

A disc changer comprising a rolling track.

The invention relates to a disc changer for storing disc-shaped information carriers and transporting the information carriers into and out of a scanning position.

The invention further relates to an information disc player comprising a disc changer for storing disc-shaped information carriers and transporting the information carriers  
5 into and out of a scanning position, a turntable which is rotatable about an axis of rotation for supporting and rotating an information carrier in the scanning position, and a scanning device for scanning the information carrier in the scanning position.

10 A disc changer and an information disc player of the kinds mentioned in the opening paragraphs are known from WO 96/34386. The known disc changer is provided in the known information disc player and comprises a carousel-like support unit for the information carriers. The support unit is rotatable about an axis of rotation by means of an electrical motor and comprises a number of supporting surfaces for storing and supporting the individual  
15 information carriers. The information carriers are transported into and out of the scanning position by rotating the support unit carrying the information carriers about the axis of rotation of the support unit. When an information carrier has been transported into the scanning position, the information carrier is supported by the turntable of the information disc player and is scanned by means of the scanning device of the information disc player by rotating the  
20 information carrier about the axis of rotation of the turntable and by displacing a scanning unit of the scanning device in a radial direction relative to the axis of rotation of the turntable.

A disadvantage of the known disc changer and the known information disc player is that the carousel-like support unit constitutes a rather bulky rotatable part of the disc changer having a relatively high moment of inertia. Therefore, the electrical motor for rotating  
25 the support unit and transporting the information carriers into and out of the scanning position must be able to exert a relatively high mechanical torque on the support unit.

It is an object of the invention to provide a disc changer and an information disc player of the kinds mentioned in the opening paragraphs, in which the information carriers can be transported into and out of the scanning position by means of a transport device having displaceable parts with a relatively small mass and/or rotatable parts with a relatively small moment of inertia, so that the information carriers can be transported into and out of the scanning position by means of an actuator exerting only a relatively small mechanical force or torque.

To achieve this object, a disc changer in accordance with the invention is characterized in that the disc changer comprises a closed stationary guiding track for storing and guiding the information carriers, said guiding track having a transport direction and a width which, viewed in a direction perpendicular to the transport direction, substantially corresponds to a diameter of the information carriers, said guiding track being respectively bounded, viewed in a direction perpendicular to the transport direction, by a rolling track, which is stationary relative to the guiding track for cooperation with a circumferential part of the information carriers, and a driving member for rolling the information carriers along the rolling track by cooperation with said circumferential part.

To achieve this object, an information disc player in accordance with the invention is characterized in that the disc changer used therein is a disc changer in accordance with the invention.

In the disc changer in accordance with the invention, the information carriers are supported by the stationary guiding track. Since the width of the guiding track substantially corresponds to the diameter of the information carriers, the information carriers fit substantially without any tolerance between the rolling track and the driving member, so that the information carriers can be rolled by the driving member along the rolling track by the cooperation of the driving member with the circumferential parts of the information carriers. Since the guiding track is closed, the guiding track can be substantially completely filled with the information carriers, and the information carriers can be transported relative to the guiding track in an endless manner and without hindrance in the transport direction or in a direction opposite to the transport direction. Since the guiding track and the rolling track constitute stationary parts of the disc changer, and the driving member constitutes the only displaceable and/or rotatable part of the disc changer, the mass of the displaceable parts and/or the moment of inertia of the rotatable parts of the disc changer are relatively small, so that the information carriers can be transported into and out of the scanning position by means of an actuator exerting only a relatively small mechanical force or torque.

A particular embodiment of a disc changer in accordance with the invention is characterized in that the guiding track is annular and the rolling track is circular, the driving member comprising a roller which is rotatable about an axis of rotation substantially coinciding with a common central axis of the guiding track and the rolling track and which is driveable by means of an electrical motor. In this particular embodiment, a very simple construction of the disc changer is achieved. Since the driving member comprises said roller, the driving member also has a very simple construction and a very low moment of inertia.

A further embodiment of a disc changer in accordance with the invention is characterized in that the roller comprises an annular supporting surface which extends transversely to the axis of rotation for cooperation with a circumferential part of a main side of the information carriers. Since the roller is provided with said annular supporting surface, the information carriers are rolled along the rolling track mainly by the cooperation of the roller with said circumferential part of said main side of the information carriers, and substantially without any cooperation of the roller with the outer edges of the information carriers. In this way, it is not necessary for the information carriers to fit in a very close manner between the rolling track and the driving member to achieve the necessary cooperation between the information carriers, the rolling track, and the driving member. As a result, the width of the guiding track does not need to be very accurate, and also the loading and unloading of the information carriers into and out of the disc changer is facilitated.

A yet further embodiment of a disc changer in accordance with the invention is characterized in that the guiding track comprises an annular supporting surface for cooperation with a main side of the information carriers, and the rolling track comprises a circular cylindrical rolling surface for cooperation with an outer edge of the information carriers, said supporting surface of the guiding track extending substantially perpendicularly to the axis of rotation and being bounded by the rolling track, said rolling surface of the rolling track extending substantially perpendicularly to the supporting surface of the guiding track. As a result of said cooperation of said rolling surface of the rolling track with the outer edge of the information carriers, good rolling properties of the information carriers along the guiding track without any substantial slip are achieved, so that a reliable operation of the disc changer is achieved. As a result of said cooperation of said rolling surface of the rolling track with the outer edge of the information carriers and said cooperation of said supporting surface of the guiding track with said main side of the information carriers, an accurate position of the information carriers relative to the guiding track is achieved in directions perpendicular to the transport direction.

A particular embodiment of a disc changer in accordance with the invention is characterized in that the guiding track and the rolling track are formed by a circular cylindrical recess provided in a main frame of the disc changer, wherein the guiding track is formed by a bottom part of said recess and the rolling track is formed by a side wall of said recess, the roller being rotatably journaled in said bottom part. In this manner, the guiding track and the rolling track are formed in a very simple manner, so that the construction of the disc changer is further simplified.

A further embodiment of a disc changer in accordance with the invention is characterized in that the disc changer comprises a detector system for detecting a presence of an information carrier in the scanning position. In the disc changer in accordance with the invention, it is principally not possible to determine a position of the information carriers in the transport direction relative to the guiding track and the scanning position as a function of a position of the driving member. As a result of the use of said detector system, the presence of an information carrier in the scanning position can be detected independently of the position of the driving member, so that it is possible to detect whether the information carrier is in a correct position to be scanned.

A yet further embodiment of a disc changer in accordance with the invention is characterized in that the detector system comprises two optical detectors which are arranged to detect the circumferential part of an information carrier which is present in the scanning position. As a result of the use of said two optical detectors, a reliable and accurate detection of the presence of an information carrier in the scanning position is achieved.

A particular embodiment of an information disc player in accordance with the invention is characterized in that the guiding track, the rolling track, and the driving member of the disc changer are provided on a drawer of the information disc player which is displaceable from an operational position, in which the drawer has been retracted into a housing of the information disc player, to a loading position, in which the drawer is at least partially outside of the housing. In this manner, the loading and unloading of the information carriers into and out of the information disc player is facilitated.

A further embodiment of an information disc player in accordance with the invention, wherein the guiding track and the rolling track of the disc changer used therein are formed by a circular cylindrical recess provided in a main frame of the disc changer, is characterized in that the recess of the disc changer is provided in the drawer. In this manner, a very simple construction of the information disc player is achieved.

The invention will be further explained below with reference to the drawing, in which

Figure 1 schematically shows an information disc player according to the invention,

Figure 2 shows a disc changer according to the invention, which is used in the information disc player of figure 1,

Figure 3 shows a section taken on the line III-III in figure 2,

Figure 4 schematically shows a section taken on the line IV-IV in figure 2, and

Figure 5 schematically shows an alternative embodiment of a disc changer according to the invention.

The information disc player according to the invention shown in figure 1 comprises a housing 1 with a front side 3, which has an opening 5 and accommodates a control panel 7. The information disc player is further provided with a drawer 9 which is displaceable, via the opening 5, from an operational position 11, in which the drawer 9 has been retracted into the housing 1, into a loading position 13, in which the drawer 9 is at least partially outside of the housing 1. The drawer 9, which is shown in detail in figure 2, is for this purpose provided with two linear guiding members 15 and 17 by means of which the drawer 9 is guided along two linear guiding members of the housing 1, which are not shown in the figures. The information disc player is further provided with driving means for displacing the drawer 9 into and out of the housing 1, said driving means being also not shown in the figures and comprising, for example, a toothed rack mounted on a bottom side 19 of the drawer 9 for cooperation with a toothed wheel which is rotatably journaled relative to the housing 1 and is driveable by means of an electric motor.

As shown in figure 2, the information disc player comprises a disc changer 21 according to the invention, which is provided on the drawer 9 and is used for storing a number of disc-shaped information carriers, in the embodiment shown three CD's 23a, 23b, 23c, and selectively transporting the information carriers 23a, 23b, 23c into and out of a scanning position 25 in which the information carriers 23a, 23b, 23c can be scanned by means of a scanning device 27 of the information disc player in a manner to be described in detail hereafter. According to the invention, the disc changer 21 comprises a closed or endless guiding track 29, which is stationary relative to the drawer 9 and has a transport direction X. In the embodiment shown in figure 2, the guiding track 29 is annular and is respectively

bounded, viewed in a radial direction perpendicular to the transport direction X, by a driving member 31 and a circular rolling track 33 which is also stationary relative to the drawer 9 and concentrically surrounds the guiding track 29. As shown in figure 3, the driving member 31 comprises a roller 35 which is rotatable about an axis of rotation 37 substantially coinciding with a common central axis 39 of the guiding track 29 and the rolling track 33. The roller 35 is driveable by means of an electrical motor 41 via a number of gear wheels 43, 45, the motor 41 being mounted on the bottom side 19 of the drawer 9. The roller 35 comprises an annular supporting surface 47 which extends transversely to the axis of rotation 37. The guiding track 29 comprises an annular supporting surface 49 extending substantially perpendicularly to the axis of rotation 37. The supporting surface 49 of the guiding track 29 is bounded by a circular cylindrical rolling surface 51 of the rolling track 33, which extends substantially perpendicularly to the supporting surface 49 of the guiding track 29.

In the loading position 13 of the drawer 9 shown in figure 1, the disc changer 21 is easily accessible for a user of the information disc player, and the information carriers 23a, 23b, 23c can be stored into the guiding track 29 of the disc changer 21 by the user. As shown in figures 2 and 3, the guiding track 29 has a width W which, viewed in a direction perpendicular to the transport direction X, substantially corresponds to a diameter D of the information carriers 23a, 23b, 23c. In the embodiment shown in figures 2 and 3, said width W is slightly smaller than said diameter D, so that a circumferential part 53 of a main side 55 of the information carriers 23a, 23b, 23c is supported near the rolling track 33 by the supporting surface 49 of the guiding track 29 and is supported near the axis of rotation 37 by the supporting surface 47 of the roller 35. When the information carriers 23a, 23b, 23c have thus been stored into the disc changer 21, the drawer 9 is closed and one of the information carriers 23a, 23b, 23c, for example the information carrier 23b, is selected to be played. The information carrier 23b is transported into the scanning position 25 by driving the roller 35 in a counter-clockwise direction Y as shown in figure 2. The supporting surface 47 of the roller 35 then cooperates with the circumferential parts 53 of the information carriers 23a, 23b, 23c under the influence of friction forces, so that the three information carriers 23a, 23b, 23c are jointly rolled by the roller 35 along the rolling surface 51 of the rolling track 33, the rolling surface 51 cooperating with the outer edges 55 of the information carriers 23a, 23b, 23c. As a result, the three information carriers 23a, 23b, 23c are jointly guided along the guiding track 29 and transported in the transport direction X, so that, starting from the situation shown in figure 2, the information carrier 23a is transported out of the scanning position 25 and the information carrier 23b is transported into the scanning position 25. To increase the friction

forces between the information carriers 23a, 23b, 23c and the supporting surface 47 of the roller 35 and to prevent any slip between the information carriers 23a, 23b, 23c and the supporting surface 47, the roller 35 comprising the supporting surface 47 can be made from, for example, rubber, so that a reliable operation of the disc changer 21 is achieved. Since the rolling track 33 comprises said circular cylindrical rolling surface 51 for cooperation with the outer edges 55 of the information carriers 23a, 23b, 23c, good rolling properties of the information carriers 23a, 23b, 23c along the rolling track 33 without any substantial slip and accurately defined positions of the information carriers 23a, 23b, 23c in directions perpendicular to the transport direction X are achieved. The rolling properties of the information carriers 23a, 23b, 23c along the rolling track 33 can be further improved by providing the rolling surface 51 of the rolling track 33 with, for example, a rubber layer.

The driving member 31 constitutes the only main part of the disc changer 21 according to the invention which is rotatable relative to the drawer 9, and the disc changer 21 does not have any further main parts which are displaceable relative to the drawer 9. Since the driving member 31 only has a relatively small moment of inertia relative to the axis of rotation 37, a mechanical torque to be exerted by the electrical motor 41 for rotating the driving member 31 and transporting the information carriers 23a, 23b, 23c is considerably limited, so that the motor 41 can be of a relatively small type. Since the main parts of the disc changer 21 according to the invention are constituted by the guiding track 29, the rolling track 33, and the driving member 31, the disc changer 21 has a simple construction. The construction of the disc changer 21 shown in figure 2 is further simplified in that the guiding track 29 is formed by a bottom wall 57 of a circular cylindrical recess 59 which is provided in an upper surface 61 of the drawer 9, in that the rolling track 33 is formed by a side wall 63 of said recess 59, and in that the roller 35 is rotatably supported in said bottom wall 57 by means of a journal 65. The drawer 9 thus constitutes a main frame of the disc changer 21.

In the disc changer 21 according to the invention, it is principally not possible to determine a position of the information carriers 23a, 23b, 23c in the transport direction X as a function of an angular position of the driving member 31. Therefore, as schematically shown in figure 2, the disc changer 21 further comprises a detector system 67 by means of which the presence of one of the information carriers 23a, 23b, 23c in the scanning position 25 can be detected. The detector system 67 comprises two optical detectors 69, 71 which are arranged in the supporting surface 49 of the guiding track 29 in two positions opposite to the circumferential part 53 of an information carrier 23a, 23b, 23c when this information carrier 23a, 23b, 23c is in a correct position to be scanned by the scanning device 27. As shown in

figure 2, the optical detectors 69, 71 are arranged very close to the outer edge 55 of an information carrier 23a, 23b, 23c when this information carrier 23a, 23b, 23c is in the scanning position 25, so that an accurate and reliable detection of the presence of this information carrier 23a, 23b, 23c in the scanning position 25 is possible. Only when both  
 5 detectors 69, 71 detect the presence of the circumferential part 53 of one of the information carriers 23a, 23b, 23c, this information carrier 23a, 23b, 23c is considered to be in a correct position to be scanned by the scanning device 27, and the driving member 31 is stopped. It is noted, that the circumferential parts 53 of the information carriers 23a, 23b, 23c may be provided with optically detectable data about the information present on the information  
 10 carriers 23a, 23b, 23c, so that the detectors 69, 71 can also be used for detecting an information carrier 23a, 23b, 23c which has been specifically selected to be played.

As schematically shown in figure 4, the information disc player further comprises a turntable 73 which is rotatable about an axis of rotation 75 by means of an electrical motor 77. The motor 77 and the turntable 73 are supported by a support arm 79  
 15 which is coupled to the drawer 9 so as to be displaceable in opposite directions Z and Z' perpendicular to the supporting surface 49 of the guiding track 29 by means of a driving unit not shown in figure 4. When the information carriers 23a, 23b, 23c are being transported along the guiding track 29, the turntable 73 is in a position below the supporting surface 49, so that the information carriers 23a, 23b, 23c can freely move along the guiding track 29. When the  
 20 detectors 69, 71 detect the presence of a selected information carrier 23a, 23b, 23c in the scanning position 25, the turntable 73 is lifted through an opening 81 present in the supporting surface 49, so that the information carrier 23a, 23b, 23c present in the scanning position 25 is lifted up from the supporting surface 49 and is supported by the turntable 73. The scanning device 27 is mounted to the drawer 9 and comprises an optical scanning device 83, which can  
 25 be of a type which is usual in optical disc players and is not shown in detail in figure 4. The scanning device 83 is mounted on a sledge 85 which is displaceable in opposite radial directions R and R' relative to the axis of rotation 75 of the turntable 73 by means of a displacement unit 87 mounted to the drawer 9. To scan the information present on the information carrier 23a, 23b, 23c in the scanning position 25, this information carrier 23a, 23b,  
 30 23c is rotated by the turntable 73 about the axis of rotation 75 of the turntable 73 and, simultaneously, the scanning device 83 is displaced in the radial direction R, R' by the displacement unit 87, so that the scanning device 83 follows a helical information track present on the information carrier 23a, 23b, 23c.

Since the width W of the guiding track 29 is slightly smaller than the diameter D of the information carriers 23a, 23b, 23c, and the circumferential parts 53 of the information carriers 23a, 23b, 23c are supported by the supporting surface 47 of the roller 35, it is not necessary for the information carriers 23a, 23b, 23c to fit in a very close manner between the rolling track 33 and the driving member 31. As a result, the information carriers 23a, 23b, 23c can be loaded into and unloaded from the disc changer 21 without much effort, and also the information carriers 23a, 23b, 23c can be transported by the driving member 31 in a smooth manner. Furthermore, the width W of the guiding track 29 does not have to be very accurate, so that the manufacture of the disc changer 21 is further simplified. It is noted, that the invention also covers embodiments of a disc changer in which the information carriers are rolled with their outer edges along a rolling track and in which a driving member also cooperates with the outer edges of the information carriers. In such embodiments, however, the information carriers must fit substantially without any tolerance between the rolling track and the driving member to achieve a correct operation of the disc changer, so that the guiding track must have a width which is substantially equal to the diameter of the information carriers. Therefore, the expression "a circumferential part of the information carriers" in claim 1 includes both the circumferential part 53 as described before and the outer edge 55 of the information carriers.

Since the guiding track 29 is closed, the guiding track 29 can be substantially completely filled with information carriers, and the information carriers can be transported relative to the guiding track 29 in an endless manner and without hindrance also when the guiding track 29 is substantially completely filled. It is noted, that the driving member 31 can also be rotated in a clockwise direction Y', whereby the information carriers 23a, 23b, 23c are transported in a transport direction X' opposite to the transport direction X. This is meaningful if, for example starting from the situation shown in figure 2, the information carrier 23c is to be transported into the scanning position 25.

It is further noted, that the invention also covers embodiments of a disc changer in which a larger number of information carriers can be stored in the disc changer. An example of such an embodiment is an embodiment, in which the disc changer comprises an annular guiding track having an outer radius which is substantially larger than the diameter of the information carriers, and a driving member having a roller with an outer diameter which is substantially larger than the diameter of the roller 35 of the disc changer 21 of figure 2. Another example of such an embodiment is schematically shown in figure 5. The alternative embodiment of a disc changer 89 shown in figure 5 comprises an oval stationary guiding track

91 which is respectively bounded, viewed in a direction perpendicular to a transport direction X, by an oval stationary rolling track 93 and by an oval driving member 95 which comprises an endless driving belt 97 arranged around two driving wheels 99, 101. As a result of the oval shape of the guiding track 91, a maximum number of eight information carriers 103 can be  
5 stored in the disc changer 89. It is noted, that the disc changers 21 and 89 discribed before can also be filled with a number of information carriers 23, 103 which is smaller than the maximum number of information carriers (three and eight, respectively).

It is further noted that the invention also covers embodiments of a disc changer in which the rolling track is provided at an inner side of the guiding track and the driving  
10 member is provided at an outer side of the guiding track, as well as embodiments of a disc changer in which the rolling track and/or the driving member have another construction and/or shape than the rolling tracks and driving members described before.

It is finally noted that the invention does not only cover disc changers for use in information disc players for reading and/or writing optical information discs, but also disc  
15 changers for use in information disc players for reading and/or writing magneto-optical information discs, magnetic information discs, or any other kind of information disc to be scanned by a suitable scanning device of the information disc player.

## CLAIMS:

1. An information disc player comprising a turntable which is rotatable about an axis of rotation for supporting and rotating a disc-shaped information carrier in a scanning position, a scanning device for scanning such information carrier in the scanning position, and a tray for storing several of these disc-shaped information carriers, which tray includes a disc changer for transporting the information carriers into and out of the scanning position, which disc changer comprises an endless stationary guiding track for storing and guiding the information carriers, which guiding track has a transport direction and a width which, viewed in a direction perpendicular to the transport direction, substantially corresponds to the diameter of the information carriers, and which guiding track is bounded, viewed in a direction perpendicular to the transport direction, by a rolling track, which is stationary relative to the guiding track for cooperation with a circumferential part of the information carriers, and by a driving member for rolling the information carriers along the rolling track by cooperation with said circumferential part.
2. An information disc player as claimed in Claim 1, wherein the tray is part of the drawer whereby the guiding track, the rolling track, and the driving member of the disc changer are provided on the drawer, which drawer is displaceable from an operational position, in which the drawer has been retracted into a housing of the information disc player, to a loading position, in which the drawer is at least partially outside the housing.
3. A disc player as claimed in Claim 1 or 2, wherein the guiding track is annular and the rolling track is circular, the driving member comprising a roller which is rotatable about an axis of rotation substantially coinciding with a common central axis of the guiding track and the rolling track and which is driveable by means of an electric motor.
4. A disc player as claimed in Claim 3, wherein the guiding track comprises an annular supporting surface for cooperation with a main side of the information carriers, and the rolling track comprises a circular cylindrical rolling surface for cooperation with an edge of the information carriers, said supporting surface of the guiding track extending

substantially perpendicular to the axis of the rotation and being bounded by the rolling track, said rolling surface of the rolling track extending substantially perpendicular to the supporting surface of the guiding track.

6. A disc player as claimed in Claim 5, wherein the guiding track and the rolling track are formed by a circular cylindrical recess provided in a main frame of the disc changer, wherein the guiding track is formed by a bottom part of said recess and the rolling track is formed by a side wall of said recess, the roller being rotatably journalled in said bottom part.

7. A disc player as claimed in Claim 1 or 2, wherein the disc changer comprises a detector system for detecting the presence of an information carrier in the scanning position.

8. A disc player as claimed in Claim 7, wherein the detector system comprises two optical detectors which are arranged to detect the circumferential part of an information carrier which is present in the scanning position.

9. A disc player as claimed in Claim 6 referring back to Claim 2, wherein the recess of the disc changer is provided in the drawer.

10. A disc changer for use in the disc player as claimed in any one of the preceding Claims, which changer is characterized as described in any one of said Claims.