 10 is exactly in the ejection position, the tips of the sliding arms 222 and 223 extend off the face of the front end of the other tray 10 in the storage position, but even if they do not, a significant effect of downsizing the device is produced.

[0176] Also, in the above described embodiment, the back part of the subtray 12 is converged upward, but it may be converged downward or toward the center. Also, the rear end (back part) of the tray 10 in general as well as the subtray 12 may be converged. In this case, the tray 10 is not formed to be separable, but the thickness of the device can be reduced.

[0177] In addition, the disk drive part 16 is a fixed unit, but the disk drive part 16 may be a movable unit. Also, instead of moving the holder 14 in vertical direction, it may be moved in a horizontal direction as a longitudinal type. In this case, the vertical movement, upward movement and downward movement

described in the specification are reinterpreted as movements in horizontal directions.

Industrial Applicability

[0178] For the disk drive device of the present invention, a tray is separable into a main tray and a subtray, and only the subtray can be operated, thus making it possible to reduce the size and thickness of the device. Also, for the disk drive device of the present invention, an expandable and contractible guiding portion is provided, the tray is formed to be separable, and the main tray is made to be long enough to reach the playing position, thus making it possible to reduce the depth dimension of the device and provide quality and functions equivalent to those of a device having a longer depth dimension.

CLAIMS

1. A disk drive device provided with a mechanism for feeding a tray having a disk thereon to a disk drive part,

CHARACTERIZED IN THAT

there are provided a plurality of trays which are stacked in a vertical direction, each of the trays consisting of a pair of a main tray and a sub tray, the main tray moving from an ejection position to a storage position, the sub tray being housed in and movable relative to its corresponding main tray;

each of the disks can be put on each of the sub trays; and

when the sub trays move from the ejection position to the storage position together with respective main trays, the sub trays move from a horizontal direction to an oblique direction, and the sub trays are disposed at the storage position in such a manner that the tips, on the side toward the disk drive part, of the sub trays are adapted to be converged.

2. The disk drive device according to claim 1, wherein the main tray and the subtray are so disposed as to overlap each other in vertical direction at the position in which the disk is ejected, and the subtray having the disk thereon is separated from the main tray, and is moved to the disk drive part when the disk is driven in the disk drive part.

3. The disk drive device according to claim 1, wherein said subtrays are arranged in parallel with one another at the position in which said disk is ejected.

4. The disk drive device according to any of claims 1 to 3, wherein said disk drive part has a holder that receives said subtray, and is moved to the rotation position together with said disk on this subtray.

5. The disk drive device according to any of claim 4, wherein said holder is formed so as to be rotatable in keeping with the gradient of said subtray.

6. A disk drive device comprising:
 - a plurality of main trays;
 - a plurality of subtrays that can have disks thereon, each of which is put on a corresponding main tray, and can be moved relative to the main tray; and
 - a mechanism for feeding the subtray having the disk thereon to a disk drive part,wherein the plurality of main trays having the subtrays thereon are disposed so as to be stacked in vertical, and the tip of the each subtray on the side toward the disk drive part side is converged when the disk is stored in the tray.
7. The disk drive device according to claim 6, wherein the main tray and the subtray are so disposed as to overlap each other in vertical direction at the position in which the disk is ejected, and the subtray having the disk thereon is separated from the main tray, and is moved to the disk drive part when the disk is driven in the disk drive part.
8. The disk drive device according to claim 6, wherein the subtrays are arranged in parallel with one another at the position in which the disk is ejected.
9. The disk drive device according to any of claims 6 to 8, wherein the disk drive part has a holder that receives the subtray, and is moved to the rotation position together with the disk on this subtray.
10. The disk drive device according to any of claim 9, wherein the holder is formed so as to be rotatable in keeping with the gradient of the subtray.

11. A disk drive device in which a tray having a disk thereon can be pulled out,
CHARACTERIZED IN THAT

a guiding portion for guiding and holding the tray is formed so as to be expandable and contractible so that the guiding portion becomes longer when the tray is in the ejection position than when the tray is in the storage position.

12. The disk drive device according to claim 11, wherein the guiding portion comprises a fixed guiding guide, and a sliding arm capable of being slid relative to this guiding guide.

13. The disk drive device according to claim 12, wherein the tray comprises two members that are separated into a main tray and a subtray at the playing position, and when the tray is driven in the direction of ejection, the main tray hits against the sliding arm to push the sliding arm in the direction of pullout, and the rear end part of the subtray is placed on this sliding arm, and the main tray, the subtray and the sliding arm are pulled out in one united body.

14. The disk drive device according to claim 11, 12 or 13, wherein the tip of the guiding portion extends off the face of the front end of the tray in the storage position when the guiding portion gets longer.

15. A disk drive device in which a tray having a disk thereon can be pulled out,
CHARACTERIZED IN THAT

the tray is formed so as to be separable into a main tray and a subtray, and the main tray is made to be long enough to reach a playing position, and only the subtray is moved from a storage position to the playing position, and the

main tray and the subtray are guided by a guiding portion to be moved to the ejection position in one united body.

16. The disk drive device according to claim 15, wherein the guiding portion comprises a fixed guiding guide, and a sliding arm capable of being slid relative to this guiding guide.

17. The disk drive device according to any of claims 11 to 16, wherein the plurality of trays can be so disposed as to be stacked in vertical direction.