April 18, 1944. C. CHEDISTER 2,346,905

SOUND RECORDING

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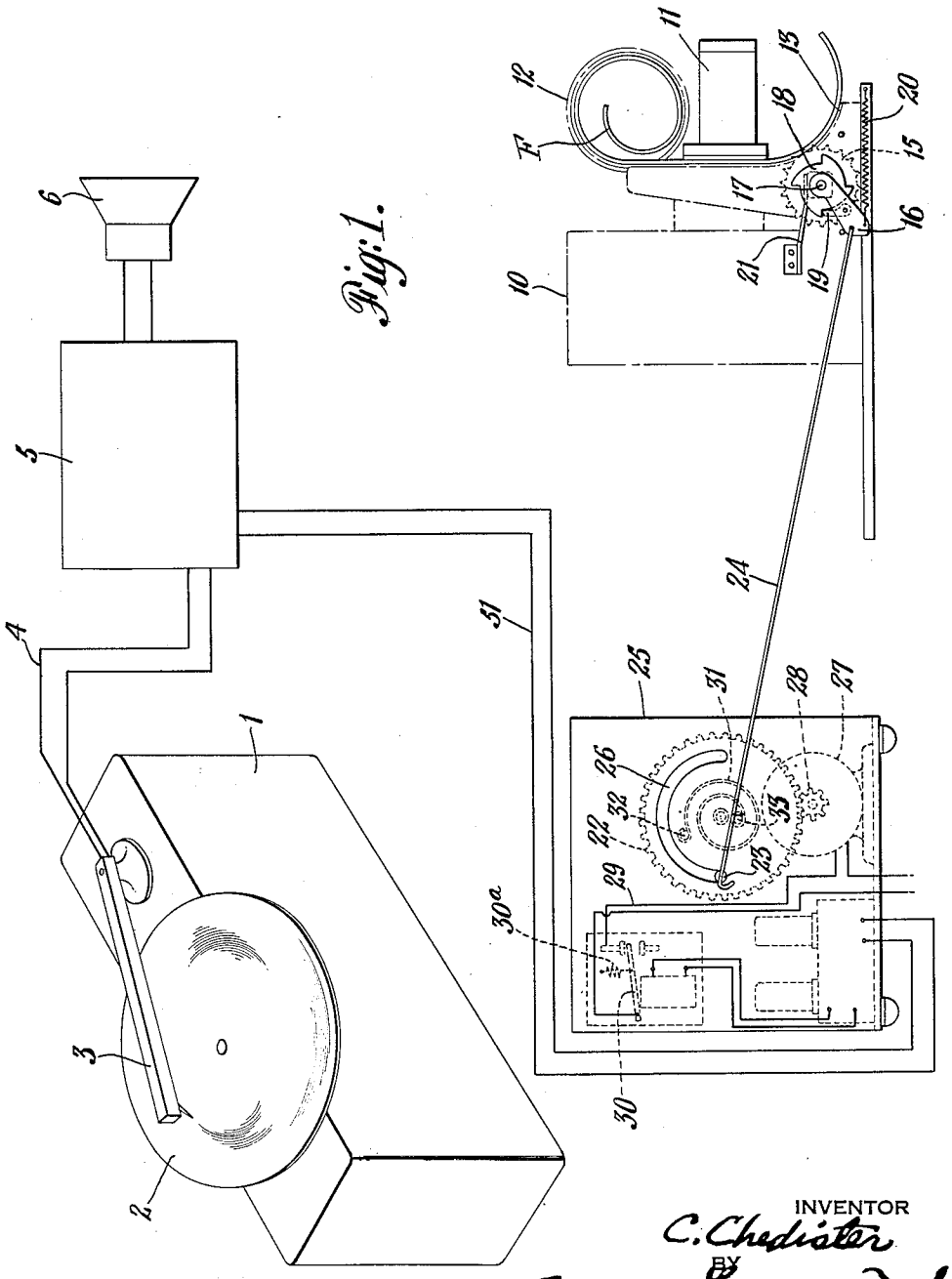


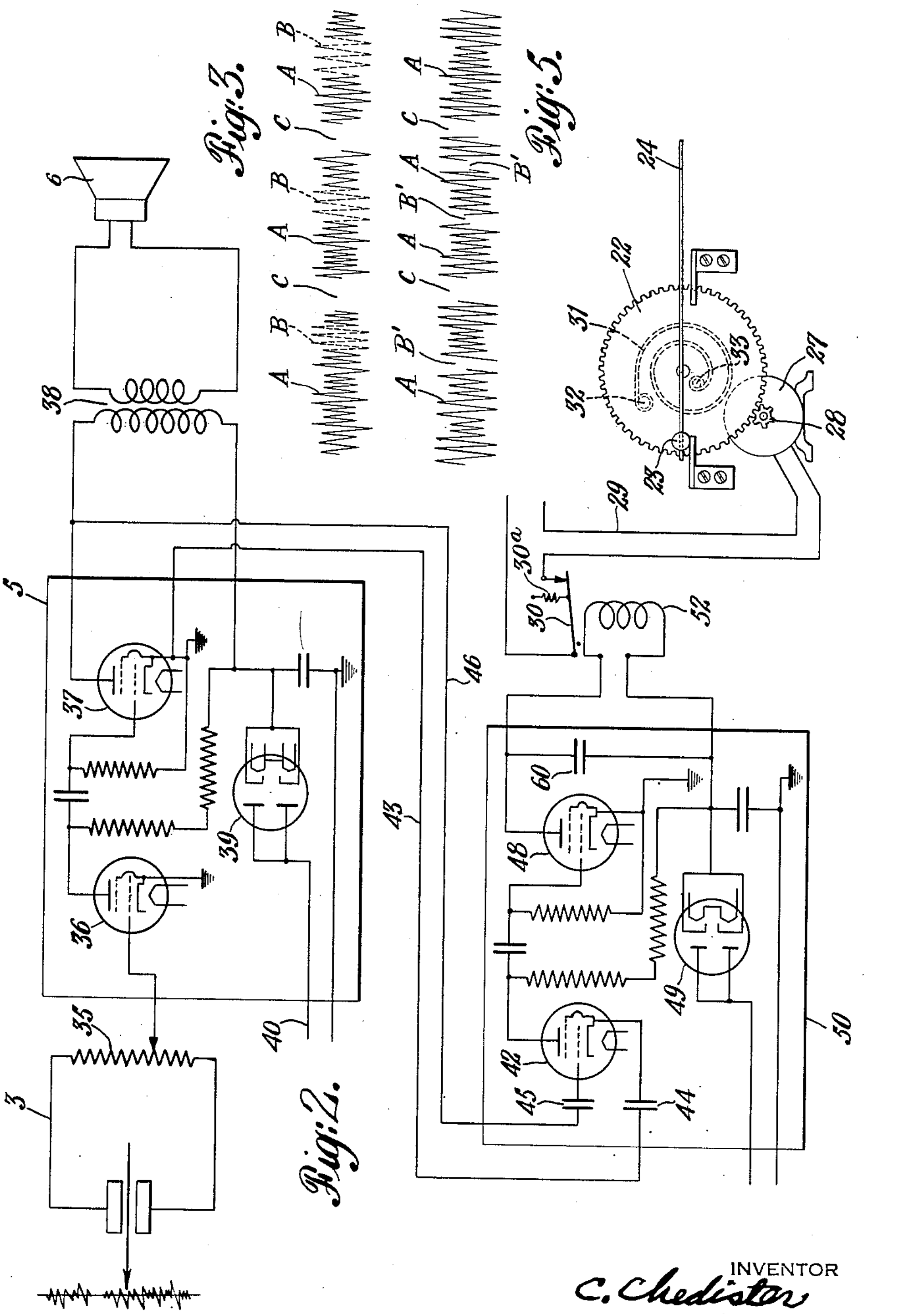
Fig. 1.

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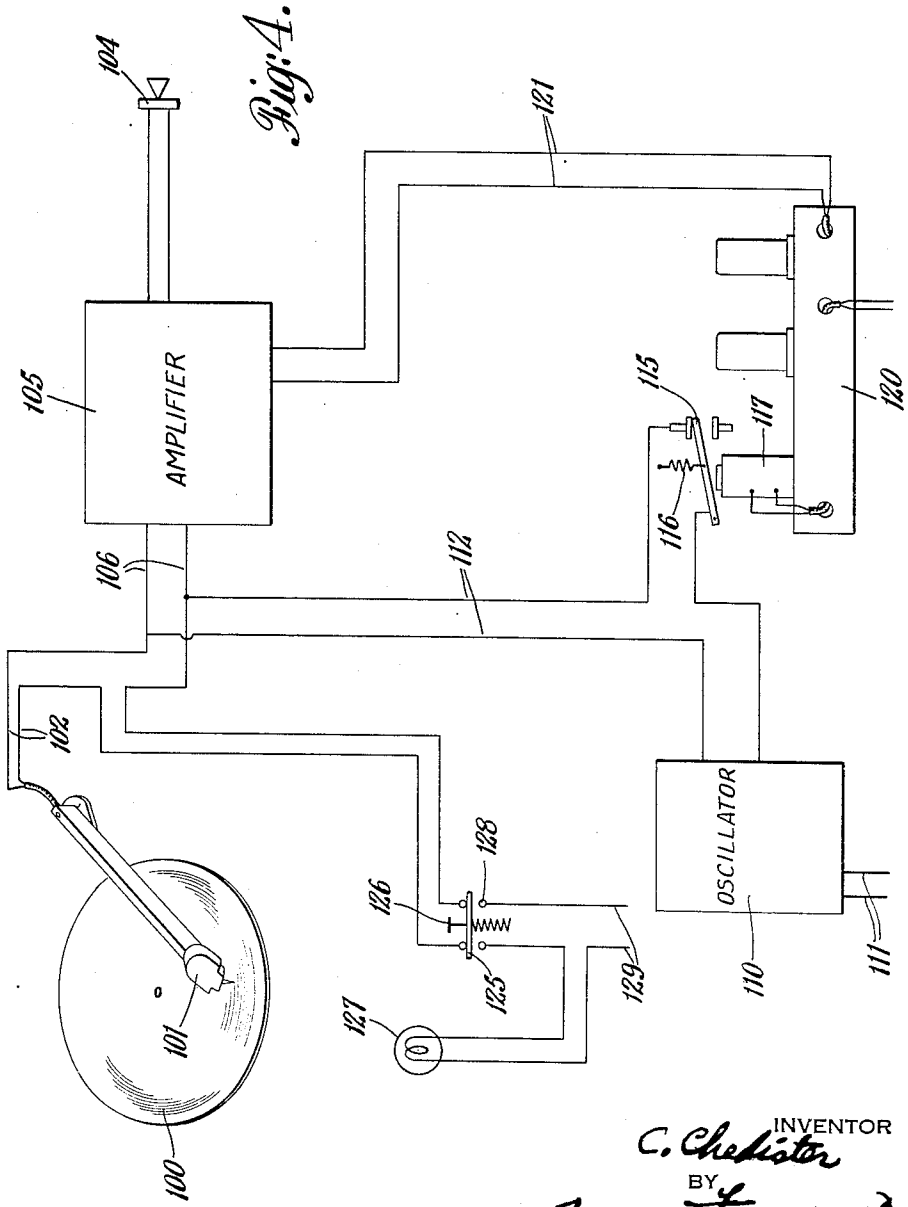
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Fig. 4.



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SOUND RECORDING

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8 Claims. (Cl. 88—28)

The invention relates to sound recording and to a mechanism for operating apparatus in predetermined automatic relation to reproduction from a sound record.

Objects and advantages of the invention will be set forth in part hereinafter and in part will be obvious herefrom, or may be learned by practice with the invention, the same being realized and attained by means of the instrumentalities and combinations pointed out in the appended claims.

The invention consists in the novel parts, constructions, arrangements, combinations and improvements herein shown and described.

The accompanying drawings, referred to herein and constituting a part hereof, illustrate one embodiment of the invention, and together with the description, serve to explain the principles of the invention.

Of the drawings:

Fig. 1 is a partly diagrammatic view of an apparatus embodying the invention;

Fig. 2 is a wiring diagram of the apparatus shown in Fig. 1;

Fig. 3 is a diagrammatic view of typical portions of a sound record embodying the invention;

Fig. 4 is a diagrammatic view of apparatus for recording the novel sound record of the invention; and

Fig. 5 is a view similar to Fig. 3 of a modified form of record.

The invention is directed to providing novel methods and mechanism for controlling the operation of apparatus in predetermined relation to the reproduction from a sound record. The invention also comprises a novel recording method and means for producing a sound record capable of functioning in and with said control mechanism and further comprises the novel sound record so produced. The principles of the invention are broadly applicable to sound records and sound recording of either the photoelectric film type or the mechanical sound records, such as the disc type. In the present application embodiments of only the latter form will be shown and described in detail, but the application of the invention of the equivalent form of photoelectric records of sound on film will be obvious to those skilled in the art.

One object of the invention is to provide mechanism for effecting and controlling the actuation of film-feeding means in conjunction with the playing or reproducing of sound from a sound record which contains sound sequences relating to the subject matter shown on the film. The invention is especially applicable to the actuation of the frame-by-frame feeding mechanism of a still or slide film projector, primarily for the purpose of advancing the roll of film one frame at the end of a predetermined sound sequence on the record being played. The problem of automatically operating film feeding mechanism in conjunction with the playing of a sound record is a difficult one as the frequency of the operations is necessarily irregular because of the varying lengths of sound sequences applicable to the various pictures in the film. Many unsuccessful attempts have been made to produce a practical and inexpensive automatic mechanism for this purpose but prior to the present invention there has been no successful solution of the problem and the commercial method currently employed is to provide an audible signal (such as a gong sound) on the sound record at the end of each sound sequence so that an operator may manually actuate the film feed mechanism at each gong signal.

Another object of the invention is to provide a novel record having recordings thereon coordinated with and supplemental to the usual recordings of sound sequences whereby an accurate and convenient control of the film-feed actuating means is provided. The invention is designed to utilize for control spaces on the sound record which are silent, the term "silent" being defined as a space in the record track having no recorded or impressed frequency and thus having a complete absence of any frequency to which the phonograph pick-up would be sensitive. One difficulty in attempting to utilize such silent spaces on a record for control in the actuating circuit is that silent spaces frequently occur in the recordings of normal speech, music or other audio sequences. Consequently in previous efforts to utilize silent spaces for this purpose it has been necessary to provide actuating mechanism which would function only upon a silent space of a predetermined and unusual length and to provide elaborate and unreliable devices for preventing control actuations when silent spaces of less than said unusual length occurred in the record.

One object of my invention is to produce a record and a mechanism capable of functioning therewith wherein silent spaces of relatively short length may be utilized for control purposes and also to prevent naturally occurring silent spaces from effecting unintended actuations of said mechanism. In accordance with these objects I therefore provide a sound record on which the

normal sound recording has interpolated therewith recordings of an inaudible frequency to which the phonograph pick-up is electrically sensitive or responsive. Said inaudible frequencies are interpolated into the sound record at all normally silent points therein, thereby preventing the accidental occurrence of a silent space having no recorded frequency at any place in the record except where such "silent space" is intentionally provided for the purpose of mechanism actuation or control. Consequently the normal record produced by my invention comprises a normal sound track with all the breaks or silent spaces normally occurring in such sound track or sequence filled in with an inaudible frequency interpolated for the purposes above described, said record also having silent spaces of no recorded frequency at predetermined points only where it is desired to actuate the film feed or other mechanism to be controlled. Consonant with the foregoing it will be clear that the control and actuating mechanism of my invention is designed to cooperate with a record of the type described; while the invention also provides means for automatically making records having said characteristics.

With respect to the control and actuating mechanism provided by the invention, said mechanism is designed and intended to operate upon any desired length of silent or no-frequency record track. Consequently the record as a whole is not prolonged by the interpolation of silent spaces of undue length heretofore made necessary by mechanism intended to cooperate with such no-frequency spaces. On the other hand, my mechanism does not require a pick-up or operating circuit tuned to any particular frequency, as it will operate only upon a complete absence of recorded frequency. Consequently the mechanism is free from the delicacy and inaccuracy of those tuned circuits which are designed to function upon or in connection with an imposed frequency of predetermined value. Furthermore, because there is no inaudible frequency superposed upon or synchronous with the recording of normal sound, I avoid any possibility of heterodyne currents in the pick-up. Neither is there any possibility that the control circuit may be unintentionally operated by the chance occurrence of a frequency accidentally the same as that intended for the tuned control circuit.

The pick-up and control circuit provided by my invention is an exceedingly simple one and makes possible the construction of a device which can be conveniently built into the casing of present commercial forms of combined phonograph and slide film sets.

It will be understood that the foregoing general description and the following detailed description as well are exemplary and explanatory of the invention but are not restrictive thereof.

Referring now in detail to the present preferred embodiment of the invention illustrated by way of example in the accompanying drawings, the general layout of the apparatus is diagrammatically shown in Fig. 1. A phonograph 1 is provided with suitable motor driven support for sound record 2 having electrical pick-up arm 3 of standard construction. The usual pick-up circuit 4 runs to a standard amplifier 5 which is connected to a suitable loud speaker 6.

A slide film projector 10 is diagrammatically indicated as having projecting lens 11 and a conventional curved film support 12 for holding the unfed portion of the film roll F, the roll thence passing through the projector gate and, after projection, onto a curved disposal track 13.

Conventional means for feeding said film F frame-by-frame through the projector gate comprises sprocket wheel 15 which is rotatable unidirectionally to feed the engaged film by means of an actuating lever 16. The film is adapted to be advanced one frame upon rotating the lever a full stroke clockwise to the position shown in Fig. 1. Ratchet wheel 18, fixed to the wheel 15, and pawl 19, fixed to the lever 16, cause the sprocket wheel to turn with the lever during said clockwise movement of the lever, but permit the lever to have an idle return movement in the counter-clockwise direction, said movement being effected by the tension spring 20. Leaf spring 21 lying against a square hub on the sprocket wheel provides for accurate register of the fed film with the gate. Thus a rearward or clockwise pull on the lever 16 causes the film to advance one frame, while the lever returns to its original position after completion of said feeding stroke so as to be in position to feed the film another frame on the next clockwise actuation.

Automatically controllable power means are provided by the invention for actuating the film-feed lever 16. As embodied a motor driven gear wheel 22 is provided with an eccentric pin 23 projecting axially from its flat surface. A lanyard 24 is attached at one end to the lever 16 and at its other end to the pin 23. Gear wheel 22 is mounted on a horizontal shaft within a casing 25. Said casing is provided with an arcuate slot 26 through which the pin 23 extends. Said slot 26 is preferably of 180°, concentric with the travel of pin 23 and acting as stop means at either end of its arcuate path.

Means are provided for imparting motion to gear wheel 22, said means comprising electric motor 27 having gear 28 meshing with gear 22. Said motor is normally stationary, its line circuit 29 being normally open and under control of magnetic relay-operated switch 30 as hereinafter described in detail. A helical spring 31 is mounted about the shaft of gear wheel 22, one end of said spring being fixed to a stationary pin 32 on the casing and the other inner end being fixed to a stud 33 on the wheel 22. When wheel 22 is free to turn, spring 31 causes it to rotate counter-clockwise through the 180° arc imposed by slot 26 to the position shown in Fig. 1. By such movement the lanyard 24 will be drawn a distance sufficient to retract lever 16 and feed the film one frame. Upon closing the motor circuit 29, the motor will cause the gear 22 to rotate in the opposite direction against the spring, return the pin 23 to the opposite point and therewith permit lever 16 to return to its initial position whereby the film feed is ready for the next frame.

Referring now to Fig. 2 it will be seen that the wiring diagram of the pick-up 3 and the amplifier 5 are conventional and may be of any suitable form. As embodied, current from the volume control 35 of the pick-up feeds into the grid of the first amplifier tube 36. The plate out-put of tube 36 is in turn resistance-coupled to the grid of second amplifier tube 37. The plate out-put of tube 37 feeds to the out-put transformer 38 of the loud speaker 6. A rectifier tube 39 is provided to rectify the plate current of the amplifier tubes, and preferably said recifier tube makes the circuit capable of use with either A. C. or D. C. current from the line 40.

In accordance with the invention means are provided for automatically energizing motor 27 to return lever 16 whenever silent, no-frequency spaces occur on the sound record and to cause spring 31 to draw said lever through the feed motion whenever frequency vibrations on the record are resumed. For this purpose the invention provides a second amplifier circuit 50 which may be substantially a duplicate of amplifier 5. The plate out-put of tube 37 is fed into the grid of tube 42 by wire 46 and the corresponding cathode or ground circuit connection is connected from tube 37 to tube 42 by wire 43. Condensers 44 and 45 are inserted in the circuit wires 43 and 46 respectively for the purpose of permitting only the A. C. component to be amplified by tube 42. A second stage of amplification in amplifier 50 is provided by tube 48 and rectification is provided by the tube 49.

As will be clear from the circuit diagram, both amplifiers 5 and 50 are energized whenever the needle of the pick-up 3 is vibrated by some frequency on the record. If the frequency picked up by the needle is within the audio range, sound will be reproduced over the loud speaker 6; while if the frequency is of non-audible characteristics, the circuit of amplifier 5 will also be energized but no audible sound will be transmitted from the loud speaker. In all cases, however, when frequency, either audible or inaudible, is transmitted to the pick-up needle, the circuit of amplifier 50 will be energized.

The plate signal from amplifier tube 48 energizes relay 52 for controlling magnetic switch 30 which is across the power line 29 of the motor 27. A condenser 60 may be inserted across the line of relay 52 to prevent chatter or introduction of any undesirable signal therein. When energy is transmitted through the second amplifier 50 the relay 52 is thereby energized to hold the switch 30 open so that no current is transmitted to the motor 27. Thus whenever the pick-up encounters any frequency on the record the motor 27 will be stationary. However, when a silent space of no frequency is encountered by the pick-up, the relay 52 will be de-energized, thus closing switch 30 and causing motor 27 to rotate. A spring 30*a* is provided to close switch 30 when the relay 52 is de-energized. So long as the silent, no-frequency space on the record is in contact with the pick-up needle the energized motor will hold the wheel 22 in a position 180° opposite that shown in Figs. 1 and 2. When the pick-up needle again encounters frequency, either audible or inaudible, on the record track, relay 52 is again energized to open switch 30 and the lanyard and lever 16 are drawn back to the position of Figs. 1 and 2 and thereby advance the film.

Thus a complete actuation of the film-feeding mechanism is effected by the sequential effects of a silent space and a frequency or energy space on the record track. The silent space effects movement of the actuation lever in one direction and the frequency effects the opposite movement. Obviously the sequence of frequency and no-frequency can be utilized in the other order as well, merely by reversing the direction of switch 30 so that the power stroke of lever 16 may be effected when energy is transmitted to motor 27 and the return movement of the lever accomplished by means of the frequency parts of the record. In either case, however, the complete cycle of actuation is effected by a sequence of frequency and no-frequency or vice-versa, on the record.

In Fig. 3 there is a diagrammatic showing of a typical record track as would be imposed on a groove in the record in accordance with the invention. The solid wave lines A indicate audible frequencies, while the dotted wave lines B indicate inaudible frequencies, which are interpolated wherever and whenever it is desired to fill in a normally silent space in the recording so as to prevent actuation of the film feed at such normally occurring silent space. For example, if the audible frequencies A be considered as representing parts of a speech, the inaudible frequencies B would be interpolated during normal pauses in such speech as would occur for example at the end of a phrase or sentence. Said inaudible frequencies B may be of any suitable range either above or below the normal audio range. However, when it is desired to provide actuation of the film feed by de-energizing the circuit of amplifier 50, the record will have spaces C of no recorded frequency and those spaces will be utilized as hereinabove described to actuate the motor switch 30 and thereby make the power stroke of the film-feeding lever 16. Inasmuch as the switch 30 and motor 27 will be operated instantaneously upon the occurrence of any blank space C it will be obvious that such spaces need not have any unusual or predetermined length but may be of relatively short duration, for example one-half second, or even one-tenth second. Because of this feature of the invention it is possible to introduce control movements for the film feeding mechanism without any apparent break in the continuity of a sound script as for example where it may be desired to feed the film during part of a song. For such purpose normally existing pauses of such short duration may usually be found or provided in an appropriate place in the record and such a short break in the sound would be unnoticed, but would be sufficient to actuate the feeding mechanism.

The control mechanism of the invention is also capable of operation with a record having no interpolated inaudible frequency B. In such case (Fig. 5) the blank or no-frequency spaces C will be of a length substantially greater than any normally occurring silent space B' in the speech or music being recorded. In order to prevent undesired closings of the switch 30 upon the occurrence of such normally silent spaces B', the condenser 60 will be of such increased value or capacity that it will introduce a time delay in the functioning of the relay 52. By suitably predetermining the capacity of the condenser 60 with respect to the relatively short, normal silent spaces B' in the sound sequences of the record it is thus possible to cause the relay 52 to become de-energized only when a blank space C on the record exceeds the discharge capacity of condenser 60.

Referring now to the means provided by the invention for producing a record having recorded frequencies and blank spaces of the character indicated in Fig. 3, a suitable mechanism therefor is shown in Fig. 4. As embodied a record blank 100 is mounted in convenional manner for making recordings thereon by a recording tool 101. The tool is provided with suitable circuit wires 102 for receiving frequencies to be impressed upon the record, said frequencies being converted into mechanical movement at the tool in any suitable or conventional manner not shown.

For the transmission of sound sequences or audio frequencies to the recording tool a microphone 104 is connected in conventional manner to an audio amplifier 105 and thence by leads 106 to the tool circuit 102.

In accordance with the invention, oscillations of an inaudible frequency are impressed upon the record through the tool 101 at those points B in the sound sequence which are normally silent. For this purpose an oscillator 110 for generating inaudible frequency is connected to a power circuit at 111 and leads by circuit wires 112 into the tool circuit 102. The oscillations may be of a frequency either above or below the audible range for a reproducing loud speaker. I prefer to use an inaudible high frequency above 10,000 cycles per second.

Means are provided for automatically closing circuit 112 to transmit the frequency B of the oscillator to the cutting tool 101 only at such times as there is an absence of audio frequency from the amplifier 105, as would occur during a pause in normal speech for example. For this purpose a relay-controlled switch 115 is provided across the circuit 112, said switch being normally closed by a spring 116 and adapted to be opened by energizing of a relay 117. Energy is transmitted to relay 117 through an amplifier 120 and said amplifier is connected by lead wires 121 to the out-put of audio amplifier 105. Hence whenever audio energy is being transmitted from the microphone through audio amplifier 105, the relay 117 will be energized and circuit 112 thereby opened. However, whenever a silence occurs in the audio sequence, switch 115 will close and during such silence inaudible frequencies will be transmitted to the tool circuit 102 from the oscillator 110, thereby providing the frequency interpolations B as previously described.

For providing the blank, no-frequency spaces C on the record 100, I provide switching means for arbitrarily cutting out the transmission of any frequency to the tool 101 at any desired or predetermined point in the record. For this purpose a double-pole switch 125 is provided across the line 102 to the recording tool. Said switch 125 is manually operable by push button 126 so that the operator may interpose a blank space C at any desired point in the record by merely pushing the switch button 126 for any required length of time. By so opening switch 125 it is obvious that transmission of frequencies from both the audio amplifier 105 and the oscillator 110 will be eliminated. For convenience of operation a signal light 127 may be connected for operation by the opening of switch 125. The second pole 128 of the switch lies across the power line 129 to the signal lamp 127 so that when circuit 102 is broken the lamp will be lighted and vice-versa. By this means the artist or operator making the record will be apprised of the timing of the blank spaces and thereby convenienced in making the record.

The invention in its broader aspects is not limited to the specific mechanisms shown and described but departures may be made therefrom within the scope of the accompanying claims without departing from the principles of the invention and without sacrificing its chief advantages.

What I claim is:

1. In a control mechanism in combination a sound record having audible frequencies and inaudible frequencies recorded thereon in tandem relation, said record also having interposed blank spaces of no recorded frequency, a pick-up, an electrical control device operable in one sense by transmission through the pick-up of either of said types of frequencies and operable in the opposite sense when the pick-up encounters one of said blank spaces.

2. In a control mechanism in combination a sound record having audible frequencies and inaudible frequencies recorded thereon in tandem relation, said record also having interposed blank spaces of no recorded frequency, a pick-up, a movable member, an electrical control for said member, said control being responsive to both of said types of frequencies to move said member in one direction and responsive to said blank spaces to move the member in the opposite direction.

3. In a control mechanism in combination a sound record having frequencies recorded thereon and interposed with blank spaces of no recorded frequency, a pick-up, a slide film projector having a film correlated with said recorded frequencies, a film feeding means, and an electrical control device operable in one sense when the pick-up encounters a blank space to actuate said feeding means in one direction and operable in the opposite sense when frequency is transmitted through the pick-up to actuate said feeding means in the opposite direction.

4. In a control mechanism in combination a slide-film projector, a film feeding device therefor having a two-directional movement for feeding the film frame-by-frame, a sound record having recorded frequencies and blank spaces thereon, a pick-up for the record, and a control device responsive to the effect of said frequencies on the pick-up for moving said feeding device in one direction and responsive to the effect of said blank spaces on the pick-up for moving the feeding device in the opposite direction.

5. In a control mechanism in combination a slide-film projector, a film feeding device therefor, a sound record having recorded frequencies and blank spaces thereon, a pick-up for the record, a device to be actuated, a control means for said device responsive to the effect of said blank spaces on the pick-up, and means for preventing response by the control means from a blank space shorter than a predetermined length.

6. The method of producing a sound record for controlling the feed of a slide film in a projector which comprises recording successive sound sequences appropriate to the successive scenes on the film to be projected concurrently with the reproduction of the record, spacing said sound sequences with blank spaces of no recorded frequency at points in the record corresponding to the feeding of the film from one scene to the next, and filling all silent places in the record except those occupied by said blank spaces with an inaudible recorded frequency.

7. In a control mechanism in combination a sound record having audible frequencies and inaudible frequencies recorded thereon in tandem relation, said record also having interposed blank spaces of no recorded frequency, a pick-up, and an electrical control device operable in one sense when the pick-up encounters a blank space and operable in the opposite sense when any frequency is transmitted through the pick-up.

8. In a control mechanism in combination a slide-film projector, a film-feeding device therefor, a sound record having recorded sound frequencies appropriate to the successive scenes on the film to be projected concurrently with the

reproduction of the record, said sound sequences being spaced by blank spaces of no recorded frequency at points in the record corresponding to the feeding of the film from one scene to the next, all silent places in the record except those occupied by said blank spaces being filled with an inaudible recorded frequency, a pick-up for the record, and control means for moving the film operable through the pick-up, said control means being operated to move the film only when the pick-up encounters one of said blank spaces and being restrained from film-feeding movement by either audio or inaudible frequencies on the record.

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