

July 31, 1928.

1,679,054

F. J. SEABOLT

AUTOMATIC PHONOGRAPH

Original Filed Nov. 12, 1921 4 Sheets-Sheet 1

Fig. 1.

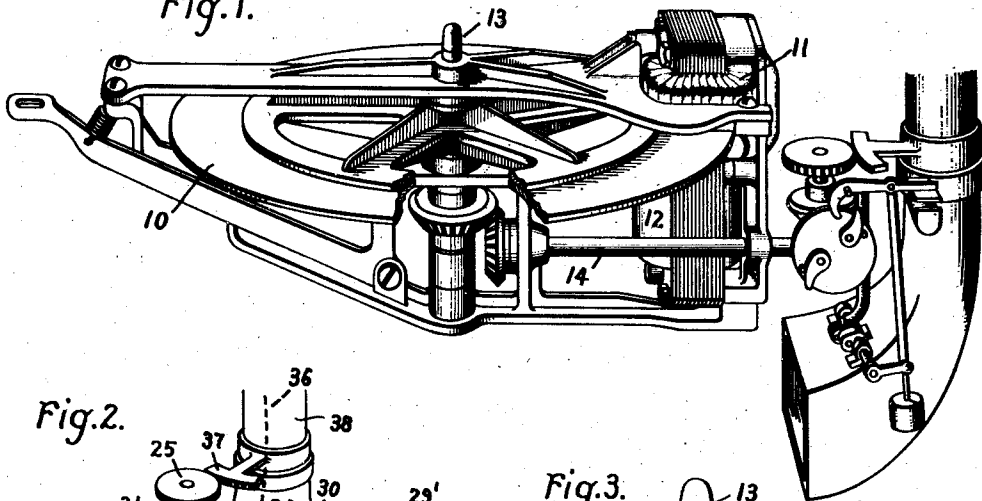


Fig. 2.

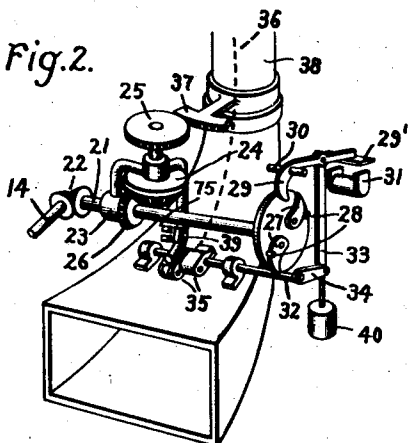


Fig. 3.

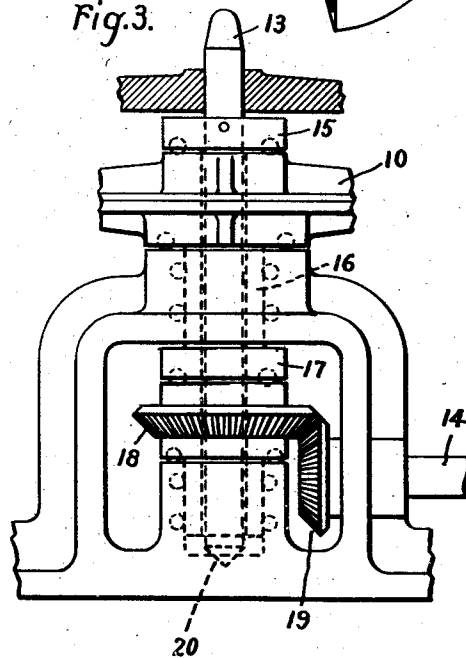


Fig. 4.

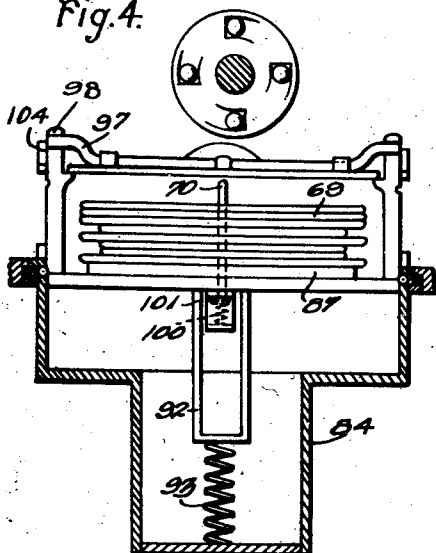


Fig. 19

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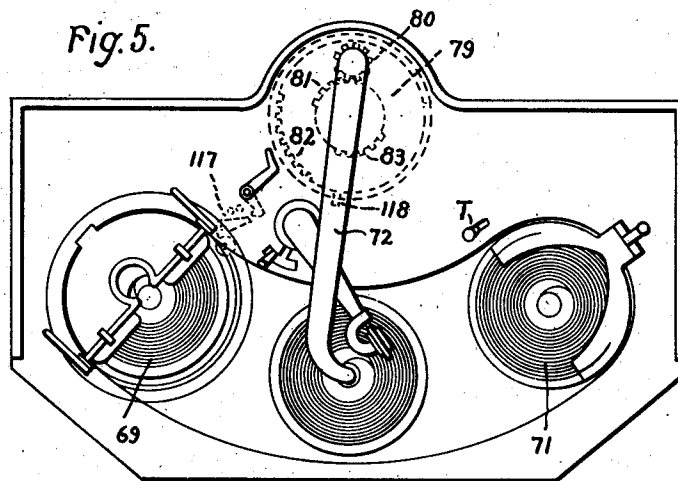


Fig. 6.

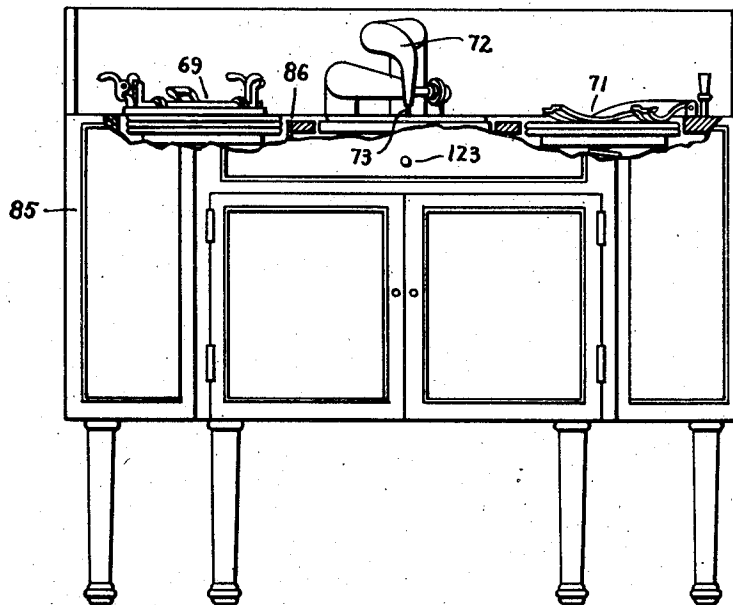


Fig. 7.

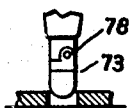
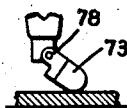


Fig. 8.



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Fig. 9.

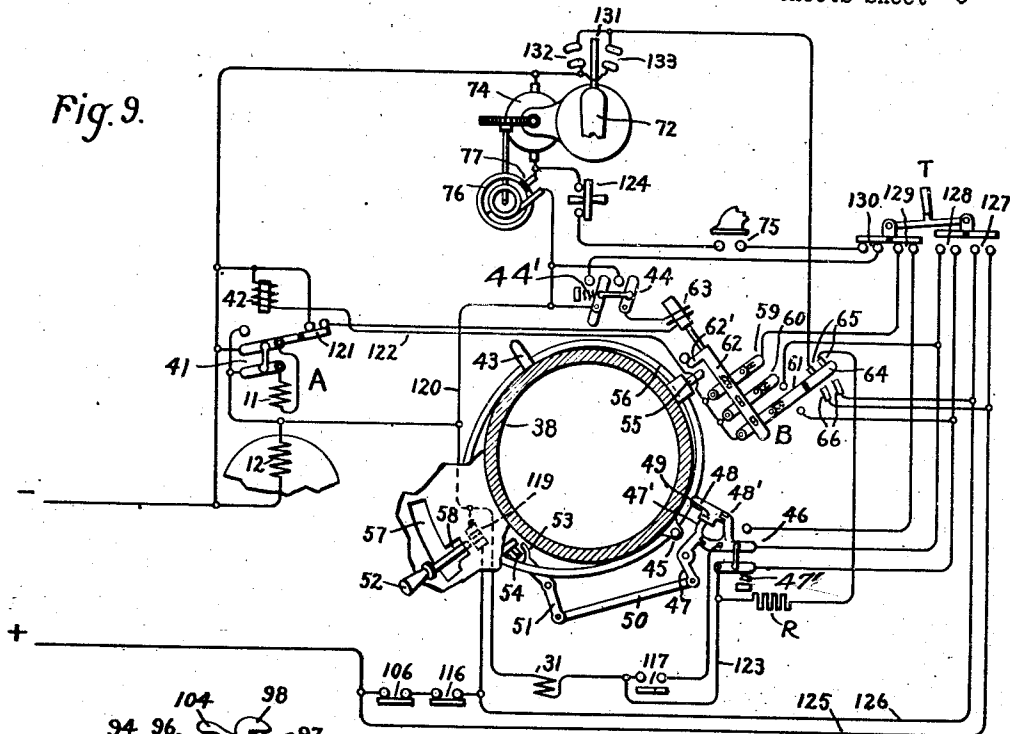


Fig. 10.

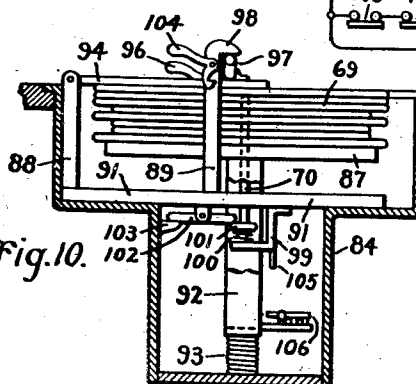


Fig. 11.

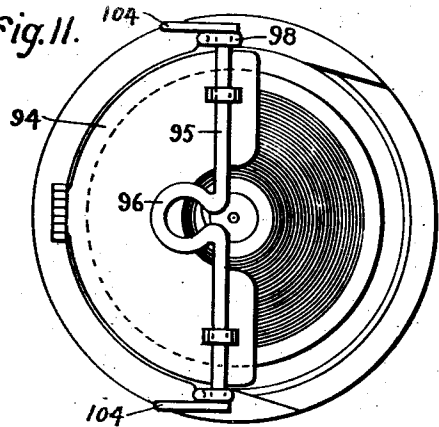


Fig. 17.

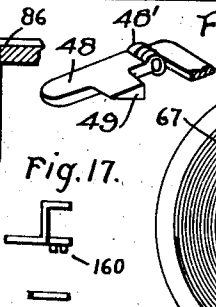


Fig. 13.

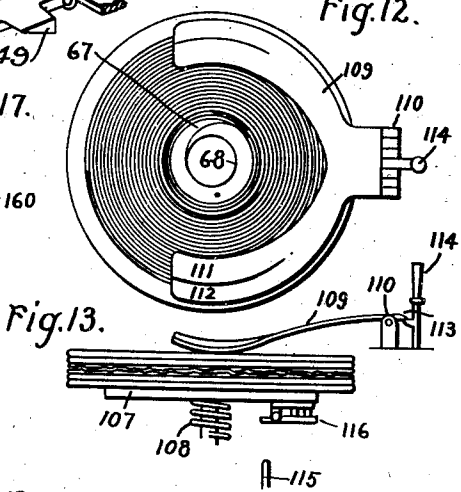


Fig. 18.



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Fig. 14.

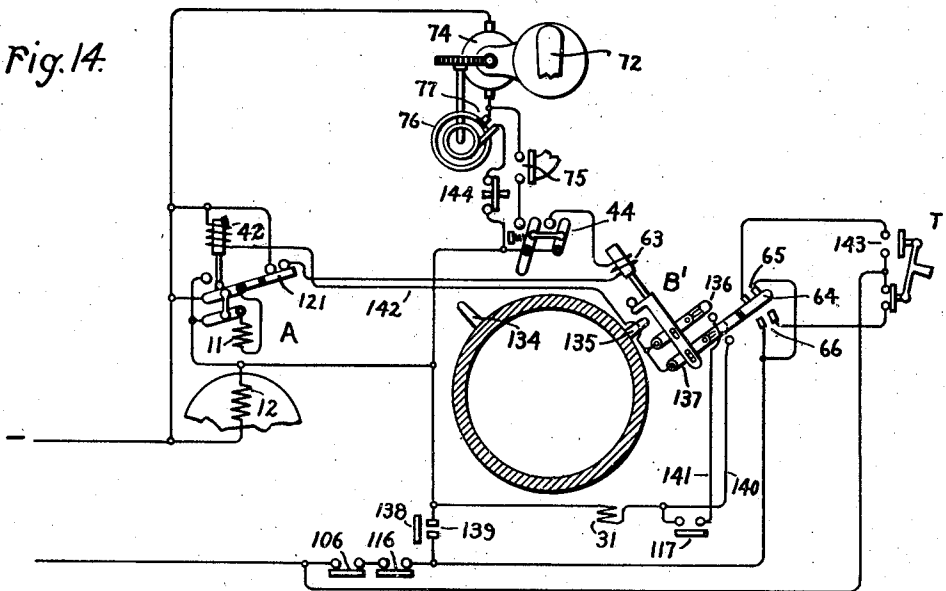


Fig. 16.

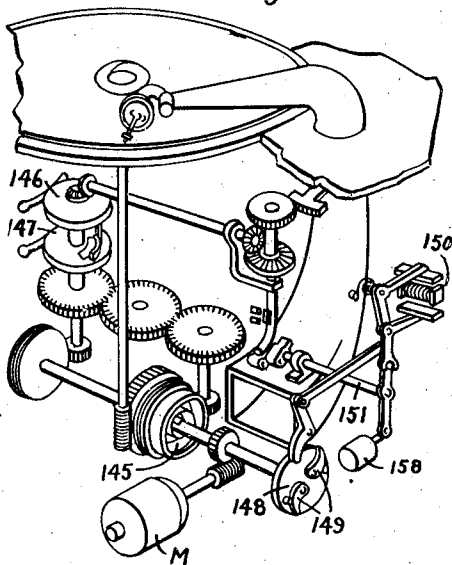
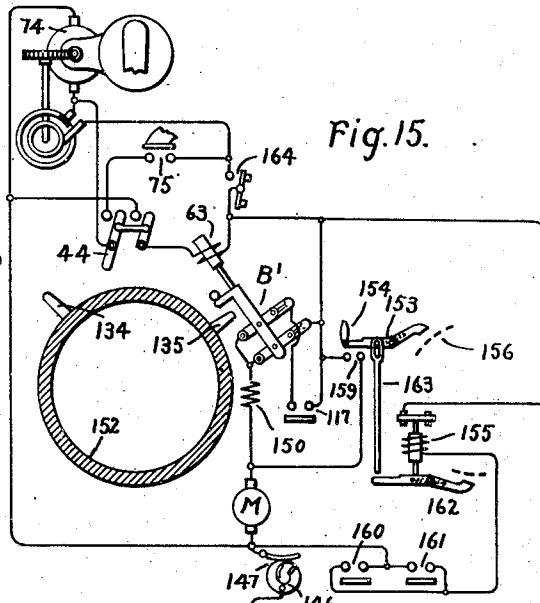


Fig. 15.



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+ *Frank Seabolt*

UNITED STATES PATENT OFFICE.

FRANK J. SEABOLT, OF SCHENECTADY, NEW YORK, ASSIGNOR, BY DIRECT AND MESNE ASSIGNMENTS, TO THE PHONOGRAPH COMPANY, A CORPORATION OF DELAWARE.

AUTOMATIC PHONOGRAPH.

Application filed November 12, 1921, Serial No. 514,448. Renewed September 8, 1925.

My invention relates to a control of phonographs and the like and provides improved means whereby a device of this character may be caused to operate as a repeating phonograph and also to play different records which are automatically shifted into playing position.

In my previous Patent No. 1,623,559, I have described and claimed means whereby, upon the completion of a record, the tone arm is returned to starting position and a new record is automatically shifted into position to take the place of the one which has just been played. This takes place while the tone arm is being returned so that the second record will be played. This action is repeated until a number of records which may be of different sizes and which are placed in the magazine have been played. In the arrangement described in said application, however, the phonograph employed is a spring operated phonograph in which the spring is rewound by an electric motor, although the invention is in no sense limited to that type of phonograph.

In carrying out my present invention I employ an electrically driven, as distinguished from a spring driven, phonograph. Such machines are now in successful commercial use and to some extent have replaced the spring driven phonograph. One of the features of my invention resides in the provision of means whereby when the end of a record is reached, the needle is lifted and the tone arm is shifted to starting position by the motor of the electrically operated phonograph. The particular arrangement which I have provided for carrying this into effect consists in reversing the phonograph motor and providing means whereby when the motor operates in one direction it drives the phonograph table and when it operates in the opposite direction it drives the needle lifting and returning gear. This I accomplish in one form by having the phonograph motor connected to the phonograph table and to the returning mechanism by slip or ratchet connections oppositely arranged so that when the motor is operating in one direction it drives the table and when it is operated in the opposite direction it will drive the returning mechanism. I also provide improved means for bringing about the automatic operation of the record shifting mechanism and also

provide an improved control system all of which is applicable either to a spring driven machine or to an electrically driven machine.

In the accompanying drawing illustrating my invention in various forms, Fig. 1 is a perspective view of an electrically driven machine provided with my improvements; Fig. 2 is a perspective view of the needle lifting and returning mechanism; Fig. 3 is a detailed view of the slip connections between the motor and the mechanism which it drives; Fig. 4 is a detail of the slip connection; Fig. 5 is a plan view of the automatic phonograph arranged in a cabinet; Fig. 6 is a side view of the same partially broken away; Figs. 7 and 8 show details of the record shifting mechanism; Fig. 9 is a diagram of the electrical connections and mechanical arrangement of an automatic phonograph embodying my improvements; Figs. 10 to 13 show details of the feeding and receiving magazines; Fig. 14 shows diagrammatically a simplified arrangement for an automatic machine employing an electrically driven phonograph; Fig. 15 is a similar view of a control for a spring driven machine; Fig. 16 shows the arrangement of parts of an electrically wound spring driven machine; Figs. 17 and 18 show magazine switches of the normally open type; Fig. 19 shows a section of the magazine at right angles to that shown in Fig. 10 and Fig. 20 shows a detail of projection 48.

Referring first to Fig. 1, it will be seen that I have provided an electrically driven phonograph motor of the inductor disk type. This type of machine is now well known commercially and forms no part of my present invention. As indicated in the drawing, 10 represents the inductor disk which is driven from the two coils 11 and 12 arranged on opposite sides of the disk, the arrangement being such that when both of these coils are energized the disk will be driven in a well understood manner. This disk drives the shaft 13 upon which the phonograph table is mounted. As above stated, this particular phonograph forms no part of my invention and is merely shown for purposes of illustrating an electrically driven machine which is readily reversible by simply reversing the current through one of the windings.

Referring to Fig. 3, it is seen that the rotor 10 is arranged to drive the shaft 13 when the rotor turns in one direction and drive shaft 14 when it turns in the opposite direction. In the particular arrangement of Fig. 3 I have illustrated ball clutches which operate as slip or ratchet connections. The disk 15 is secured to the shaft 13 and is provided with the ball clutch as shown in detail in Fig. 4 so that when the rotor 10 turns in one direction it will drive the shaft 13. Secured to the rotor 10 by a sleeve 16 is another disk 17 provided with a similar ball clutch for driving the bevel gear 18 which meshes with the bevel gear 19 mounted upon the shaft 14. The shaft 13 has anti-friction step bearings at 20 and all bearings are provided with ball bearings as shown to reduce the friction. From this arrangement it will be seen that when the rotor 10 turns in one direction it will drive the disk 15 secured to the shaft 13 upon which the table is mounted so that the table will be rotated in a well understood manner. During this time the gear 18 will not be driven, since the ball clutch at 17 is arranged to slip at this time. Therefore, nothing rotates but the rotor 10 with the disk 17 attached to it and the shaft 13. When the direction of rotation of the rotor is reversed, disk 15 and the shaft 13 will remain stationary and the gear 18 will be rotated to drive gear 19 and shaft 14.

When the shaft 14 is rotated it drives a shaft 21 through bevel gears 22. Shaft 21 has loosely mounted upon it a bracket 23 for supporting bevel gear 24 and spur gear or knurled disk 25. Bevel gear 26 secured to the shaft 21 cooperates with bevel gear 24 to drive the disk 25. Upon the end of the shaft 21 is a disk provided with two pawls 27 having pins 28 behind them. When the pawl disk 27 turns, these pawls when they reach the upper position drop over slightly into engagement with a lever 29 pivoted at 30 and turn the same on its pivot. The end of the lever 29 is provided with an armature 29' which cooperates with an electro-magnet 31 which holds the lever 29 in the position to which it is turned by the pawl. Shaft 32 is turned by the lever 29 through the agency of a link 33 which is pivoted to the lever 29 and to an arm 34 on shaft 32. As the lever 29 is turned on its pivot, therefore, by one of the pawls 27, the shaft 32 is turned through a portion of a revolution. Mounted upon the shaft 32 are two members 35 which perform two functions; namely, lifting the needle through a flexible band 36 and also turning the bracket 23 on the shaft 21 so as to bring the disk 25 into mesh or engagement with sector 37 secured to the tone arm 38. The turning of the bracket is accomplished by a projection 39 from the bracket which en-

gages one of the members 35. The arrangement of these two members is such that the bracket will not be turned unless there is a strain upon the band 36 which lifts the needle so that in case the needle is not lifted the tone arm will not be turned. The details of these parts 35 in connection with the band 36 and the bracket 39 are fully disclosed in my previous patent above referred to and further detailed description seems unnecessary. The dash pot 40 is connected with the link 33 so as to retard the return of the lever 34 and hence the dropping of the needle when the magnet 31 is deenergized but does not retard the movement of the parts in the opposite direction as will be well understood.

Referring now to Fig. 9, A represents the electrically operated phonograph just described having the two windings 11 and 12 one of which, viz winding 11, has the direction of current through it reversed by reversing switch 41, having an operating winding 42. When the winding 42 is deenergized the switch assumes the position shown. The tone arm 38 is shown in section as provided with a fixed lug 43 for operating switch 44 when the end of a record is reached, this switch being normally held in open position as shown in the drawing by a spring 44'. A second fixed lug 45 is arranged to operate the double pole switch 46 when the needle is turned back to the starting position of a large record but does not operate the switch when the needle is turned back to the starting position of a small record. The switch is shown in its operated position in which it is held by a latch 47. When released, the latch is returned to its opposite position by a spring 47'. The lug 45 operates the switch through a projection 48 which is hinged at 48' so as to be lifted up vertically and clear the lug 45 when the latch 47 is moved to latching position. To this end the latch 47 is provided with a projection 47' which engages a beveled or tapered part 49 of the projection 48 to turn it on its hinge. The latch is moved to latching position when the phonograph is started as hereinafter described and, therefore, when the phonograph is running the lug 45 cannot engage the projection 48 to operate the switch 46 from its normal position. The latch 47 is operated by a link 50 from pivoted lever 51 operated by starting lever 52. Since the starting lever 52 travels with the tone arm while the record is being played and the lever 51 turns on a fixed pivot, the latter is provided with a yoke 53 which is engaged by a pin 54 on the starting lever 52 when the latter is in its normal or stopping position. It is through this yoke that the latch 47 is operated by the starting lever. When the phonograph is started, therefore, if the switch 46 is in the position shown in the drawing by reason of

the needle being in the starting position of a large record, the latch 47 will hold the switch in that position and also lift the projection 48 so that the lug 45 will not engage it. If the switch should be in the opposite position by reason of the needle being in the starting position of a small record, the latch will not engage the switch although the projection 48 will be lifted. All of this with the exception of the hinged projection 48 is disclosed in my patent above referred to.

The lug 55 is not normally fixed to the tone arm but is locked to it when the machine is started. The means for locking this lug 55 to the tone arm has been fully described in my previous patent above referred to and in my earlier patents, numbers 1,622,005 and 1,622,814 and, therefore, requires no detailed description. When the operating lever 52 is pulled outward to start the machine, the lug 55 is locked to the tone arm by the bail 56 with a toggle action. The lever 52 and lug 55 are now both locked to the tone arm, the lever moving in the slot 57 in the top board of the machine. To stop the machine, the lever must be brought back to its normal position so that it can move inward in the radial slot 58. It is this lug 55 which operates the limit switch B to stop the return movement of the tone arm.

The limit switch B comprises three switch levers 59, 60 and 61, each cooperating with its own switch contact as shown. These three switch members are operated by an operating member 62 having a pin and slot connection with each of the switch members. The operating member 62 is moved in a direction to close the switch members (downward to the right in Fig. 9) by an electromagnet 63 controlled by the switch 44. The operating member 62 is provided with a projection 62' which is engaged by the adjustable lug 55 which is secured to the tone arm when the machine is started, to open the switch members successively. This successive opening it will be seen is accomplished by having the slots in the operating member of different lengths as will be well understood. The switch lever 61 is provided with an insulated projection 64 cooperating with contacts 65 and 66, for purposes hereinafter described. The tone arm is thrown to a position such that the lug 43 will operate the switch 44 to energize the electromagnet 63 and close the limit switch B by a spiral groove 67 (Fig. 12). This groove starts with the end of the main groove and extends to a point at a fixed distance from the center of the record indicated by the circle 68. In other words, when the needle is moved to the circular groove 68, the tone arm during such movement closes the switch 44 through lug 43 and energizes the electromagnet 63 which closes the limit switch B. The construction of the switch levers 59, 60

and 61 is fully shown in my previous Patent No. 1,623,559 above referred to and needs no further description except to explain that they are operated as snap switches by the operating member 62.

In Figs. 5 to 8 I have shown an arrangement for automatically changing records. This arrangement is substantially the same as that described in my Patent No. 1,623,559 above referred to. It will be observed that a stack of records, of different sizes if desired, is placed in a magazine at the left side of the phonograph table from which the records are automatically fed to the phonograph table and then automatically fed to the right side of the table. While the tone arm is being returned with the needle lifted to its initial position, a record is shifted to the right and another record is moved to the left on to the table to take its place. When the needle drops, therefore, a new record shall have taken the place of the one which has just been played. To this end, all of the records of a certain diameter have the groove begin substantially the same distance from the edge of the record. Instead of this, a spiral groove of steep pitch such as is employed at the center of the record may be employed which will start at the proper distance from the edge and end at the beginning of the record groove.

Referring to Figs. 5 and 6, it will be seen that a stack of records is placed in a magazine at 69. This magazine will hold records of any standard size which are centered in the magazine by a pin 70 (see Fig. 10). The records are automatically fed to the level of the table, i. e., when a record is withdrawn another takes its place, in a manner hereinafter described. At 71 is another magazine for receiving the records after they have been played. In other words, the stack of records is transferred from magazine 69 to 71. For accomplishing this purpose, I employ, in the particular arrangement shown, an arm 72 having a pin 73 (Figs. 7 and 8) at its outer end which registers with the center hole of the record. This arm is moved by an electric motor 74 (Fig. 9) which is energized at contacts 75 (see Fig. 2) when the needle is lifted and also by switch 44. The stopping of the motor, however, is controlled by the motor itself after it has made a predetermined number of revolutions. When the motor starts, therefore, it always makes a predetermined number of revolutions before stopping and in doing so causes the arm 72 to go through its complete cycle. This is accomplished by the slip rings or commutator 76 having an insulated portion at 77. During the playing of the record, the arm is in the central position as shown in Fig. 5, the pin 73 on its end acting as a centering pin instead of the usual pin on the table. When

the arm 72 is started, it moves with it the record which has been played to the right as far as the magazine 71, the arm then starts to the left leaving the record behind in the magazine. The arm now moves over to the center of the records in the magazine 69 and the pin 73 drops into the center hole of the top record. The arm now moves back to the right carrying with it the top record, the other records below it being held by the centering pin 70, and finally stops at the playing position on the table. All this takes place while the tone arm is being returned with the needle lifted. The arrangement of the pin 73 in the end of the arm is shown in Figs. 7 and 8. The pin is hinged at 78 so that it will glide over the record when the arm is moved to the left, but when the arm is moved to the right it assumes a vertical position as shown in Fig. 7 and carries the record with it.

In order to bring about the sequence of operations of the arm 72 just described, I employ a mutilated annular gear 79 which is driven slowly by the motor 74 (Fig. 9). The reduction gearing between the motor and this annular gear is such that the motor in making its predetermined number of revolutions turns the annular gear through one complete turn. The pinion 80 which drives the arm 72 is engaged on one side by the teeth of the annular gear at 81 to turn the arm in one direction (to the right) and on its opposite side by the teeth 82 to turn the arm in the opposite direction (to the left). The number of teeth at 81 are sufficient to carry the arm from the center over to the magazine at the right, while the teeth at 82 will carry the arm from that point over to the center of the records in the magazine 69. The teeth 83 will then carry the arm from that point back to the playing position, thus completing the cycle.

Turning now to the details of the magazines, the magazine 69 is shown in Figs. 10 and 11. It comprises a casing 84 in the top of the cabinet 85 having its top flush with the top of the phonograph table at 86. Within this casing is a platform 87 upon which the records to be played are stacked. The centering pin 70 passes through this platform and also through the center holes in the successive records. This pin is vertically movable a slight distance because it should be high enough to enter the last record when the magazine is filled but must be out of the way when the top record is drawn off. A sliding frame consisting of three rods 88, 89 and a third rod which is back of rod 89 in Fig. 10 and not shown mounted on a base 91 is arranged to be moved upward from its lowermost position shown in Fig. 10 to an upper position where it is held by a latch (not shown). Secured to the platform 87 is a U-shaped member 92

which passes freely through the base 91. When the frame is raised, therefore, the base engages the platform and lifts it. Between the bottom of the U-shaped member 92 and the bottom of the casing is a spring 93 which forces the stack of records upward when one record has been removed. Hinged to the top of rod 88 is a cover plate 94 which may be swung to vertical position. This cover plate is held down by a rod 95 having a loop 96 in its middle portion and having its ends bent into the form of cranks 97 adapted to engage with hooks 98 in the tops of rods 89 and 90. It will be obvious that by turning the rod 95 from the position shown in Figs. 10 and 11 until the loop 96 is vertical, the cranked ends will pass from under the hooks and assume a horizontal position against the cover. In this position the cranks will clear the hooks when the cover is turned on its hinge. Secured to the underside of the base 91 is a bracket 99 which supports the pin 70 through a spring 100, the rod being provided with a collar 101 upon which the spring bears. When the frame is up, the pin extends upward to the cover plate 94, but when the frame is pushed down as shown in Fig. 10, a pivoted lever 102 on the under side of the base 91 engages a stationary lug 103 on the casing, forcing the inner end of the lever which normally engages the collar 101 downward so as to move the pin downward against the spring 100. The downward movement of the pin is just about equal to the thickness of a record so that the top record may be slid off without being interfered with by the pin. The frame is held down by the two hooks 104 pivoted on rods 89 and 90 and engaging projection on the casing (not shown). These hooks have finger grips and are hung so as to automatically engage their projections when the frame is pushed down. To lift the frame, the loop 96 having been turned to a vertical position, the finger grips are taken hold of and by pulling upward, the hooks are disengaged from the projections and the frame may be lifted up and latched. This magazine is fully described in my previous Patents Numbers 1,622,814 and 1,623,559 above referred to.

To load the magazine, therefore, the frame is raised and latched and the cover plate is swung to the vertical position. The records, which may be of both sizes if desired, are now stacked onto the platform, the center pin passing through the holes in the records. As many records as desired within the capacity of the magazine may be introduced. In Fig. 10 I have shown the magazine only partially filled. The cover is now clamped down and the frame is pushed downward. As the frame moves downward, the platform, which is spring

pressed upward, does not move until the cover plate reaches the records. From then on, the records and the platform also move compressing the spring. Of course, if the magazine had been filled the records would have moved at once. When the frame reaches the bottom it is latched, the center pin being moved down to the position shown in dotted lines in Fig. 10. It will be obvious now that if the top record is drawn out, the platform will be moved upward by the spring so that the next record will take the place of the one removed. When the last record is removed, a lug 105 engages switch 106 and moves it out of engagement with its contacts. This will stop the machine as hereinafter described.

The magazine 71 is shown in Figs. 12 and 13. It consists of a platform 107, spring pressed upward by a spring 108. When there are no records in the magazine, the platform 107 is substantially flush with the rotating table. When a record is moved on to the platform, it passes under a guide 109 pivoted at 110. The ends of this guide are turned upward as shown so as to start the record under the guide and the spring 108 then yields as the record is forced downward so that its upper surface is at the level of the table or below. Each end of the guide is divided into two fingers 111 and 112 which may yield somewhat. Fingers 111 are a little higher than fingers 112 and are for engaging a small record at its edge, whereas fingers 112 engage a larger record at its edge. When a large record enters the magazine, therefore, the fingers 112 engage it at its edge and force it downward, the fingers 111 not engaging the record, but when a small record enters, the fingers 111 engage it and force it downward, the fingers 112 not engaging it. The guide 109 is held in place by a latch 113 having an operating handle 114. The latch and handle are on a resilient support so that when the guide is forced downward, the latch will automatically lock it. To remove the records, the handle 114 is pulled to the right and the guide 109 lifted. When the magazine is filled with records to its limit, stop 115 which is mounted in the magazine casing, engages switch 116 and causes it to be disengaged from its contacts. The machine will then be stopped as hereinafter described. Shown in dotted lines on Fig. 5 is a switch 117, which is caused to engage its contacts when a large record is drawn from the magazine 69 and is latched in that position. When the arm 72 moves to the left to remove a record from the magazine a stop 118 trips the latch and opens the switch. When a small record is drawn out, the switch 117 is not operated. This is likewise described in my said previous Patent No. 1,623,559.

In Fig. 9 I have shown a diagram of connections for the complete machine. Referring to this figure it will be seen that when the starting lever 52 is pulled outward, as shown, the contacts 119 make contact and establish a circuit through the windings of the electric phonograph motor from the positive side of the line through magazine switches 106 and 116 which are closed, through winding 12 and also through winding 11, by way of the reversing switch in parallel to the negative side of the line. This starts the machine. As shown in the drawing, a large record has been put in the machine and the switch 46 has been moved against its spring pressure and latched there until the machine is again stopped. The switch T is shown positioned for automatic operation, i. e., the way it is operated when there are records in magazine 69 and magazine 71 is ready to receive records. When the end of the record is reached the tone arm is thrown over quickly by the groove 67 and the lug 43 closes switch 44. The immediate effect of this is to close switch B, the circuit being from positive conductor 120 through one blade of switch 44, and the winding of electromagnet 63 through an interlock 121 on the reversing switch to the negative side of the line. The closing of this switch energizes conductor 122 which energizes the electromagnet 42 of reversing switch A, thereby reversing the phonograph motor. The circuit through which wire 122 is energized is as follows: from the positive side of the line and magazine switches 106 and 116, contacts 119, through the holding magnet 31 (see Fig. 2) thence through wire 123, switch 46, thence through the switch B and out to wire 122. It is assumed that switch 117 is open, i. e., the last record drawn out of the magazine was a small record and did not close it. The same circuit would have been established, however, if switch 117 were closed. The reversing switch being operated, the phonograph motor starts to rotate in the opposite direction, but as above explained does not drive the table but lifts the needle and turns the tone arm back. As soon as the reversing switch operates it deenergizes electromagnet 63 at the interlock 121, but switch B remains closed. As the rotation of the phonograph motor in the opposite direction lifts the needle it closes the contacts 75 (see also Fig. 2) thereby energizing the record shifting motor 74, the circuit being from positive wire 120, switch 44, contacts 75, stop switch 124, motor 74 to the negative line. The motor now starts to shift the record and as it turns the commutator 76, a circuit is established through the commutator which is independent of switch 44, switch contacts 46 and stop switch 124. The motor 74 will therefore continue to

operate until it has completed its cycle and shifted the records as above described. Assuming that the next record drawn out is a small one, the return movement will be stopped when the lower switch lever of switch B opens since neither of the other two parallel circuits through the other two switch levers is closed. The opening of the circuit at the lower switch blade will stop the return movement and drop the needle by the deenergizing of magnet 31 at the starting position of the small record which has just been shifted to playing position. It also deenergizes the reversing switch which will now return to its normal position and by again reversing the phonograph motor, drives the table. The small record will now be played. Assume now that a large record is next drawn from the magazine. The switch 117 will now be closed and upon the return movement the opening of the lower switch lever of switch B will not stop the return movement since a parallel circuit is established through the middle switch lever. The return movement will now continue until the middle switch lever is opened which will correspond with the starting point on a large record. If a small record had been placed on the machine first, the switch 44 would be in the opposite position and the middle and upper switch levers of switch B would be brought into play, the middle one for a small record and the upper one for a large record. All of this is fully described in my previous Patent No. 1,623,559 above referred to.

Assume now that the last record has been withdrawn from the magazine so as to open the magazine switch 106. The circuit can now no longer go direct to contacts 119 but must go through wire 125, contacts 66 (which are now closed) and wire 126. The operation will, therefore, not be stopped immediately upon the removal of the last record, as this would leave the shifting arm 72 and the tone arm in an intermediate position. The movement continues until the first switch blade is operated to open the circuit at contacts 66. The record will then be in playing position and the needle will be dropped. The same thing will happen if the magazine 71 should be filled and the magazine switch 116 opened. Unless at least one record is now placed in the magazine 69 or if the stopping is due to the filling of the magazine 71, until the latter is emptied, the machine cannot be played again automatically. By throwing the switch T to the opposite direction, however, individual records may be played. The closing of switch T short circuits magazine switches 106 and 116 at contacts 127 and connects wire 123 with the middle lever of switch B through contacts 128 instead of to the lower lever. It

also opens the circuit to the upper lever at contacts 129 so that only the middle lever is effective. The machine may now be played as a repeating machine, any record that is put on the table manually being repeated. The record shifting motor 74 will not start since its starting circuit is opened at contacts 130.

In order to prevent the needle from being dropped in case for some reason the record shifting arm should be retarded I provide the contacts 66 which are closed every time the lower switch lever opens. In case when it opens, the record is not in place, the contact 131 on the record shifting arm 72 will bridge either the contacts 132 or 133 thereby maintaining a circuit for holding magnet 31 through wire 123, resistance R contacts 65, thence through either contacts 132 or 133 to the negative side of the line. The needle will thus be held up until the record gets into position. This circuit is merely a safety factor and does not ordinarily come into play. At any time while the machine is playing records from the magazine, a record may be repeated by opening the circuit of the motor 74 at switch 124.

The operation of this simplified arrangement shown in Fig. 14 is as follows: When the starting lever 138 is operated to bridge contacts 139, the phonograph motor A is started as before by the energizing of winding 12 direct and the energizing of winding 11 through the reversing switch having the operating magnet 42. Nothing else is energized at this time, it being understood that the magazine switches 106 and 116 are closed. When the end of a record is reached, the lug 134 operates the switch 44 as before to energize the electromagnet 63 and close limit switch B', the circuit being as before through the interlock 121 on the reversing switch. The closing of switch B' completes a circuit through holding magnet 31, wire 140 (and in parallel through wire 141 if switch 117 is closed) wire 142 and magnet 42 to the minus line. The reversing switch is now operated to reverse the phonograph motor as before and the needle is lifted and the tone arm starts to turn back. When the needle lifts, contacts 75 are closed and, the switch 44 being closed, the record shifting motor 74 starts and completes a holding circuit through commutator 76 as before. If a small record is now drawn from the magazine and placed on the table, the return movement of the tone arm will be stopped when the switch lever 137 is operated by lug 135 since switch 117 will be open. This will be the proper stopping point for a small record and the holding magnet 31 will be deenergized to drop the needle. When a large record is drawn from the magazine, switch 117 will be closed and the return movement will not be stopped until switch

136 is operated which corresponds with the stopping position of a large record. The operation will thus continue until either the last record is drawn off or the receiving magazine is filled. Upon the opening of either of the magazine switches 106 or 116 the machine will stop but not until the tone arm is turned back and the last record is in place on the table, whereupon the circuit will be opened at contacts 66. The machine cannot now be operated until the magazine switches 106 and 116 are closed. By throwing the switch T' to the opposite position, however, the machine may be played manually. This will short circuit the switches 106 and 116 through contacts 143 and contacts 65. When the end of a record is now reached, the machine will be stopped immediately since the short circuit around switches 106 and 116 will be opened at contacts 65. This cuts off current to both the phonograph motor and the shifting motor and everything stops. If the tone arm is returned manually so as to open switch B' the record may be played again or another record may be placed manually upon the table and played. It will be understood that a record may be replaced manually by drawing the record off the table to the right (Fig. 5) and a new record inserted from the left. At any time during automatic operation, a record drawn from the magazine may be repeated by operating switch 144 to open the circuit to the shifting motor 74.

In Fig. 15 I have shown a similar system adapted for use with a spring operated phonograph which is wound by an electric motor and in Fig. 16 I have shown the mechanism for winding the spring and returning the tone arm with the needle lifted. This mechanism, however, is fully described in my previous Patent No. 1,623,559 above referred to. Referring first to Fig. 16 the motor M winds the spring 145 through the gearing as shown, the winding being controlled by the sliding contacts 146 and 147, one driven by the motor and the other by the spring. As the motor winds, the disk 148 provided with pawls 149 lifts the needle and throws the tone arm returning mechanism into mesh as above described, the magnet 150 holding the parts in place. As described in my said previous Patent No. 1,623,559, the arrangement is such that if the magnet is deenergized the shaft 151 which lifts the needle and throws the returning mechanism into mesh, will not be turned but if the magnet 150 is energized said shaft will be turned and held in turned position.

This arrangement is identical with that described in my said earlier Patent No. 1,623,559 and, therefore, requires no further description.

Referring now to Fig. 15, the tone arm 152 is provided with the same two lugs 134 and 135 and the switch B'. Switch 44 and shifting motor 74 are as before. This being a spring operated machine a brake lever 153, provided with an operating handle 154 is necessary. This machine is started by shifting the starting lever to the position shown in the drawing, thereby taking off the brake and releasing the table 156. The machine now starts and plays a record. As the spring runs down the contacts 146 and 147 slide on each other and finally after a part of the record has been played make contact. This does not, however, close the circuit to the motor until the switch 44 is closed as before energizing the electromagnet 63 which closes limit switch B'. The circuit of the motor is now closed as follows from the positive side of the line through sliding contacts 146 and 147, motor M, holding magnet 150, limit switch B', to the minus line. The motor now starts to wind the spring and in doing so lifts the needle and throws the tone arm turning mechanism into mesh through the agency of disk 148 and shaft 151. The holding magnet 150 being energized, the shaft 151 will be turned and will be held by magnet 150. As soon as the needle is lifted, contacts 75 will be closed and the shifting motor will start, making its own circuit as before. Assuming that a small record is drawn from the magazine, the switch 117 will be open and the winding of the motor and hence the returning movement of the tone arm will be stopped when the lower switch lever of limit switch B' is opened. This corresponds with the starting position of a small record and since the holding magnet 150 is deenergized, the needle will be dropped, and retarded by the dash pot 158. The new record will then be played. If a large record is drawn from the magazine, switch 117 will be closed and the return movement will be stopped and the needle dropped when the upper switch lever of limit switch B' is opened, this corresponding with the starting position of a large record. It will be understood that in these winding operations, the spring is not completely wound to its original condition but it is wound enough. When the starting lever is thrown to stopping position, the contacts 159 are bridged and the circuit of the motor is completed independently of the limit switch B' from the positive line through sliding contacts 146 and 147, motor M, contacts 159 to the negative line. The motor will now be completely wound and the circuit opened at contacts 146 and 147. It will be noted that in this case the magazine switches 160 and 161 are normally open and are only closed when the feeding magazine is full (see Figs. 17 and 18). If now the last record is drawn from the magazine, the

auxiliary brake 162 will be closed by its operating electromagnet. As it closes the circuit of the operating electromagnet is opened at the contacts but the brake being the usual over-center type will remain on. As the auxiliary brake goes on, the rod 163 is pushed upward. This rod has a pin and slot connection with the main brake lever so that as the rod is pushed upward the main brake is not affected. The table will now be stopped but the motor will continue to wind the spring and return the tone arm to its proper starting position whereupon the circuit will be opened at the limit switch B' and the needle dropped. In order to again start the machine the main brake lever must be thrown to stopping position, thereby winding the machine, independently of the limit switch B' by the bridging of contacts 159. The applying of the main brake releases the auxiliary brake through rod 163. The magazine switch must now be opened by placing a record or records in the magazine, otherwise as soon as the machine has run sufficiently to close contacts 146 and 147 the auxiliary brake will again be applied. By opening the switch 164 any record drawn from the magazine may be repeated.

In Fig. 14 I have shown a simplified system of control involving fewer parts. This arrangement does not have all of the features above described but it provides all of the essentials. The principal thing that it does not do is to operate as a repeating phonograph when records are placed on the table manually. There is nothing to set the circuits for the particular size of record placed on the table. The circuits are always set for the record which comes from the magazine and takes no account of the one which is manually placed upon the table. There is no limit stop which is fixed in different positions with reference to the tone arm when the machine is started, nor is there a switch which is set for the particular record played. There are only two lugs or projections on the tone arm, viz; 134 and 135, both fixed to the tone arm. The limit switch B' has only two switch levers 136 and 137 the latter being provided as before with the extension 64 cooperating with contacts 65 and 66. The electromagnet for operating switch B' is the same as above and is controlled in the same way. The phonograph motor A is as above described as is also the record shifting motor 74. The switch T' which shifts from manual to automatic operation has two contacts instead of four as in the switch above described. When the switch T is in the position shown in the drawing it is arranged for automatic operation. When it is moved to bridge contacts 143, it is arranged for manual operation.

In operation it is practically identical with that described with reference to Fig. 15.

In this case the magazine switches 106 and 116 are normally closed as in the case of the arrangement shown in Fig. 9. Outside of this the automatic operation is identical with that of Fig. 15. When one of the magazine switches opens the machine will continue to run until the limit switch 137 is opened by the return of the tone arm to starting position whereupon the phonograph will be stopped. For manual operation the switch T' will be moved to bridge the contacts 143. The machine may now be used for manual operation with one or both of the magazine switches open, but as soon as the limit switches are closed at the end of a record, the machine will stop since there will now be no short circuit around the magazine switches. The machine cannot again be started for automatic operation without proper attention to the magazines so as to close switches 106 and 116.

While I have described my invention as embodied in concrete form and as operating in a specific manner in accordance with the provisions of the patent statutes, it should be understood that I do not limit my invention thereto, since various modifications thereof will suggest themselves to those skilled in the art without departing from the spirit of my invention, the scope of which is set forth in the annexed claims.

What I claim as new and desire to secure by Letters Patent of the United States, is:—

1. The combination with an electrically driven phonograph motor of means for reversing the same, a turntable and a tone arm provided with a needle, mechanism for lifting the needle and returning the tone arm, and connections between the motor, the phonograph table and said mechanism whereby when the motor runs in one direction it drives the table but not the mechanism and when it is driven in the opposite direction it drives the mechanism but not the table.

2. The combination with an electrically driven phonograph motor, a turntable and a tone arm provided with a needle, of a reversing switch for the motor and means for automatically operating the same upon the completion of a record, a one way driving connection between the motor and the phonograph table, mechanism for returning the tone arm, and a one way driving connection between the motor and said mechanism, said driving connections from the motor having opposite driving directions.

3. The combination with an electrically driven phonograph motor of an electro-magnetic reversing switch therefor, a turntable and a tone arm provided with a needle, mechanism for returning the tone arm, means for energizing the reversing switch upon the completion of a record and deenergizing it when the tone arm is returned and driving connections between the motor, 130

phonograph table and return mechanism whereby when the motor reverses in one direction it drives the phonograph table but not the said mechanism and when the motor runs in the opposite direction it drives the mechanism but not the phonograph. 15

4. The combination with a phonograph including a rotatable turn-table and a tone arm, of an electric motor for driving the turntable comprising a rotating disc armature connected to the table so that the table will rotate at the same speed as the armature, electro-magnetic means for driving said armature, a magazine for records, a record shifting mechanism and means whereby when the end of a record is reached, the record shifting mechanism will be connected to the disc armature to be driven by the same and replace the played record by one from the magazine. 20

In witness whereof, I have hereunto set my hand this 10th day of November, 1921.

FRANK J. SEABOLT.