Dec. 17, 1940. V. H. SEVERY 2,225,323

SOUND REPRODUCING APPARATUS

Original Filed April 27, 1936 2 Sheets-Sheet 1

Fig. 1.

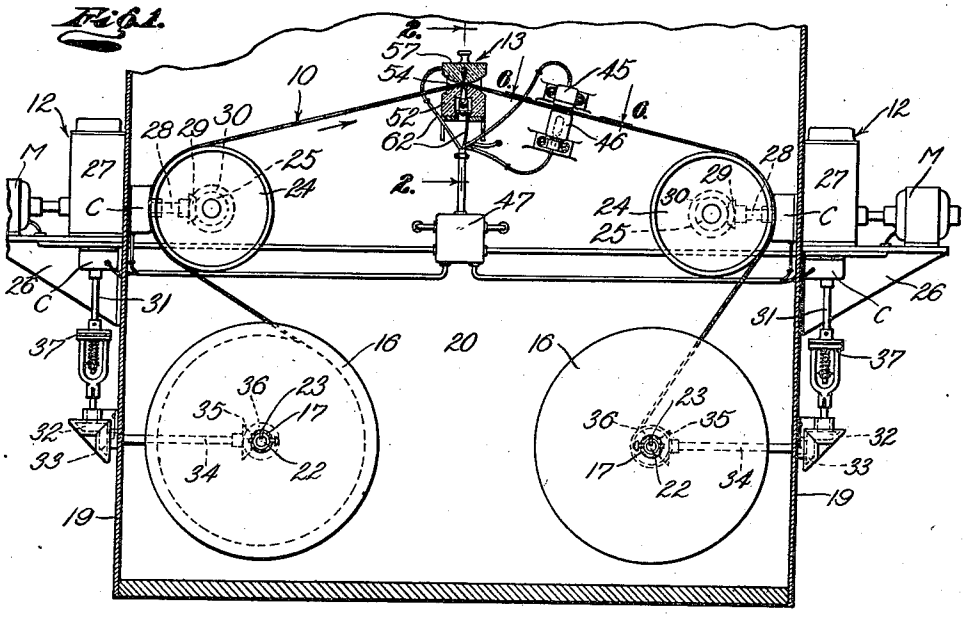


Fig. 2.

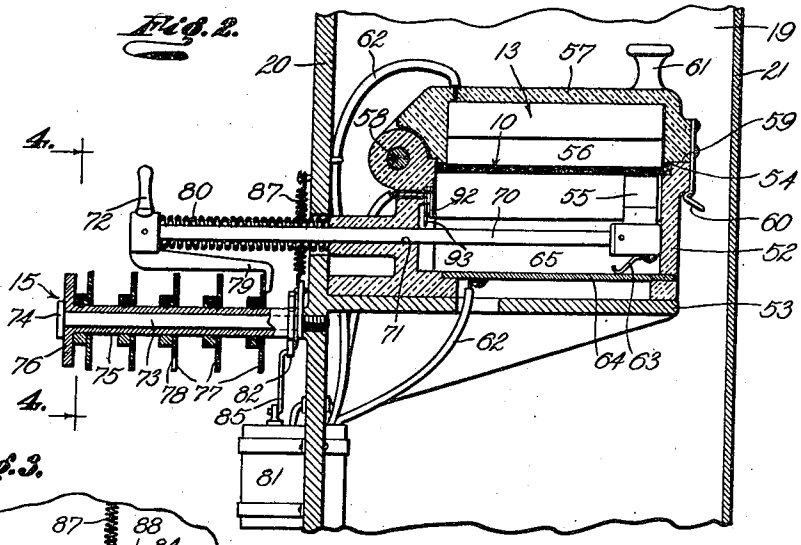
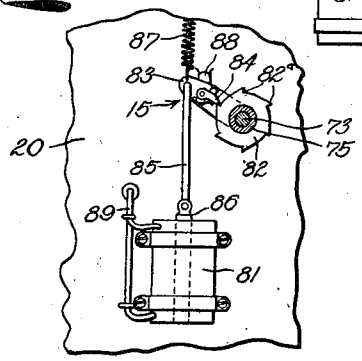


Fig. 3.



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SOUND REPRODUCING APPARATUS

Original Filed April 27, 1936 2 Sheets-Sheet 2

Fig. 4.

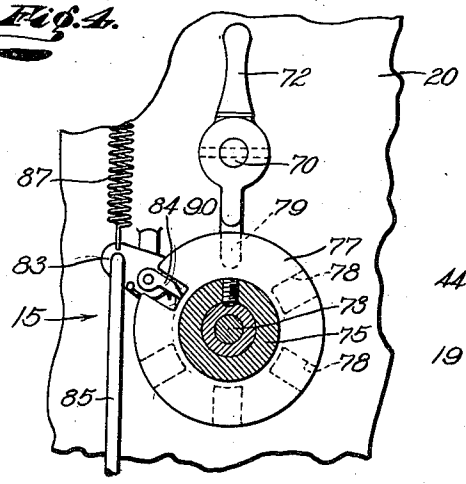


Fig. 5.

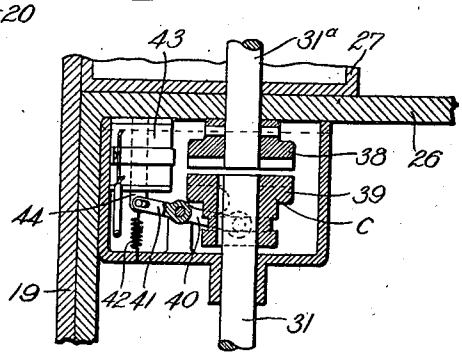


Fig. 6.

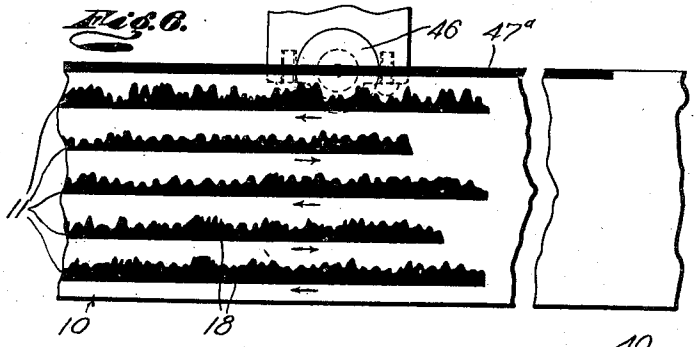


Fig. 7.

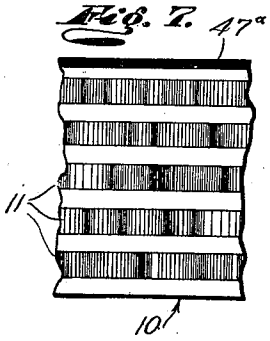
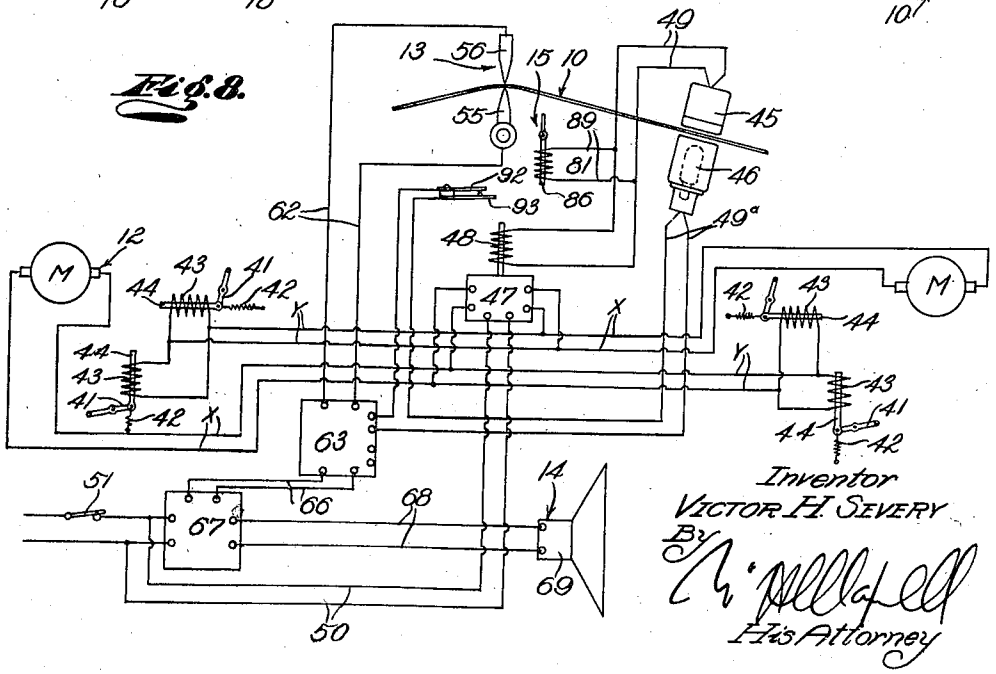


Fig. 8.



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Patented Dec. 17, 1940 2,225,323

UNITED STATES PATENT OFFICE

2,225,323

SOUND REPRODUCING APPARATUS

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Application April 27, 1936, Serial No. 76,568
Renewed May 18, 1940

8 Claims. (Cl. 179—100.1)

This invention relates to sound reproducting apparatus and it is a general object of the invention to provide a practical improved and particularly effective electrostatic sound reproducing apparatus.

Another object of this invention is to provide an electrostatic sound reproducing apparatus operable to faithfully and accurately reproduce recorded sound programs of various natures.

Another object of this invention is to provide a sound reproducing apparatus embodying an electrostatic pick-up and a record strip alternately moved lengthwise in opposite directions and bearing a multiplicity of sound tracks which successively cooperate with the pick-up, as the record strip alternately travels in opposite directions, to thereby reproduce in succession the programs or sound matter of the individual sound tracks.

Another object of this invention is to provide a sound record for use in reproducing apparatus of the character mentioned above that comprises a band or strip of flexible non-magnetic and non-electrical conducting material which may be of great length and which bears a plurality of sound tracks of metallic or partially metallic material for influencing an electrostatic pick-up. The novel sound band of the present invention may be of such length that each sound track thereof may individually comprise a complete recording or chapter of a recording, such as a radio program of a given duration, or the sound complement of a reel or motion picture film, or any other sound program.

Another object of this invention is to provide an electrostatic sound reproducing apparatus of the character mentioned that is entirely automatic in its operation, requiring no attention subsequent to its initial conditioning and energization.

Another object of this invention is to provide a sound reproducing apparatus that automatically moves the elongate sound record in alternate directions and automatically shifts or conditions the electrostatic pick-up to be successively influenced by the sound tracks of the record during successive alternate movements of the record to thereby reproduce the sound material of the individual tracks, there being a minimum time interval between the successive passage of the sound tracks through the pick-up.

Another object of this invention is to provide a sound record for use in apparatus of the character mentioned above that is inexpensive to produce and reproduce and that is in convenient form for handling, shipping, etc. The record provided by the present invention is in the form of a single continuous strip of flexible sheet material which may be wound upon a suitable reel for convenient handling, shipping, etc.

The various objects and features of my invention will be fully understood from the following detailed description of typical preferred forms and applications of my invention, throughout which description reference is made to the accompanying drawings, in which:

Fig. 1 is a vertical detailed sectional view of the apparatus provided by the present invention. Fig. 2 is an enlarged fragmentary vertical detailed sectional view taken as indicated by line 2—2 on Fig. 1 and illustrating the pick-up and its control. Fig. 3 is an enlarged fragmentary vertical detailed sectional view of the ratchet and solenoid coil of the pick-up control. Fig. 4 is an enlarged fragmentary detailed sectional view taken as indicated by line 4—4 on Fig. 2. Fig. 5 is an enlarged fragmentary detailed sectional view illustrating one of the releasable clutches. Fig. 6 is a fragmentary plan elevation of the record being a view taken substantially as indicated by line 6—6 on Fig. 1. Fig. 7 is a fragmentary plan elevation of another form of record and Fig. 8 is a schematic wiring diagram of the circuits involved in the invention.

The present invention provides, generally, an elongate sound record 10 bearing a multiplicity of sound bands or sound tracks 11, means 12 for alternately moving the record 10 longitudinally in opposite directions, an electrostatic pick-up 13 responsive to or influenced by the tracks 11 and operable to impose current modulations on a loud speaker unit 14, means 15 for automatically conditioning the pick-up 13 for successive cooperation with the sound tracks 11, and other parts, the details and functions of which will be hereinafter described.

The record 10 is an important feature of the invention. The record 10 bears or carries the multiplicity of sound bands or tracks 11 and owing to the fact that it may be of great length the individual tracks 11 may be continuous tracks each constituting a recording of a complete sound program. In accordance with the invention the record 10 is an elongate strip of flexible material. The record 10 is preferably formed of non-magnetic and non-electrical conducting material, such as paper, fabric, Cellophane or similar sheet material or a combination of such materials. The record 10 is preferably of uniform width throughout its length and the length of the record is,

of course, determined by the length of the sound tracks 11. The record 10 is preferably wound on a reel 16 for easy handling and for assembly in the apparatus. When employed or threaded in the sound reproducing apparatus the record 10 is wound from one reel 16 to a second reel 16 and then wound back on the first reel, and so on.

The reels 16 may be of suitable or typical construction and may embody hubs 17 and suitable side flanges. The opposite ends of the sound record 10 are suitably connected or associated with the hubs 17 of the reels. In practice tabs or reduced end parts on the record 10 may be inserted in slots in the hubs 17. It is to be understood that the sound reproducing apparatus of the invention is adapted to handle sound records bearing sound tracks 11 of different sound programs.

The sound tracks 11 extend longitudinally of the record 10 and are transversely spaced one from the other for successive cooperation with the pick-up 13. The tracks 11 alternately extend longitudinally in opposite directions as indicated by the arrows in Fig. 6. It is a feature of the invention that there may be a number of sound tracks 11 on a single record 10. In the particular case illustrated in the drawings there are five tracks on the record 10, it being understood that the invention is not to be construed as limited to this particular number of sound tracks. The sound tracks 11 may be of the hill and dale or variable area type illustrated in Fig. 6 or may be of variable density type illustrated in Fig. 7.

The sound tracks 11 may be produced and printed in any of the well known manners, it being understood, of course, that the variations in the areas of the tracks 11 or the variations in the densities of the tracks, as the case may be, are truly representative of the sound matter recorded. The tracks 11 are formed of metallic or partially metallic material. The sound tracks 11 of the record 10 may be of an ink containing a suitable non-magnetic electrical conducting material in a finely divided or colloidal state. The sound tracks 11 may be produced photographically, in which case the metallic silver of the tracks is sufficient to properly influence or affect the electrostatic pick-up 13. The sound tracks 11 are preferably equally spaced apart transversely of the record 10 and may have straight base edges 18. The tracks 11 on the record 10 may be of different lengths. However, in the present instance it will be considered that the tracks are of substantially the same length. The sound tracks 11 terminate some distance inwardly from the opposite ends of the record 10 to permit the proper threading of the record in the apparatus and to insure the cooperation of the complete sound tracks with the pick-up 13.

The means 12 for moving the sound record 10 is preferably in the nature of a driven or power actuated means controlled to automatically move the record 10 longitudinally in opposite directions. A suitable structure or frame is provided to carry the means 12 and other parts of the apparatus. In the particular case illustrated in the drawings this frame includes two spaced vertical end members 19 connected by side members 20 and 21. A removable or hinged door may be provided on one of the members to give access to the interior of the apparatus. The means 12 includes two spaced parallel shafts 22. The shafts 22 may be supported by suitable bearings on the member 20 and are substantially horizontal. The shafts 22 are provided to carry the reels 16. Keys 23 or other suitable means may connect the reels 16 with the shafts 22 to turn therewith. The record moving means 12 includes two spaced drums or pulleys 24. The pulleys 24 are rotatably supported by suitable bearings 25 on the side member 20. The pulleys 24 are rotatable about horizontal axes and a pulley 24 is spaced above each reel 16. The pulleys 24 are provided with leather or similar material to cooperate with the record 10.

A driving or operating motor M is provided for rotating each pulley 24 and the adjacent reel 16. The motors M are preferably synchronous motors. Suitable brackets 26 on the frame members 19 may carry the motors M. The motors M drive the adjacent pulleys 24 through suitable speed reducing and speed governing mechanisms 27 so that the pulleys are rotated at constant speeds to properly move the record 10. A driven shaft 28 of each speed reducing mechanism 27 carries a gear 29 which meshes with a gear 30 on the shaft of a pulley 24. The reel shafts 22 are rotated to take up the record 10. Each speed reducing mechanism 27 drives a shaft 31. The shafts 31 carry gears 32 which mesh with gears 33 fixed on shafts 34. The shafts 34 each have a gear 35 meshing with a gear 36 on a reel shaft 22. The reels 16 are rotated at higher rates than the pulleys 24 to properly take up the record 10 during the first portion of each movement of the record. Suitable friction clutches 37 are interposed in the shafts 31. The clutches 37 are adapted to slip under increased torque resulting from the increase in the diameter of the record 10 being wound on the reels 16. A positive releasable clutch C is provided between each speed reducing mechanism 27 and the adjacent shaft 31. Similar positive releasable clutches C are provided between each speed mechanism 27 and the adjacent shaft 28.

Fig. 5 of the drawings illustrates a clutch C of a reel drive. It is to be understood that the clutches C in the reel drives and the pulley drives may be identical. The clutch C illustrated in detail in Fig. 5 includes a toothed clutch member 38 fixed on a driven shaft 31a of the adjacent speed reducing mechanism 27. A complementary toothed clutch member 39 is shiftably splined on the shaft 31 and is adapted to cooperate with the member 38. A pivoted yoke 40 cooperates with the member 39 to shift the same. The yoke 40 has a projecting arm 41 and a spring 42 is connected with the arm 41 to urge the member 39 into cooperation with the member 38. A solenoid coil 43 is provided to release the shiftable clutch member 39 from the driven clutch member 38. The armature 44 of the coil 43 is pivotally and shiftably connected with the arm 41. When the coil 43 is energized the yoke 40 is pivoted to shift the clutch member 39 out of engagement with the clutch member 38.

The record moving means 12 includes an automatic control for effecting alternate energization of the motors M and the alternate energization of the clutch solenoid coils 43 whereby the record 10 is alternately moved in opposite directions. This automatic control of the means 12 includes a photo-electric cell 45 and an exciting lamp 46 for the cell. The photo-electric cell 45 and the lamp 46 are arranged at opposite sides of the record 10 adjacent an edge of the record. The cell 45 and the lamp 46 are preferably positioned

in opposite sides of a tensioned web portion of the record 10 adjacent the pick-up 13. The record 10 carries an opaque or relatively opaque band 47a adjacent one of its edges, which band passes between the cell 45 and its lamp 46. The band 47a preferably terminates some distance beyond the ends of the sound tracks 11.

The motors M and the coils 43 of the several clutches C are under the control of a reversing switch 47 which in turn is under the control of the photo-electric cell 46. Any suitable or conventional type of double reversing switch 47 may be employed in the apparatus. The switch 47 is controlled or thrown by a solenoid coil 48. The energized conductors or leads 49 of the photo-electric cell C are connected with the terminals of the coil 48 whereby the coil 48 is energized when an end of the opaque band 47a passes the lamp 46 and the cell 45. The motors M each have an energizing circuit or a pair of leads X extending to the switch 47. The solenoid coils 43 of the clutches C have their energizing leads Y connected with the motor energizing leads X. The leads Y governing the coils 43 of the clutches C at or adjacent one mechanism 27 are connected in the energizing leads X governing the motor M associated with the other mechanism 27 and the leads Y from the solenoid coils 43 of the clutches C adjacent the said other mechanism 27 are connected in the energizing leads X of the motor M associated with the first mentioned mechanism 27. When an end of the opaque band 47a passes the photo-electric cell 45 the switch 47 is operated to de-energize the motor M and the coils 43 which have been energized to effect movement of the record 10 and to energize the other motor M and the other coils 43 and thus effect movement of the record 10 in the opposite direction. Power lines or conductors 50 supply the reversing switch 47 with current and a manual switch 51 is provided in one of the lines 50 to govern the apparatus.

The electrostatic pick-up 13 is influenced by or is responsive to the sound tracks 11 of the record 10 to impose electric current modulations on the amplifier and loud speaker unit 14 which reproduces the sound matter of the tracks 11. The pick-up 13 includes a body 52 of Bakelite or other insulating material supported on a shelf 53 on the frame member 20. A groove 54 is provided in the upper side of the body 52 to receive and guide the record 10. The body 52 is preferably positioned midway between the pulleys 24 and in a plane above the pulleys. The bottom walls of the groove 54 are inclined or curved downwardly in opposite directions toward the pulleys 24. The record 10 is trained over the body 52 to bear on the bottom wall of the groove 54 with suitable pressure whereby the record is maintained taut or under proper tension.

The pick-up 13 includes two field members 55 and 56. The field member 55 is positioned in the body 52 below the record 10 and the field member 56 is located above the record. The field members 55 and 56 are formed of suitable electrical conducting material and their opposing edge portions are tapered to relatively narrow edges to produce concentrated fields. The lower field member 55 is proportioned to oppose or face only one track 11 of the record 10 and is shiftable between positions opposing the sound tracks 11 by the means 15. The upper field member 56 is normally stationary and is of sufficient length to extend transversely across the major portion of the record 10 to be responsive to all of its sound tracks 11. The field members 55 and 56 have their opposing edges spaced from the record 10 to leave a field gap or field space through which the record moves.

The upper field member 56 of the pick-up 13 is carried by a gate 57. The gate 57 is shiftable to a position to permit the easy threading of the record 10 in the groove 54. The gate 57 is of Bakelite or other insulating material and has one end carried by a pivot pin or hinge pin 58 on the body 52. Cooperating shoulders 59 of the body 52 and gate 57 hold or stop the gate 57 in the position where its field member 56 is in proper relation to the record 10. A spring clip 60 or the like, may be provided to releasably hold the gate 57 in its down position where the field member 56 extends across the upper face of the record 10. A handle 61 may be provided on the gate 57 to facilitate its manipulation.

Conductors 62 extend from the field members 55 and 56 to a suitable pre-amplifier 63. The conductor 62 connected with the field member 56 has a flexible portion at the gate 57 to allow pivoting of the gate. An automatic switch electrically connects the other conductor 62 with the lower field member 55. This switch may comprise a flexible contact or brush 63 electrically connected with the field member 55 and a contact strip 64 on the bottom wall of a slot 65 in the body 52. The contact strip 64 is electrically connected with the conductor 62. The slot 65 extends transversely of the groove 54 and the contact brush 63 bears against and moves on the strip 64 during movement of the field member 55 transversely of the record. Conductors 66 connect the pre-amplifier with the amplifier 67 of the unit 14 and leads or conductors 68 connect the amplifier 67 with a suitable speaker 69. Movement of a variable area or variable density metallic sound track 11 through the field of the pick-up 13 produces fluctuations in the circuit of the pick-up which modulations or fluctuations are imposed on the speaker unit 14 through the medium of the pre-amplifier 63 and the amplifier 67 to be reproduced as sound. The metallic sound tracks 11 are in effect the movable armatures of the pick-up 13 and their character, of course, determines the sound produced by the speaker 69.

The means 15 for automatically conditioning the pick-up 13 for successively cooperating with the spaced sound tracks 11 operates to shift the field member 55 between the positions where it opposes or faces the individual spaced sound tracks. The means 15 includes a shiftable rod 70 carrying the field member 55. The rod 70 is of insulating material or is suitably insulated from the field member 55. The rod 70 extends through the slot 65 and passes outwardly through an opening 71 in the pick-up body 52. A knob or handle 72 is provided on the outer end of the rod 70 to facilitate its manual operation. The means 15 includes a fixed shaft 73 projecting from the frame member 20 adjacent the rod 70. The shaft 73 is parallel with the rod 70 and has an annular flange 74 on its outer end. A rotatable sleeve 75 is provided on the shaft 73 and has an annular flange 76 cooperating with the flange 74.

Longitudinally spaced discs 77 are fixed to the rotatable shaft 75. The number and the spacing of the discs 77 correspond to the number and spacing of the sound track 11 of the record 10. The outermost disc 77 is preferably spaced inwardly from the flange 76. Each disc 77 has a radial slot 78 extending inwardly from its periphery. The slots 78 lie in spaced radial planes,

the slots 78 of adjacent discs 77 being circumferentially spaced. The circumferential spacing of the slots 78 is preferably equal. A finger 79 is rigidly connected with the rod 70 and is adapted to cooperate with the discs 77. A spring 80 surrounds the rod 70 and is arranged under compression between the handle 72 and the body 52 to urge the finger 79 outwardly. Thus the finger 79 is urged outwardly against the inner side of a disc 77. The finger 79 is shaped and proportioned to readily pass through the slots 78. The parts are proportioned and related so that the engagement of the finger 79 with the innermost disc 77 locates the field member 55 in proper relation to the sound track 11 at one edge of the record 10.

Means is provided to automatically turn the sleeve 75 a partial rotation at the end of each movement of the record 10 to successively align the slots 78 of the discs 77 with the finger 79 and thus allow the successive transverse advancement of the field member 55 from one track 11 to the other. A solenoid coil 81 is mounted on the member 20 below or adjacent the shaft 73. A ratchet wheel 82 is fixed on the sleeve 75. A pawl arm 83 is freely movable or pivoted on the shaft 73 adjacent the ratchet wheel 82. A spring pressed pawl 84 is carried by the arm 83 and is adapted to cooperate with the teeth 82ª of the wheel. A link 85 is pivotally connected with the arm 83 and the armature 86 of the coil 81. A spring 87 is connected with the arm 83 to return the arm and the armature 86 when the coil 81 is de-energized. A stop 88 is provided to limit the return movement of the arm 83. The pawl 84 on the arm 83 normally engages a tooth 82ª.

When the coil 81 is energized the pawl 84 cooperates with a tooth 82ª to turn the sleeve 75 and bring a slot 78 to a position where the finger 79 passes through it to be stopped by the adjacent disc 77. This movement of the finger 79 is accompanied by corresponding movement of the field member 55 and the finger 79 is stopped to properly align the field member 55 with a sound track 11. Leads 89 extend from the terminals of the coil 81 and are connected in the leads or conductors 49 of the photo-electric cell 45 whereby the coil is under the control of the cell. Accordingly, upon excitation of the cell 45, when an end of the opaque band 47ª passes the cell, the coil 81 is energized to permit the advancement of the field member 55 to a position in alignment with the next or adjacent sound track 11. This shifting of the member 55 is substantially simultaneous with the de-energization of one motor M and the energization of the other motor M as above described. The flange 76 of the sleeve 75 is engageable by the finger 79 to limit the transverse movement of the field member 55 after passage through the slot 78 in the outermost disc 77. Movement of the finger 79 from the outermost disc 77 to the flange 76 brings the field member 55 to a position where the brush contact 63 is out of engagement with the contact strip 64 so that the pick-up unit 13 is automatically de-energized when the last sound track 11 has completely passed through the pick-up. Aligned slots 90 are provided in the four inner discs 77 in alignment with the slot 78 of the outer or fifth disc to permit the manual return of the finger 77 from the flange 76 to the inner side of the innermost disc 77. The parts are related so that the finger 79 does not enter the slots 90 when the apparatus is in operation.

Means is provided for automatically de-energizing the photo-electric cell unit at the completion of operation of the apparatus. A switch is connected in one lead 49ª of the lamp 46. This switch may comprise a stationary contact 92 and a movable or flexible contact 93. The contacts 92 and 93 are normally in engagement. The movable or flexible contact 93 is positioned to be engaged by an insulated part of the field member 55 when the control finger 79 moves from the outermost disc 77 to the flange 76. This engagement moves the contact 93 out of engagement with the contact 92 to break the circuit to the lamp 46.

To condition the apparatus for operation a record 10 is first arranged in and threaded through the apparatus. The reel 16 bearing the record 10 may be arranged on a shaft 22 to turn therewith. The record 10 is trained over the adjacent pulley 24 and then through the pick-up 13. The gate 57 may be lifted to facilitate the easy arrangement of the record 10 through the pick-up. The gate 57 is, of course, returned to its down position following the threading of the record. The record 10 is then trained over the other pulley 24 and secured to the hub 17 of the adjacent reel 16 to be wound on the reel. The field member 55 of the pick-up 13 is manually adjusted or moved to the end position where it is properly aligned with the first sound track 11 of the record. The manual switch 51 may then be closed to energize the apparatus.

A motor M drives or rotates the reel shaft 22 of the empty or take-up reel 16 and drives the adjacent pulley 24 through the speed reduction mechanism 27. As above described, the coils 43 of the clutches C controlling the other reel 16 and the other pulley 24 are energized whereby the clutches C are released to permit free unreeling of the record from the loaded reel 16. It is preferred that the sound tracks 11 and the band 47 terminate some distance from the ends of the record 10 to permit the proper threading of the record in the apparatus and to permit initial movement of the record before a sound track 11 passes through the pick-up 13. The arrow in Fig. 1 of the drawings illustrates the direction of movement or travel of the record 10 when the device is conditioned and energized, as just described. The record 10 is moved at a constant rate and is taken up on the take-up reel 16 after it is drawn over the actuated pulley 24. The take-up reel 16 is rotated faster than the driven pulley 24 to properly take-up the first portion of the record 10 and as the diameter of the sound record on the take-up reel increases the clutch 37 may slip.

During the movement of the record 10 a sound track 11 moves past or between the field members 55 and 56 of the pick-up 13 to vary the potential of the pick-up circuit and thus produce electrical modulations or fluctuations which are imposed on the loud speaker 14 to be converted into sound. The opaque band 47ª passes between the cell 45 and its exciting lamp 46 to maintain the cell in a normal condition. As the record 10 may be of great length the sound track 11 may constitute the record of a complete sound recording. When substantially the entire record 10 has been wound upon the take-up reel 16 the end of the first sound track 11 may pass through the pick-up 13 at which time, or immediately subsequently, the end of the opaque band 47ª passes the cell 45. The lamp 46 then excites the cell 45 to energize the coil 81 and the coil 46. Energization of the coil 81 effects a partial rotation of the sleeve 75

through the medium of the pawl 84 and the ratchet wheel 82 to bring the slot 78 of the first disc to a position to receive or pass the finger 79. The spring 80 moves the rod outwardly until the finger 79 strikes the second disc 77. This movement of the rod 70 brings the field member 55 into alignment with the second sound track 11. The above described energization of the coil 48 throws the switch 47 to de-energize the motor M which has effected the movement of the record 10 and the coils 43 of the clutches C at the other end of the apparatus, and simultaneously energizes the other motor M and the other coils 43. The record 10 is thus moved in the opposite direction to the arrow in Fig. 1, being drawn through the pick-up 13 by the actuated pulley 24 and wound upon the adjacent reel 16. This moves the second sound band or track 11 through the pick-up 13 in the proper direction. Thus the second sound band 11 actuates or influences the pick-up 13, which in turn energizes or influences the speaker unit 14 to reproduce the sound matter of the second sound track. The record 10 is again substantially entirely re-wound on the reel 16 and upon the passage of the end of the second sound track 11 through the pick-up 13 the cell 45 is again excited to energize the coil 81 and actuate the switch 47. Thus the apparatus is automatically conditioned to move the record 10 in the opposite direction to have its third sound track 11 pass through the field of the pick-up 13.

The above described operation continues until the end of the last sound band or track 11 passes through the pick-up 13. Substantially simultaneously with the passage of the last track 11 through the pick-up 13 the end of the opaque band 47a passes the cell 45 again effecting excitation of the cell. The excitation of the cell 45 results in the release of the finger 49 from the last or outermost disc 77 and actuation of the reversing switch 47. When the finger 79 passes through the slot 78 of the outermost disc 77 it moves outwardly to strike the flange 76. This movement is accompanied by movement of the brush contact 63 beyond the end of the contact strip 64 thus breaking the circuit to the pick-up 13. Movement of the finger 79 against the flange 76 is also accompanied by engagement of the insulated part of the member 55 with the contactor 93 to break the circuit to the lamp 46. Thus the pick-up 13 and the photo-electric cell 45 are automatically de-energized when the last sound track 11 has passed through the pick-up. The reversal of the switch 47 energizes a motor M to effect the rewinding of the record 10 on its original reel 16. The switch 51 may then be opened to de-energize the apparatus.

Following the playing or use of the record 10 it may be removed from the apparatus and another record 10 may be threaded or trained through the apparatus, as described above. The pick-up 13 may be easily conditioned for use by moving the finger 79 through the aligned slots 90 to bring it into engagement with the innermost disc 77 which also positions the field member 55 in alignment with the first sound track 11 of the record. The switch 51 may then be closed to again energize or actuate the apparatus.

Having described only typical preferred forms and applications of my invention, I do not wish to be limited or restricted to the specific details herein set forth, but wish to reserve to myself any variations or modifications that may appear to those skilled in the art or fall within the scope of the following claims.

Having described my invention, I claim:

1. Sound reproducing apparatus including, a record comprising an elongate flexible strip, and longitudinally extending sound tracks and a control track on the strip, an electrostatic pick-up, and means for alternately moving the record longitudinally in opposite directions through the field of the pick-up to cause the sound tracks to successively cooperate with the pick-up, said means being governed by the control track on the record.

2. Sound reproducing apparatus including, a record comprising an elongate flexible strip carrying a control record and a plurality of transversely spaced longitudinally extending sound tracks on the strip, a single pick-up, means alternately moving the record strip longitudinally past the pick-up to cause the sound tracks to successively influence the pick-up, and means conditioning the pick-up for successive response to the sound tracks, the said means being controlled by the control record.

3. Sound reproducing apparatus including, an elongate flexible paper record having a control record and a plurality of transversely spaced longitudinally extending non-magnetic, metallic sound tracks on the record, means operable to move the record longitudinally in opposite directions, a pick-up adapted to be influenced by the sound tracks, and a control for said means whereby the said means alternately moves the record in opposite directions, the control being governed by the control record.

4. Sound reproducing apparatus including, an elongate flexible record, a plurality of transversely spaced longitudinally extending sound tracks on the record, an electrostatic pick-up comprising a relatively stationary field member, means controlled by the record for shifting the field member, and a shiftable field member, means alternately moving the record strip longitudinally in opposite directions past the field members, and means for aligning the movable field member with a sound track upon each change in the direction of movement of the record.

5. Sound reproducing apparatus including, an elongate flexible record, a plurality of transversely spaced longitudinally extending sound tracks on the record, an electrostatic pick-up comprising a relatively stationary field member, and a shiftable field member, means for moving the record longitudinally in opposite directions, means controlled by the record for shifting the movable field member into alignment with the sound tracks, and an automatic control for said means for effecting reversal of movement of the record and shifting of the movable field member into alignment with an adjacent sound track when the end of a sound track passes the pick-up.

6. Sound reproducing apparatus including, an elongate flexible record, a plurality of transversely spaced longitudinally extending sound tracks on the record, an electrostatic pick-up comprising a relatively stationary field member, and a shiftable field member, means for shifting the shiftable field member, and an automatic control for the last mentioned means controlled by the record to effect the automatic alignment of the shiftable field member with an adjacent sound track upon the end of a sound track passing the pick-up.

7. Sound reproducing apparatus including, an elongate flexible record, a plurality of transversely spaced longitudinally extending sound tracks on the record, an electrostatic pick-up comprising a relatively stationary field member, and a shiftable field member, means for shifting the shiftable field member between positions where it is aligned with the several sound tracks, and a control for the last mentioned means operable to automatically effect shifting of the shiftable field member at the end of each movement of the record, the control including a photo-electric cell governed by the record.

8. Sound reproducing apparatus including, an elongate flexible record, a plurality of transversely spaced longitudinally extending sound tracks on the record, an electrostatic pick-up comprising a normally stationary field member, a shiftable field member, and means supporting one field member for movement away from the other field member to facilitate the threading of the record between the members, means operable to alternately move the record longitudinally in opposite directions, and means controlled by the record for shifting the shiftable field member at the end of each movement of the record to align it with an adjacent sound track.

VICTOR H. SEVERY.