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(54) **Disc loading device**

(57) A disc loading device has a slide base 17 driven by a driving motor 13, a first rotary unit 27 rotatably mounted on the slide base 17, a second rotary unit 39 similarly rotatably mounted on the slide base, means 87, 88, 91, 92 for biasing the first and second rotary units into rotation, guide means 85, 86 mounted parallel to the sliding direction of the slide base 17 and operable to regulate the rotation of said first and second rotary units against the biasing of the biasing means and allowing for movement of the rotary units which move together with the slide base 17, disc position control means 56, 57 mounted on the slide base 17 and at a position facing the first and second rotary units, and disc transport means (126) (of also Fig. 7) mounted on the slide base 17 and operable to transport the disc in a direction perpendicular to the sliding direction of the slide base 17. The rotary units are rotated against the biasing means by the joint operation of disc insertion and the disc position control means and is returned under the control of the guide means. A disc 20 inserted into the loading device 100 is loosely supported by the first and second rotary units and the disc position control means and transported with the slide base 17 in the sliding direction of the slide base, after which the disc is transported by the transport means 126 in a direction at right angles to said sliding direction so as to be engaged on a turntable (16) (of also Figs. 4, 11, 14). Disc clamping is disclosed (e.g. Fig. 14).

FIG.2

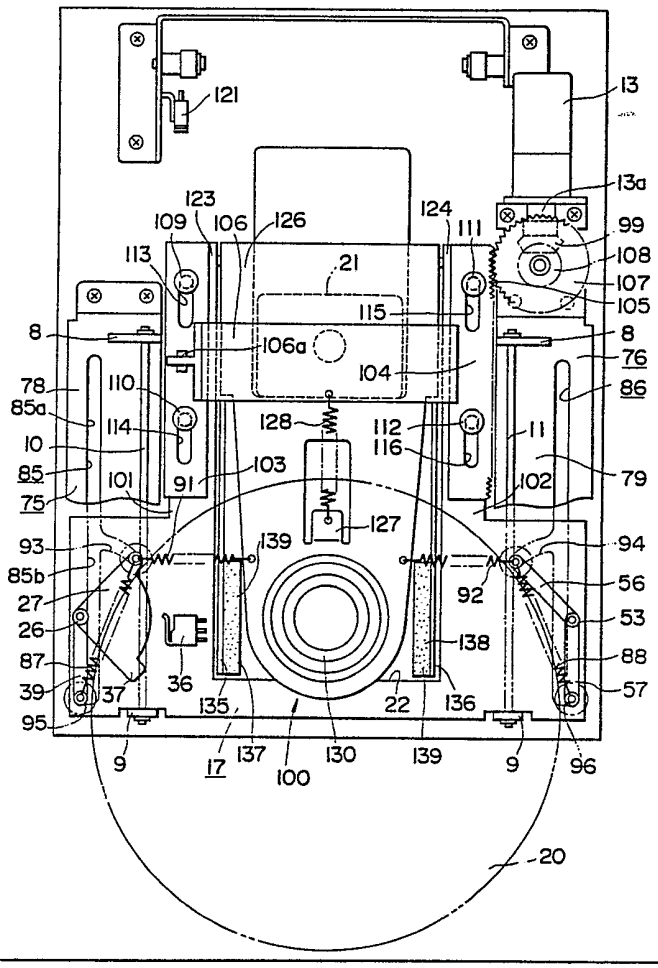

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FIG.1

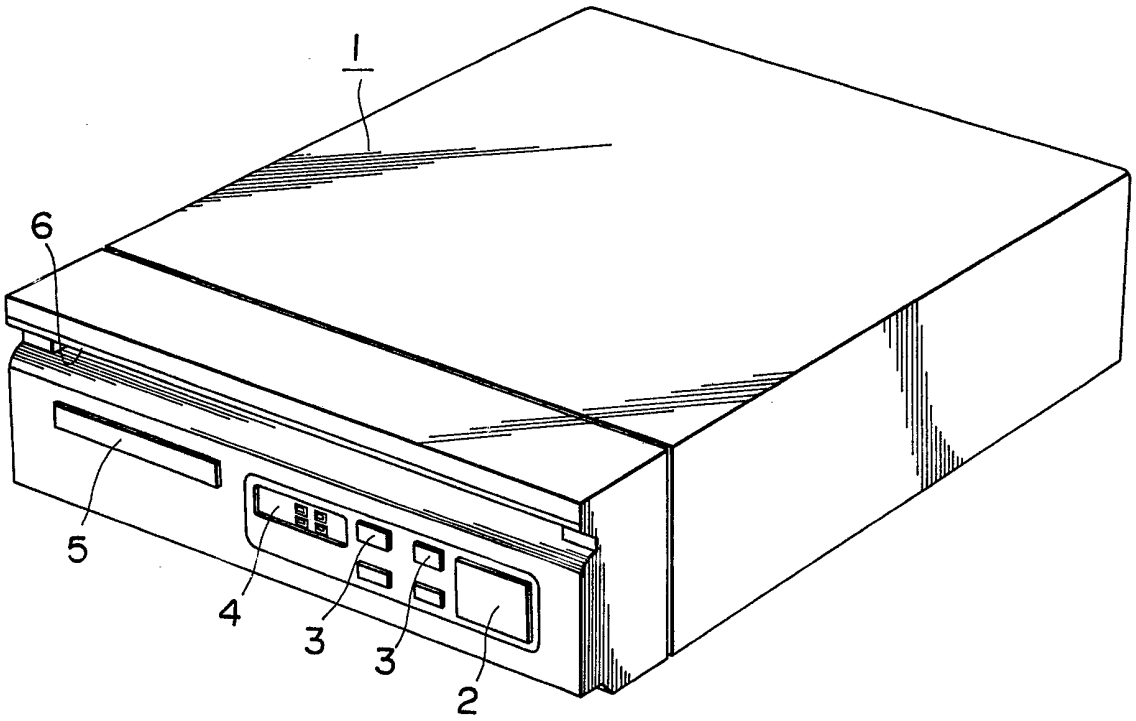

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FIG.2

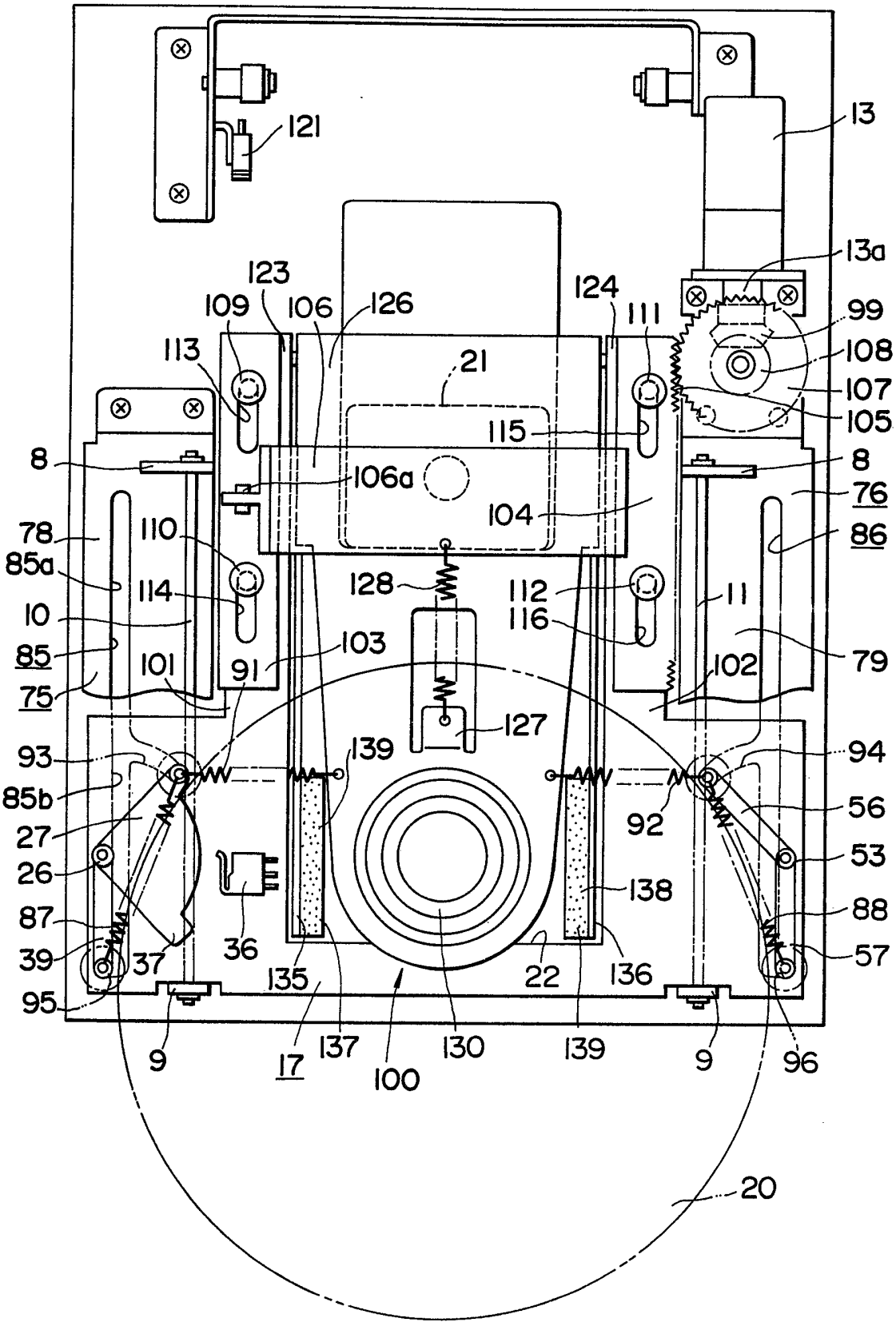

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FIG.3

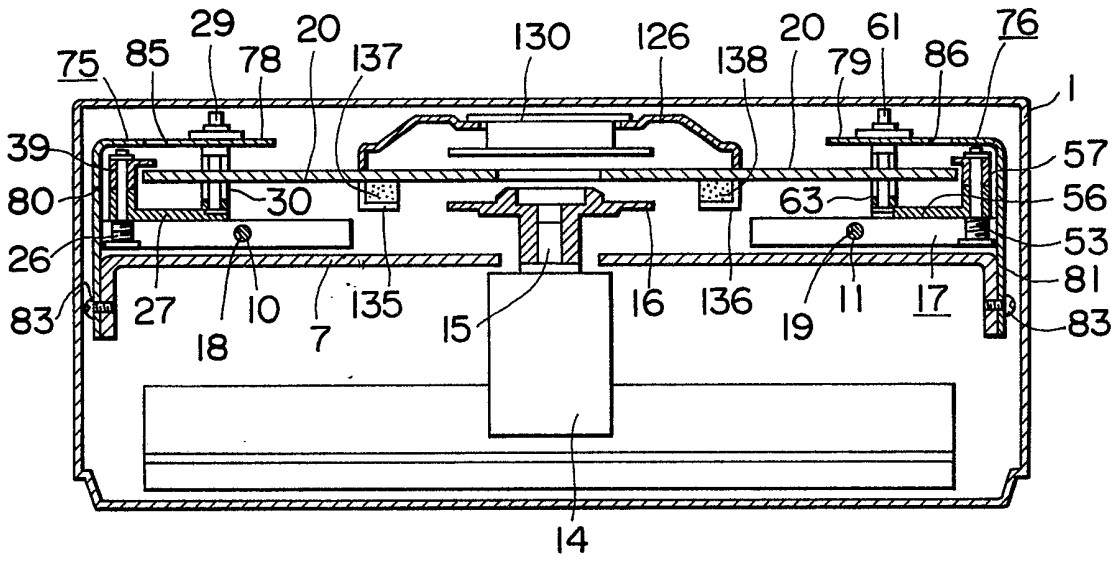

FIG.4

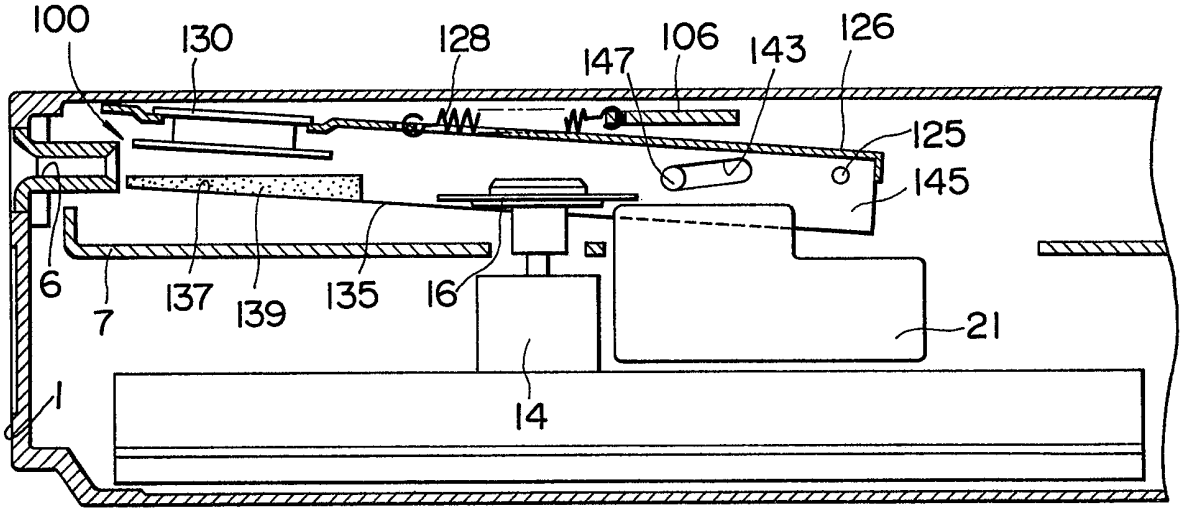

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FIG.5

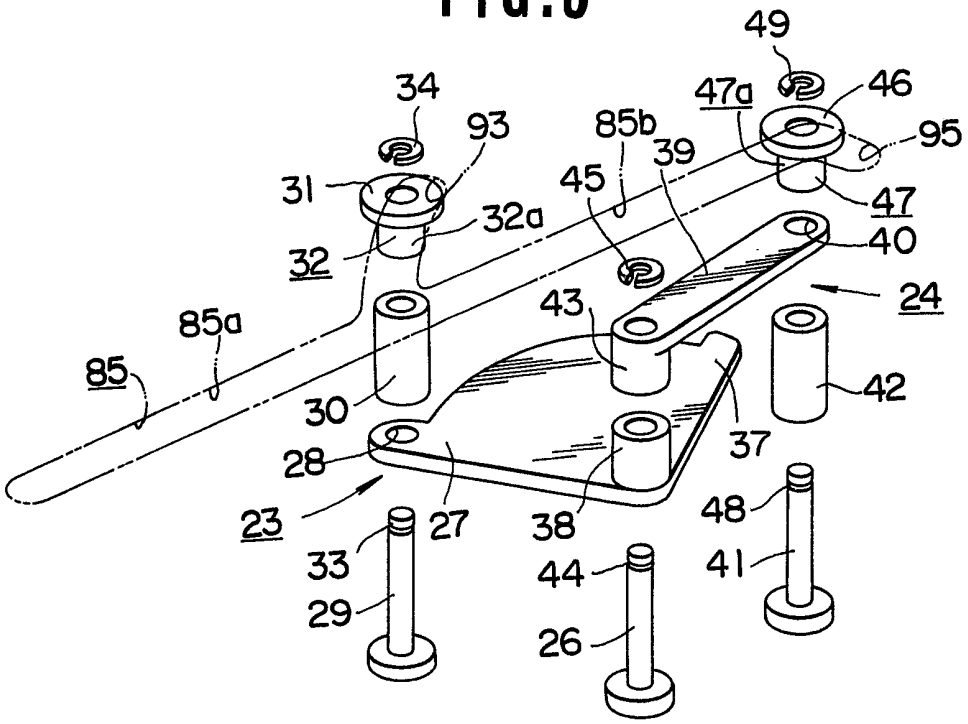

FIG.6

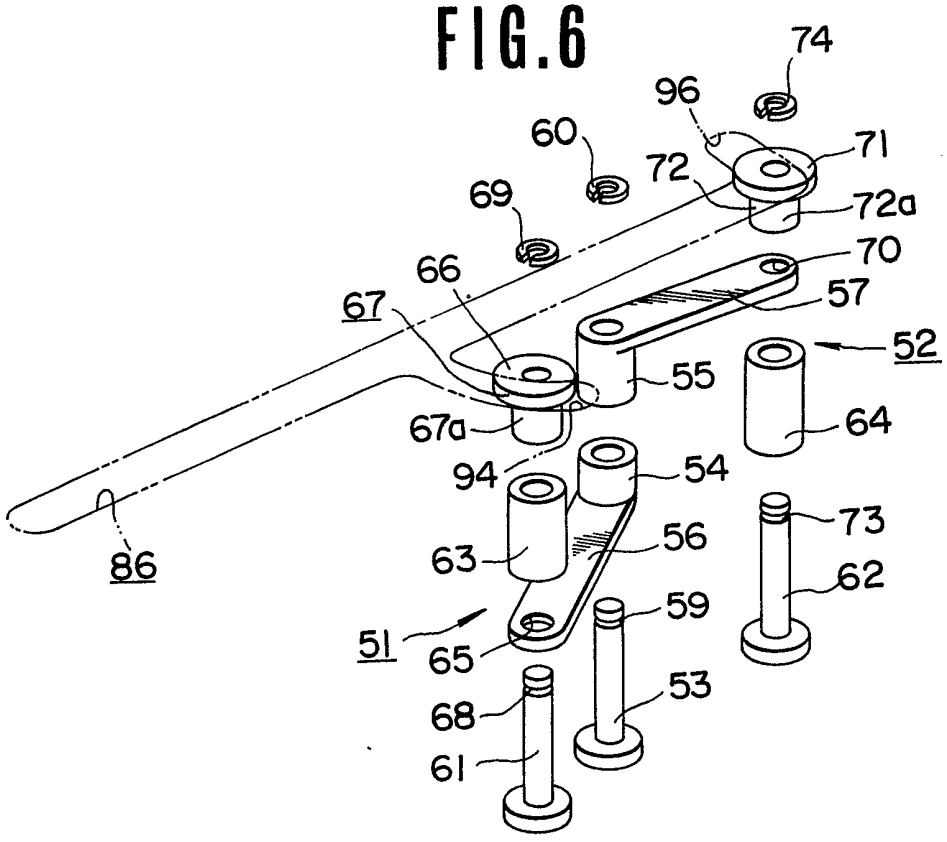

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FIG.7

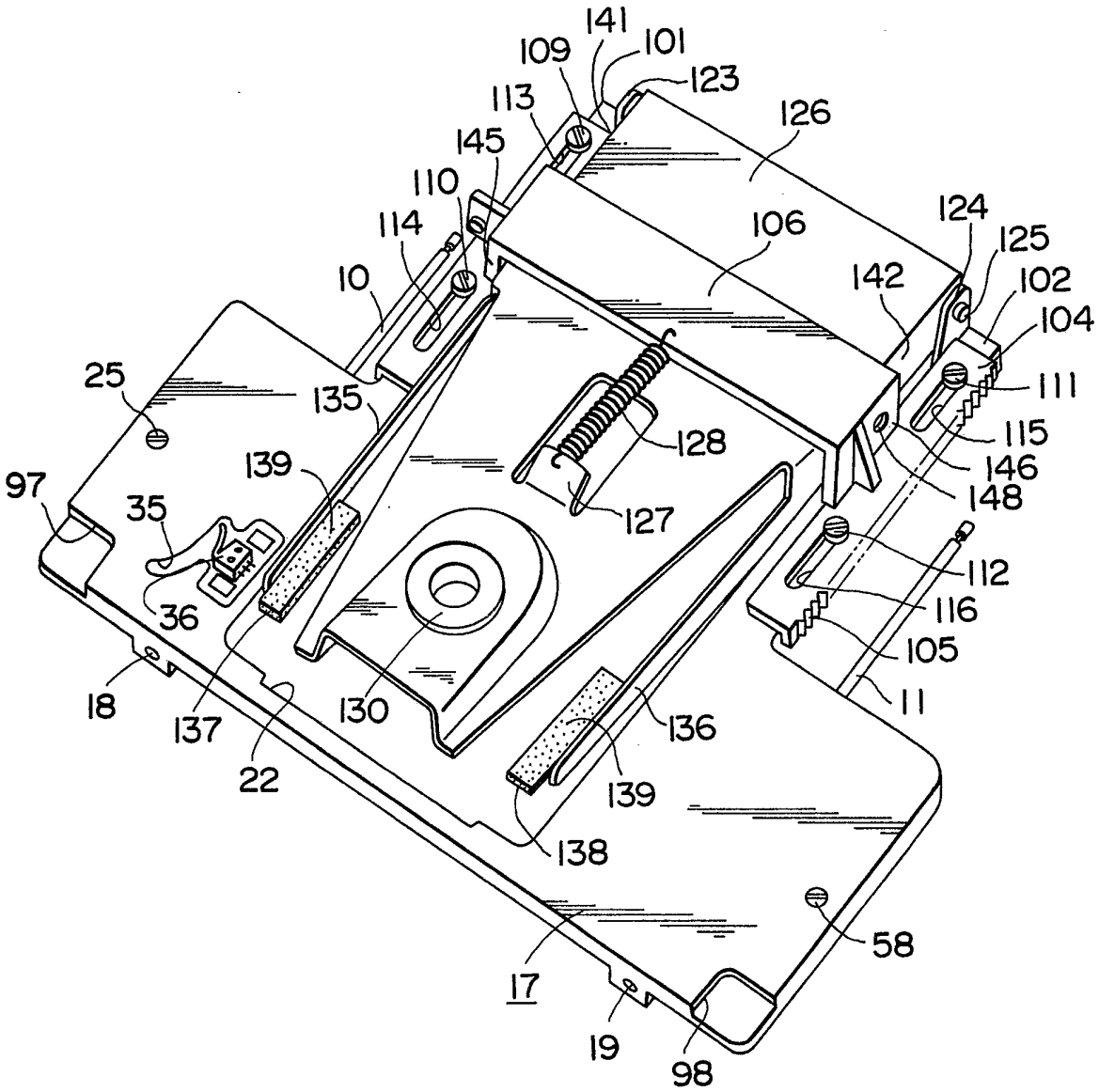

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FIG.8

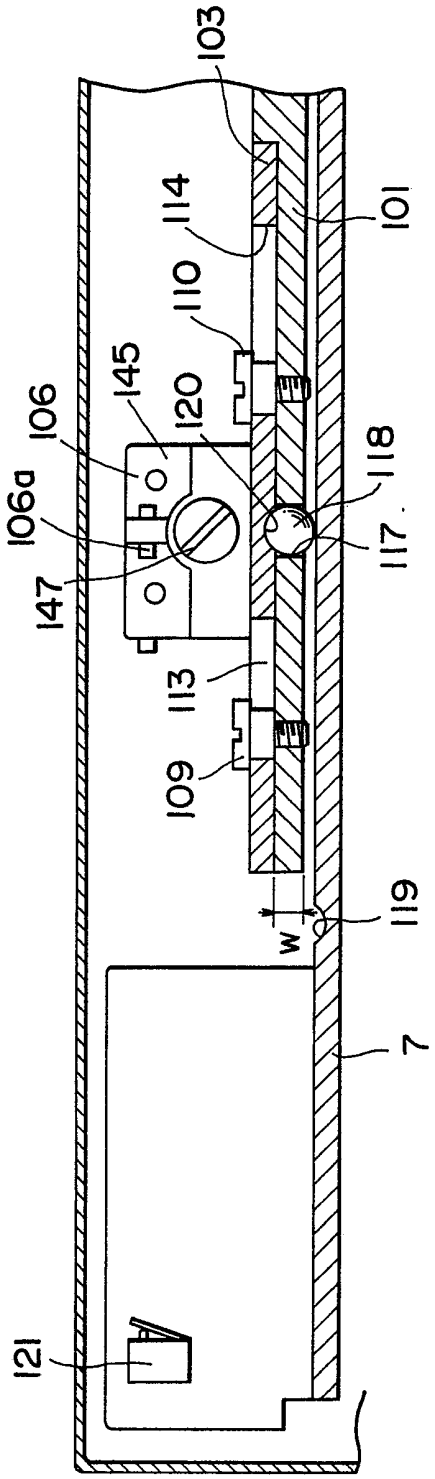

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FIG.9

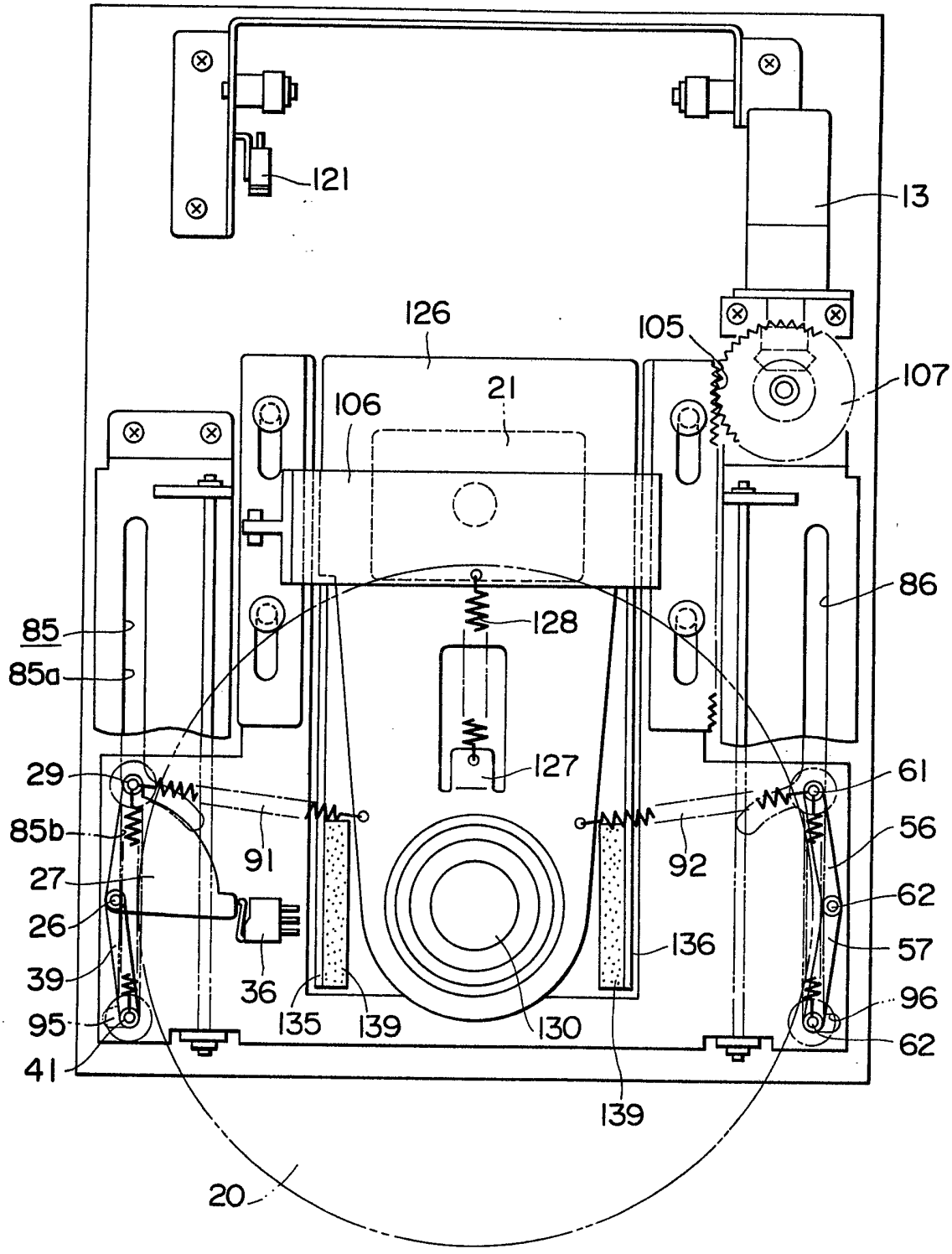

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FIG.10

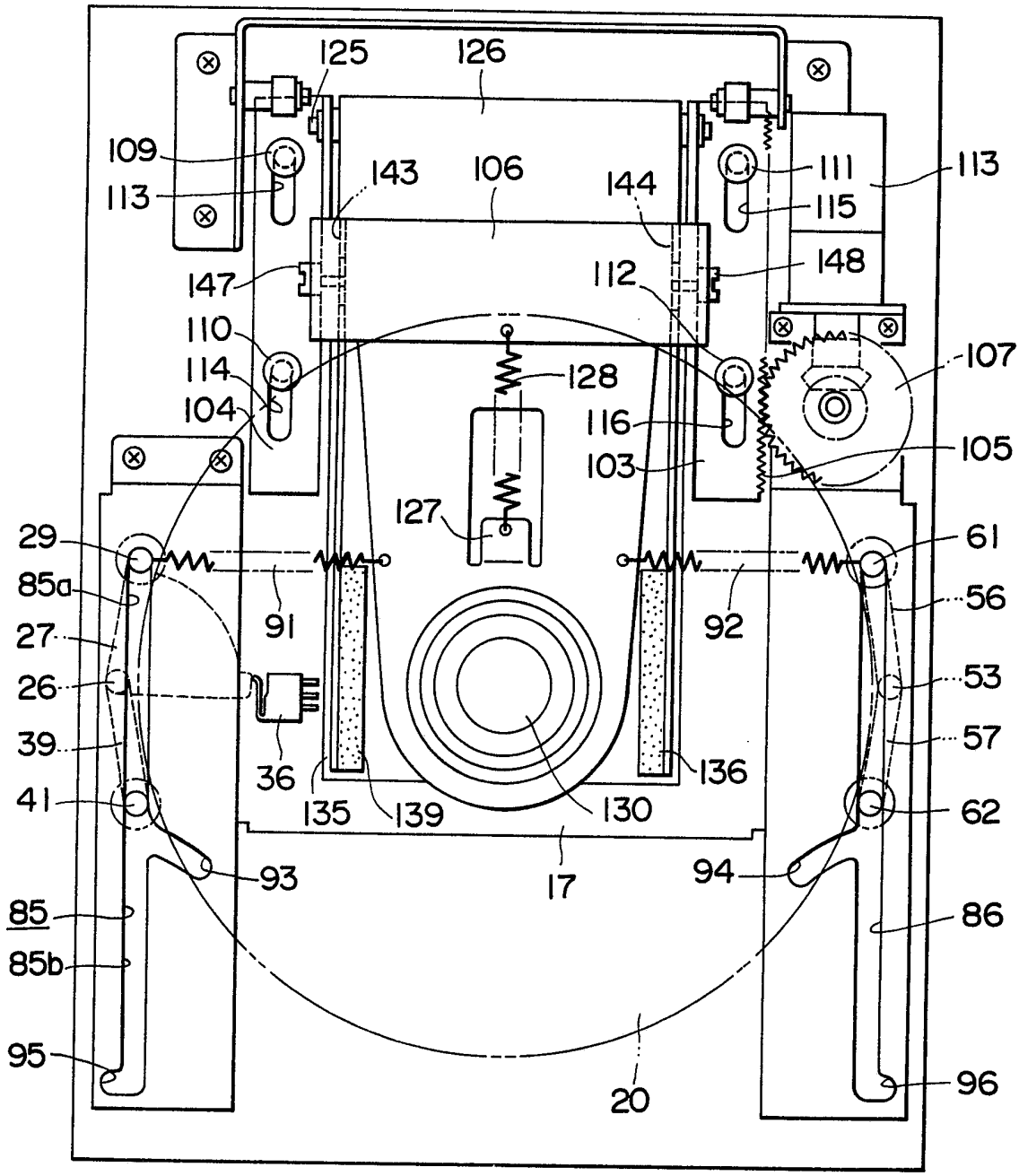

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FIG.11

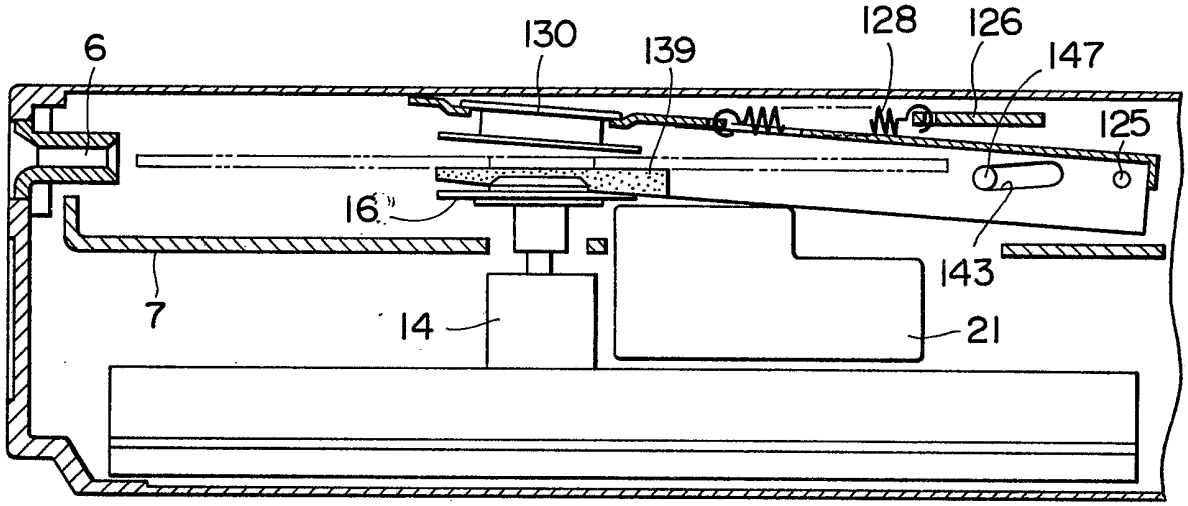

FIG.12

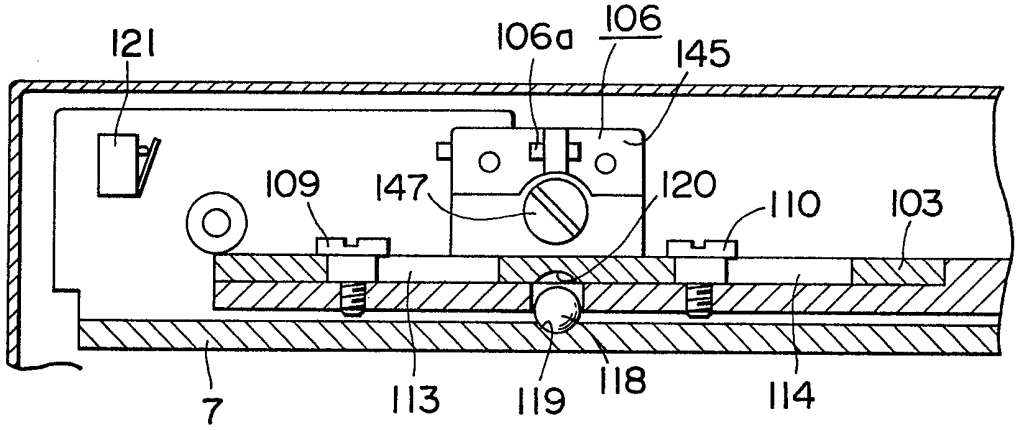

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FIG.13

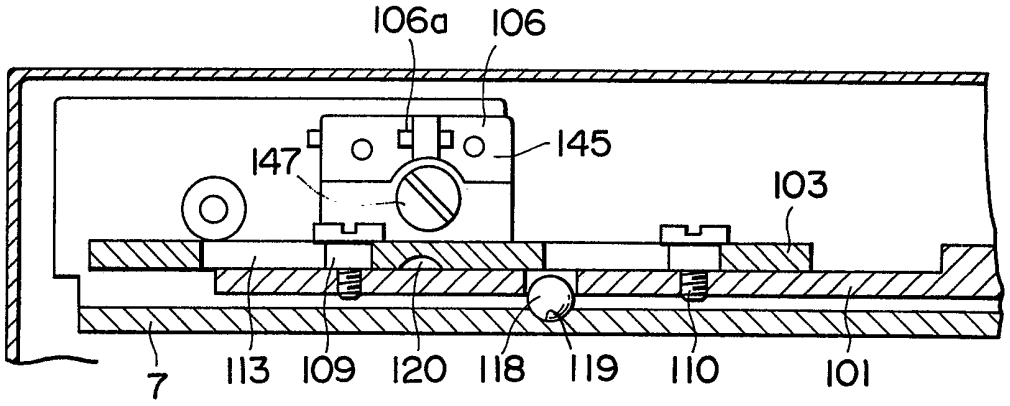
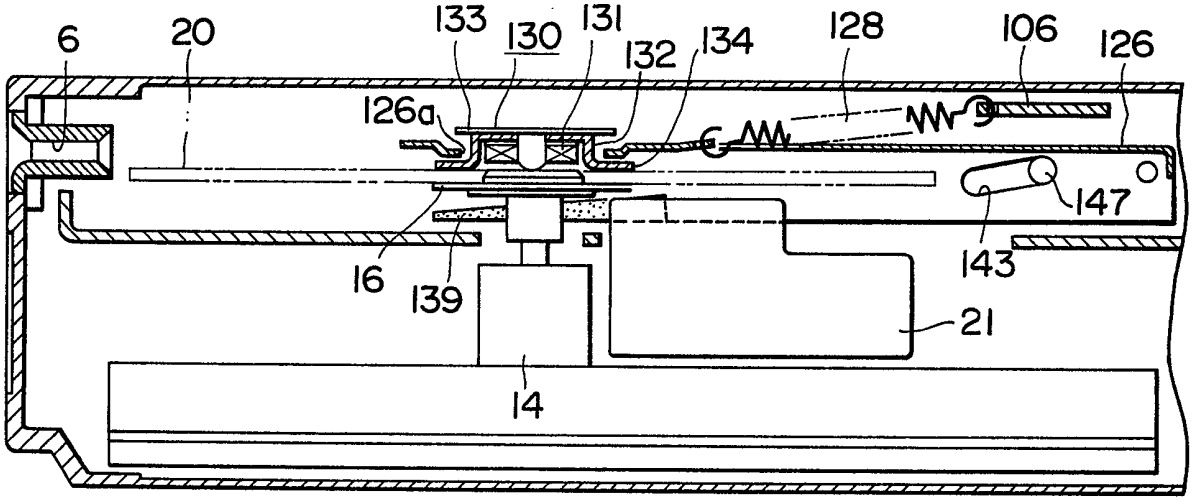


FIG.14



SPECIFICATION

Disc loading device

The invention relates to a loading device whereby an annular article such as an optical, video or record disc can be transported onto a turntable provided in a playback device such as disc player.

In optical disc players of the kind utilising a laser beam for reading information recorded on an optical disc, it has been customary to automate a series of disc loading operations comprising drawing the disc into the player proper, transporting the disc onto a turntable and securely placing the disc on the turntable.

For loading the disc on the record player, a disc transfer table is mounted reciprocably in a player housing, whereby the disc can be transported onto the turntable. However, the overall size of the device tends to be increased due to provision of the transfer table. In addition, it is not practicable to install the player in a narrow space because the disc loading and unloading operation need be performed with the disc transfer table drawn out of the player.

In addition, in prior-art loading devices, means for transferring the disc from the insertion opening to the turntable and means for securing the thus transferred disc on the turntable have been driven by separate driving means, thus complicating the sequential operation of transferring and mounting the disc to the turntable.

According to the invention there is provided a disc loading device comprising a disc insertion opening, a slide base slidable by a driving source, a first rotary unit and a second rotary unit rotatably supported on the slide base, means for causing rotation of the first and second rotary units, disc position control means mounted on the slide base at a position facing the first and second rotary units, the first and second rotary units and the disc position control means being effective to surround the disc as it is inserted via the insertion opening and the driving source being effective to slide the slide base to transport the disc thereon in a direction parallel to the disc surface, and means for moving the disc or disc engaging and turning means in a direction perpendicular to the disc surface, thereby to engage the disc with the disc engaging and turning means.

By means of the device according to the invention an annular article such as an optical disc can be transferred to a predetermined position, for example onto the turntable of a player, without resorting to transfer means such as a reciprocable disc transfer table.

The transfer is preferably effected by simply pushing the article into the insertion opening of the player.

The disc loading device can be small-sized, simple in structure and convenient to operate and can transfer the annular article in two mutually perpendicular directions by one and the same driving means.

The disc loading device can be capable of positively preventing the insertion of articles other than a disc of predetermined size or format.

The invention is diagrammatically illustrated by way of example in the accompanying drawings, in which:—

Figure 1 is a perspective view showing an optical disc player incorporating a disc loading device according to the invention;

Figure 2 is a plan view showing the disc loading device with an optical disc inserted halfway into the device;

Figure 3 is a front sectional view of the disc loading device;

Figure 4 is a side elevational view of the disc loading device;

Figure 5 is an exploded perspective view showing a first rotary unit and a second rotary unit of the disc loading device;

Figure 6 is an exploded perspective view showing a third rotary unit and a fourth rotary unit of the disc loading device;

Figure 7 is a perspective view showing a slide base and a chuck plate of the disc loading device;

Figure 8 is a sectional view showing a coupling mechanism coupling the slide base and the chuck plate together;

Figure 9 is a plan view showing a disc inserted and supported on rotary arms of the disc loading device;

Figure 10 is a plan view showing a disc transferred onto a turntable of the disc loading device;

Figure 11 is a side elevational view showing a disc transferred onto the turntable of the loading device;

Figure 12 is a sectional view showing a slide plate and an associated leg piece and showing the state in which a slide ball has dropped into a mating recess in a chassis base plate and only the slide plate is slidable;

Figure 13 is a sectional view showing the slide plate and the leg piece and showing the state in which only the slide plate has slid to the innermost side of the player; and

Figure 14 is a side elevation of the disc loading device showing a disc mounted on the turntable.

The embodiment of the invention hereinafter described relates to an optical disc player in which a laser beam is directed onto a signal recording surface of the optical disc for reading out and reproducing an information signal recorded on the disc.

Referring to Figure 1, an optical disc player 1 has a front panel mounting a playback start-stop button 2, a tune select button 3, a tune number and time display 4, an eject button 5, and a disc insertion opening 6 through which an optical disc 20, Figure 2, can be inserted for mounting and playback in the player 1.

A loading device of the player 1 includes a disc inserting unit 100 for insertion through the disc insertion opening 6. The loading device has a slide base 17 slidably mounted on a pair of parallel guide shafts 10, 11 above a chassis base plate 7 mounted in the player 1. The guide shafts are

carried by a pair of upright supporting projections 8, 9 formed by partially cutting out the base plate 7 (Figures 2 and 3). The slide base 17 may be driven, by a driving source in the form of an electric motor 13, from the insertion opening 6 towards a turntable 16 while being guided by the guide shafts 10, 11. The turntable 16 may be driven in rotation together with a spindle 15 by a spindle motor 14. The slide base 17 is formed as a flat plate having parallel bores 18, 19 therein which receive the guide shafts 10, 11 by which it is slidably supported. A centre cut-out 22 is provided in the slide base 17, into which may be introduced an optical pick-up unit 21 designed for radiating a laser beam to the turntable 16 and to an optical disc 20 on the turntable 16 when the slide base 17 has been shifted to the turntable 16.

A first rotary unit 23 and a second rotary unit 24 are rotatably supported by one edge of the slide base 17 for loosely supporting the inserted disc 20 in co-operation with disc position regulating means as later described. As shown in Figure 5, the first rotary unit 23 comprises a substantially sector-shaped first rotary arm 27 and a cylindrical member 30 rotatably fitted over a support shaft 29 engaged in a through-hole 28 in the first rotary arm 27. The first rotary arm 27 is mounted for rotation about a supporting shaft 26 mounted on the slide base 17 and passing through a through-hole 25 in the rotary arm 27. The member 30 is supported by a cylindrical holder 32 having a flange 31, and mounted on the supporting shaft 29 by having a circlip 34 engaged in a mating groove 33 in the end of the supporting shaft 29. The first rotary arm 27 of the first unit 23 is also formed with a switch operating end 37 which can be introduced into a through-hole 35 provided in one side of the slide base 17 and to operate a first changeover switch 36 of the electric motor 13 which actuates the slide base 17.

The second rotary unit 24 comprised a second rotary arm 39 and a cylindrical member 42 engaged on a supporting shaft 41 which is engaged in a through-hole 40 in the rotary arm 39. The supporting shaft 26 passes through a spacer 38 and a cylindrical extension 43 of the second rotary arm 39 axially aligned with the spacer 38, so that the second rotary arm 39 is maintained at a predetermined height above the surface of the first rotary arm 27 and supported for rotation by the supporting shaft 26 by having a circlip 45 fitted in a mating groove 44 in the supporting shaft 26. The cylindrical member 42 is engaged on the supporting shaft 41 so as to be disposed below the second rotary arm 39. The member 42 is supported by a cylindrical holder 47 which is provided with a flange 46 and through which is passed the supporting shaft 41 which is projected via the through-hole 40 in the second rotary arm 39 above the upper surface of the second rotary arm 39. The member 42 is mounted to the supporting shaft 41 for clamping the second rotary arm 39 in co-operation with the holder 47 by having a circlip 49 engaged in a mating recess 48 in the end of the supporting shaft 41. The member 41 is mounted in this manner to the second rotary arm 39 so as to be at the same mounting level as that of the cylindrical member 30 mounted to the first rotary arm 27 and the upper surface of the slide base 17.

To the opposite side of the slide base 17, there are mounted a third rotary unit 51 and a fourth rotary unit 52 opposed to the first and second rotary units 23, 24 and making up position control means for loosely supporting the inserted optical disc 20 in co-operation with the first and second units 23, 24. As shown in Figure 6, the third and fourth rotary units 51, 52 are provided with a third rotary arm 56 and a fourth rotary arm 57, respectively, associated with cylindrical extensions 54, 55 for insertion of a supporting shaft 53, respectively. These rotary arms 56, 57 are placed so that the extensions 54, 55 are stacked one upon the other and the supporting shaft 53, which is introduced into a through-hole 58 in the slide base 17 and is thus secured upright on the slide base 17, may be passed through the extensions 54, 55. The rotary arms are mounted for rotation to the supporting shaft 53 by having a circlip 60 fitted into a mating groove 59 formed in the foremost part of the supporting shaft 53. A pair of cylindrical members 63, 64 are rotatably mounted via supporting shafts 61, 62 to the foremost parts of the third and fourth rotary arms 56, 57. The cylindrical member 63 attached to the third rotary arm 56 is passed over the supporting shaft 61 so as to be disposed on the upper surface of the third rotary arm 56, the shaft 61 being in turn engaged in a through-hole 65 of the third rotary arm 56, starting from the lower side of the arm 56. The member 63 is supported by a cylindrical cap or holder 67 having a flange 66 and engaged on the supporting shaft 61, and is mounted on the supporting shaft 61 along with the holder 67 by having a circlip 69 engaged in a mating groove 68 in the foremost part of the supporting shaft 61. The cylindrical member 64 mounted to the fourth rotary arm 57 is passed over the supporting shaft 62 so as to be disposed below the lower surface of the rotary arm 57. A cylindrical cap or holder 72 having a flange 71 extends via a through-hole 70 in the foremost part of the rotary arm 57 above the upper surface of the arm 57 for supporting the member 64. A circlip 74 is engaged in a mating groove 73 in the foremost part of the supporting shaft 62 for mounting the member 64 to the supporting shaft 62, the member 64 clamping the fourth rotary arm 57 between it and the cap 72. The cylindrical members 63, 64 are mounted to the third and fourth rotary arms 56, 57 so as to be at the same mounting height relative to the upper surface of the slide base 17.

It should be noted that the supporting shaft 26 mounted on the slide base 17 for supporting the first and second rotary members 23, 24 and the supporting shaft 53 likewise mounted on the slide base 17 for supporting the third and fourth rotary members 51, 52 are disposed on opposite sides of

the slide base 17 on a straight line extending perpendicular to the sliding direction of the slide base 17, and that the distance between the supporting shaft 26 for the first and second rotary arms 27, 39 and the supporting shaft 29 is equal to the distance between the supporting shaft 53 for the third and fourth rotary arms and the supporting shaft 61, while the distance between the supporting shafts 26 and 41 is equal to that between the shafts 53 and 62.

To the opposite sides of the chassis base plate 17, there are mounted a pair of guide units 75, 76 formed of metallic sheets of L-shaped cross-section for regulating the direction and range of movement of the first and second rotary members 23, 24 and those of the third and fourth rotary member 51, 52 moved with the slide base 17. The guide members 75, 76 are formed by horizontal sections 78, 79 extending on the guide rods 10, 11 for supporting the slide base 17, and upright sections 80, 81 secured to the base plate 7 by screws 83 attached to the sides of the base plate 7. A pair of guide grooves 85, 86 are formed in the horizontal sections 78, 79 of the guide members 75, 76 extending parallel to the sliding direction of the slide base 17. In the guide groove 85 formed in the horizontal sections 78 of the guide unit 75, there are engaged cylindrical sections 32*a*, 47*a* of the holders 32, 47 supporting the cylindrical members 30 42, that are supported by the supporting shafts 29, 41 mounted upright on the first and second rotary arms 27, 39 of the first and second rotary units 23, 24 as described above. In the guide groove 86 formed in the horizontal section 79 of the other guide member 76, there are engaged cylindrical sections 67*a*, 72*a* of holders 67, 72 supporting the cylindrical members 63, 64 supported by the supporting shafts 61, 62 that are mounted upright on the foremost parts of the third and fourth rotary arms 56, 57 of the third and fourth rotary units 51, 52.

A tension spring 87 is mounted between the ends of the supporting shafts 29, 41 mounted to the ends of the first and second rotary arms 27, 39 of the first and second rotary units 23, 24 engaged by the holders 32, 47 in the guide groove 85 of the guide member 75, as described above, and acts as means for biasing the first and second rotary arms 27, 39 into rotation in a direction to approach towards each other. Similarly, a tension spring 88 is mounted between the ends of the supporting shafts 61, 62 mounted to the ends of the third and fourth rotary arms 56, 57 of the third and fourth rotary units 51, 52 engaged by the holders 67, 72 in the guide groove 86 of the other guide member 76, and acts as means for biasing the third and fourth rotary arms 56, 57 into rotation in a direction to approach towards each other.

The guide grooves 85, 86 formed in the guide units 75, 76 are provided at positions in the slide base 17 offset more inwardly than the common supporting shaft 26 for the first and second rotary arms 27, 39 or the common supporting shaft 53 for the third and fourth rotary arms 56, 57 towards the disc 20 placed on the slide base 17. Thus the first and second rotary arms 27, 39 and the third and fourth rotary arms 56, 57 are biased by the tension springs 87, 88 in a direction to approach towards each other and towards the disc 20 placed on the slide base. Thus the cap members 32, 47, 67, 72 associated with the supporting shafts 29, 41, 61, 62 are pressured against the inner sides of the guide grooves 85, 86. Thus the guide grooves 85, 86 act for regulating the rotation against the bias of the tension springs 87, 88 associated with the first and second rotary arms 27, 39 and with the third and fourth rotary arms 56, 57, respectively. The first and second rotary arms 27, 39 mounted via the supporting shaft 26 mounted upright on the slide base 17 and the third and fourth rotary arms 56, 57 similarly mounted via the supporting shaft 53 mounted upright on the slide base 17 are caused to follow the sliding movement of the slide base 17 and be guided by the guide grooves 85, 88 in a direction parallel to the sliding direction of the slide base 17 over the extent of the guide grooves 85, 86.

It should be noted that, in the disc mounting state shown in Figure 2 in which the slide base 17 is positioned at the disc inserting opening 6 of the disc player 1 and in the disc ejecting state in which a disc 20 placed on the turntable is ejected, the first and third rotary arms 27, 57 are rotated under the force of the tension springs 87, 88 and disc discharge springs 91, 92 and are thereby brought towards each other so that the distance therebetween becomes less than the diameter of the disc 20. A pair of arcuate rotation guide grooves 93, 94 are formed at about the mid-points in the lengths of the guide grooved 85, 86 so that the supporting shafts 29, 61 associated with the first and third rotary arms 27, 57 may be introduced thereinto. The rotation guide grooves 93, 94 are curved towards the disc inserting unit 100 which is situated at the forward side of the slide base 17. The foremost ends of the guide grooves 85, 86 are contiguous to clearance grooves 95, 96 into which are respectively engaged the supporting shaft 41, 62 mounted at the front sides of the second and fourth rotary arms 39, 57 that are pressed by the disc 20 and thereby turned laterally of the slide base 17 against the operation of the tension springs 87, 88. In this manner, the distance between the supporting shafts 41, 62 at the end parts of the opposite second and fourth arms 39, 57 becomes slightly larger than the diameter of the optical disc 20 during insertion of ejection of the optical disc 20.

The forward side corners of the slide base 17 are formed with steps 97, 98 for engaging with base ends of the supporting shaft 41, 62 in order that the second and fourth rotary arms 39, 57 moved with the slide base 17 and reaching to the guide grooves 93, 94 contiguous to the guide grooves 85, 86 are not received within these guide grooves 93, 94.

The guide groove 85 for guiding the first and second rotary arms 27, 39 of the first guide unit 75 is hereinafter described in detail. The guide groove 85 represents first and second guide means limiting the rotation of the first and second guide arms 27, 39. These first and second guide means are formed as one continuous groove. The second rotation guide groove 93 acting as first groove allowing for rotation of the first rotary arm 29 when inserting the disc 20 is provided halfway along the guide groove 85 so as to be contiguous thereto and curved towards the disc inserting unit 10 as mentioned hereinabove. The inner portion of the guide groove 85 contiguous to the guide groove 93 is a second groove 85*a* inhibiting the first rotary arm 27 from rotation during sliding of the slide base 17 and causing the rotary arm 27 to be moved in the same direction as the direction in which the slide base 17 is moved. The clearance groove 95 contiguous to the foremost part of the guide groove 85 represents the third groove allowing for sidewise clearance of the second rotary arm 39 during insertion of the optical disc 20. The groove connecting the clearance groove 95 of the first guide groove 85 to the second groove 85*a* represents a fourth groove 95 inhibiting rotation of the secondary rotary arm 39 and causing the second arm 39 to be moved in the same direction as the direction in which the slide base 17 is moved.

The other guide groove 86 for guiding the third and fourth rotary members 51, 52 during sliding of the slide base 17 is similar to the aforementioned guide groove 85 and hence is not further described herein for simplicity.

The rear side of the slide base 17 provided with the first and second rotary members 23, 24 and the third and fourth rotary members 51, 52, on the side directed to the inner side of the player 1, is formed with a pair of leg pieces 101, 102, extending towards the inner side of the player 1. The leg pieces 101, 102 extend parallel to the through-holes 18, 19 receiving the guide shafts 10, 11 and are spaced apart from each other a distance sufficient to receive the turntable 16 and the optical pick-up unit 21.

A pair of slide plates 103, 104 integrally formed with a U-shaped connecting member 106 are superimposed on the leg pieces 101, 102, as shown in Figure 7. A toothed rack 105 is formed along the outer side edge of the slide plate 104. A gear 107 meshes with the rack 105 to transmit torque from the driving electric motor 13 to cause the slide base 17 to slide along the guide rods 10, 11 (Figure 2). The transmission system is made up of a bevel gear 108 coaxial with the gear 107 which meshes with the toothed rack 105 and a second bevel gear 99 mounted to a driving shaft 13*a* of the driving electric motor 13. The driving motor 13 is housed in a minimum space within the player 1 with the driving shaft 13*a* thereof extending parallel to the sliding direction of the slide base 17.

The slide plates 103, 104 are mounted over the leg pieces 101, 102 by stationary screws 109, 110, 111, 112 on the leg pieces 101, 102 engaging in elongate through-holes 113, 114, 115, 116 provided in the slide plates and having their long axes in the sliding direction of the slide base 17 so that the plates 103, 104 may be slid on the leg pieces within a stroke equal to the length of the elongate holes 113 to 116. A through-hole 117 is bored in each of the leg pieces 101, 102 about midway of the zone covered by the slide plates 103, 104. A slide ball 118, Figure 8, having a diameter greater than the thickness of the leg piece 101 or 102 is disposed in each through-hole 117 and held between the slide plates 103, 104 and by the chassis base plate 7 supporting the leg pieces 101, 102. The chassis base plate 7 has a pair of semi-circular recesses 119 for receiving the slide balls 118 when the slide base 17 has slid to an innermost position within the player 1. The slide plates 103, 104 are also provided with semi-circular recesses 120 for receiving the slide balls 118 when the slide plates 103, 104 are located on the leg pieces 101, 102 at the most forward position of the slide base 17, that is, when the stationary screws 109, 110, 111, 112 abut the rearmost edges of each of the elongate holes 113, 114, 115, 116. Thus, when the slide base 17 is disposed at its most forward side within the player 1 adjacent the disc inserting slot 6, and the slide balls 18 are not received in the recesses 119 in the base plate 7, the steel balls 118 are clamped between the leg pieces 101, 102 and the slide plates 103, 104, which are then driven by the driving motor 13 and slide as one with the slide base 17. As the slide base 17 reaches its innermost position within the player 1 so the slide balls 118 are received in the mating recesses 119 in the base plate 7 and disengaged from the recesses 120 in the slide plates 103, 104, only the slide plates 103, 104 are slid on the leg pieces 101, 102 so as to be movable further into the inside of the player 1.

A second changeover switch 121 is provided on the chassis base plate 7 towards the inner side of the player 1 and operates so that an operating element is disposed in opposition to an operating boss 106*a* provided on the connecting member 106 connecting the slide plates 103, 104 for stopping the operation of the driving motor 13. When the slide plates 103, 104 have slid to a fully inward position in the player 1, the switch 121 is changed over by the operating boss 106*a* of the connecting member 106 and stops the operation of the motor 13.

A pair of upright elements 123, 124 are rigidly mounted at the rear edges of the pair of leg pieces 101, 102 and a chuck plate 126 is mounted to be freely pivotable about a transverse rotary shaft 125 mounted between the upright elements 123, 124. The chuck plate 126 is carried by the shaft 125 as indicated in Figure 4. The chuck plate 126 is mounted below the lower surface of the U-shaped connecting member 106 interconnecting the slide plates 103, 104 and extends from a region intermediate the leg pieces 101 and 102 to adjacent the cut-out 22 in the slide base 17. The

chuck plate 126 is normally biassed towards the connecting member 106 *i.e.* upwardly as seen in Figure 2 by a tension spring 128 installed between the connecting member 106 and a centre projection 127 on the chuck plate 126.

Towards the front side of the chuck plate 126, there is provided a disc clamp unit 130 to clamp a disc 20 on the turntable 16 in co-operation with the turntable 16. As shown in Figure 14, the disc clamp unit 130 is to constructed and arranged that a holder section 132 having an enclosed magnet 131 is loosely fitted in a through-hole 126*a* in the chuck plate 126 and prevented from extrication by a pair of flanges 133, 134 provided at opposite ends of the holder section 132, while the section 132 is slightly movable in the thrust direction and radial direction with respect to the chuck plate 126. In this manner, a disc 20 positioned on the turntable 16 may be clamped in a manner free from positioning error.

At the opposite sides of the chuck plate 126, there are provided a pair of disc supporting arms 135, 136 each having an L-shaped cross-section. Towards the front side of the disc supporting arms 135, 136, disc supporting members 137, 138 are mounted horizontally in opposition to the disc clamp unit 130 and provided with felt protective members 139 having inclined supporting surfaces for preventing damage to a disc 20.

The chuck plate 126 has side walls 141, 142 at the inner end, and a pair of inclined slots 143, 144 forming cam surfaces are formed in the side walls 141, 142. As shown in Figure 4, a pair of guide pins 147, 148 mounted on upright portions 145, 146 of the connecting member 106 are engaged in the slots 143, 144. The slots 143, 144 are inclined with a downward gradient from the base to the front sides of the chuck plate 126. When the slide plates 103, 104 move with respect to the leg pieces 101, 102 of the slide base 17 and slide inwardly of the player 1, the guid pins 147, 148 shifting with the slide plates moved inwardly of the player 1 also and slide within the inclined slots 143, 144. Thus the chuck plate 126 is pivoted towards the turntable 16 about the shaft 125 against the force of the tension spring 128 so that the disc supporting members 137, 138 of the disc supporting arms 135, 136 are disposed below the turntable 16 and a disc 20 carried on the members 137, 138 is placed on the turntable 16, while the disc clamp unit 130 is pressed against the turntable 16.

The sequence of operations for loading a disc 20 into the disc player and ejecting the thus mounted disc therefrom will now be described.

When mounting a disc 20, the eject button 5 on the front surface of the player 1 is first pressed to reverse the operation of the driving motor 13, so that the slide base 17 is moved to a forward position proximate to the disc insertion opening 6, as shown in Figures 2 and 4. With the slide base 17 thus shifted to the forward position of the player 1, the foremost part of the first rotary arm 27 of the first rotary unit 23 and that of the third rotary arm 56 of the third rotary unit 51 are located in register with the rotation guide grooves 93, 94, as shown in Figure 2, so that the supporting shafts 29, 61 are withdrawn into the rotation guide grooves 93, 94 under the tension of the tension springs 87, 88 and the disc ejection springs 91, 92. The second rotary arm 39 of the second rotary unit 24 and the fourth rotary arm 57 are situated in the guide grooves 85, 86 and the ends of the supporting shafts 41, 62 are disposed at the forward ends of the guide grooves 85, 86.

A disc 20 is then introduced through the disc insertion opening 6 of the disc player 1 on the disc supporting members 137, 138 of the chuck plate 126. The second and fourth rotary arms 39, 57, whose supporting shafts 41, 62 are positioned at the forward ends of the guide grooves 85, 86 in turn mounted parallel to each other with a spacing less than the diameter of the disc 20, are rotated into the clearance grooves 95, 96 against the force of the tension springs 87, 88, until the centre aperture 20*a* of the disc 20 is moved beyond a straight line interconnecting the supporting shafts 41, 62. As the disc 20 is inserted further and the centre aperture of the disc is shifted beyond the straight line interconnecting the supporting shafts 41, 62, the second and fourth rotary arms 39, 57 are restored into the guide grooves 85, 86 under the force of the tension springs 87, 88 for abuttingly supporting the outer rim of the disc 20.

The first and third rotary arms 27, 56, whose supporting shafts 29, 61 are pulled into the rotation guide grooves 93, 94 so that the spacing therebetween is less than the diameter of the disc 20 are rotated along the rotation guide grooves 93, 94 by the disc 20 against the force of the tension spring 87, 88 and the disc ejection spring 91, 92 until the supporting shafts 29, 61 are introduced into the guide grooves 85, 86. This rotation of the first and third rotary arms occurs simultaneously with the aforementioned rotation of the second and fourth rotary arms 39, 57.

It should be noted that, since the first and third rotary arms 27, 56 are guided by a pair of guide grooves 85, 86 spaced apart from each other a distance less than the diameter of the optical disc 20, the distance between these first and third rotary arms 27, 56 is not extended to larger than the maximum diameter of the disc 20. In this manner, the disc can be prevented from being inserted excessively into the player.

When the disc 20 has been inserted until the centre aperture 20*a* thereof is positioned at the centre of the disc clamp unit 130, the first to fourth rotary arms 27, 39, 57, 56 having been rotated into the guide grooves 85, 86 under the effect of insertion of the disc 20, the disc 20 is loosely supported at the centre at four points, that is, the supporting shafts 29, 41, 61, 62 of the first to fourth rotary arms 27, 39, 56, 57, as indicated in Figure 9.

When the sector-shaped first rotary arm 27 has been rotated in the aforementioned manner by insertion of a disc 20, the first changeover switch 36 is activated by the switch actuating member

37 provided on the end of the arcuate section of the rotary arm 27 so that the driving motor 13 is driven in the loading direction. With the driving motor 13 thus driven in the loading direction, the slide base 17 is transferred along the guide shafts 10, 11 inwardly of the disc player 1. Thus the disc 20 loosely supported on the slide base 17 by the rotary arms 27, 29, 56, 57 is also transferred inwardly of the disc player. The slide base 17 is transferred to the inner zone of the player 1 until the centre aperture 20*a* of the disc 20 loosely supported on the slide base is positioned in register with the turntable 16 in the disc player 1 (Figures 10 and 11). The first to fourth rotary arms 27, 39, 56, 57 loosely supporting the disc 20 will have been moved by this time along the guide grooves 86, 87 parallel to the sliding direction of the slide base 17. During sliding movement of the disc 20 with the slide base 17 from the front side of the player proper 1 to the turntable 16, the slide balls 18 are disposed on the chassis base plate 7 as shown in Figure 8 and are not engaged in the recesses 119 of the base plate 7. Thus the slide balls 118 are pressured by the leg pieces 101, 102 and the slide plates 103, 104, with the slide plates 103, 104 making a sliding movement as one with the slide base 17.

When the slide base 17 has been shifted in this manner until the centre aperture 20*a* of the disc 20 is in register with the turntable 16, the slide balls 118 will be engaged in the recesses 119 of the chassis base plate 7 (Figure 12). Thereafter the slide plates 103, 104 alone slide on the leg pieces 101, 102 and are shifted further into the inner zone of the player 1, as shown in Figure 13. When only the slide plates 103, 104 are slid in this manner, the guide pins 147, 148 introduced through projections 145, 146 of the connecting member 106 interconnecting the slide plates 103, 104 are slid in the inclined slots 143, 144 in the chuck plate 126 so that the plate 126 is pivoted about the shaft 125 towards the turntable 16 against the force of the tension spring 128. The disc supporting members 137, 138 of the disc supporting arms 135, 136 are thus brought to a level below the turntable 16 and the disc 20 supported on the supporting member 137, 138 is shifted in a direction perpendicular to the sliding direction of the slide base 17 and is thereby placed on the turntable 16. Simultaneously, the disc clamp unit 130 is brought to a disc clamping position and the disc 20 is centred and clamped on the turntable 16 as shown in Figure 14. When the slide plates 103, 104 have been shifted to the innermost position in the player 1, the changeover switch 121 is operated by the slide plate 103 so that the operation of the motor 13 ceases thereby completing the loading of the disc 20 into the player 1. The playback start/stop button 2 can then be pressed to cause the turntable 16 and the optical pick-up unit 16 to start their operation of effecting playback operation of the disc 20.

The eject operation for taking the disc 20 out of the player 1 upon completion of playback will now be described.

When the eject button 5 is pressed the motor 13 is driven in reverse. Since the slide balls 118 are engaged at this time in the recess 119 of the chassis base plate 7, only the slide plates 103, 104 are slid on the leg pieces 101, 102, towards the front side of the player 1 until the slide balls 118 are engaged in the recesses 120 of the slide plates 103, 104. During sliding only of the slide plates 103, 104, the guide pins 147, 148 passed through the projections 145, 146 of the connecting member 106 are also moved in the inclined slots 143, 144 in the chuck plate 126 towards the front side of the player 1 with the slide plates 103, 104. The chuck plate 126 is thus pivoted above the turntable 16 about the shaft 125 under the force of the tension spring 128 and the disc clamp unit 130 is separated from the turn table 16. The disc 20 previously supported on the turntable 16 is now placed on the supporting members 137, 138 of the dis supporting arms 135, 136 and brought to the position shown in Figure 11 in which the disc is kept floating over the turntable 16. As the motor 13 is driven further in reverse, the rear edges of the slots 113, 114, 115, 116 in the slide plates 103, 104 are abutted by the screws 109, 110, 111, 112 so that the slide plates 103, 104 are slid together with the leg pieces 101, 102 of the slide base 17, the slide balls 118 engaging in the recesses 119 in the base plate 7 as shown in Figure 12. The slide base 17 made fast with the slide plates 103, 104 is driven forwardly *i.e.* towards the front side of the player 1. As the slide base 17 is driven in this manner towards the front side of the player 1, the first and second rotary arms 27, 39 and the third and fourth rotary arms 56, 57 are guided along the respective guide grooves 85, 86 and shifted to the front side of the player 1 along with the slide base 17. As the supporting end shafts 26, 61 of the first and third rotary arms 27, 56 are facing to the guide grooves 85, 86, these rotary arms 27, 56 are introduced into the rotation guide grooves 93, 94 under the force of the disc ejection springs 91, 92. As the first and third rotary arms 27, 56 are rotated into the rotation guide grooves 93, 94 under the force of the ejection springs 91, 92, the disc 20, so far held loosely by the first to fourth rotary arms 27, 39, 56, 57 is ejected out of the insertion opening 6 of the player 1 as shown in Figure 2 to complete the disc ejection operation.

As the first rotary arm 27 has been rotated into the rotation guide groove 93, the first changeover switch 36 is activated by the switch operating element 37 on the rotary arm 27 to stop the operation of the driving electric motor 13.

During the sliding of the slide base 17 towards the front of the player 1, the second and fourth rotary arms 39, 57 also pass through the inlet region of the rotation guide grooves 93, 94 contiguous to the respective guide grooves 85, 86. However, the base ends of the supporting end shafts 41, 61 of the rotary arms 39, 57 are engaged in the steps 97, 98 at the forward corners of the slide base 17 so that the rotary arms 39, 57 may be moved across the front ends

of the guide grooves 85, 86 without entering these rotation guide grooves 93, 94.

In the above embodiment, position control means adapted for loosely supporting the disc 20 in co-operation with the first and second rotary members 23, 24 are constituted by a pair of rotary arms similar to the first and second rotary members 23, 24, that is, third and fourth rotary members 51, 52 including third and fourth rotary arms 56, 57 carried by the single supporting shaft 53, said rotary arms 56, 57 being guided along the guide groove 86 so as to be introduced into the rotation guide groove 94 for ejecting the disc 20. In a modified embodiment, the position control means need only control the direction and position of the movement of the optical disc 20 caused by the movement of the slide base 17 and thus may be designed as a control wall for controlling the direction of movement of the disc 20 through the range of movement of the disc 20.

Next, in the above embodiment, the cylindrical members 30, 42, 63, 64 are rotatably associated with the supporting shafts 26, 41, 56, 61 associated in turn with the first to fourth rotary arms 27, 39, 56, 57, for ensuring smooth insertion and ejection of the disc 20 and preventing damage to the disc 20. The cylindrical members 30, 42, 63, 64 may however be omitted if the supporting shafts 26, 41, 56, 61 are manufactured from abrasion resistant material or an abrasion resistant coating is provided at the peripheral surfaces of the supporting shafts.

CLAIMS

1. A disc loading device comprising a disc insertion opening, a slide base slidable by a driving source, a first rotary unit and a second rotary unit rotatably supported on the slide base, means for causing rotation of the first and second rotary units, disc position control means mounted on the slide base at a position facing the first and second rotary units, the first and second rotary units and the disc position control means being effective to surround the disc as it is inserted via the insertion opening and the driving source being effective to slide the slide base to transport the disc thereon in a direction parallel to the disc surface, and means for moving the dis or disc engaging and turning means in a direction perpendicular to the disc surface, thereby to engage the disc with the disc engaging and turning means.

2. A disc loading device according to claim 1, in which the disc position control means includes a third rotary unit, a fourth rotary unit and means for rotating the third and fourth rotary units.

3. A disc loading device according to claim 1 or claim 2, in which the means for causing rotation of the first and second rotary units is a spring.

4. A disc loading device according to claim 2, in which the means for rotating the third and fourth rotary units is a spring.

5. A disc loading device according to any one of claims 1 to 4, in which the moving means engages the disc with the disc engaging and turning means by moving the disc.

6. A disc loading device according to claim 5, in which the moving means comprises disc supporting means for controlling the vertical position of a disc inserted into the device, and control means for controlling vertical travel of the disc supporting means.

7. A disc loading device according to claim 6, in which the disc supporting means comprises a disc clamper movable vertically with the disc supporting means.

8. A disc loading device according to claim 6, in which the control means comprises cams provided on one of the disc supporting means and members driven by the driving source and cam followers provided on the other one of the disc supporting means and said members.

9. A disc supporting device according to claim 8, in which the driven members are mounted on the slide base, which is driven in a direction parallel to the surface of a disc inserted into the device through a coupling element interposed between the driven members driven by the driving source and the slide base and stopped when the driving connection between the slide base and the driven members formed by the coupling element is cancelled, the driven members being further moved after the driving connection is cancelled for causing the operation of the cams and cam followers.

10. A disc loading device according to claim 9, in which the vertical travel of the disc turning means rotatably supported on the slide base is controlled by the operation of the cams and cam followers.

11. A disc loading device according to claim 1, in which the driving source is activated by a switch operated by the second rotary unit when the second rotary unit has been rotated for surrounding the disc in co-operation with the first rotary unit and the disc position control means, the driving source then starting the sliding of the slide base.

12. A disc loading device according to claim 1, in which the first rotary unit comprises first guide means for limiting the rotation of the first rotary unit.

13. A disc loading device according to claim 1, in which the second rotary unit has second guide means for limiting the rotation of the second rotary unit.

14. A disc loading device according to claim 1, in which the first rotary unit has first guide means for limiting the rotation of the first rotary unit and the second guide has second guide means for limiting the rotation of the second rotary unit.

15. A disc loading device according to claim 14, in which the first and second guide means are contiguous to each other.

16. A disc loading device according to claim 12, in which the first guide means comprises a first groove which permits rotation of the first rotary unit during disc insertion and a second groove which limits rotation of the slide base in the same direction as that of the rotation

of the first rotary unit during sliding of the slide base.

17. A disc loading device according to claim 13, in which the second guide means comprises a third groove which permits rotation of the second rotary unit within a predetermined range during disc insertion and a fourth groove which limits rotation of the slide base in the same direction as that of rotation of the second rotary unit during sliding of the slide base.

18. A disc loading device comprises a disc insertion opening, a first rotary unit, means for rotating the first rotary unit, and disc position control means mounted in opposition to the first rotary unit, the first rotary unit and the disc position control means causing the disc to travel in a direction parallel to the disc surface upon insertion of the disc into the insertion opening, means being provided for moving the disc or disc engaging and turning means in a direction perpendicular to the disc surface, whereby the disc is engaged with the disc engaging and turning means.

19. A disc loading device according to claim 18, including a second rotary unit facing the disc position control means and spaced a predetermined distance apart from the first rotary unit, and means for causing rotation of the second rotary unit, the disc position control means and the second rotary unit causing the disc to travel in a direction opposite to the disc inserting direction for ejecting the disc.

20. A disc loading device substantially as hereinbefore described and illustrated with reference to the accompanying drawings.

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