

May 16, 1961

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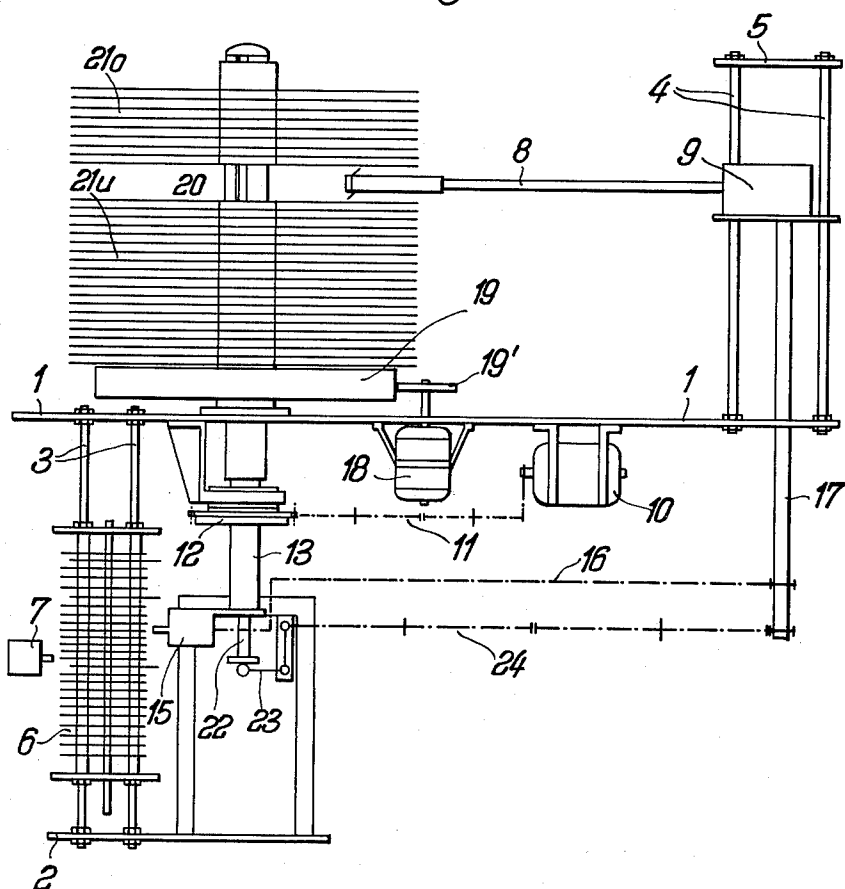
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RECORD CHANGER FOR TALKING MACHINES

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2 Sheets-Sheet 1

Fig. 1



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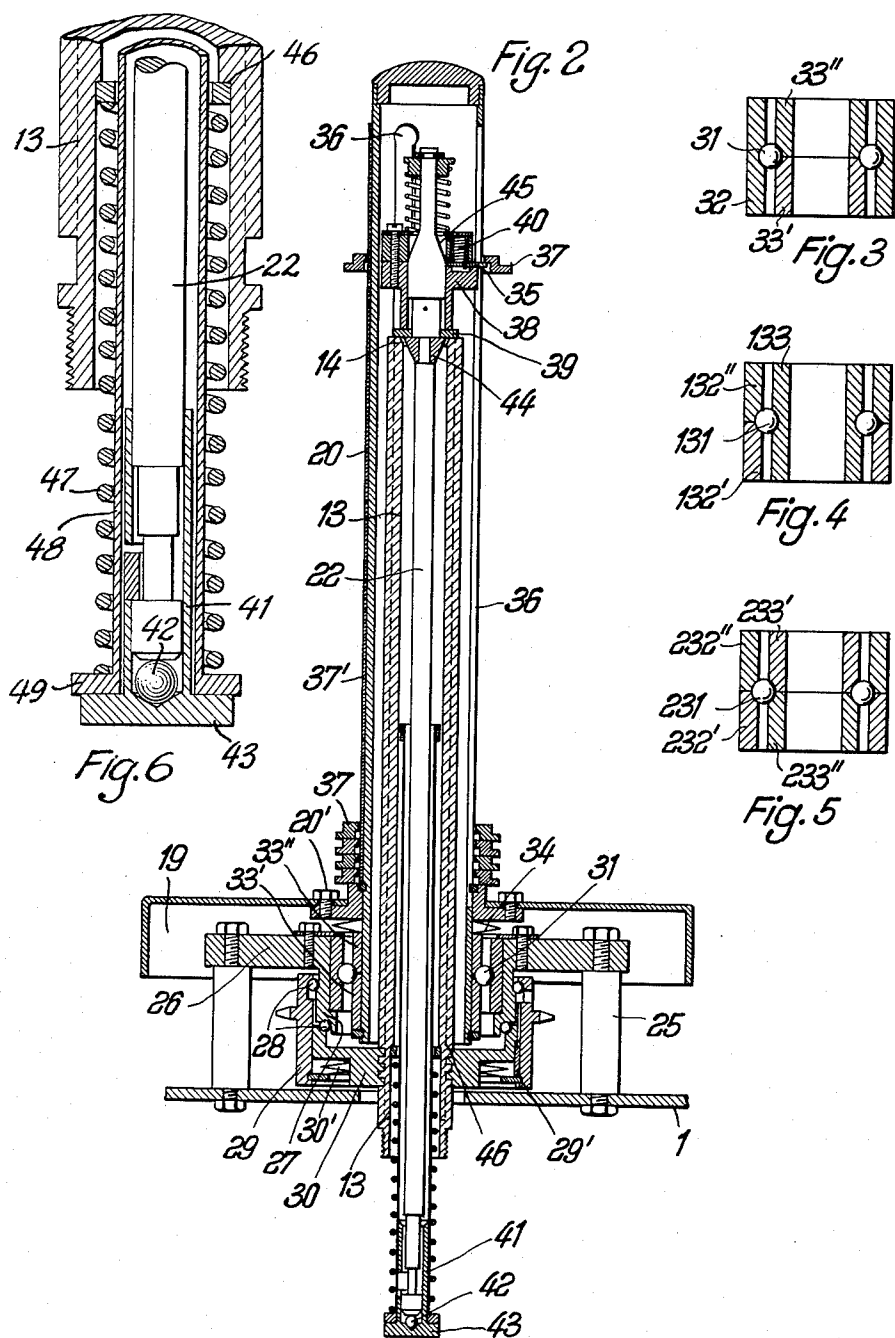
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RECORD CHANGER FOR TALKING MACHINES

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This invention relates to a record-changer in which a stack of disc records, each provided with a large central hole, is arranged upon a stack mandrel or spindle which revolves during the playing of a record and in which the stack can be divided from time to time, by gripper members mounted in the interior of the stack spindle, at the place of the record to be played, and it is primarily concerned with the improved supporting of the stack spindle and of the operative elements lodged therein in the foundation of the apparatus.

A known constructional form of a record-changer of this nature discloses a vertical hollow spindle for the records, carried by superposed spacing gripper rings, which is rotatably supported in two rings of balls in a socket ring standing upon a mounting plate, and is driven through rubber wheels and a driving plate secured to it.

In seeking the selected record the gripper members are displaced vertically by the aid of a lifting spindle ascending in the interior of the hollow stack spindle until the disc-seeker, moving synchronously therewith, has found the appropriate record. They then engage, with their tongues protruded at this moment by a control rod, through longitudinal slots in the hollow stack spindle, into the spacing gripper ring of this record, and raise this record farther and the part of the stack of records located above it, for the purpose of forming a working gap for the tone arm, whereupon the tone arm is swung into this working gap, and at the same time the hollow stack spindle, and all the records located upon it, are set in rotation. The weight of the partial stack of records lifted is here carried, through the medium of the gripper members, by the aforementioned non-rotating control rod. Between the control rod and the gripper arrangement, multiple ball bearings are fitted at the requisite positions.

Although the kinematic construction of this known arrangement thus appears to be satisfactory, it does not yield tonally pure and noiseless reproduction of records. The object of the present invention is to remedy this defect. According to the invention this problem is fundamentally solved by the fact that the bearings for the stack spindle, and the adjusting and supporting members arranged therein and acting upon the stack of records, are constructed in a particularly advantageous manner.

The invention therefore relates to a record-changer with a stack of records arranged upon a rotating vertical stack spindle and divisible at the place of the record to be played, wherein the stack spindle is rotatably supported in a socket secured fast to the casing, and can be driven by means of a friction wheel, the record-gripper members can be taken along by a lifting spindle, which, by an adjusting nut mounted in the socket, is vertically displaceable in the interior of the stack spindle, and, with the aid of a spring-loaded control rod, which is vertically displaceable in the interior of the lifting spindle by means of a control cam fixed to the casing, are displaceable radially outwards through longitudinal slots in

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the stack spindle for the purpose of gripping a record disc, and the record gripped by the gripper members, together with the records located above it in the stack, is additionally displaceable vertically with the help of the control rod for the purpose of temporarily forming a working gap for the tone arm to be swung in and out relatively to this gap.

According to the invention, the stack spindle is rotatably supported, in the socket secured fast to the casing, by means of a ball bearing which comprises only a single ring of balls arranged in a plane perpendicular to the axis of the stack spindle, and at least one race ring is divided in this plane.

The invention is based upon the following inventive considerations and discoveries: in playing a record, its speed, and therefore that of the stack spindle carrying it, must be absolutely constant, since the human ear detects even the slightest fluctuations in speed as unendurable distortions of pitch, namely the so-called "howling." Apart from the conditions in the actual drive, namely in the motor, or in toothed-wheel or friction-wheel gears, the speed of revolution is materially dependent upon the quality of the bearing supporting the stack spindle. This supporting is difficult in record-changers, owing to the fact that in consequence of the general construction of the device the bearing circles must have an unusually large radius, and therefore already exhibit in themselves a greater frictional resistance than ordinary small bearings.

The maintenance of a constant speed of revolution is in the present case rendered still more difficult by the fact that no reserve power can be provided in the drive: for on grounds of economy a friction-wheel gear must be employed the transmission members of which consisting for instance of rubber, are not sufficiently rigid in form to be able to transmit relatively great driving forces without deformation, and the fluctuations in speed conditioned thereby. With the weak driving forces that are permissible, however, even the slightest fluctuations in the bearing friction give rise to such disturbing fluctuations in speed. Owing to the necessarily large size of bearing, the use of journal bearings is precluded, because with the large bearing surfaces even trifling variations in the film of lubricant, or differences of temperature, cause unavoidable fluctuations in speed. Even the aforementioned known stack-spindle bearing, however, with the aid of two rows of ball bearings, is imperfect. The stack spindle bearing is stressed both by axial forces and by radial forces. The axial forces arise from the weight of the stack of records and the intrinsic weight of the stack-spindle and its internal organs, while the radial forces are brought about by the application pressure of the friction drive and by centrifugal forces owing to the unavoidably eccentric position of the stack-spindle aggregate as a whole. A further disadvantage of ball bearings of the usual construction as compared with plain bearings consists in the considerable bearing noise, which has a particularly disadvantageous effect upon the reproduction of the record when it occurs unevenly. In such bearings, with two rows of balls, with means such as alone come into question for the economical manufacture of a mass production article such as a record-changer, not even uniformity can be attained, let alone a sufficient reduction of the bearing noise. In such bearings with two rows of balls one row must be constructed as a fixed bearing, and the other, owing to differences of temperature, as a loose bearing, the fitting of which is critical. If the loose bearing is too firmly seated, the small driving forces provided do not suffice for the correct adjustment of the balls, and the result is ball noise, on account of partly fluttering and partly jamming balls. If the loose bearing is too loosely seated, on the other

hand, there is the risk that all the balls may give rise to fluttering noises.

These disadvantages of a two-row ball bearing are entirely eliminated, or at least reduced to a practically immaterial trace, in the bearing according to the present invention. By employing only a single row of balls instead of two rows, the ball noise in itself is already substantially reduced, and the running irregularities in the loose bearing member of the known two-row ball bearing are also absent. There therefore remains, in the bearing according to the present invention only quite a slight and also uniform bearing noise, which does not disturb the reproduction of records.

For the purpose of satisfactorily taking up both the radial and the axial forces, the bearing is constructed as a divided double-shoulder bearing in which at least one race is divided in the running plane of the row of balls. On the lines of this invention, therefore, either the inner or the outer race ring or both, must be divided in this manner. In consequence of this axial division the axial ball clearance or set of balls may primarily be kept as small as may be desired, which results in a corresponding automatic reduction in the size of the radial ball clearance or set of balls. Consequently this novel bearing can be economically manufactured with great exactitude.

In the sense of this invention, moreover, the lifting spindle lodged in the hollow stack spindle, and not rotating but only axially displaceable, with which the record-gripper is adjusted to the desired stack-separating plane, can be supported in a particularly reliable manner.

The special construction of a record-changer with record discs arranged one above another upon a stack-spindle, has the result that this lifting spindle has a disproportionately great free length above its adjusting nut, and therefore executes where possible, with incorrect mounting of the adjusting nut, inadmissibly large swaying movements with its head.

The mounting of the lifting spindle is effected at two places, namely on the one hand at the lower end in a slideway, and on the other hand, further up, in the thread of the adjusting nut. Since not only the record-gripper but also the tone arm are brought to the correct playing height by the lifting spindle, the tone arm is secured to the spindle underneath the adjusting nut, and exerts upon the adjusting nut bearing, owing to its eccentric arrangement, considerable radial and axial forces.

In the case of the known record-changer already mentioned, the adjusting nut is mounted in a plain bearing, and is rotatably supported upon an axial pin of a ring socket and axially clamped between the ring socket and the fixed foundation plate supporting the ring. It is found by experience that this mounting does not work without disturbance. On the basis of inventive considerations the cause of disturbance has been recognised to be that the wide manufacturing allowances that are necessary for mass production in stamping the mounting plate, and in the mass formation of the holes and screw threads for the socket supports and so forth, are liable to be additive in an incalculable manner, so that a steady mounting of the lifting spindle is not ensured, and furthermore the remaining bearings in the socket, particularly the sensitive stack-spindle bearing previously discussed, are injuriously stressed.

In order to obviate these disadvantages of the known arrangement without giving up the requisite wide manufacturing allowances, according to a further development of the invention, the adjusting nut for the lifting spindle of the record-gripper and of the tone arm is supported in a single bearing, which is carried by the socket that also carries the stack-spindle bearing. This adjusting-nut bearing preferably consists of a two-row bearing, wherein the two rows of balls are resiliently clamped to one another in an axial direction. The rows of balls may however alternatively be rigidly clamped together

by means of a nut. By this mounting of the adjusting nut on a single structural member, the surfaces of which that are important for supporting purposes can be manufactured by rotary machining of the highest accuracy, and in a precision ball bearing, a steady supporting of the lifting spindle is ensured without special manufacturing expenditure.

The invention also concerns itself, within the scope of the fundamental problem of the tonally pure reproduction of records, with the supporting of the control rod by which the record-gripper members are shifted radially outwards at the position of the selected record through the longitudinal slots in the stack-spindle, for the purpose of grasping this record. This control rod, during the playing of a record, carries the weight of the lifted partial stack of revolving records. In the known record-changer previously mentioned, the control rod does not participate in the rotation of the record, and a ball bearing is arranged between it and the record-gripper. For this ball bearing, however, the same considerations apply which were put forward further back for the stack-spindle supporting bearing, and it is found by experience that this ball bearing does in fact form likewise, at the head of the control rod, a source of disturbance leading to tonal fluctuations. Since, as mentioned previously, the rotational driving forces available are but small, there is not the possibility of replacing the disturbing ball bearing on the head of the control rod by an equivalent plain bearing.

As compared with this known arrangement, the record-changer according to the present invention is characterized by the feature that the control rod supporting the raised partial stack of records for the record-gripper members consists of two ends, the lower one of which, a very short end, bears non-rotatably on the control cam mounted fixedly on the casing, while the very long upper end, with the aid of a one-ball journal bearing, is mounted in the lower end, and participates in the rotation of the stack of records. This constructional alteration, as compared with the known arrangement, involves not merely a simple exchange of a ball bearing for a different type of bearing, but yields, within the framework of the present problem, a decisive improvement. The control rod, like the lifting spindle, constitutes a long bar member supported at one end, with a working surface located at the free end, and therefore has a tendency to execute swaying movements. In the known constructional form, with a ball bearing arranged at the head of the control rod, this is subjected, on account of the great leverage, to comparatively large radial loads, and therefore tends towards irregular revolution, leading to disturbances in reproduction. With the formation of the control rod according to this invention, however, any existing radial forces have practically no effect at all on the journal bearing, because this bearing is located close to the rocking point of any swaying. The axial loads occurring in the journal bearing are practically without effect, since they are taken up by the carrying ball without noise and practically without resistance to rotation.

Finally, the invention is also concerned with the elimination of a further source of disturbance located in the interior of the stack-spindle. This consists, as inventive investigations and considerations have shown, in possible frictional contact between the control rod and the stressing spring pressing it against the control cam. Since this stressing spring, constructed as a spiral spring, is effective only during the period of operation, in which the control rod has urged the record-gripper members outwards, and brings the upper record stack, thereby divided off, to tone-arm working distance from the lower record stack, and thus carries it, it is supported on the lifting spindle, and therefore does not participate any more than the latter in the rotation of the stack-spindle, the record-gripper members and the control spindle. A rotary bearing must therefore be arranged between the non-rotating stressing

spring and the rotating part of the control rod. Accord-

ing to the invention this rotary bearing consists of the aforementioned journal bearing between the two sections of the control rod, in that the stressing spring is supported with its upper end on the non-rotatable lifting spindle and with its lower end on the likewise non-rotatable under portion of the control rod. Now however there is also the risk that the stressing spring, owing to the forces occurring during operative compression, may lose its cylindrical form, may deviate laterally with a part of its coil right into the region of the control rod, and check the latter in its rotation. In order to preclude this jamming, which would lead to disturbances in reproduction in a further development of the invention, between the stressing spring and the control rod is arranged an intermediate sleeve which is supported in the correct position, preferably by means of a flange, at the non-rotatable lower end of the control rod.

The constructional example hereinafter more fully described, and illustrated in the accompanying drawings, is intended to explain the invention more fully, but not to restrict it.

Figure 1 shows a diagrammatic front view of a record-changer with record-preselecting means, in which the invention is incorporated;

Figure 2 shows a partial longitudinal section through the stack-spindle, with associated constructional and operational parts;

Figure 3 shows a diagrammatic longitudinal section of one constructional form of the stack-spindle bearing;

Figure 4 shows a diagrammatic longitudinal section through another form of construction of a stack-spindle bearing;

Figure 5 shows a diagrammatic longitudinal section through yet another constructional form of a stack-spindle bearing; and

Figure 6 shows on a larger scale a partial view of the lower part of Figure 2.

Since the invention is concerned essentially with the construction of a record-changing means, only those parts of a disc-record reproducing apparatus are shown in the general view of Figure 1 which are requisite for the elucidation and comprehension of the invention.

The apparatus represented in Figure 1 comprises an instrument frame, consisting of two mounting plates 1 and 2 and two pairs of supporting columns 3 and 4, the latter of which are connected with one another by a head plate 5. To the pair of columns 3 is secured a selector register 6 of a record-preselecting device of the usual construction, which is actuated by a diagrammatically represented selecting head 7, electro-magnetic for example, in a manner known in itself. The other pair of columns 4 serves as a guide for the vertically adjustable tone arm 8, which can be swung in and out, and the swinging members of which are denoted generally by 9.

On the under side of the motor board or upper mounting plate 1 is secured the main driving motor 10, which, by way of a diagrammatically indicated gear train 11 which can be engaged and disengaged, drives an adjusting nut 12 for a square-threaded hollow lifting spindle 13. This lifting spindle 13 supports with its head portion 14 (Figure 2) the record gripper members, which will be hereinafter described in connection with Figure 2, and carries in the lower region a sensing organ 15 for the selector register 6 of the record-preselecting device. The sensing organ 15 is connected, by a diagrammatically represented connecting member 16, with a tone-arm lifting column 17 for joint up-and-down-movement, and furthermore, in a manner not illustrated, is so constructed that it is normally urged towards the selector register 6, but after striking against that selector-register slide which is protruded to correspond to the selected record it deviates for a short time, urges the slide back again into the normal position, and at the same time, through electrical switching means, disconnects the train of gears 11, so that the lifting spindle 12 and the tone arm 8 remain stationary at

the level of the selected record in the stack of records to be hereinafter described. After the record has been played, the lifting spindle is set in motion again by mechanical and electrical controlling means not further illustrated.

The record motor 18 carried by the mounting plate 1 drives the turntable 19 through a friction wheel 19', and also the stack-spindle 20 rigidly connected therewith for the record-stack 21_a, 21_b.

In the interior of the lifting spindle 13 is arranged a control rod 22, which bears with its foot upon a control lever 23. This control lever 23 is fulcrumed on the lifting spindle 13, and is so actuated, by gear and cam elements 24 diagrammatically indicated, that it moves the control rod 22 up and down within the lifting spindle in the working rhythm, for purposes known in themselves, to be hereinafter more fully explained.

The construction of the stack-spindle of the record-changer, in which the invention is embodied, will now be described in detail with reference to Figure 2.

On the upper mounting plate 1, by means of short columns 25, a socket 26 is secured, the bores and working surfaces of which are very accurately machined. The socket 26 has a wide central bore, with a downwardly extending sleeve extension 27. The external periphery of this sleeve forms the inner bushing of a two-row ball bearing 28, the outer bushing of which is according to the invention made in two parts, and is formed in the upper part by a sprocket wheel 29 and in the lower part by an adjusting nut 30 for the lifting spindle 13. The chain wheel 29, driven by the main motor 10 in a manner previously described is keyed in an axially displaceable manner to the adjusting nut 30 at 29', and the two parts 27 and 30 are pressed against one another by a spring 30', in the region of the balls.

In the interior of the sleeve 27 is arranged a one-row ball bearing 31, the outer bushing 32 (Fig. 3) of which is made in one part and its inner bushing in two parts 33' and 33''. On the lines of this invention it is however also possible, according to Figure 4, to divide the outer bearing bush into two parts 132' and 132'' instead of the inner bearing bush 133. A further constructional possibility is shown in Figure 5. Here, in the case of the bearing 231, both the inner bearing bush (233' and 233'') and the outer bearing bush (232' and 232'') are made in two parts. The two parts of the divided bearing bush are pressed against one another, in the example illustrated, by a compression spring 34 (Figure 2). The bearing 31 carries the stack-spindle 20, with the turntable 19 secured to it at 20'. The stack-spindle 20 is constructed as a sleeve surrounding the lifting spindle 13. In a manner known in itself, it is provided with longitudinal slots 36 corresponding in number and arrangement to the record-gripper members 35. Upon the stack-spindle 20 are threaded carrier rings 37 of the usual construction for the record discs 21 (Figure 1). A longitudinal rib 37' on the stack-spindle then engages in a radial groove in each carrier ring 37, and ensures the rotation of the records.

The record-gripper system arranged in the interior of the stack-spindle 20 is of the usual construction. A hollow carrier body 38, which normally rests with its foot plate 39 upon the head member 14 of the lifting spindle 13, serves as a horizontal sliding bearing for the slider-like record-gripper members 35, which are normally urged by a torsion spring 40 into their retracted position within the external periphery of the stack-spindle.

In the interior of the hollow lifting spindle 13 is arranged the aforementioned control rod 22. It consists, as will be gathered more particularly from the large-scale partial view in Figure 6, of the very long actual upper end of the rod and the short lower end 41, which is constructed as a thrust bearing, with a bottom ball 42 for the lower end of the rod 22 and an end flange 43. The control rod 22 has in its upper section a collar 44 (Fig. 2).

and an inclined control surface 45. The axial arrangement of the collar 44 and the control surface 45 relatively to one another and to the head member 14 of the lifting spindle 13 is made such that during the upward travel of the control rod 22 inside the lifting spindle, first the inclined surface 45 becomes operative and allows the record-gripper slider 35 to extend through the stack-spindle slots 36 into the record-carrying or turntable ring 37, and only then does the collar 44 bear on the foot plate 39 of the record-gripper carrier 38, and subsequently raise the record-gripper system 35, 37, 38, 40 and the upper part 21, (Figure 1) of the stack of records, which contains the record seized by the gripper sliders 35 as the lowest one, through the height of the tone-arm working gab (Figure 1).

In Figure 2 is represented the condition in which the collar 44 just touches the foot-plate 39 of the record-gripper carrier 38, and Figure 1 shows the device with the working gap opened. After the record has been played, the control rod 22 is lowered again, whereby first the stack of records is re-united, and then the gripper sliders 35 are released, and these then set free, under the influence of the torsion spring 40, the record previously selected. The stack of records is thereby made ready again for the next selecting and playing operation.

As will readily be gathered more particularly from Figure 6, between the end flange 43 of the lower end 41 of the control rod 22 and an inner collar 46 of the lifting spindle 13 is clamped a helical compression spring 47, which, during the upward stroke, hereinbefore described, of the control rod 22, is further compressed. Between the helical spring 47 and the ends 22 and 41 of the control rod is arranged a sleeve 48 with an end flange 49, which is designed to prevent, in a manner previously indicated according to the invention, any disturbing contact between the two operative elements.

The advantages attained by the form of construction hereinbefore described in detail are set forth and explained in detail in a previous passage.

It will be obvious from the foregoing statements, to any technologist, that the invention, with respect to its applicability and its usefulness, is not restricted to the constructional form illustrated, but is also of advantage in conjunction with other types of disc-record apparatus, in which the supporting by operative elements participating in the rotation of the turntable may lead to disturbances in the reproduction of sound.

What we claim is:

1. A record handling mechanism for apertured disc-type records comprising a power source, a vertical spindle for accommodating said records, said spindle being coupled to said source for being rotated, and a ball bearing supporting the spindle for rotation; said bearing including two races and no more than one group of coplanar balls between the races, at least one of said races comprising two sections abutting in the plane of the balls.

2. A mechanism is claimed in claim 1, wherein the spindle is substantially vertical, comprising means supporting the bearing and thereby said spindle in fixed vertical position.

3. A mechanism as claimed in claim 1, wherein the spindle is substantially vertical and is adapted to support a stack of superposed records, the spindle further defining at least one axial slot, said mechanism further comprising first means slidable within the spindle in a vertical direction, second means coupled to said first means to control the vertical displacement of the latter, an engaging member on said first means and extending through said slot to engage the stack of records in accordance with said vertical displacement, and control means coupled to said engaging member to control the extending of the engaging member through said slot and thereby the engaging of said stack.

4. A mechanism as claimed in claim 3, comprising a threaded portion on the first means, and a threaded member engaging said threaded portion and coupled to said power source for the vertical displacement of the first means.

5. A mechanism as claimed in claim 4, wherein said threaded member includes a portion constituting a race for a further ball bearing, comprising a support supporting the first said bearing and including a portion constituting a further race for said further bearing, and a group of balls between the races of said further bearing to complete the latter.

6. A mechanism as claimed in claim 5 comprising a sprocket wheel on the threaded member coupling the latter to said power source.

7. A mechanism as claimed in claim 5 comprising a spring urging the races of the further bearing together.

8. A mechanism as claimed in claim 1, wherein the spindle is hollow and defines at least one axial slot, comprising a hollow tube displaceable within the spindle, a carrier body resting atop said tube, a rod displaceable within the tube to lift the carrier body therefrom, and a record engaging member on the carrier body and extending through the slot to lift a portion of the records in accordance with the displacement of the hollow tube.

9. A mechanism as claimed in claim 8, wherein the engaging member is displaceable on said carrier body, comprising a spring coupled to the engaging member to urge the latter into a retracted position with respect to said slot, said rod engaging said engaging member to urge the latter outwardly of the slot by overcoming the action of the spring.

10. A mechanism as claimed in claim 9 wherein the rod is extendible through said carrier body and includes a first portion for engaging said engaging member and a second portion for engaging the carrier body, said first and second portions being spaced so that the engaging member and carrier body are engaged in sequence.

11. A mechanism as claimed in claim 9 comprising an end thrust bearing supporting said rod in said hollow tube.

12. Apparatus for selectively elevating a portion of a vertical stack of centrally perforated records with respect to the remainder of said stack comprising a rotatable hollow spindle adapted to extend through the records of said stack and defining a lateral opening, first means at least in part in said spindle and vertically and radially displaceable with respect to the spindle for selectively engaging the stack, and second means coupled to the first means to displace the same vertically and radially for selecting and elevating said portion.

13. Apparatus as claimed in claim 12 wherein the first means comprises a hollow tube within and rotatable with the spindle, a carrier body resting on said tube, a record engaging member displaceable on the carrier body radially with respect to the spindle, and resilient means urging the engaging member to a radially innermost position whereat engagement with the stack is avoided.

14. Apparatus as claimed in claim 13 where said record means comprises a rod displaceable in the hollow tube for sequentially engaging said engaging member and carrier body for respectively urging the engaging member radially outward and lifting the carrier body from said hollow tube.

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