

Feb. 2, 1937.

A. A. THOMAS

2,069,595

RECORDING AND REPRODUCING APPARATUS

Filed March 30, 1929

4 Sheets-Sheet 1

Fig. 1

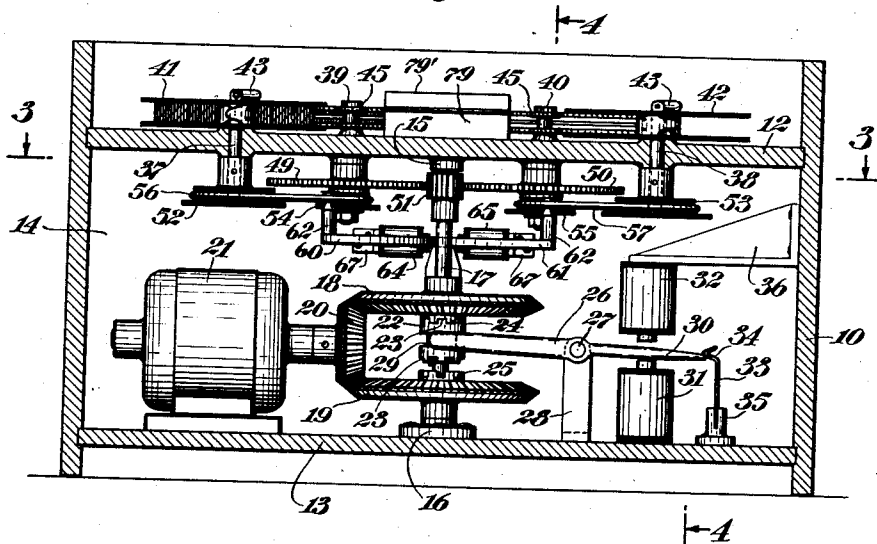
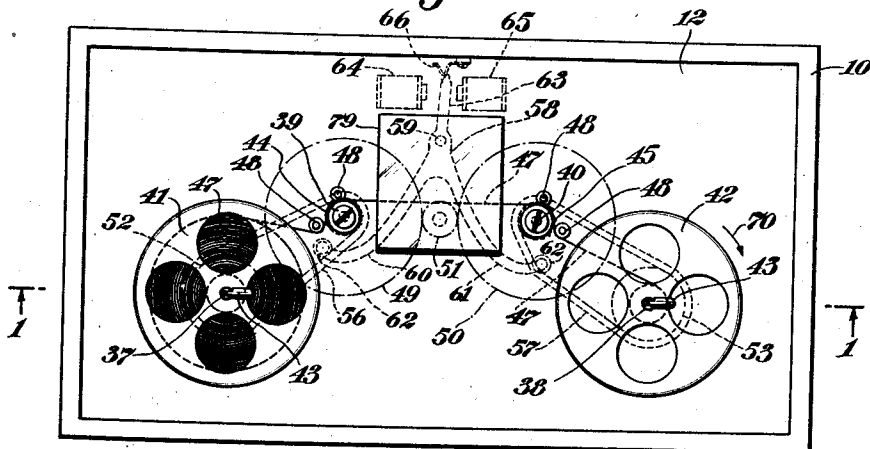


Fig. 2



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Fig. 3

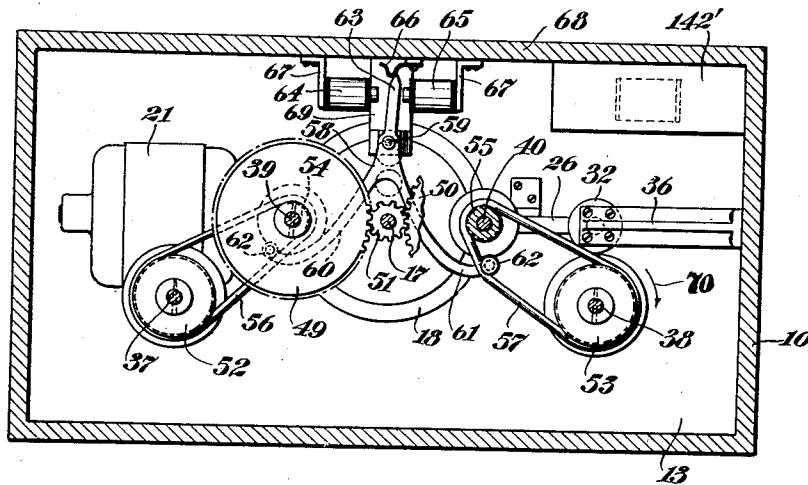
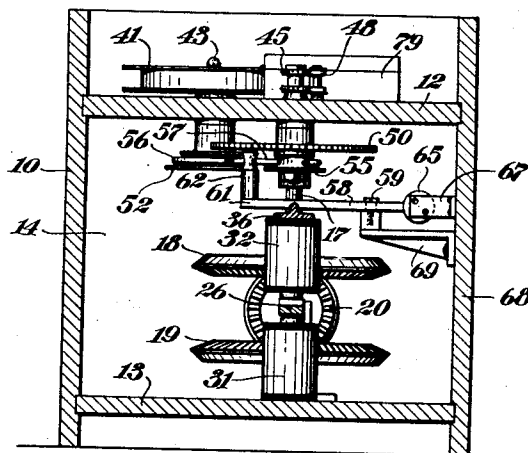


Fig. 4



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Fig. 5

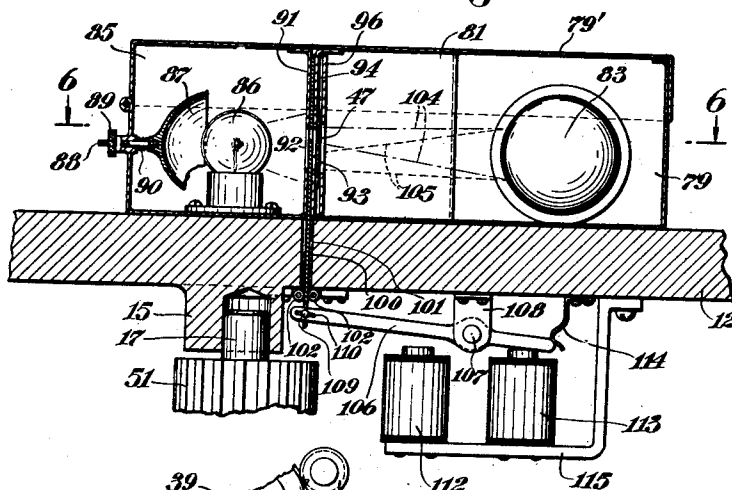


Fig. 5a

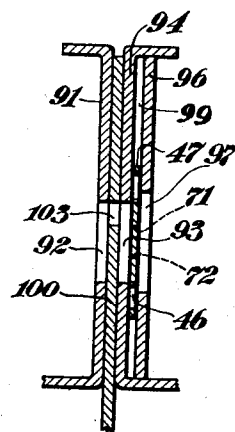


Fig. 6

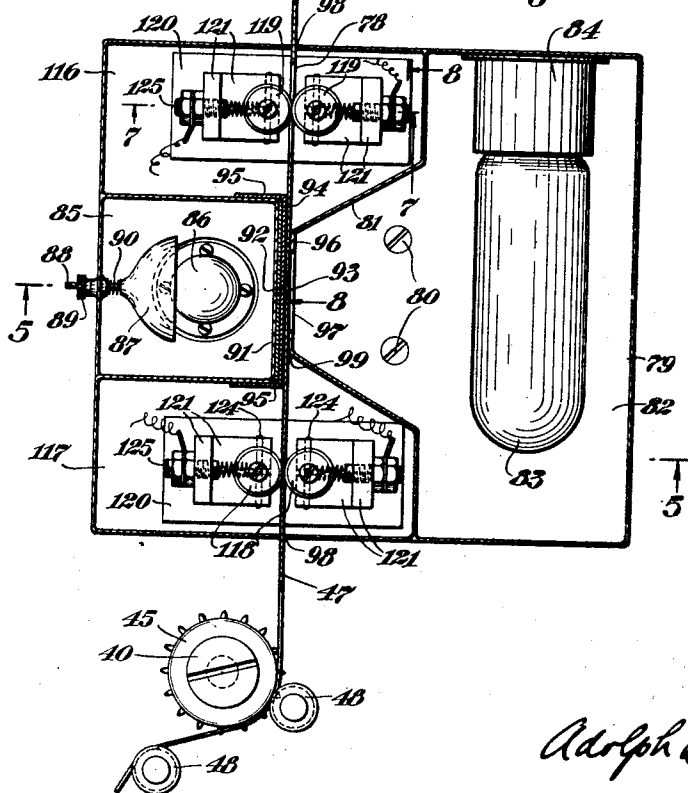
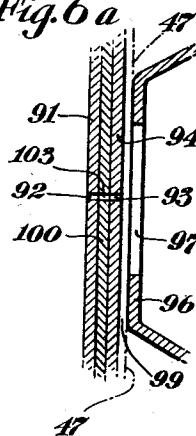


Fig. 6 a.



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Fig. 7

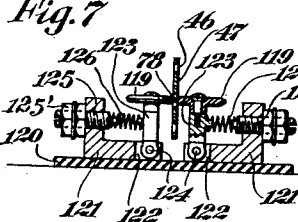


Fig. 8

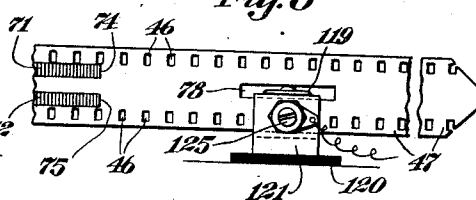


Fig. 10

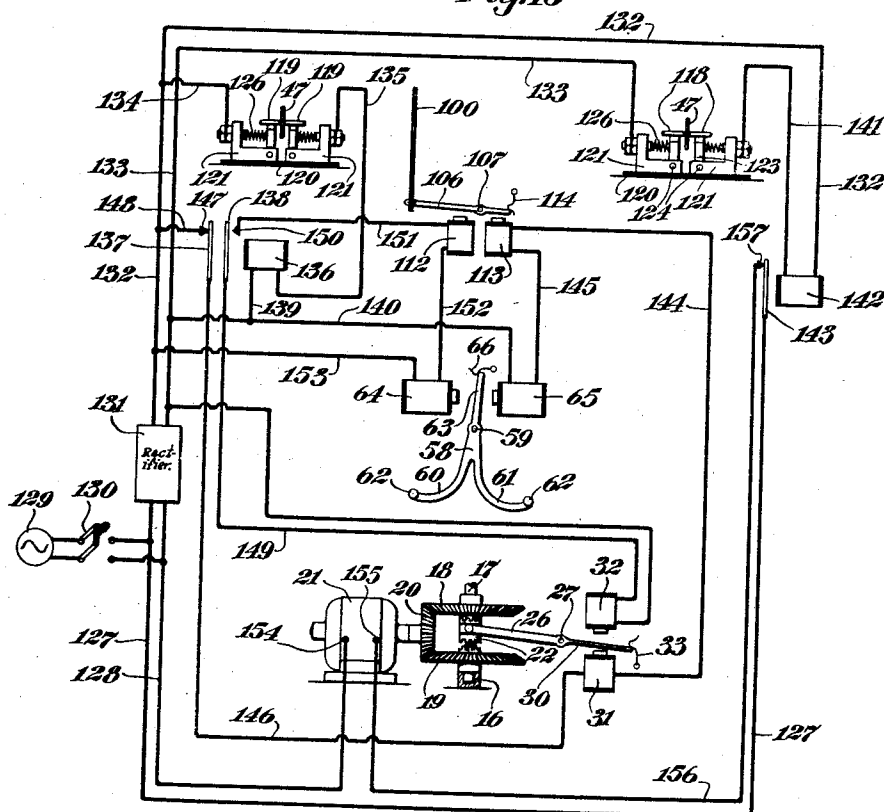
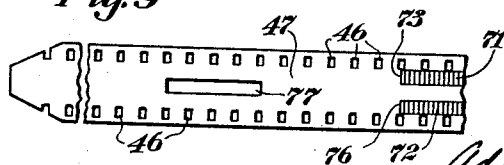


Fig. 9



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UNITED STATES PATENT OFFICE

2,069,595

RECORDING AND REPRODUCING
APPARATUS

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a corporation of Delaware

Application March 30, 1929, Serial No. 351,240

18 Claims. (Cl. 179—100.3)

This invention relates to the art of recording and reproducing sound and other vibrations by optical methods in which a strip of film is subjected to variations of light in accordance with transmitted vibrations. In sound films heretofore made, there is but a single sound track running lengthwise of the film, either along the center or (as in talking movie films) along one edge of the picture.

According to my invention, I multiply the capacity of a sound film by recording thereon in two or more tracks, which are played alternately in reverse directions when the film is unwound and rewound. When the end of a track is reached, automatic mechanism controlled by the film is itself brought into action to accomplish two things: first, to establish operative relation between the optical recording or reproducing device and the next sound track; second, to reverse the driving connections of the reels. I also provide means for automatically stopping the film when the end of the last sound track is reached, so that when the machine stops playing, the film is fully rewound, ready to be put away or played over again.

My new reproducing machine is particularly useful as a household phonograph, as it can be embodied in a small cabinet. I dispense with disk records, turntables and stylus reproducers with their attendant disadvantages. The multiple-record film of my invention may be of any length within practical limits, and therefore of greater capacity than the combined tracks on a large double disk record. Then, too, films on spools are more durable, more safely shipped and more easily stored than the disk records heretofore used.

The novel features and practical advantage of my new recording and reproducing apparatus will be understood from a description of the accompanying drawings, in which

Fig. 1 shows a vertical cross-section of a film phonograph embodying my invention, the section being taken on line 1—1 of Fig. 2;

Fig. 2 is a plan of the machine;

Fig. 3 represents a horizontal section on line 3—3 of Fig. 1;

Fig. 4 is a vertical section approximately on the broken line 4—4 of Fig. 1;

Fig. 5 illustrates, on an enlarged scale, certain details of the optical translating device associated with the film, this view being partly in section on the broken line 5—5 of Fig. 6;

Fig. 5a is a detail of Fig. 5 on an exaggerated scale;

Fig. 6 represents a plan view on section line 6—6 of Fig. 5;

Fig. 6a is a detail of Fig. 6 on an exaggerated scale;

Fig. 7 is a sectional view on line 7—7 of Fig. 6, showing the switch rollers controlled by the film;

Fig. 8 is a fragmentary view on the broken line 8—8 of Fig. 6 to show certain features at one end of the film;

Fig. 9 shows the other end of the film; and

Fig. 10 is a diagram of circuits controlled by the film.

A suitable outer case or cabinet 10 has a top board 12 and a base 13, which are spaced to provide a chamber 14 for containing the driving mechanism of the machine. The top board 12 and base 13 carry a pair of vertically aligned bearings 15 and 16 for supporting a rotary shaft 17. Bevel gears 18 and 19 are mounted idly on shaft 17 and arranged to mesh with a bevel pinion 20 fixed on the driving shaft of a suitable prime mover 21. This is preferably a small electric motor, D. C. or A. C. type, fixed on the base or bottom plate 13 of the cabinet. A slidable clutch sleeve 22 is mounted on shaft 17 between the bevel gears 18 and 19. The clutch sleeve 22 always rotates with shaft 17, but it is slidable thereon into locking engagement with either of the gears 18 and 19. For this purpose, the ends of clutch 22 are provided with teeth 23 adapted to mesh with teeth 24 and 25 projecting from the bevel gears 18 and 19. It may be assumed that, when the clutch 22 engages the teeth of gear 18, the driving shaft 17 runs in a forward direction, and when clutch 22 is moved into engagement with the teeth of the lower gear 19, the rotation of shaft 17 is reversed.

The reversing clutch 22 is operated by an arm or lever 26 pivoted at 27 on a suitable stand or bracket 28 fixed on base 13. A simple way to connect the clutch 22 with the actuating lever 26 is to provide one end of the latter with a yoke adapted to engage in a slot or groove 29 in the clutch. The rear end of lever 26 is in the form of (or otherwise carries) an armature 30 arranged between the cores of a pair of solenoids or electromagnets 31 and 32. It is clear from Fig. 1 that, when solenoid 31 is energized, the front end of lever 26 is rocked up to move the clutch sleeve 22 into engagement with the upper bevel gear 18. When solenoid 32 is energized, the armature 30 is drawn up and the front end of lever 26 moves down to throw the clutch sleeve 22 into engagement with the lower bevel gear 19, whereby the

rotation of shaft 17 is reversed. A spring arm 33 has a cam head 34 arranged to engage the rear end of lever 26 to hold the same firmly in either actuated position. The lower end of spring arm 33 is mounted in a boss or bracket 35 carried by the base 13, which also supports the lower solenoid 31. If the solenoids 31 and 32 are continuously energized while the shaft 17 is running, the holding arm 33 is not necessary. The upper solenoid 32 may conveniently be mounted on a bracket 36 secured to a side wall of the cabinet.

The top board 12 carries four rotary shafts 37, 38, 39 and 40. The two shafts 37 and 38 project above the top board 12 and are adapted to support a pair of film spools or reels 41 and 42. Lugs 43 may be pivoted to the upper ends of shafts 37 and 38 to hold the spools 41 and 42 firmly in place, while at the same time permitting their easy removal and insertion. The upper ends of the two intermediate shafts 39 and 40 carry sprockets 44 and 45, which engage the sprocket holes 46 of film 47 for driving the same at predetermined speed, according to standard practice. Each sprocket wheel has associated with it several rollers 48 to guide the film properly over the sprockets, as is usual in motion picture machines. Fig. 2 indicates clearly the path of film 47 in passing from one spool to the other. The sprocket shafts 39 and 40 carry at their lower ends a pair of gear wheels 49 and 50 arranged in mesh with a pinion 51 fixed on the vertical driving shaft 17. The transmission ratio between pinion 51 and sprocket gears 49 and 50 is such that the sprocket shafts 39 and 40 are driven at the correct speed. It is hardly necessary to add that the drawings are not intended to show this transmission ratio with mathematical accuracy.

The spool shafts 37 and 38 are provided at their lower ends with grooved pulleys 52 and 53, which always rotate with the shafts. The lower ends of sprocket shafts 39 and 40 carry grooved pulleys 54 and 55, which in this case are smaller than the pulleys 52 and 53. Elastic bands or belts 56 and 57 connect the pairs of pulleys 52-54 and 53-55. These elastic belts, which may consist of rubber, rubberized leather, coil springs and the like, are so adjusted that normally they permit slipping on the pulleys 52-54 and 53-55. However, one of the belts is always held taut to establish a positive drive between the connected pulleys. In the present machine I employ a belt-tightener in the form of a lever 58 pivoted at 59 and having a pair of diverging arms 60 and 61 which carry rollers 62. The lever 58 has an extension 63 which comprises or carries an armature arranged between a pair of solenoids 64 and 65. A bevelled spring arm 66 may be used to hold the lever 58 in either of its actuated positions. The solenoids 64 and 65 may conveniently be mounted on brackets 67, secured to the adjacent wall or panel 68, which also carries a bracket 69 for supporting the lever 58.

It is clear from Fig. 3 that, when the solenoid 65 is energized, the lever 58 is rocked clockwise (as viewed in that figure) and the roller 62 of arm 61 tightens the belt 57, so that a direct positive drive is established between the sprocket shaft 40 and the spool shaft 38. It is assumed that, when the belt 57 is tightened, the spool 42 is rotated in the direction of arrow 70 to unwind the film from spool 41. When the solenoid 64 is energized, the lever 58 is rocked the other way and the roller 62 of arm 60 tightens the belt 56 to establish a positive drive between the sprocket shaft 39 and the spool shaft 37. This occurs during the reverse rotation of the vertical shaft 17 to

rewind the film on spool 41. When the belt 57 is tightened during the forward movement of the film, the belt 56 is sufficiently loose to permit the sprocket wheel 44 to unwind the film from spool 41 as required. When the belt 56 is tightened during the rewinding of film 47, the slack belt 57 allows the spool 42 to rotate at a variable rate of speed for unwinding of the film. The movements of lever 58 from one position to the other take place automatically at the proper moment, as will later be explained.

The film 47 carries a pair of sound tracks or bands 71 and 72, which are indicated merely in a diagrammatic way and extend substantially parallel along the edges of the film. Looking at Figs. 9 and 8, which show the beginning and end portions of the film, the upper sound track 71 begins at 73 and ends at 74, while the other sound track 72 begins at 75 and ends at 76. In other words, the two sound tracks are arranged reversely, the second track beginning where the first track ends. If we assume that the sound track 71 is played during the forward movement or unwinding of the film, the sound track 72 is played during the reverse movement or rewinding of the film. In the broader aspect of this invention, the flexible record member 47 may be a thin steel tape, and the sound tracks 71 and 72 may be recorded magnetically in a manner well understood by those familiar with this art. I prefer, however, to make the member 47 in the form of a photographic film on which the record tracks 71 and 72 are produced by optical methods well known to the acoustic engineer. The film 47 is provided near its ends with longitudinal slots 77 and 78, which are arranged approximately at the center and spaced a short distance from the ends of sound tracks 71 and 72. The purpose of slots 77 and 78 will be described in due course.

The film 47 in passing between the drive sprockets 44 and 45 is subjected to the action of an optical reproducing device contained in a closed box 79, which is best shown in Figs. 5 and 6. This box may conveniently be made of sheet metal and fixed in proper position to the top board 12 by screws 80 or otherwise. A transverse partition 81 in the box provides a light-proof chamber or compartment 82 in which a photoelectric cell or tube 83 is mounted. It will not be necessary to show or describe the inside construction of tube 83, because several types of photoelectric cell are available in the market, and their construction and operation are fully understood by electrical experts in this particular field. I need only mention that the cell 83 is in the form of a vacuum tube adapted to be inserted into a base or socket 84 in compartment 82. The box 79 is provided with a small light-proof chamber 85 containing a lamp 86 and a reflector 87. The latter is preferably adjustable by being mounted on a screw rod 88 which carries a set-screw 89 and a coil spring 90. When the set-screw 89 is turned one way or the other, the reflector 87 is moved axially toward or away from the lamp 86, the spring 90 holding the reflector firmly in adjusted position. If the reflector 87 is made spherical, there is no harm in its being rotated during the axial adjustment thereof. The wall 91 of lamp chamber 85 has a long narrow slit 92 in axial alignment with lamp 86 and reflector 87, and a similar slit 93 is formed in a wall or plate 94, slightly spaced from the wall 91. A simple way to support the plate 94 is to provide it with lateral flanges 95, which are attached to

the side walls of lamp chamber 85 by solder, screws, rivets or otherwise. The section 96 of partition 81 has an opening 97 of considerably greater area than the slits 92 and 93.

5 The box 79 is provided at opposite sides with a pair of aligned slots 98, through which the film 47 passes. The slots 98 are preferably arranged in line with the narrow space 99 that separates the plates 94 and 96, as will be clear from Figs. 6 and 6a. The film 47 is thus arranged between the double slit 92—93 of lamp chamber 85 and the opening 97 of cell chamber 82. Consequently, the rays of light from lamp 86 are controlled by film 47 before they strike the photoelectric cell 83. It is important that only one sound track shall be in operative position at one time, and for this purpose I provide a shutter 100 arranged to move up and down in the space between plates 91 and 94. The top board 12 of the cabinet has a slot 101 through which the shutter extends. Antifriction rollers 102 may be provided to assist in guiding the shutter and facilitating its movement. The shutter 100, which is made of suitable sheet material, has a short narrow slit 103 in line with the longer slits 92 and 93. When the shutter 100 is in upper position, the slit 103 guides the light rays from lamp 86 through the upper sound track 71, while the lower sound track 72 is cut off from all light. This means that the action of photoelectric cell 83 is under the control of sound track 71 during the forward run of the film.

When the shutter 100 is moved down, the slit 103 is in line with the lower sound track 72, while the upper sound track 71 is now optically inert. Therefore, in the lower position of shutter 100, the photoelectric cell 83 is under the control of sound track 72 during the rewinding of the film. The slits 92 and 93 are sufficiently long to be optically connected by the shutter slit 103 in either position of the shutter. The light opening 97 in partition 81 is large enough to permit the passage of light to cell 83 through either of the sound tracks. In Fig. 5, the dash-dot lines 104 represent roughly the path of the light rays that reach the photoelectric cell 83 when the slit in shutter 100 is raised in line with sound track 71. The dotted lines 105 are supposed to indicate the path of light that strikes the photoelectric cell when the slit of the shutter is in alignment with the lower sound track 72. If desired, condensing lenses may be used in box 79 in the path of rays from lamp 86, but I have omitted such lenses to simplify the drawings. A hinged cover 79' permits ready access to the interior of box 79.

The shutter 100 is operated automatically at the right moment by a lever 106 pivoted at 107 on a bracket 108 fixed to the underside of the top board 12. The lever 106 is operatively connected to the shutter 100 in any practical way. In Fig. 5 I have shown the shutter provided with a pin 109 arranged to engage in a slot 110 at the free end of lever 106. For simplicity I have shown the lever 106 in the form of an armature or magnetic bar actuated in reverse directions by a pair of solenoids or electromagnets 112 and 113. A bevel-headed spring 114 attached to the underside of top board 12 may be employed to hold the armature lever 106 in either actuated position. The solenoids 112 and 113 are supported in any convenient way, as by a bracket 115 secured to the top board 12. It is clear from Fig. 5 that, when the solenoid 113 is energized, the shutter 100 is raised to bring the slit 103 in line with the upper sound

track 71. When the solenoid 112 is energized, the lever 106 pulls the shutter 100 down until the slit 103 is in line with the lower sound track 72. The circuit of solenoid 112 is closed automatically when the end of sound track 71 is reached, at which time the driving shaft 17 is automatically reversed, as about to be described.

The partition 81 and the walls of lamp chamber 85 in control box 79 form two compartments 116 and 117 on opposite sides of the lamp chamber. The compartments 116 and 117 contain two pairs of contact rollers 118 and 119, respectively. Since these two pairs of rollers are supported in identical manner, it will only be necessary to describe the mounting of one pair. At the bottom of each chamber 116 and 117 is an insulating base plate 120 carrying two L-shaped brackets 121 of conducting material. Each bracket is slotted at 122 to accommodate the lower end of an arm 123 pivoted on a pin 124 mounted in the bracket and extending across the slot, as best shown in Fig. 7. The arms 123 carry the contact rollers 118 and 119, which may be cut or stamped from sheets of brass, copper, aluminum, or other good conducting metal. The brackets 121 carry each a screw 125, which has a head 125' adapted to serve as a binding post. An expanding coil spring 126 is supported between each arm 123 and screw 125 to force the associated pair of contact rollers toward each other. The insulating film 47 normally holds the rollers of each pair 118 and 119 out of contact.

During the movement of the film in either direction, the rollers 118 and 119 ride along the center of the film in a path between the sound tracks 71 and 72. The springs 126 are just strong enough to push the rollers gently against the film, so that they will not injure the same. When the slot 77 or 78 comes in alignment with a pair of rollers, the latter are pushed by the springs 126 into contact with each other to close an electric circuit. The contact rollers 119 are so positioned that, when the end of the first sound track 71 is reached, the slot 78 comes in line with the rollers and closes certain circuits (presently to be explained) for reversing the drive shaft 17 and moving the shutter 100 downward into operative alignment with the second sound track 72. When the end of sound track 72 is reached, the slot 77 allows the rollers 118 to engage and close a circuit that opens the switch of motor 21, so that the machine stops. The slots 77 and 78 are shown in exaggerated dimensions for clearness.

The circuit connections controlled by the rollers 118 and 119 are illustrated diagrammatically in Fig. 10, now to be described. Main leads 127 and 128 are connected to a source of current 129, which may be an ordinary house-lighting system. A hand-operated switch 130 may be interposed for connecting and disconnecting the leads 127 and 128. If alternating current is used, a suitable rectifier 131 should be inserted in conductors 132 and 133 to supply direct current to the various solenoids and relays. One of the rollers 119 is connected to conductor 132 by a wire 134, and the companion roller is connected by a wire 135 to one side of a solenoid or relay 136, which controls a pair of switch arms 137 and 138. The other side of relay 136 is connected by a wire 139 to a conductor 140, which in turn is connected to conductor 133. One of the contact rollers 118 is connected by a wire 141 to one side of a solenoid or relay 142, which controls a switch arm

143. The other side of relay 142 is connected to conductor 132. I might mention here that the relays 136 and 142 are of any standard make and they may conveniently be enclosed in a box 142' (see Fig. 3). A wire 144 connects one side of solenoid 113 with one side of solenoid 31, and the other side of solenoid 113 is connected by a wire 145 to one side of solenoid 65. The other side of solenoid 31 is connected by a wire 146 to the switch arm 137, which normally engages a contact 147 connected by a wire 148 to conductor 132. One side of solenoid 32 is connected by a wire 149 to switch arm 138, which is normally out of engagement with the associated contact 150 connected to solenoid 112 by a wire 151. The other side of solenoid 112 is connected by a wire 152 to one side of solenoid 64, the other side of which is connected by a wire 153 to conductor 132. One terminal 154 of the electric motor 21 is connected to the circuit lead 128, and the other motor terminal 155 is connected by a conductor 156 to the switch contact 157, which normally engages the associated switch arm 143. It is hardly necessary to add that I have used the words "wire" and "conductor" in this paragraph to designate broadly any practical form of electrical connection, whether wire, rod, plate, or what not.

Let us assume that the film 47 is running in a forward direction—that is to say, the shaft 17 is driving the sprockets 44 and 45 in a clockwise direction as viewed in Fig. 2, so that the film is wound off spool 41 onto spool 42. When the end 74 of sound track 71 is reached, the rollers 119 move into contact through slot 78 in film 47 and close the circuit through relay 136, which attracts the switch arms or armatures 137 and 138, thereby moving the arm 137 away from contact 147 and at the same time moving the arm 138 against contact 150. The opening of switch 137—147 breaks the circuits of solenoids 31, 65 and 113, thereby releasing the associated levers 26, 58 and 106, respectively. The closing of switch 138—150 by relay 136 energizes the three solenoids 32, 64 and 112, whereby these three operations take place: the lever 26 connects the clutch 22 with bevel gear 19, the lever 58 is rocked to tighten the belt 56, and the lever 106 is actuated to pull down the shutter 100 into operative relation to the lower sound track 72. It will thus be clear that, when the end of the first sound track 71 is reached, the driving shaft 17 is reversed and the lower sound track 72 is subjected to the action of the optical reproducing mechanism in box 79.

The reverse movement of film 47 accomplishes two things: it winds the film back on spool 41 and causes operation of the reproducing mechanism by means of the lower sound track 72. When the end 76 of sound track 72 is reached, the rollers 118 come into contact through slot 77 in the film and thereby close the circuit of relay 142, which moves the arm 143 away from contact 157, whereby the motor circuit is interrupted and the film stops. The reversing of the film when unwound and its rewinding take place automatically without attention by the operator. It is assumed that when the film has stopped on being rewound, the switch 130 is thrown open, so that no current is wasted when the pairs of rollers 118 and 119 engage each other after removal of the film. The main switch 130 is not intended to be closed until after a new film has been inserted in the machine. The movable switch arms 137, 138 and 143 are supposed to spring back to normal position as shown in Fig. 10 when the switch relays 136 and

142 are de-energized. Consequently, when the main switch 130 is closed again to start a new film, the solenoids 32, 64 and 112 are energized to actuate the associated members 26, 58 and 106, respectively, into normal position for the forward drive of the film.

I have not considered it necessary to show and describe any loudspeaking mechanism controlled by the photo-electric cell 83, because the art of recording and reproducing sound photo-electrically is replete with systems of various kinds for translating sound into light variations to form a track on a film and for converting this track into audible sound. Although I have shown only two sound tracks 71 and 72, it is manifest that more than two sound tracks may be provided, depending largely on the width of the film used. It is preferable to have an even number of record tracks, such as two, four, six, etc., so that the film is wound back to original position when the machine is through playing. That puts the film in condition to be removed and replaced by another. Although I have referred to the tracks 71 and 72 as sound tracks, it is obvious that, in the broader aspect of my invention, those tracks may represent any other type of record. The movable shutter 100 represents only one way of controlling the record tracks 71 and 72, and other expedients may be resorted to for accomplishing the same purpose. At the present time, however, I think that a movable shutter control, such as I have disclosed, is perhaps the simplest arrangement for that purpose. I say this in a suggestive and not a restrictive sense. When in certain claims I speak of a tape or film having a pair of record tracks, I mean at least two tracks without excluding the idea of more than two. I use the word "tape" broadly to include a magnetic band, an optical film, and perhaps other practical forms of flexible recording and reproducing ribbons.

The basic features of my invention may undoubtedly be embodied in other forms than herein set forth, and I therefore do not wish to be limited to the details herein described and shown in the drawings. Changes and modifications will probably occur to others without departing from the scope of the invention as defined in the appended claims.

I claim as my invention:

1. Film-controlled photo-electric mechanism having a movable shutter for changing the direction of light to the film, a source of light and photo-electric means operatively associated with the film and said shutter, which is mounted to move independently of said source of light, and means controlled by the film itself for automatically operating said shutter at a predetermined moment, said film-controlled means automatically resetting the shutter to initial position.
2. The combination of a photographic film movable in an optical field, a shutter movable independently of said optical field for shifting the light laterally of the film, and electromagnetic means controlled by the film for automatically operating said shutter at predetermined intervals, said electromagnetic means automatically resetting the shutter to initial position.
3. The combination of a photographic film supported for operative movement, an optical field for said film, means for holding said film and optical field against relative lateral displacement, a member arranged in said optical field and movable independently thereof for changing the direction of light to said film, and means whereby the film itself controls the operation of said mem-

ber and automatically restores it to initial position.

4. In acoustic apparatus, the combination of a film having a plurality of reversely arranged sound tracks, a source of light and a photo-electric element arranged on opposite sides of said film in operative relation thereto, mechanism for driving said film forwardly and reversely, a movable shutter for exposing only one track at a time to light rays from said source, means for mounting said shutter to move relatively to said source of light, means controlled by the film for operating said shutter at the end of each sound track, and means whereby the film-controlled operation of said shutter at the end of the last track automatically returns the shutter to initial position.

5. In acoustic apparatus, the combination of a flexible tape having a plurality of reversely arranged sound tracks, driving mechanism for said tape, said mechanism including means for automatically reversing the movement of said tape when the end of a sound track is reached, reproducing means operatively associated with said sound tracks during the forward and reverse movements of said tape, means including a member movable independently of said tape and reproducing means for automatically subjecting said tracks successively to the action of said reproducing means, and means whereby the operation of said track-selecting means at the end of the last track automatically returns said last-mentioned means to initial position.

6. In acoustic apparatus, the combination of a flexible tape having a plurality of reversely arranged sound tracks, driving mechanism for said tape, said mechanism including electric means controlled by the tape itself for automatically reversing the movement of said tape when the end of a sound track is reached, reproducing means operatively associated with said sound tracks during the forward and reverse movements of said tape, means including a member movable independently of said tape and reproducing means for automatically subjecting said tracks successively to the action of said reproducing means, and means whereby the operation of said track-selecting means at the end of the last track automatically returns said last-mentioned means to initial position.

7. In acoustic apparatus, the combination of a film having a plurality of reversely arranged sound tracks, a source of light and a photo-electric element arranged on opposite sides of said film in operative relation thereto, said film and the associated optical members being held against relative movement laterally of the film, mechanism for driving said film forwardly and reversely, means whereby light rays from said source pass only through one sound track at a time during the forward and reverse movements of the film, said means including a member movable independently of said source of light, and means for automatically causing said track-selecting means at the end of the last sound track to be in operative position for the first sound track of the next film.

8. An electric phonograph comprising mechanism for running a length of sound film from one spool to another, an electric motor for operating said mechanism, said film having at least a pair of reversely arranged sound tracks and a slot at the end of each track, a photo-electric reproducing device operatively associated with said film, said device including a stationary

source of light, a shutter movable relatively to said source of light for exposing one of said tracks to the action of said device during the forward run of said film, said shutter being movable independently of said reproducing device, electromagnetic means for reversing the operation of said mechanism to rewind the film, switch contacts controlled by one of said slots for actuating said reversing means when the end of the first track is reached, means controlled by said switch contacts and slot for operating said shutter to expose the second sound track to the action of said reproducing device during the return movement of said film, and other switch contacts controlled by the other slot for stopping said motor and said mechanism when the end of the second track is reached.

9. The combination of a photographic film movable in an optical field, a slidable shutter for shifting the light laterally of the film, means for mounting said shutter to move independently of said optical field, and means controlled by the film itself for operating said shutter at predetermined intervals and automatically restoring it to initial position.

10. The combination of a photographic film supported for operative movement, said film bearing a plurality of substantially parallel record tracks, means for providing an optical field for said film, a shutter movable independently of said optical field for shifting the light from one track to another, and means for automatically operating said shutter when the end of a track is reached, said operating means automatically restoring the shutter to initial position at the end of the last track.

11. The combination of a photographic film having a plurality of record tracks arranged in reverse relation, an optical field operatively associated with said film, means for driving said film through said field in alternately opposite directions, a shutter movable relatively to said optical field and automatically operated at each reversal of the film for shifting the light from one track to the next, and means whereby said shutter at the end of the last track is automatically restored to initial position.

12. The combination of a photographic film supported for operative movement, said film bearing a plurality of substantially parallel record tracks, means for providing an optical field for said film, a shutter movable relatively to said optical field for shifting the light from one track to another, and electromagnetic means controlled by the film itself for automatically operating said shutter when the end of a track is reached, said electromagnetic means automatically restoring the shutter to initial position at the end of the last track.

13. In acoustic apparatus of the class described, the combination of a sound film supported for movement in either direction and having a slot near each end, reproducing means controlled by said film, two pairs of switch members associated with said film, each pair of said members normally engaging opposite sides of said film and being held thereby in open position, each of said slots causing one pair of switch members to engage and close an electric circuit, means controlled by one pair of said members for reversing the movement of the film, and means controlled by the other pair of members for stopping the film.

14. In sound-reproducing apparatus, the combination of a film having a plurality of sound

- tracks, optical reproducing mechanism associated with said film, means for moving the film through the optical field of said mechanism, a shutter movable independently of said optical mechanism for exposing only one track at a time to said mechanism, electromagnetic means for operating said shutter, switch means controlled by the film for energizing said electromagnetic means when the end of each sound track is reached, and means whereby said film-controlled operation of the shutter at the end of the last sound track automatically returns the shutter to initial position.
15. In sound-reproducing apparatus, the combination of mechanism for driving a sound film which carries a plurality of reversely arranged record tracks, said mechanism including means for automatically reversing the direction of movement of said film when the end of a sound track is reached, an optical reproducing device associated with said film, a shutter mounted to move independently of said device for exposing only one track at a time to the action of said device, means controlled by the film when moving in either direction for automatically operating said shutter at the end of a track, and means whereby said film-controlled operation of the shutter at the end of the last sound track automatically returns the shutter to initial position.
16. The combination of a stationary source of light, a stationary photo-electric cell, a film movable lengthwise between said elements and provided with a plurality of record tracks, means for preventing relative lateral movement of said source of light and said film, means for directing

light rays from said source to said cell through said film tracks, said means including a movable member adapted to direct light rays through one record track at a time, said member being movable with respect to said light source and said cell, electromagnetic means for operating said member, and film-controlled electric connections for energizing said electromagnetic means to actuate said member at predetermined intervals.

17. Film apparatus comprising, a stationary source of light, a photo-sensitive film, means for moving said film lengthwise in either of two opposite directions, means for preventing relative lateral movement of said source of light and the film, light-directing means movable relatively to said source of light for directing said light upon said film in a beam of a width less than the width of said film, and means for relatively moving said light directing means and said film at predetermined time intervals for directing said light upon different longitudinal portions of said film.

18. A film apparatus comprising a stationary source of light, a photo-sensitive film, means for longitudinally moving said film, means for defining said light in a beam less in width than the width of said film, means for preventing relative lateral movement of said source of light and the film, light directing means movable relatively to said source of light for directing said beam of light upon said film, and means for relatively shifting said light directing means and said film at predetermined time intervals with respect to the longitudinal movement of said film.

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