

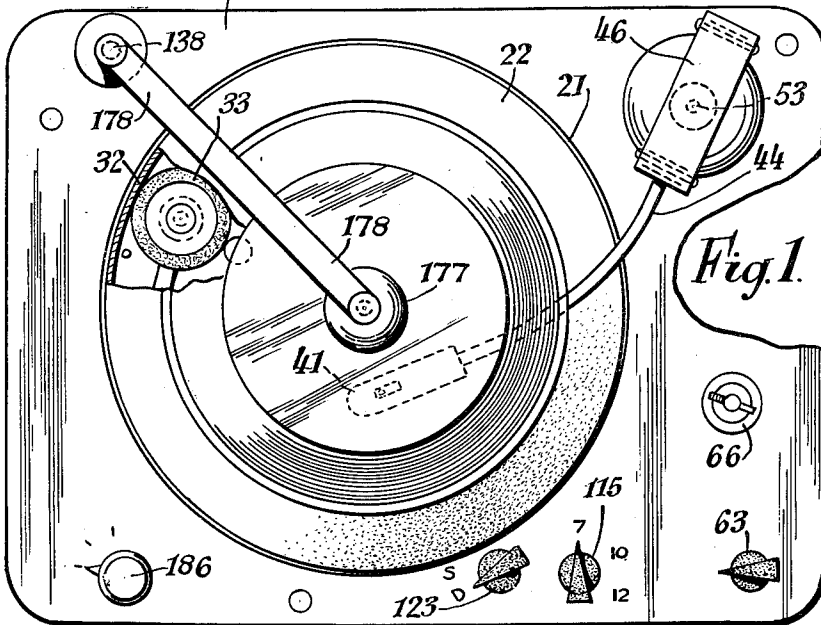
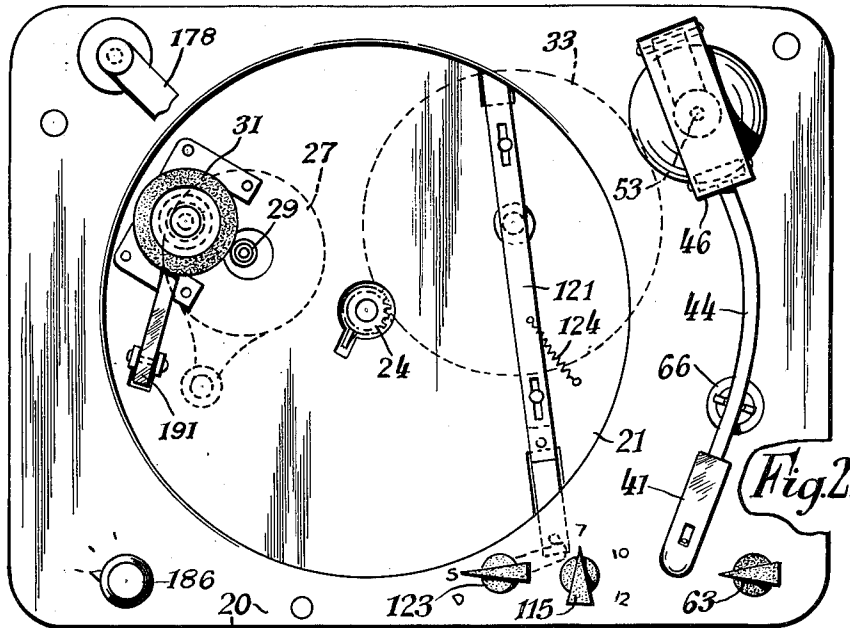
May 15, 1962

J. FOSTER ETAL  
SOUND REPRODUCING MACHINES

3,034,793

Filed May 29, 1958

9 Sheets-Sheet 1



INVENTORS  
JOSEPH FOSTER  
RICHARD HENRY MALLARD  
BY  
MAXWELL E. SPARROW  
ATTORNEY

May 15, 1962

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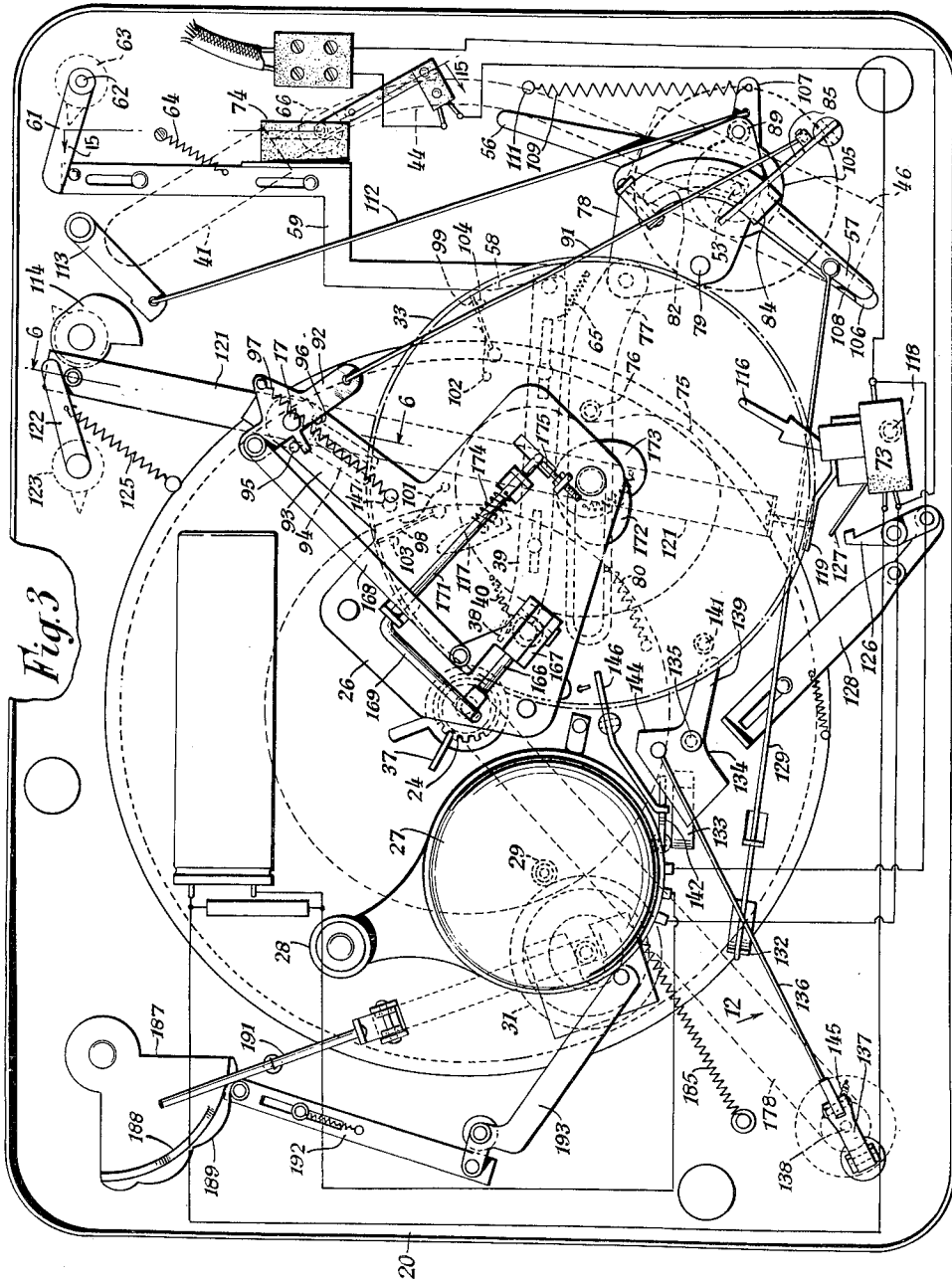


Fig. 3

INVENTORS  
JOSEPH FOSTER  
RICHARD HENRY MALLARD  
BY  
MAXWELL E. SPARROW  
ATTORNEY

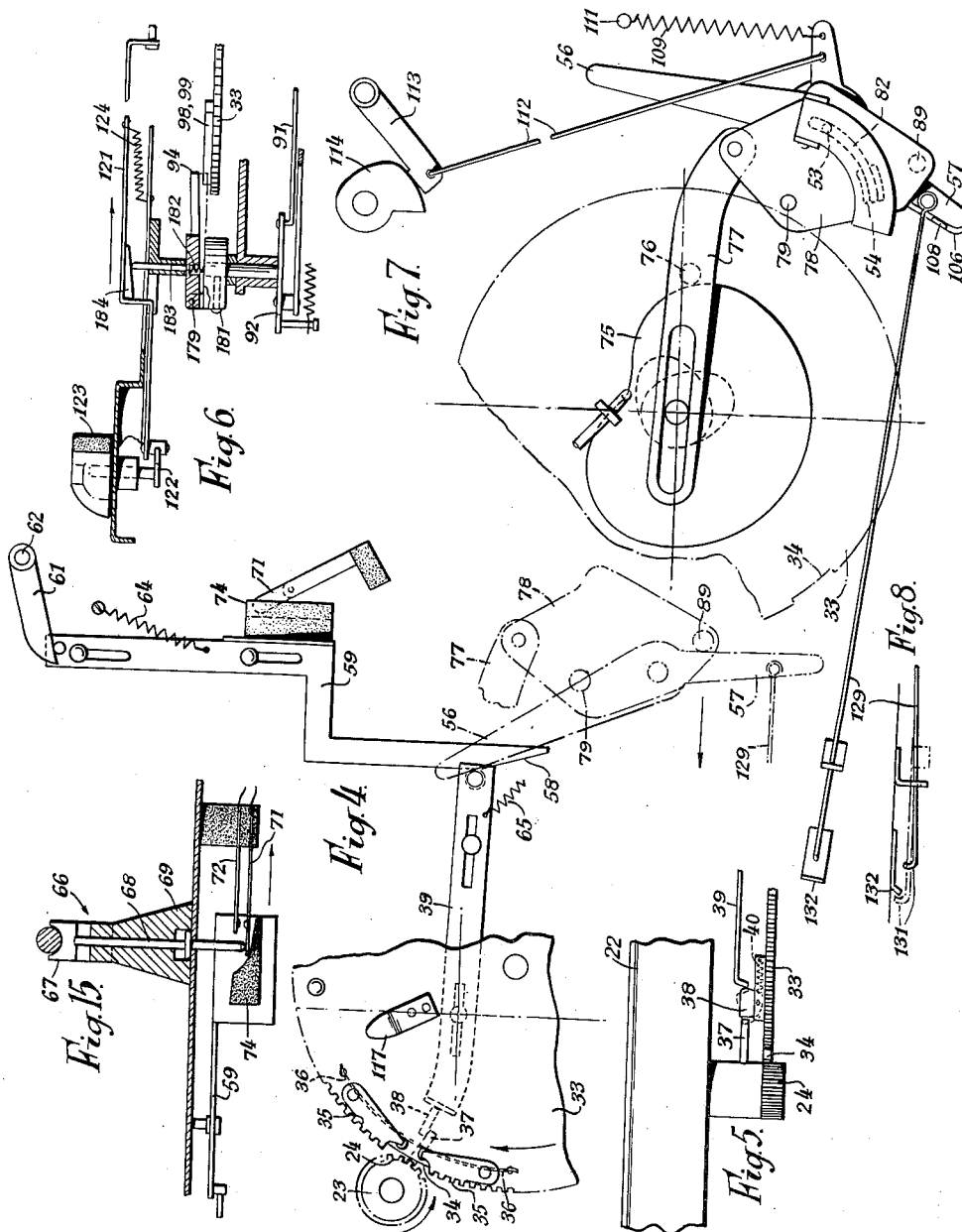
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INVENTORS  
JOSEPH FOSTER  
RICHARD HENRY MALLARD  
BY  
MAXWELL E. SPARROW  
ATTORNEY

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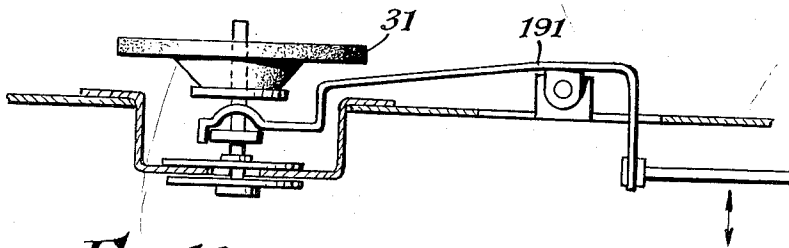
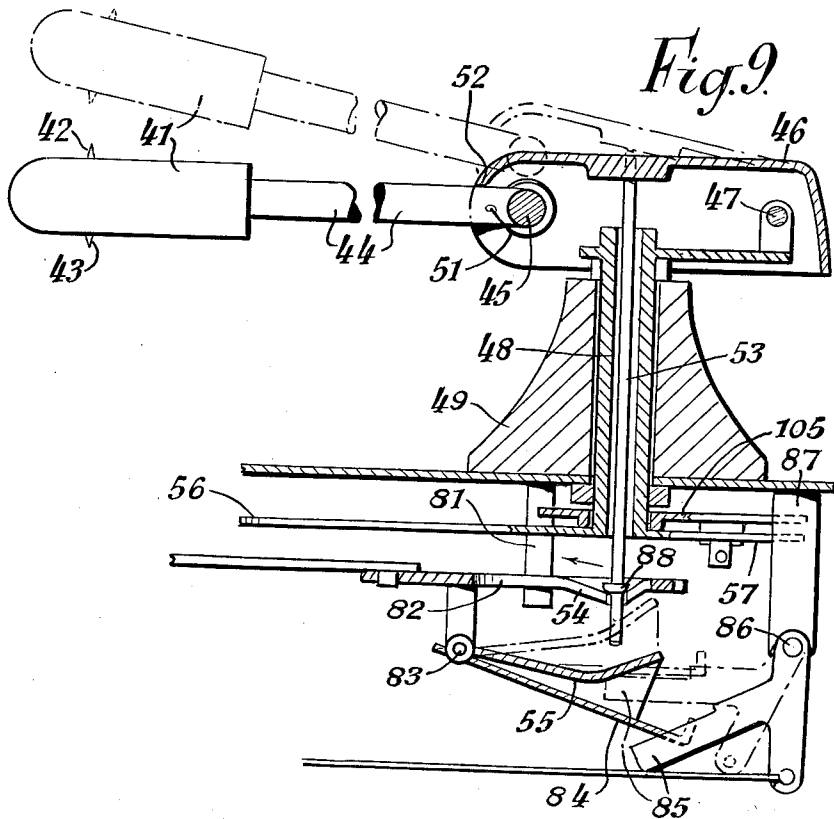


Fig. 16.

INVENTORS  
JOSEPH FOSTER  
RICHARD HENRY MALLARD  
BY  
MAXWELL E. SPARROW  
ATTORNEY



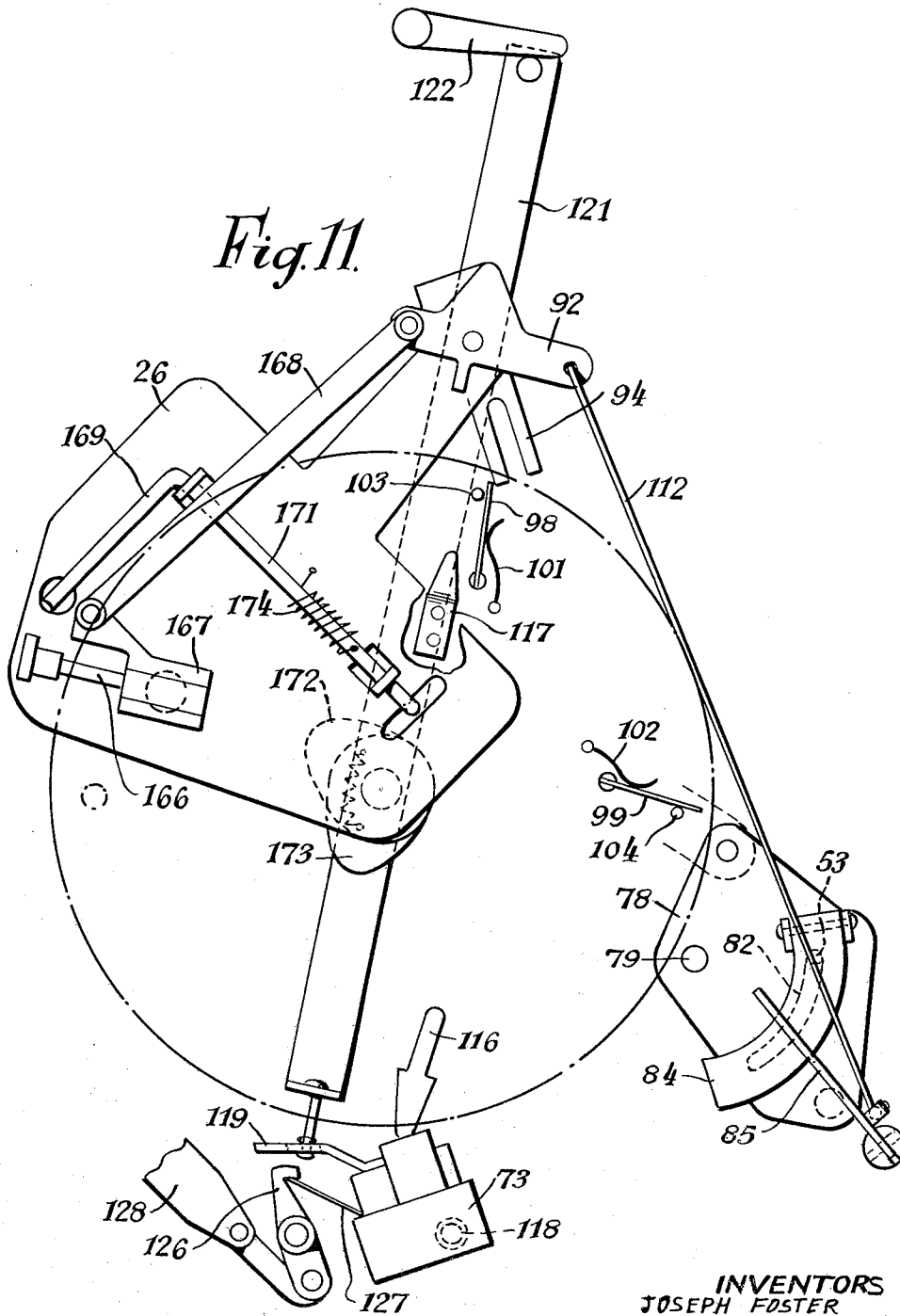
May 15, 1962

J. FOSTER ET AL  
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Filed May 29, 1958

9 Sheets-Sheet 6



INVENTORS  
JOSEPH FOSTER  
RICHARD HENRY MALLARD  
BY  
MAXWELL E. SPARROW  
ATTORNEY

May 15, 1962

J. FOSTER ET AL  
SOUND REPRODUCING MACHINES

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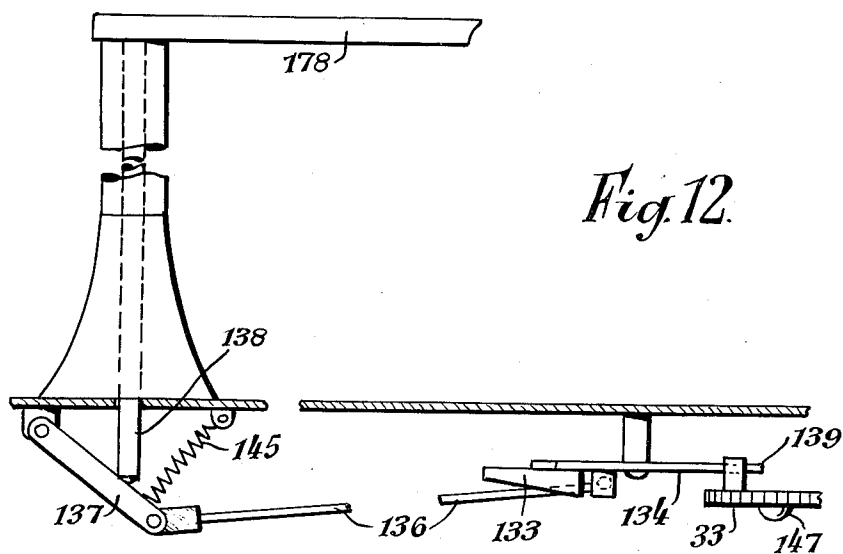


Fig. 12.

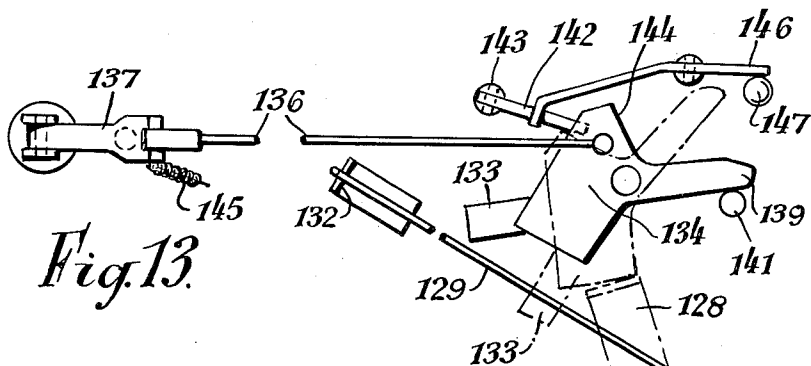


Fig. 13.

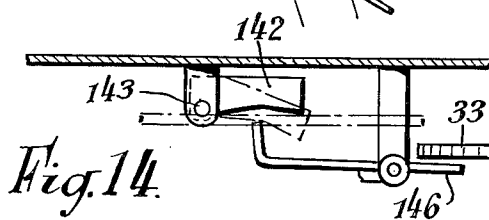


Fig. 14.

INVENTORS  
JOSEPH FOSTER  
RICHARD HENRY MALLARD  
BY  
MAXWELL E. SPARROW  
ATTORNEY

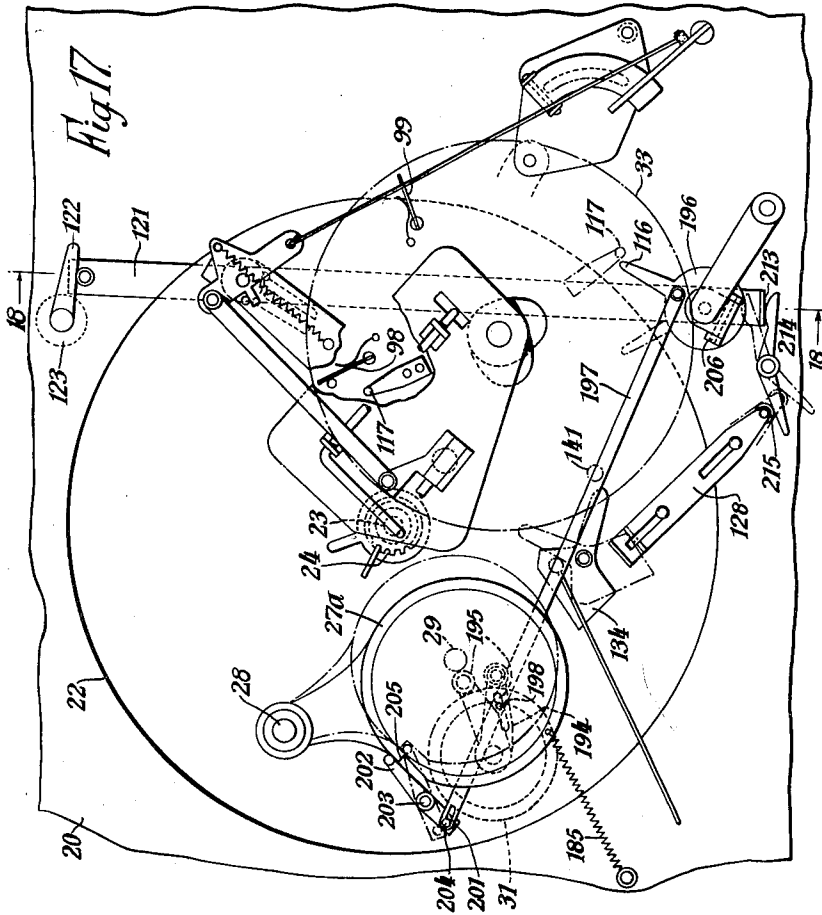
May 15, 1962

J. FOSTER ETAL  
SOUND REPRODUCING MACHINES

3,034,793

Filed May 29, 1958

9 Sheets-Sheet 8



INVENTORS  
JOSEPH FOSTER  
RICHARD HENRY MALLARD  
BY *McQuell & Sparrow*  
ATTORNEY

May 15, 1962

J. FOSTER ETAL

3,034,793

SOUND REPRODUCING MACHINES

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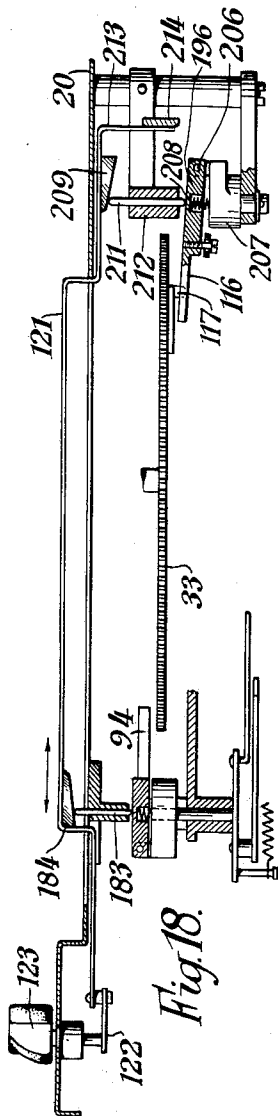


Fig. 18.

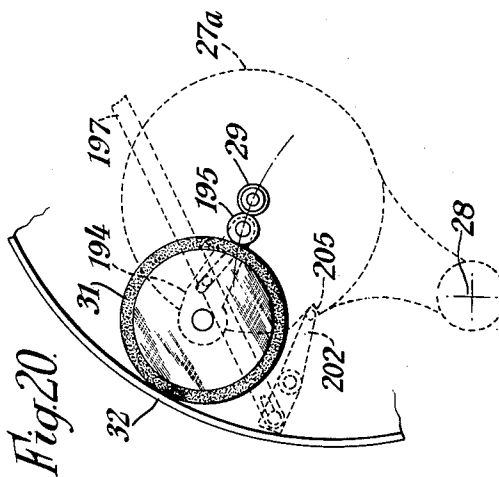


Fig. 20.

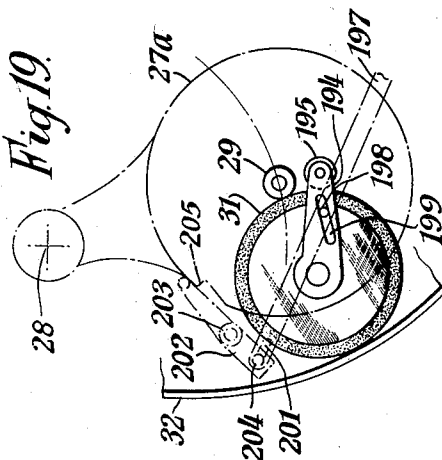


Fig. 19.

INVENTORS  
JOSEPH FOSTER  
RICHARD HENRY MALLARD  
BY *Maxwell E. Spanow*  
ATTORNEY

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3,034,793

**SOUND REPRODUCING MACHINES**

Joseph Foster and Richard Henry Mallard, London, England, assignors to Foster-Mallard Limited, London, England

Filed May 29, 1958, Ser. No. 739,455

13 Claims. (Cl. 274—10)

This invention relates to sound reproducing machines, of the kind in which grooved disc-shaped records and a pick-up device are used in association with an amplifier, a plurality of records placed on the machine to be played one after the other being stacked above a turntable, and lowered one-by-one on to the turntable, the lowering of each record being effected by mechanism driven from the turntable and set in motion by the pick-up arm when it reaches the inner end of the playing groove of a record. Since such machines are arranged to play only the upper side of each record when it rests on the turntable, the turntable is arranged to be driven only in one direction, and the sequence of operations at each change from one record to another is the same.

The object of the present invention is to provide a sound reproducing machine of the kind referred to, in which the undersides of the records can be played before they are lowered on to the turntable, so that, with a stack of records mounted above the turntable, the under side of the lowest record is first played, that record is then allowed to fall on to the turntable and its upper side played, after which the lower side of the next record is played, and so on.

It will be apparent that, during the playing of the underside of a record, the latter will have to revolve in the direction opposite to that in which it revolves during playing of the upper side.

According to the present invention, in a sound reproducing machine for playing grooved disc-shaped records comprising a turntable, means for supporting a plurality of records coaxially above the turntable for rotation therewith, a pick-up device having stylus means adapted to engage records both above and below said pick-up device, and means for lowering the records one by one on to the turntable, the lowering of each record being effected by mechanism driven by driving means which also drives the turntable and are set in motion by the pick-up arm at the termination of the playing of a record, the driving means for the turntable and the record-supporting means are reversible, and mechanism for bringing the pick-up to a starting position on a record surface is selectively operable, depending on the direction in which the turntable is rotating when its operation is initiated, to drop a record on to the turntable and bring the pick-up into starting position on the upper surface of that record, or to bring the pick-up into starting position in relation to the under surface of the lowest record of the stack.

Further, according to the invention a sound-reproducing machine for playing disc-shaped records, comprises a turntable, means for supporting a plurality of records coaxially above the turntable for rotation therewith, a pick-up device having stylus means adapted to engage records both above and below said pick-up device, means for dropping the records one-by-one on to the turntable, a rotary control member, reversible driving means for said turntable and control member, means responsive to movement of the pick-up arm to the inner end of a record groove to initiate rotation of said control member by said driving means, means operated by said control member to displace the pick-up vertically and horizontally clear of the records, means operated by the said control member to reverse the reversible driving means when the said control member has moved approximately

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half a revolution from its normal position in either direction, and means selectively operable by said control member according to its direction of rotation from the normal position to bring the pick-up into playing relation with a record above the turntable, or to allow a record to fall on to the turntable and bring the pick-up into playing relation with the said record.

The invention is hereinafter described with reference to the accompanying drawings in which:

FIGURE 1 is a plan view of one embodiment of a sound reproducing machine according to the invention;

FIGURE 2 is a view similar to FIGURE 1 with the turntable removed;

FIGURE 3 is an underneath plan view, on an enlarged scale, of the machine shown in FIGURES 1 and 2;

FIGURE 4 is a partial underneath plan view showing the mechanism for starting the operation of the machine;

FIGURE 5 is a scrap elevation of part of the mechanism shown in FIGURE 4;

FIGURE 6 is a section on the line 6—6 of FIG 3;

FIGURE 7 is another partial underneath plan view of the mechanism for operating the pick-up arm;

FIGURE 8 is a scrap elevation of a part of the mechanism shown in FIGURE 7;

FIGURE 9 is a sectional elevation of the pick-up arm mounting and control mechanism;

FIGURE 10 is a sectional elevation of the record supporting spindle and record release mechanism;

FIGURE 11 is an underneath plan view of the mechanism for controlling the record release;

FIGURE 12 is an elevation, taken in the direction of the arrow 12 in FIGURE 3, showing mechanism for stopping the machine at the completion of the playing of a batch of records;

FIGURE 13 is an inverted plan view of the mechanism shown in FIGURE 12;

FIGURE 14 is a detail view, in elevation, of some of the parts shown in FIGURE 13;

FIGURE 15 is a sectional elevation, approximately on the line 15—15 of FIGURE 3, showing the starting switch;

FIGURE 16 is a scrap elevation of the variable speed control mechanism;

FIGURE 17 is an underneath plan view, similar to FIGURE 3, showing a modification;

FIGURE 18 is a section on the line 18—18 of FIGURE 17;

FIGURE 19 is an underneath plan view corresponding to part of FIGURE 17 but with the motor shown in chain-dotted lines; and

FIGURE 20 is a plan view of the parts shown in FIGURE 19.

The sound reproducing machine according to the invention is of the kind in which a gear-wheel driven by a pinion rotating with the turntable, is brought into mesh with the said pinion by the final inward movement of the pick-up arm, and, by its rotation, effects the necessary movements of the pick-up arm and record dropping mechanism.

In known sound reproducing machines employing such a gear-wheel, the said wheel, each time it comes into engagement with the pinion, makes one complete revolution and then becomes disengaged from the said pinion, the rotation of the gear-wheel, through suitable mechanism, first lifting the pick-up clear of the record, then swinging it outwardly beyond the periphery of the record, then releasing the next record, and finally returning the pick-up to the starting groove of the next record.

The sound-reproducing machine according to the present invention, being arranged to play the underside of each record before it is dropped on to the turntable, must, of

course, be provided with a turntable which is capable of being revolved in both directions. Reversal of the turntable is effected by the gear-wheel which at each change operation, makes a half turn, effects the reversal, and returns to its normal position. Thus the gear-wheel motion depends on the direction in which the turntable has been rotating during the playing of the last record side, and the two motions are each arranged to effect the necessary movements of the pick-up arm with or without operation of the record dropping mechanism, for the two kinds of change which are called for. Provision is made for rendering parts of the mechanism inoperative so that the machine can operate in substantially the known manner to play only the upper sides of the records.

Referring mainly to FIGURES 1, 2, 3 and 4 of the drawings, a base plate 20, recessed at 21 to receive a turntable 22, carries all the various mechanism hereinafter described. The turntable is mounted on a hollow spindle 23 (FIGURE 10) the lower part of which is formed as a gear pinion 24, the spindle 23 rotating on a sleeve 30 fixed to and projecting upwardly from a plate 26 supported below the base plate 20, the spindle 23 resting on a ball thrust bearing 25 arranged between its lower end and the plate 26.

The turntable is driven by a reversible electric motor 27 mounted to swing about a pivot at 28, the spindle of the electric motor carrying a stepped drive wheel 29 engaging a friction wheel 31 which in turn engages the internal surface of a peripheral rim 32 on the turntable. Details of the drive mechanism are given later in this specification.

A gear wheel 33, mounted on a spindle extending between bearings on the base-plate 20 and the plate 26 has its teeth interrupted at 34 (FIGURE 4), two pivoted members 35, 35 urged outwardly by springs 36, 36, bearing teeth which occupy parts of the gap at the two ends thereof, leaving a clear space in the middle. The teeth of the gear wheel 33 mesh with the teeth of the pinion 24 so that, although, when the gap in the gear wheel is opposite the pinion the turntable can rotate independently of the gear wheel, a small angular displacement of the gear wheel brings the two wheels into driving relation. The initial angular displacement of the gear wheel is effected by a radial pin 37 on the hollow spindle 23 engaging a rocker 38 (FIGURE 5) displaced into the path of the pin 37 against a return spring 40 by a bar 39 slidably mounted on the base plate 20 the rocker being moved into position for engagement by the pin 37 when movement of the gear wheel is to be initiated.

A pick-up 41 having two styli 42 and 43 (FIGURE 9) which project upwardly and downwardly respectively, is mounted on an arm 44 pivoted for movement about a horizontal axis at 45 in a housing 46 itself mounted for movement about a horizontal axis at 47 on the top of a hollow spindle 48 pivotally mounted to turn about a vertical axis in a pillar 49 fixed to the base plate 20. A light spring 51 urges the arm 44 upwardly relative to the housing 46, against a stop 52 in the housing. A rod 53 passing through the hollow spindle 48 engages the housing 46 and is movable vertically by ramps 54 and 55 below the base plate 20 to lift or lower the pick-up 41. The hollow spindle 48 has fixed to its lower end two radial arms 56 and 57, the arm 56 co-operating with the bar 39 to bring the gear wheel 33 into mesh with the pinion 24 at the end of the playing of each record side, whilst the arm 57 co-operates with a catch mechanism, hereinafter described, to stop the machine when a stack of records has been played.

The bar 39 is also operable to move the projection 38 into the path of the pin 37 by a ramp 58 on a slide member 59 movable to displace the bar 39 by an arm 61 on a spindle 62 carrying a knob 63 on the top of the base plate. The ramp on the slide member 59 is normally held by a spring 64 clear of the bar 39. The bar

39 is itself urged in a direction to hold the projection 38 clear of the pin 37 by a spring 65.

A rest 66 is provided for the arm 44 carrying the pick-up 41, the rest consisting of a cradle 67 (FIGURE 15) mounted on a rod 68 slidable vertically in a pillar 69 on the base plate 20, the lower end of the rod 68 engaging a spring contact 71 to urge it downwardly, under the weight of the arm 44, away from another contact 72. These contacts are arranged in the main supply circuit of the electric motor 27, in which is also included a reversing switch 73 actuated by the gear-wheel 33 as hereinafter described. The contacts 71, 72 can also be closed, when the arm 44 is on the rest 66, by a ramp 74 (FIGURES 4 and 15) carried by the slide member 59.

It will be appreciated that when the machine is not in operation, the gap 34 in the teeth of the gear wheel 33 is opposite the pinion 24, and in this position of the gear wheel the bar 39 is in a position to be engaged by the ramp 58.

The gear wheel 33 is in the same position during the playing of a record, so the bar 39 is also in the same position, and lies in the path of the arm 56 as the latter swings inwardly with the pick-up arm 44, the arm 56 being so set in relation to the pick-up arm that it engages and displaces the bar 39 when the stylus reaches the inner end of the groove in a record. Thus the movement of the knob 63 to move the slide member 59 closes the circuit of the electric motor 27 and moves the projection 38 into the path of the pin 37 so that the gear wheel 33 is caused to rotate, and rotation of the gear wheel is also initiated at the end of the playing of each record side. The gear wheel 33 carries a symmetrical cam 75, the periphery of which rises in both directions from a low point to a point spaced about 90° from the said low point, the remainder of the periphery being an arc about the centre so that it constitutes a dwell portion. The cam 75 (FIGURES 3 and 7) is engaged by a follower 76 on a slide bar 77 slotted to receive the gear wheel spindle, one end of the slide bar 77 being pivoted to a plate 78 pivotally mounted at 79 on a stem 81 depending from the base plate so as to swing in a horizontal plane. The slide bar 77 is acted on by a spring 80 urging the follower 76 against the cam 75. The plate 78 is slotted at 82 for the passage of the rod 53, the slot 82 being arcuate about the center of the stem 81, and the edges of the slot being deformed as shown in FIGURE 9 to form the ramp 54. The plate 78 carries, on a horizontal pivot at 83 spaced below its underside, the other ramp 55, this ramp being also of arcuate form with its center at the axis of the stem 81, and having integral with it an arm 84 which rests on a lever 85 pivoted at 86 to a post 87 depending from the base plate. The rod 53 carries a collar 88 which co-operates with the ramp 54, and its lower end co-operates with the ramp 55. The plate 78 carries a stud 89 which co-operates with the arm 57 fast with the hollow spindle 53, as will be hereinafter described.

In the normal position of the gear wheel 33, the follower 76 is at the lowest point of the cam 75, and during a half-revolution of the gear-wheel it is moved through its full stroke returning to the lowest point during the succeeding half-revolution. Each operation of the gear-wheel 33 thus swings the plate 78 to and fro through an arcuate path, taking the ramps 54 and 55 with it, and during a part of this swinging movement, the stud 89 transmits movement through the arm 57 to the pick-up arm 44, as will be hereinafter described.

The lever 85 acts on the ramp 55 through the arm 84 to lift it into an operative position when required, this ramp serving to raise the pick-up to a position for playing the underside of a record and to lower it clear of the record for outward swinging after the side has been played. The lever 85 is connected by a pivoted link 91 to one end of a lever 92 pivoted intermediate its ends to an extension 93 of the plate 26, the lever being ar-

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ranged to move as one with a fork 94, and being free to swing between stops 95, 96 against either of which it is urged by a toggle spring 97. The gear wheel 33 carries two pivoted trip members 98 and 99 urged by springs 101, 102 against stops 103, 104 on the gear wheel, each of these trip members being adapted to rock the fork 94 and lever 92 through their dead-center position in one direction during movement of the gear wheel, and to pass the fork idly during the return movement of the gear wheel. In one position of the levers 92 and 85 the ramp 55 is positioned, as shown in full lines in FIGURE 9, so that it is not touched by the rod 53, but in the other position of the levers the ramp is in the position shown in chain-dotted lines in FIGURE 9, in which it is engaged by the lower end of the rod 53.

A collar 105 rotatable on the hollow stem 48 carries two radial arms 106 and 107 the arm 106 having formed on it a lug 108 which engages one side of the arm 57. The other arm 107 on the collar 105 is connected to a spring 109 anchored at 111 on the base plate and acting to draw the arm 106 towards the arm 57, the arm 107 being also connected by a pivoted link 112 to a lever 113 co-operating with a cam 114 to determine the position to which the arm 106 is drawn by the spring 109. The cam 114 is coupled to a knob 115 on the upper side of the base plate 20.

The reversing switch 73 has an operating arm 116 which co-operates with a finger 117 mounted on the gear wheel 33 in such a position that the finger engages the arm 116 to operate the reversing switch when the gear wheel 33 has moved through 180° from its normal position. The switch 73 is mounted on the base plate 20 by means of a pivot at 118, and is movable about that pivot to bring the arm 116 into or out of the path of the finger 117. An arm 119 fixed to the switch 73 is coupled for two-way operation to a slide bar 121 mounted on the base plate and acted on in turn by an arm 122 operated by a knob 123 on the top of the base plate. The slide bar 121 is urged by a spring 124 (FIGURES 2 and 6), to the position shown in FIGURE 3, in which the arm 116 is out of the path of the finger 117, the arm 122 being held in operative engagement with the slide bar 121 by a lighter spring 125 (FIGURE 3). A pivoted latch 126 engages a latch member 127 on the switch when the latter is moved to the position in which the arm 116 is in the path of the finger 117 (FIGURE 11) the latch 126 being connected to a slide bar 128 operated to release the latch in a manner hereinafter described.

The arm 57 fixed to the hollow spindle 48 carrying the pick-up arm has pivotally attached to it a link 129 having a hooked end 131 (FIGURE 8), the link being free for a limited amount of vertical movement at its hooked end so that it can normally move to and fro without engaging a lug 132 on the underside of the base plate 20, but, if lifted, engages the said lug and prevents movement of the arm 57 and spindle 48 corresponding to inward movement of the pick-up arm 44. The hooked end 131 of the link 129 is lifted when required by a ramp 133 carried by a rocker 134 pivotally mounted at 135 underneath the base plate, the rocker 134 being moved to bring the ramp into its operative position in two stages. The rocker 134 is connected by a link 136 to a lever 137 (FIGURES 3, 12 and 13), and a rod 138, moved downwardly when the last of a stack of records drops on to the turntable as hereinafter described acts, on such downward movement, to rock the lever 137 and rotate the rocker 134 from the position shown in FIGURE 3 to the position shown in full lines in FIGURE 3 in which an arm 139 on the said rocker lies in the path of a stud 141 on the gear wheel 33. Subsequent movement of the gear wheel 33 in a clockwise direction as viewed in FIGURE 3 moves the rocker 134 to the position shown in chain dotted lines in FIGURE 13, where the ramp engages and lifts the link 129. Rotation of the rocker 134 to this position allows a stop arm 142, pivoted at 143 under the base

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plate and normally supported by the rocker, to drop into a position in which it engages an edge 144 on the rocker and prevents it from returning, under the influence of a spring 145 acting on the lever 137, to its normal position. Continued rotation of the gear wheel 33 causes a lever 146 to be rocked by a cam stud 147 on the gear wheel, to release the rocker 134 and allow it to be returned to its normal position by the spring 145, leaving the link 129 hooked to the lug 132 as will be hereinafter explained. The rocker 134, as it approaches the position shown in chain dotted lines in FIGURE 13, engages and moves the slide bar 128 to release the latch 126 and allow the reversing switch 73 to move, under the influence of the spring 124, to the position in which the arm 116 is out of the path of the finger 117.

The hollow spindle 23 of the turntable 22 has extending upwardly therefrom a stem 148 the lower and upper parts of which are co-axial with the turntable, whilst a central part 149 is inclined as shown in FIGURE 10 so that its upper end forms a step on one side of the stem at 151. Above the step 151 the stem 148 is grooved radially at 152 to receive a sliding key 153 which, in its lowermost position is spaced above the step 151 by a distance slightly greater than the thickness of one record, the groove 152 being on the opposite side of the stem 148 to the step 151 and the upper co-axial portion of the stem being tapered inwardly on the grooved side as shown at 154. The key 153 serves to keep records 155 on the upper part of the stem co-axial with the turntable until they drop on to the step 151. The inclined part 149 of the stem is also slotted at 156, and in the slot 156 is mounted a lever 157 coupled by a peg and notch 158, 159 to another pivoted lever 161 formed with a cam slot 162 in which engages a pin 163 on a rod 164 slidable in the stem 148. Upward movement of the rod 164 rocks the lever 161, and, in turn, the lever 157, the upper end of the latter extending into the central hole of a record resting on the step 151 and acting, when the levers are rocked, to move that record sideways off the step 151, and allow it to drop on to the turntable. The rod is urged downwardly by a spring 165, and is raised to cause displacement of a record by a striker arm 166 mounted for pivotal movement in a vertical plane in a forked bracket 167 mounted on the underside of the plate 26 for pivotal movement in a horizontal plane. The bracket 167 is coupled by a pivoted link 168 to the end of the lever 92 remote from that to which the link 91 is connected, so that rocking of the lever 92 moves the striker arm 166 into and out of line with the rod 164.

The striker arm 166 is operated by a radial arm 169 on a rod 171 mounted in bearings on the plate 26, another radial arm on the other end of the rod 171 being moved to turn the rod 171 by either one of two cams 172, 173 rotating with the gear wheel 33. The two cams enable the rod 171 to be actuated by movement of the gear wheel 33 through a half-revolution in either direction, the cam 173 being spring loaded so as to yield when the gear wheel makes a full revolution in one direction and avoid double operation of the rod 171. The rod 171 is urged by a torsion spring 174 away from the striker arm 166 and against a stop 175.

The stack of records on the upper part of the stem 148 is retained in a horizontal position by a disc 176 resting on the top of the stack, the disc having fixed to it a pillar 177 bored to receive the stem 148, which thus holds the disc in a horizontal attitude. The lower end of the bore in the pillar 177 is counterbored to pass over the step 151, so that, when the last record of the stack is released, the disc 176 falls through a distance substantially greater than the thickness of a record. An arm 178 one end of which is secured to the upper end of the rod 138, rests on the top of the pillar 177, so that the rod 138 is moved downwardly to actuate the lever 137 by this final movement of the disc 176.

The fork 94, which co-operates with the stops 95, 96 and

the gear wheel 33 is, as shown in FIGURE 6, pivoted about a horizontal axis at 179 on a block 181 mounted to turn with the lever 92, and is urged by a spring 182 to the position, shown in FIGURE 6, in which the fork is lifted out of the path of the pivoted trip members 98, 99. A push-rod 183 co-operates with a ramp 184 on the slide bar 121 so arranged that when the said slide bar is in the position in which the reversing switch 73 is not operable by the finger 117 the fork 94 is allowed to move clear of the stops, but when the reversing switch 73 is moved to its other position the fork 94 is pushed down into the path of the stops.

The electric motor 27 is urged by a spring 185 in a direction to press the drive wheel 29, and through it the friction wheel 31 against the rim 32 of the turntable. A speed control knob 186 on the upper side of the base plate is mounted on a spindle carrying a cam member 187 (FIGURE 3) including a stepped face cam 188 and a two-lobed edge cam 189. The face cam 188 acts on a lever 191 (FIGURES 3 and 16), which, according to the step of the cam engaged by the lever, locates the friction wheel 31 in the plane of one or other of the sections of the drive wheel 29. The edge cam 189 acting through a slide bar 192 and a lever 193, moves the motor 27 about its pivot to swing the drive wheel 29 away from the friction wheel 31 as the lever 191 moves from one step to another, thus allowing the friction wheel to move without obstruction by the steps on the drive wheel. The friction wheel 31, as shown in FIGURE 16, is free to move through a short distance circumferentially of the turntable 22 so that, for either direction of rotation, it takes up a position with its center slightly in advance of a radial line through the axis of the drive wheel, providing for a smooth take up of the drive in both directions.

The sound reproducing machine described with reference to FIGURES 1 to 16 operates in the following manner. When the machine is not operating, the parts are in the positions shown in FIGURE 3, the pick-up arm resting on the cradle 67 and depressing the rod 68 to hold the contacts 71, 72 open. As will be seen the reversing switch 73 is in the position in which the arm 116 is out of the path of the finger 117. The reversing switch is set for rotation of the turntable in a clockwise direction, which is the direction for playing the upper side of a record, and the fork 94 is in the position shown in FIGURE 6. The hooked end 131 of the link 129 is engaged with the lug 132.

Assuming first that the machine is to be used to play only the upper sides of a stack of records, the records are placed on the stem 148, the lowest record resting on the step 151, the disc 176 is placed on the top of the stack, and the arm 178 is located on the top of the pillar 177. The knob 115 is set to a position corresponding to the size of the records, which are assumed to be all of the same diameter, and the knob 123 is left in the position to which it has been urged at the end of the last use of the machine. The knob 63 is turned to move the slide member 59, thus closing the contacts 71, 72 through the ramp 74 and moving the slide bar 39 to displace the rocker 38 into the path of the pin 37. The closing of the contacts 71, 72 causes the electric motor 27 to drive the turntable in a clockwise direction (as viewed from above) so that it will turn in an anti-clockwise direction as viewed in FIGURE 3. In the following description, the directions of rotation stated will assume that the machine is being viewed from underneath, as shown in FIGURE 3, to avoid confusion.

Before movement commences, the collar 88 on the rod 53 lies at the lowest point of the ramp 54, leaving the pick-up arm free to rest in the cradle 67, and the ramp 55 is clear of the end of the rod 53. On the first revolution of the turntable the pin 37 strikes the rocker 38 and moves the gear wheel 33 through a small angle in a clockwise direction until the teeth thereof mesh with

the teeth of the pinion 24, and the gear wheel continues to be carried round in that direction. The cam 75 acts on the follower 76 to move the slide bar 77 and swing the plate 78 in a clockwise direction, the ramp 54 causing the pick-up arm 44 to be raised from the cradle 67. Until this has happened, the knob 63 must be held, to prevent the contacts 71, 72 from re-opening. Rotation of the plate 78 continues until the stud 89 thereon engages the arm 57 fast with the pick-up arm 44, and a slight further rotation causes the pick-up arm to swing outwardly, and the arm 57 to move clockwise far enough to release the hooked end of the link 129 from the lug 132. The gear wheel has by this time made about a quarter of a turn. During the next half turn, the follower 76 engages the dwell portion of the cam 75, and the cam 172 rocks the rod 171 to operate the striker 166 and release a record, which falls on to the turntable.

As the gear wheel 33 performs its final quarter revolution, still in a clockwise direction, the slide bar 77 is moved by the spring 80 so as to follow the edge of the cam 75 and rotate the plate 78 in an anti-clockwise direction, the arm 57, and consequently the pick-up arm 44 being caused to follow it, by the spring 109 acting through the arm 167, collar 105, arm 106, and lug 108 until the link 112 pushes the lever 113 against the cam 114, thus bringing the parts to the position shown in FIGURE 7 and bringing the stylus 43 over the starting groove of the dropped record. The pick-up arm remains in this position, but the plate 78 continues to turn in an anti-clockwise direction until the gear wheel 33 rides out of engagement with the pinion 24, the last part of the movement of the plate 78 allowing the collar 88 on the rod 53 to ride down the ramp 54 so that the stylus engages the record and playing commences.

During the playing of the record, the pick-up arm swings inwardly (anti-clockwise in FIGURE 3) taking with it the arms 56 and 57, and the link 129. When the stylus reaches the stop groove at the inner end of the record groove, the arm 56 presses on the slide bar 39 (FIGURE 4) and moves the slide bar to again move the rocker 38 into the path of the pin 37. The gear wheel 33 therefore commences another revolution, again in a clockwise direction, and the plate 78 is rocked in a clockwise direction by the cam 75, follower 76 and slide bar 77, first lifting the pick-up arm by means of the ramp 54, and then swinging it outwardly by the interengagement of the stud 89 and arm 57. When the pick-up arm has reached its outermost position, the sequence of events following the starting is repeated.

The same sequence of events is followed at each record change. When the last record has dropped, the disc 176 falls through a substantial distance, as already described, and the rod 138 acts on the lever 137 to rock the arm 139 of the rocker 134 into the path of the stud 141 on the gear wheel 33, the stud 141 being so positioned, as shown, that the gear wheel completes its revolution for this last change without the stud touching the arm 139. When the last record has been played, however, and the gear wheel 33 commences to rotate again, the stud 141 at once engages the arm 139 and rocks the rocker 134 to bring the ramp 133 underneath the link 129, as already described. The stop arm 142 drops into position to prevent return of the rocker 134. The cam 75 swings the pick-up arm outwardly as already described, but, the link 129 being lifted by the ramp 133, the hooked end 131 thereof engages the lug 132 when the pick-up arm completes its outward swing, thus preventing the said pick-up arm from again swinging inwardly. When, therefore, the plate 78 completes its anti-clockwise swing as the gear wheel 33 reaches the end of the revolution, the pick-up arm is allowed by the ramp 54 to drop on to the cradle 67 to open the main switch. Just before this happens, the cam stud 147 on the gear wheel trips the lever 146 to lift the stop arm 142 and release the rocker 134, which is returned to the

position shown in FIGURE 3 by the spring 145, the hook 131 being then held in engagement with the lug 132 by the tension of the spring 109 acting through the arm 107, collar 105, arm 106, lug 108 and arm 57.

When the machine is used to play both sides of the records, the records to be played are stacked on the stem 152 as already described, and, before the starting knob is operated, the knob 123 is turned to move the slide bar 121 from the position shown in FIGURE 3 to the position shown in FIGURE 11. This rocks the reversing switch 73 to the position shown in FIGURE 11, in which the arm 116 lies in the path of the finger 117 on the gear wheel 33, the switch being held in that position by the latch 126. It also causes the ramp 184 to depress the rod 183 and move the fork 94 into the path of the pivoted trip members 98, 99.

When the motor is started, the gear wheel 33 is engaged with the pinion 24 as already described, and rotates in a clockwise direction. After it has turned through a small angle, the pivoted trip member 98 engages the fork 94 and moves it over its dead-center position to the position shown in FIGURE 11, thus moving the striker 166 out of line with the rod 164 and lifting the ramp 55 to the position shown in chain dotted lines in FIGURE 9. Before the trip member 98 strikes the fork 94, the plate 78 has been turned through a part of its clockwise movement, so that the rod 53 engages the flat part of the ramp 55, and the pick-up arm is not lifted. The gear wheel completes a half revolution, rocking the rod 171 idly through the cam 172, the fact that the striker 166 has been displaced preventing a record from being released, and the link 129 has its hooked end released from the lug 132 as already described.

At the completion of the half-revolution, the finger 117 engages the arm 116 of the reversing switch 73 and actuates that switch to reverse the electric motor 27, so that the gear wheel 33 stops and commences a half-revolution in the anti-clockwise direction. After the follower 76 has passed off the dwell portion of the cam 75 the pick-up arm swings in to the starting position, as already described, but, owing to the fact that the ramp 55 has been brought to its operative position, that ramp lifts the pick-up arm as the gear wheel 33 approaches its normal position, and brings the stylus 42 into the groove on the underside of the lowest record in the stack. The pick-up arm 44 is then in approximately the position shown in FIGURE 9 in chain-dotted lines, the arm 44 being depressed slightly relative to the housing 46 to move it clear of the stop 52, and being urged against the record by the spring 51.

The turntable is now rotating in a clockwise manner as viewed from underneath, so that, when the stylus reaches the inner end of the record grooves and the arm 56 moves the slide bar 39 to engage the rocker 38 with the pin 37, the gear wheel 33 is caused to rotate anti-clockwise. The initial resulting movement of the plate 78 allows the rod 53 to run down the ramp 55 so that the stylus 42 falls away from the record, and the trip member 99 again rocks the fork 94 and lever 92, back to the position shown in FIGURE 3, so that the ramp 55 falls to its inoperative position and the striker 166 moves into line with the rod 164. The pick-up arm swings outwardly as before during the first quarter-revolution of the gear wheel, and, during the next quarter-revolution, the cam 173 rocks the rod 171 and so lifts the striker 166 and rod 164 to release a record, which drops on to the turntable. At the end of this half-revolution of the gear wheel 33 the finger 117 again operates the reversing switch 73. The gear wheel 33 therefore changes its direction of rotation to clockwise, and brings the pick-up into the starting position and lowers it on to the record as for single-side playing. When the upper side of the dropped record has been played, the same sequence of operations as on starting is repeated, and the two sequences alternate throughout the playing of the stack of records.

When the last record has been dropped, the rocker 134 is moved as already described to bring the arm 139 thereon into the path of the stud 161, and, when the top side of that record has been played, the rocker 134 is operated to bring it into the position shown in FIGURE 13. In addition to bringing the ramp 133 into operative relation with the link 129 as already described, the rocker 134 moves the slide bar 128 to release the latch 126 and allow the reversing switch 73 to move back, under the influence of the spring 124, to the position shown in FIGURE 3, where the arm 116 is out of the path of the finger 117. The gear wheel 33 therefore completes a revolution in the clockwise direction as with single-side playing and switches off the machine, leaving the pick-up arm on the cradle 67.

In the modified form of sound-reproducing machine shown in FIGURES 17 to 20, the reversible electric motor 27 of the previously described machine is replaced by a non-reversible electric motor which transmits motion to the turntable 22 and to the gear wheel 33 through a reversible drive transmission, and the finger 117 on the gear wheel 33 is arranged to operate reversing means for the said transmission instead of operating a reversing switch.

The non-reversible electric motor 27a is pivotally mounted on the baseboard of the machine at 28, and for one direction of rotation of the turntable, the stepped driving wheel 29 engages directly with the friction wheel 31, reverse drive being obtained by interposing an idle roller 195 between the driving wheel 29 and the friction wheel 31. An arm 194, movable about the center of the friction wheel 31, carries the roller 195, and is operable to move the said roller in an arcuate path about the center of the said friction wheel.

Instead of the reversing switch 73 shown in FIGURE 3, there is mounted in a corresponding position a member 196 which is movable about a pivot axis parallel to the axis of the gear wheel and has an operating arm 116 lying in the path of the finger 117. The finger 117, by approaching the arm 116 alternately from opposite directions, rocks the member 196 alternately in opposite directions.

Pivotally connected to the member 196 is a bar 197 having fixed to it a pin 198 engaging in a cam slot 199 in the arm 194. The end of the bar 197 remote from the member 196 is slotted longitudinally at 201, and a lever 202, pivoted at 203 on the base plate 20, has mounted on one end of it a pin 204 slidable in the slot 201. The other end of the lever 202 engages with the casing of the motor 27a. With the parts in the position shown in FIGURE 17, the arm 194 is held in such a position that the roller 195 is spaced angularly from the drive wheel 29 and the motor 27a is urged by the coiled tension spring 185 in a clockwise direction about its pivotal mounting to engage the drive wheel 29 with the friction wheel 31, and urge the latter against the turntable rim.

When the member 196 is moved to its other position, the pin 198 moves along the cam slot 199, causing the arm 194 to move in an anti-clockwise direction, and, after the lost motion due to movement of the pin 204 in the slot 201 has been taken up, the lever 202 is caused to apply a thrust to the motor 27a to move it in an anti-clockwise direction about its pivot 28. Such movement results in the drive wheel 29 moving away from the friction wheel 31, and the relative movements of the arm 194 and the lever 202 are such that the roller 195 is able to move in between the said wheels, as shown in FIGURE 20 and in chain-dotted lines in FIGURE 17, the final movement of the lever 202 causing its end which engages the motor 27a to drop into a notch 205 in the motor casing, allowing the motor to move back slightly, and so pressing the drive wheel 29 against the roller 195, which in turn presses the friction wheel 31 against the rim 32 of the turntable. Movement of the member 196 back to the position shown in full lines in FIGURE 17 withdraws

the roller 195 from its operative position and removes the end of the lever 202 from the notch 205, allowing the motor 27a to return, under the load of the spring 185, to a position in which the drive wheel 29 engages the friction wheel 31.

In order that the gear wheel 33 may be allowed to complete a revolution in the direction corresponding to the playing of the upper side of a record on the turntable, both to allow playing of one side only of each record and to cause stopping of the machine when the last record has been played, means are provided to enable the finger 117 to move idly past the arm 116, the arm being moved downwardly out of the path of the said finger. As shown in FIGURE 18, the member 196 is pivotally mounted at 206 on a block 207, the axis of the pivot 206 being chordal to a circle about the vertical axis of the member 196. A spring 208 urges the member 196 upwardly to bring the arm 116 into the path of the finger 117, as shown in FIGURE 18.

A slide bar 121 which, in the previously described form of the machine, was coupled to the reversing switch, carries a ramp 209 acting on the upper end of a push rod 211 guided in a suitable guide bracket 212 and acting at its lower end on the member 196, the arrangement being such that, when the slide bar 121 is moved to lift the fork 94 out of the path of the trip members 98 and 99, the arm 116 is also moved out of the path of the finger 117. The setting of the knob 123 for continuous playing moves the slide bar away from the position just described, and a cranked end 213 thereof, during such setting, moves a pivotal lever 214 to displace the slide bar 128 which, in this arrangement, carries a roller 215 engaging the lever 214. The slide bar 128, as in the previously described arrangement, is displaced by a rocker 134 moved by the gear wheel 33 when the latter is allowed to complete a revolution in a clockwise direction as shown in FIGURE 17 following an initial displacement of the said rocker 134 into the path of a stud 141 on the gear wheel 33 by the dropping of the pillar 177 as previously described.

The other parts of the mechanism are substantially identical with the arrangement already described, and the operation will be readily understood by reference to the description of the operation of the previously described arrangement.

It will be understood that the invention is not limited to the precise mechanisms described herein, the various functions being able to be performed by equivalent mechanisms of different construction. For example, the release of the records to allow them to fall on to the turntable could be effected by a pivoted lever extending through the stem 148, the said lever being coupled directly or indirectly at one end to the lever 157 and being acted on at its other end by a cam or the like on the gear wheel 33. Moreover the gear wheel 33 could be replaced by a gear wheel or disc driven by the electric motor through transmission means which did not include the turntable.

We claim:

1. A sound reproducing machine for playing grooved disc-shaped records comprising a turntable, a spindle rotatable with and extending upwardly above said turntable, driving means for said turntable and spindle, reversing means for reversing the direction in which said turntable and spindle are driven by said driving means, means on said spindle for supporting a plurality of records co-axially with the turntable, the lowest record of said plurality of records being spaced vertically above the turntable, means for displacing said records one-by-one from said supporting means, said displacing means permitting said records to drop onto the turntable, a pick-up device, stylus means on said pick-up device adapted to engage records both above and below said pick-up device, a pick-up arm carrying said pick-up device, means supporting said pick-up arm for movement of the pick-up device in both horizontal and vertical directions, a rotary control member

driven by said driving means, first means on said rotary control member for effecting horizontal movement of the pick-up device, second means on said rotary control member for effecting operation of said record displacing means, a toggle member displaceable in opposite directions by successive cycles of operation of the rotary control member, ramp means operable by said rotary control member to effect vertical movement of the pick-up, said ramp means operable by said toggle member for alternatively lifting and lowering the pick-up arm, said toggle member in one position operating said ramp means to lower the pick-up arm and effect an operative connection between said second means on said rotary control member and the record displacing means, and in the other position operating said ramp means to raise the pick-up arm and remove said operative connection.

2. A sound reproducing machine for playing grooved disc-shaped records comprising a turntable, a spindle rotatable with and extending upwardly above said turntable, driving means for said turntable and spindle, reversing means for reversing the direction in which said turntable and spindle are driven by said driving means, means on said spindle for supporting a plurality of records co-axially with the turntable, the lowest record of said plurality of records being spaced vertically above the turntable, means for displacing said records one-by-one from said supporting means, said displacing means permitting said records to drop on to the turntable, a pick-up device, stylus means on said pick-up adapted to engage records both above and below said pick-up device, a pick-up arm carrying said pick-up device, means supporting said pick-up arm for movement of the pick-up device in both horizontal and vertical directions, a rotary control member driven by said driving means, linkage means for reversing said reversing means, said linkage means operated by said control member when the said control member has moved approximately half a revolution from its normal position in either direction, and means selectively operable by said control member according to its direction of rotation from the normal position to bring the pick-up into playing relation either with a record above the turntable or to allow a record to fall on to the turntable and bring the pick-up into playing relation with said record, respectively.

3. A sound reproducing machine according to claim 1, and having a cam forming part of the rotary control member and a plate movably arranged about a vertical pivot, the movement of said plate being controlled by said cam forming part of the rotary control member, said movement of said plate effecting the horizontal displacement of the pick-up for moving it outwardly after playing a record and for returning it inwardly to a position for engaging the starting groove of the next record, said cam being symmetrical about a diameter of the rotary control member, having a lift portion and a dwell portion on each side of the said diameter for transmitting the same horizontal displacement movements to the pick-up arm either by one complete revolution of the rotary control member in one direction or by a half revolution in one direction followed by a half revolution in the opposite direction.

4. A sound reproducing machine according to claim 1, and having on said record displacing means a striker mechanism comprising a thrust rod operably connected with said record displacing means and third cam means mounted on said rotary control member for actuating said striker mechanism.

5. A sound-reproducing machine according to claim 2, wherein the reversible driving means comprises a reversible electric motor.

6. A sound-reproducing machine according to claim 2, wherein the reversible driving means comprises a non-reversible electric motor and a reversible drive transmission.

7. A sound-reproducing machine according to claim 1,

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wherein the rotary control member comprises an interrupted gear wheel adapted to mesh with a pinion rotating with the turntable and normally out of engagement with said pinion, the means responsive to movement of the pick-up arm to the inner end of a record groove acting to initiate rotation of the gear wheel and bring the teeth thereon into mesh with the pinion.

8. A sound reproducing machine according to claim 3, and wherein said pivoted plate comprises a first ramp controlling vertical movement of the pick-up arm for moving the pick-up into and out of playing position for a record on top of the turntable, and a second ramp for movement between operative and inoperative positions for controlling the vertical movement of the pick-up arm for moving the pick-up into and out of playing position for the underside of a record held at a distance above the turntable.

9. A sound reproducing machine according to claim 8, and having a toggle lever moved in opposite directions by an initial movement of the rotary control member in opposite directions, and having a lever coupled to said toggle lever for moving said second ramp up and down between its inoperative and its operative position.

10. A sound reproducing machine according to claim 4, said third cam means comprising two cams, one of said two cams actuating said thrust rod when the rotary control member turns in one direction, and the other actuating the rod when said thrust rotary control member turns in the other direction.

11. A sound reproducing machine according to claim 10, and having coupling means between said toggle lever

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and said striker mechanism for moving the latter to an inoperative position when said ramp means is brought to its operative position lifting or lowering said pick-up arm.

12. A sound reproducing machine according to claim 2, and having means for preventing the rotary control member from reversing the reversible driving means for enabling the said control member to make full revolutions in one direction.

13. A sound reproducing machine according to claim 2, and having a disc resting on the uppermost record for holding the records supported above the turntable in a horizontal position and a record locating stem for guiding said disc, the disc being free to drop through a substantial distance after the last record has been dropped, and means for stopping the electric motor at the completion of a subsequent full rotation of the rotary control member gear wheel, said means being set by the drop of said disc following the dropping of the last record.

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