Oct. 19, 1937. S. E. ADAIR ET AL 2,096,020

METHOD OF MAKING A RECORD

Original Filed March 27, 1933 2 Sheets-Sheet 1

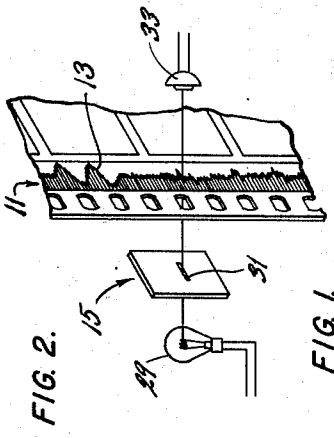


FIG. 2.

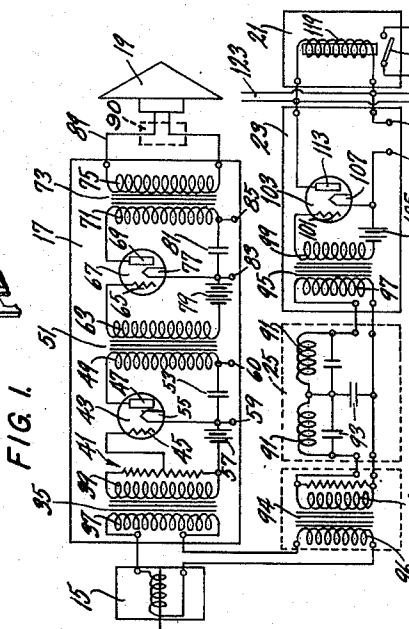


FIG. 1.

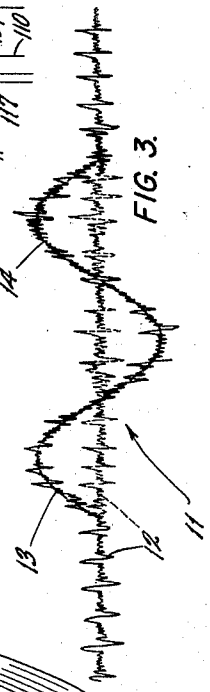
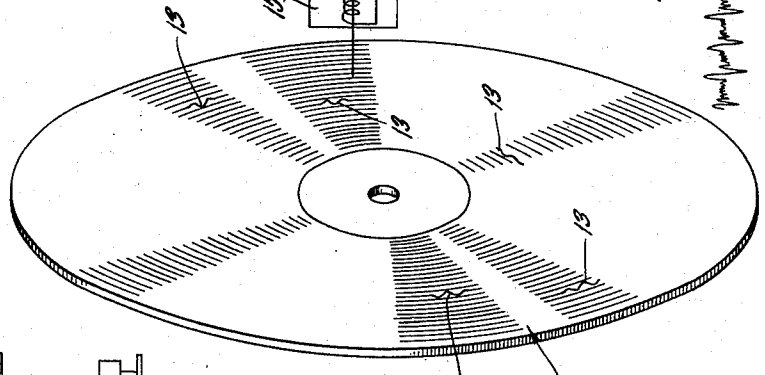


FIG. 3.



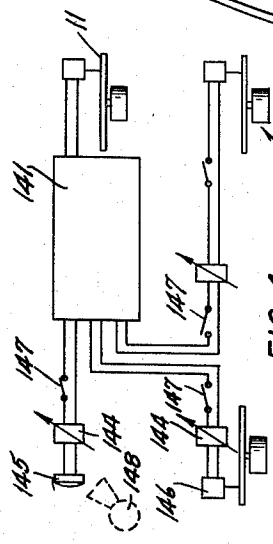


FIG. 4.



FIG. 9.

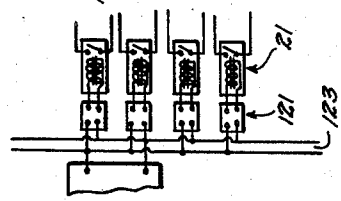


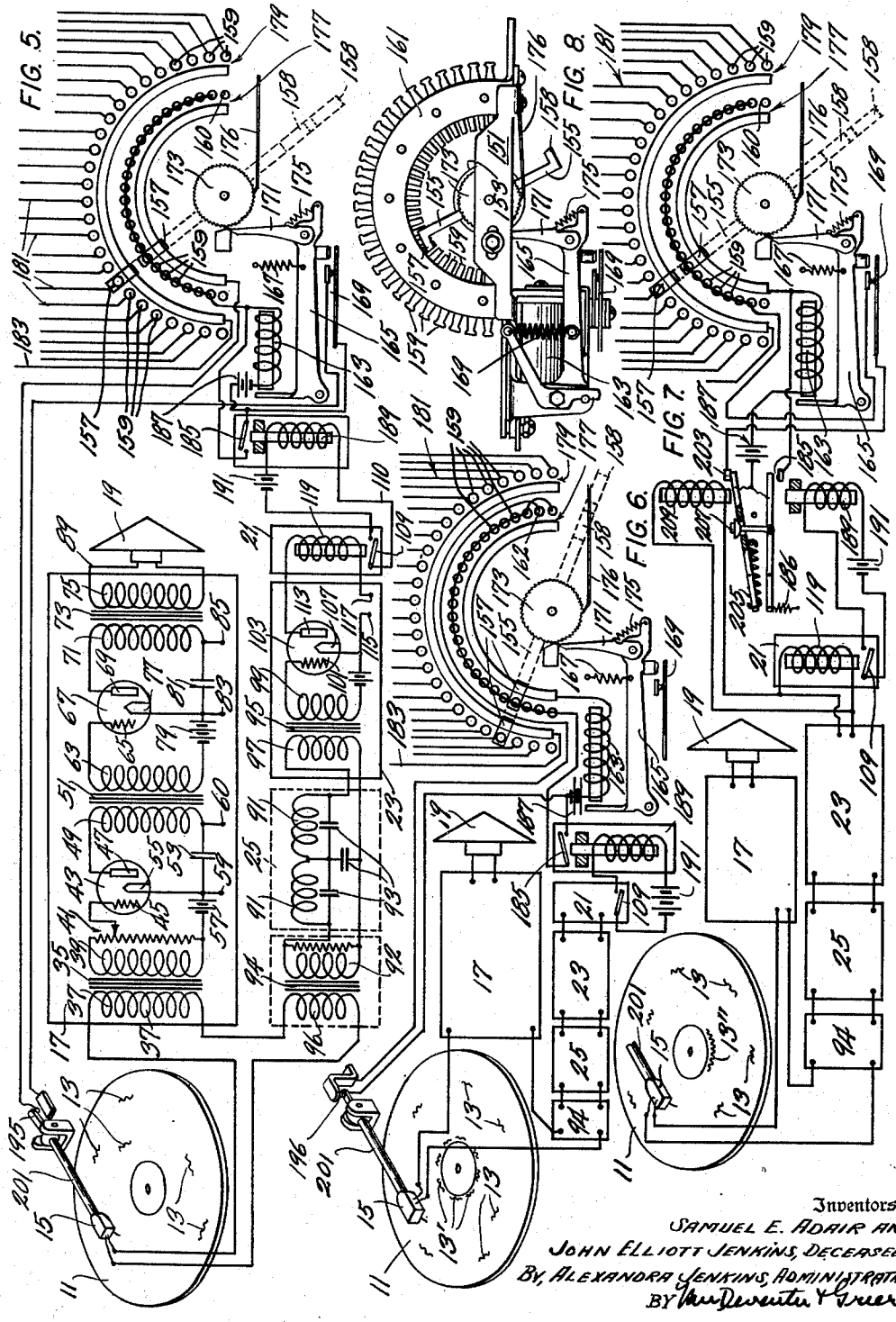
FIG. 10.

Inventors
SAMUEL E. ADAIR AND
JOHN ELLIOTT JENKINS, DECEASED,
BY ALEXANDRA JENKINS,
ADMINISTRATRIX
BY Van Benschoten & Green
Attorneys

Oct. 19, 1937. S. E. ADAIR ET AL 2,096,020

METHOD OF MAKING A RECORD

Original Filed March 27, 1933 2 Sheets-Sheet 2



Inventors
SAMUEL E. ADAIR AND
JOHN ELLIOTT JENKINS, DECEASED,
BY ALEXANDRA JENKINS, ADMINISTRATRIX
BY Van Deventer & Greer
Attorneys

Patented Oct. 19, 1937 2,096,020

UNITED STATES PATENT OFFICE

2,096,020

METHOD OF MAKING A RECORD

Samuel E. Adair, Chicago, and John Elliott Jenkins, deceased, late of Chicago, Ill., by Alexandra Jenkins, administratrix, Chicago, Ill., assignors, by mesne assignments, to Jenkins & Adair, Inc., Chicago, Ill., a corporation of Illinois

Original application March 27, 1933, Serial No. 662,860. Divided and this application February 21, 1936, Serial No. 65,129

6 Claims. (Cl. 274—41.4)

This invention relates in general to a record from which sounds or other sensory effects may be reproduced and adapted to control operative devices in conjunction with sounds or other sensory effects artificially reproduced from the record.

The present application comprises a division of the co-pending application 662,860, filed March 27, 1933 which in turn comprises a continuation in part of the application Serial No. 641,842, filed November 9, 1932 and issued as Patent Number 1,909,765 granted May 16, 1933.

An object of the invention is to provide a record having means to control the operation of any device in conjunction with the reproducing of a predetermined sound sequence or other sensory effect from the record, the operation of the device being controlled from such record.

Another object resides in providing means including a sound record for reproducing a sound sequence and for actuating an operable device from impulses in the sound record itself during the reproduction of the sequence and without interrupting or modifying the same.

Another object is to superimpose operating frequency vibrations at intervals in a sound or similar record whereby to operate a tuned relay, or other device sensitive to the operating frequency, at one or more intervals as the sound record is reproduced, in order to operate, through the agency of the relay, any mechanical or electrical device in timed relationship with the sound sequence or other sensory effects as reproduced from the record of the sound.

Another object is to produce a record or sound track from which sound or other sensory effects may be reproduced and from which track or record-operating devices may be controlled to operate in timed relation with the reproduced sensory effects.

Another object resides in the method of reproducing sound or other sensory effects from a record or other sound source while controlling the operation of operable devices in timed relation and in conjunction with the sensory effects as the same are reproduced.

Another object resides in providing a record adapted for use in automatic lecturing and demonstrating equipment whereby a lecture may be reproduced from a sound track or record, which also controls the operation of the device being operated or demonstrated in conjunction with the lecture, such equipment being especially well adapted for operating mechanical displays, such as may be arranged in shop windows, or any other convenient display location in conjunction with the loud speaker which broadcasts a sound sequence which may comprise an oral description of the device or devices being operated, or music, or both speech and instrumental music as a pleasing background.

Another object is to provide a record adapted for use in a suitable display device for automatically displaying, in sequence, a series of pictures or other visual effects in conjunction with a lecture or other sound sequence reproduced from the record or track, the control of the display being accomplished by said record or track.

Another object is to provide a record for use in an automatically operating apparatus for controlling the volume or pitch of sounds or noises produced in timed-relationship with displayed picture sequences or other visual effects as in the operation of the so-called talking moving pictures, the apparatus also being adaptable for the control of any operable device operated in conjunction with the displayed picture sequence or to operate warning signals for any purpose during the progress of the picture sequence, such, for example, as to operate warning lights in the manager's office, or in the box office, or at other stations in the theatre in order to advise the staff of the theatre of the progress of the picture sequence being shown.

Another object of the invention resides in providing a record for use with talking moving picture apparatus for reproducing a sound sequence from the record or sound track, including means for controlling the reproduced sounds and for actuating separate operating devices for controlling the theatre lights or signaling to various stations in the theatre as the sound sequence progresses, said means being actuated from the sound record or track itself.

Another object of the invention resides in providing a record for use in an apparatus for reproducing a sound sequence from the record or track, said record including means for controlling the volume or pitch of the reproduced sound and means for actuating separate devices operable in conjunction with the reproduction of the sound effect, said device being actuated from the sound track without being affected by the volume or pitch control.

Another object is to provide a method of and apparatus for producing a record or sound track from which a sound sequence, or other sequence of sensory effects, may be reproduced, and from which record or track operable devices may be actuated or controlled in timed relationship with the effects reproduced from the track or record.

Another object is to provide a record having a sound track including vibrations of a predetermined character to actuate operable devices other than the phonograph device with which the record may be used to reproduce the sound.

Other objects of the invention reside in the adaptations of the broad principles of the in-

vention to the various types of specific devices hereinafter disclosed.

Another object resides in providing automatic means operated by the record itself for turning the mechanism to a predetermined set position, such as an initial or starting position.

Another object resides in providing, in conjunction with a record of sound or other sensory effect, means operated by the record itself for controlling a selector switch or other progressively operating device, while the effect is being reproduced from the record by means of operating vibrations impressed on the record itself and for returning the switch automatically to a predetermined position, such as an initial or starting position, at a predetermined moment during the playing of the record, such as the moment when the record ends.

Another object resides in using a record of sound or other sensory effect having operating frequency components imposed on the record in conjunction with apparatus for reproducing the effect from the record and apparatus for advancing a selector switch, or other progressively operating device, in response to the frequency components wherein the selector switch is set to a predetermined position automatically at the completion of the reproduction of the record.

Another object is to provide a record having a sound track including vibrations of several distinct characters to actuate operable devices and to reset the same to a desired position or condition.

Numerous other objects and advantages of the invention will be appreciated as the same is more fully understood from the following description, which, taken with the accompanying drawings, discloses a preferred embodiment of and for the purpose of disclosing the invention.

Referring to the drawings:

Figure 1 is a diagrammatic representation of a record and record reproducing system embodying the invention, said system being actuated from a grooved sound track or record by means of a mechanical pick-up device;

Figure 2 is a diagrammatic representation of a photo-electric pick-up device, which may be substituted for the mechanical pick-up in the system shown in Figure 1 for use with a photographic record;

Figure 3 is an enlarged diagrammatic representation of one form of sound record or track having an operating frequency superimposed thereon in accordance with the present invention;

Figure 4 is a diagrammatic representation of apparatus for making a record for use in practicing the invention;

Figure 5 is a diagrammatic representation of a record reproducing system embodying the invention in which the operating components of the record are used to progressively operate a selector switch and wherein the selector switch is automatically returned to an initial or starting position when the system is conditioned to commence reproduction of the record;

Figure 6 shows a system similar to that of Figure 5 in which the record itself carries a series of operating components which cause the selector switch to be turned to a desired position from any other switch position;

Figure 7 shows a system similar to those of Figures 5 and 6 in which a single operating component on the record causes the selector switch to move to a desired position from any other switch position;

Figure 8 is a side view of the selector switch shown diagrammatically in Figures 5, 6 and 7;

Figure 9 is a perspective view showing a magnetic record which may be used in conjunction with a suitable magnetic pick-up for impressing the recorded vibrations upon a sound reproducing and device actuating system in accordance with the present invention; and

Figure 10 shows a modified arrangement of a part of the system illustrated in Figure 1.

To illustrate the invention, there is shown on the drawings, in Figure 1, an electrical system for reproducing sound and, at the same time, controlling operable devices, such as a tuned relay 21, from a record represented generally at 11, through a pick-up device 15. The sound record 11 may be made in any suitable or convenient manner known to the art and may be of any suitable form, that is to say, may be a groove formed in a cylinder or disk, as shown in Figure 1; may be photographic record on film, as shown in Figure 2; or may be a magnetic record formed, as for instance, in an iron wire as shown in Figure 9.

As shown in Figure 3, the record 11 consists of a single recorded track incorporating both a normal sound recording 12, which, for simplicity, shall be called the sound track, and a device-operating recording 13, which shall be called the operating component; that is to say, the normal sound track is combined with the operating component so that the record 11 consists, in part, of recorded vibrations 14, comprising the resultant of the sound track 12, and the operating component 13.

The operating component 13 may have a sinusoidal wave form as shown in Figure 3, or may be of more complicated configuration. The wave may be a simple wave or may be the envelope of an oscillation of higher frequency. The wave may have uniform frequency or may be a coded series of vibrations, in which case, the relay 21 is a coded relay adjusted to react only to the particular coded component in response to which it is desired to have the relay react.

The operating component moreover need not necessarily be artificially applied to the record, or the original sound, but may be a pre-selected component of the sound sequence itself, the relay 21 being adjusted to re-act to the particular selected component, as for instance, in orchestral music, the relay may be set to operate in response to a particular note of a particular instrument.

The record 11, if the operating component is applied thereto artificially, may be prepared in any suitable manner as by connecting, with a suitable recording apparatus 141, a suitable device 143 for delivering to the recording apparatus the operating component at the proper time so that the same may be superposed upon the sound vibrations as they are recorded, the sound vibrations being fed into the sound recording device by any suitable pick-up, such as a microphone 145, if the record is made from the original sound, or a pick-up device 146, where the record 11 is made from a previously recorded sound track, or a microphone and pick-up may be used together if desired as where previously recorded incidental music is to be "dubbed" as a background in the record for the original sound.

The oscillating device 143 may be an oscillating electric circuit tuned to the frequency desired for the operating component, or may be a previously

prepared record of an operating vibration having a desired frequency or frequencies. The oscillating device is connected with the recording device through a normally open control key 147, which key is closed by the operator whenever it is desired to impress the operating component upon the sound recording. This is known as "dubbing" the operating component on the sound track.

Alternatively, a device 148 capable of creating vibrations in the air, may be positioned near the sound pick-up 145 of the recording device 141, the vibration device being actuated at intervals to add the desired operating component to the sound waves reaching the pick-up device.

Numerous other methods of superposing the operating frequency upon the sound track in the record will suggest themselves to those familiar with the art of recording sound waves and the invention is not necessarily limited to any particular mode of producing the composite record 11. It is, however, preferable to prepare the composite record 11 by "dubbing" the operating frequency upon the sound track, rather than by adding the same to the sound waves before they are applied to the pick-up 145.

The foregoing methods may be employed in making record grooves in wax or similar material, and in making magnetized wire records and photographic records. It is also contemplated making magnetized wire and photographic records by first applying the actuating component upon the recorded sound track. In the case of the magnetic record, this may be accomplished by magnetizing the wire at the proper places in accordance with the desired operating component, the wire being either previously or subsequently treated to magnetize it in accordance with the sound track recording.

In photographic records, the operating component may be photographed on the undeveloped negative on which the sound track record is subsequently or has previously been photographed, and the double exposure developed on the negative from which a positive print of the composite recording can be made, or a negative of a normal sound track record may be printed as a positive and the print of a separate negative of the operating component superimposed on the positive print of the sound sequence and the double exposure developed on the positive.

The sound-reproducing and device-actuating system consists of a suitable pick-up device 15 adapted to be vibrated in accordance with the vibrations recorded on the record 11, a sound-emitting device or loud speaker 19 connected to the pick-up preferably through the amplifying system 17, and a tuned relay 21 adapted to be actuated by the operating component of the record and also connected with a pick-up device through a relay operating system 23 and filter 25.

The pick-up device 15, as shown in Figure 1 of the drawings, may consist of an ordinary magnetic device, such as is commonly used in conjunction with the ordinary grooved phonograph record, or, an ordinary mechanical phonograph pick-up may be used in conjunction with a microphone to impress the vibrations of the record 11 upon the input of the amplifying system 17.

In Figure 2 of the drawings, the sound track 11 is shown as a photographic record, such as is commonly used in the audible moving picture art and the pick-up device includes the light source 29, the aperture 31 and a target 33, comprising a photo-electric cell, or other light-sensitive device, connected to the input of the reproducing system and upon which light rays from the light source impinge after passing through the aperture and the photographic record 11, as is well known in the art.

The invention does not necessarily reside in the particular form of record and co-operating pick-up device employed but any suitable or convenient form or forms of record and co-operating pick-up device may be used to apply the vibrations of the record upon the sound reproducing and device-actuating system.

Similarly, the amplifying system 17 may be of any suitable or convenient form or arrangement for the purpose of receiving the vibrations initiated therein by the pick-up device of whatever character used, amplifying the vibrations and delivering the amplified vibrations to the sound-emitting speaker 19 and to the relay 21. In some cases, it may be possible to omit the amplifying system entirely, but ordinarily some form of amplification is desirable.

To illustrate the invention, therefore, there has been shown an amplifying system comprising a transformer 35, the primary winding 37 of which is provided for connection with the pick-up and thus forms the input of the system and the secondary winding 39 of which is connected through a variable resistance volume control arranged as a potentiometer 41 to a vacuum tube 43, the grid 45 of which is connected with the shiftable member of the potentiometer 41, the plate 47 of the vacuum tube 43 being connected to one end of the primary winding 49 of a transformer 51, the other end of the primary winding being connected through a condenser 53, to one side of the filament 55 of the vacuum tube, said side of the filament being also connected through the grid bias means, preferably an electric battery 57, with the potentiometer 41. The filament 55 may be heated in any convenient manner as is well known in the art and terminals 59 and 60 are provided for supplying the plate potential. One end of the secondary winding 63 of the transformer 51 is connected with the grid 65 of a vacuum tube 67, the plate 69 of which is connected to one end of the primary winding 71 of a transformer 73, the secondary winding 75 of which comprises the output of the amplifying system 17. The filament 77 of the vacuum valve 67 may be heated in any suitable or convenient manner and one side of the filament is connected through the grid bias means, preferably an electric battery 79, with the secondary winding 63 of the transformer 51, the same side of the filament 77 being connected through the condenser 81 with the primary winding 71 of the transformer 73. Terminals 83 and 85 are provided for supplying the plate potential.

The speaker 19 is connected by means of suitable conductors 89 to the winding 75, the relay 21 being connected, through the relay-operating system 23 and the filter 25, to the winding 37.

The filter 25 comprises inductance coils 91 and condensers 93 and forms a filter tuned to the frequency of the operating component of the record 11, so as to pass the operating component freely while attenuating and suppressing other frequencies.

The input of the filter may be connected with the output winding 75 of the amplifying system 17, or may, as shown, be connected to the secondary 92 of a transformer 94, the primary 96 of which forms a part of the primary circuit of the transformer 35. This has the advantage that the relay is not subjected to the volume control

41 of the amplifier 17 as is the case where the relay is actuated from the output of the amplifier 17. The output of the filter 25 is connected to the input of the relay-operating system 23 which comprises means to amplify the operating component and includes a transformer 95, the primary 97 of which forms the input of the system and the secondary 99 of which is connected at one end to the grid 101 of a vacuum tube 103 and the other end of which is connected through a grid-biasing means, preferably an electrical battery 105, with one side of the filament 107. The filament 107 may be heated by any suitable or convenient means well known in the art and terminals 115 and 117 are provided for applying the plate potential between the plate and filament.

The coil 119 of the tuned relay is connected across the output of the amplifier 23. The relay 21 is adapted for operation by alternating currents delivered to the coil, the function of the relay-operating system 23 being to amplify the power of the relay-operating component sufficiently to operate the relay, which may require for its operation more power than is delivered to the operating system. In some cases, it may be satisfactory to eliminate the system 23 and operate the relay directly from the pick-up or from the output of the system 17. The relay, when actuated by the operating component, operates the shiftable member 109, which may be mechanically connected to control a device to be operated, or, as illustrated, may be arranged to operate an electrical switch for controlling the circuit 110, which, in turn, may be connected to effect the electrical control of any device to be operated.

While in some cases, it may not be necessary to utilize the amplifier 23, and the filter 25, since it is possible to operate the relay 21 directly from the output of the amplifier system 17, it is, however, desirable to provide these refinements in order to insure positive operation of the relay in response to the operating component on the record.

Any desired number of relays 21 may be connected in parallel and actuated from the output of the amplifier 23, as indicated in Figure 1, by connecting the output to the bus connecters 123, and connecting a plurality of relays similar to the relay 21 for operation from the bus connecters 123, the relays being individually tuned and connected directly to the bus connecters 123 or relays, either tuned or untuned, may be connected, as shown in Figure 10, through the intermediary of band pass filters 121, that is to say filters adapted to pass the particular frequency to which the relays are desired to respond. Such band pass filters may be of construction similar to the filter 25.

If each relay is connected to the bus connecters through the intermediary of a filter, each filter may be selected or adjusted to pass a particular frequency so that by forming operating components 13 at different frequencies in the record, the several relays so connected may be caused to operate selectively. The arrangement will be more fully discussed in connection with Figure 7.

Moreover, if the relay is connected through a filter 25 and an amplifier 23, the relay itself need not be accurately tuned to the frequency of the operating component as is the case if the filter is omitted.

It is also possible to operate a plurality of tuned relays 21 directly from the output of the relay-operating system 23. With such an arrangement, the relays may be mechanically tuned accurately each to respond to an operating component for a particular predetermined frequency in order to obtain selective operation of the relays, the filter, which is preferably used in the combination, being a low-pass filter to pass all frequencies within the tuned range of the relays.

If the operating component has a frequency within the range of audible frequencies, the speaker or sound-emitting device 19 will, of course, respond to the audible frequency of the operating component whenever the same is impressed upon the system by the pick-up device.

It is possible to utilize a speaker 19, which will react only to a certain band of frequencies within the audible range and for all ordinary purposes, it is quite practical to use a speaker operating in the audible range of frequencies above 80 cycles and below 5,000 cycles since a speaker in this range will accurately reproduce all normal speech and music and it is contemplated using such a band frequency speaker and to maintain the operating components at frequencies below 80 cycles and above 5,000 cycles, even though frequencies as low as 40 cycles and as high as 10,000 cycles are audible.

In some instances, however, it may be necessary to utilize operating components having frequencies within the range of the speaker and since the reproduction of the operating component as sound may be undesirable where the sound sequence is being reproduced for its pleasing effect upon the hearer, there has been provided for eliminating the transmission of any sound by the device 19, which may be caused by the operating component.

This may be accomplished by causing the relays 21 to switch suitable filter circuits into operation in the speaker circuit so as to silence the speaker circuit to the operating frequencies only.

It is preferred, however, to filter the operating component from the circuit 89, leading to the speaker, by inserting in the conductors 89, between the output of the amplifying system 17 and the sound-emitting device 19, a band-eliminating filter 90, which functions to highly attenuate the frequencies of the operating components of the record.

In Figures 5, 6 and 7, there are illustrated systems whereby the record 11 may be utilized to control a progressively operable device, such as the selector switch illustrated in Figure 8, during the progress of the reproduction of the record and whereby the selector switch may be automatically turned to a predetermined setting from any switch position, as for instance, where it may be desired to turn the selector switch to an initial or starting position at the termination of the reproduction of the record in order to be ready for the next time the record is reproduced or played.

As shown in Figure 8 of the drawings, the selector switch comprises a frame 151 carrying a rotary element 153 comprising a blade 155, the opposite ends of which are adapted to extend from the rotary support 153 in diametrically opposite directions. The ends of the blade 155 terminate in contact portions 157, 158, adapted when the blade is rotated on the frame 151 to progressively engage the blade contacting portions of a set of terminals 159, which are carried on an insulated support frame 161 mounted on the main frame 151. The contactor 157 engages the terminals 159 in succession during one half turn of the blade 155 while the contactor 158 repeats the terminal-engaging process during another half turn of the blade. Each one of the

terminals 159 may be connected to form parts of external control circuits adapted to be actuated when the blades engage the terminals 159. The set of terminals 159 and its co-operating contactors may be multiplied to any desired degree, that is to say, the rotary switch may include a plurality of terminal sets and co-operating switch blades, sets being mounted adjacently on the frame 151 and the co-operating blades being mounted adjacently on the rotary element 153.

In the embodiment shown in Figures 5, 6 and 7 of the drawings, as is also the case in Figure 1, the pick-up device 15 is connected in series with the input windings 37 of the amplifying system 17 and 96 of the relay-actuating system which comprises the transformer 94 and filter 25 and the amplifier 23 so that the sound track 12 of record 11 may operate the loud speaker 19 through the amplifier 17 while the operating components 13 may actuate the relay 21 as previously described in connection with the system shown in Figure 1.

In Figures 5, 6 and 7 also the rotary selector switch is shown diagrammatically and there are illustrated, in each case, two sets of terminals 159 and terminal engaging blades 155, but it should be understood that any desired number of terminal sets may be used in order to multiply the control circuits actuated by the rotary switch. The rotary switch also includes a relay having a solenoid 163 mounted on the frame 151 and an armature 165 tiltably mounted on the frame adjacent the solenoid and adapted to be shifted against the base of a spring 167 whenever the solenoid 163 is energized. A switch 169 also is carried on the main frame of the rotary switch and is operatively associated with the armature 165 so as to be opened whenever the solenoid is energized. The armature 165 carries a pawl 171 extending to a ratchet wheel 173 which is fixed to the rotatable element 153. The pawl 171 is normally urged by means of the spring 175 into engagement with the ratchet wheel so that as the armature is tilted on the frame 151 by the alternate effect of the spring 167 and the energized solenoid 163, the pawl may co-operate with the ratchet wheel to progressively rotate the element 153 and thus advance the switch arms 155 into progressive contact with the terminals 159. A detent 176 also is mounted on the frame in position to co-operate with the ratchet wheel to permit it to be advanced in one direction only, by the pawl 171. The selector switch illustrated is a type commonly used in telephone circuits and it has been shown here by way of explanation rather than by limitation, since it will be obvious that the invention is not limited to any particular form of switch and, in fact, may apply to any progressively-actuated device. The progressively-actuated device to be controlled is shown diagrammatically as a rotary switch of the type illustrated in Figure 8 and including at least two sets 177 and 179 of terminals 159 and co-operating contactors. The terminals 159 of the set 179 are provided with conductors 181 whereby the same may be connected in external control circuits while means is provided to connect the contactors 157 and 158 of the set 179 with an external conductor 183 whereby to complete the external circuits in the arrangement shown in Figure 5, one end of the coil of the solenoid 163 is connected in series with a contact switch 185, the other side of which is connected in series through a source of electrical power 187, and thence to the other end of the solenoid coil. The switch 185 is actuated by a time-delay relay 189, and is closed after a predetermined time-delay when the solenoid or the relay is energized.

The solenoid 189 is arranged in a series circuit including a power source 191, and the switch 109 of a system similar to that shown in Figure 1. With such an arrangement, the relay switch 109 will close every time an operating component 13 energizes the pick-up and the relay 189 will consequently close the switch 185 and complete a circuit for energizing the solenoid 163. It is, of course, possible to dispense with the time-delay relay 189 by connecting the switch 109 directly in the operating circuit of the solenoid 163 in place of the switch 185 but it has been preferred to use a time-delay relay to eliminate operation of the operating circuit when the switch 109 is closed accidentally for an instant, as sometimes happens as a result of influences exerted upon the system other than the definite operating frequencies 13.

As the record is reproduced, the operating components 13 successively cause the relay 21 to close the switch 109 and the solenoid 189 is energized to close the switch 185. When this happens, the solenoid 163 will be energized and will actuate the armature 165 and advance the contactors 157 into engagement with the next succeeding terminal 159 of both sets 177 and 179. When the solenoid 163 is energized by the closure of the switch 185, the armature 165 in the illustrated embodiment will tilt in a clockwise direction about its pivot point against the tension of the spring 167, the pawl 171 being carried downwardly. As soon as the operating frequency ends, the switches 109 and 185 open, thus breaking the solenoid circuit and permitting the spring 167 to draw the armature in a counter-clockwise direction thus raising the pawl and advancing the ratchet wheel 173 sufficiently to turn the contacts 155 into engagement with the next adjacent terminal 159.

The operating system just described for the selector switch is in itself novel and when used with the record can be utilized to effect the control of the external-operating circuits 181—183, and thus control any desired series of operations.

After the record has been reproduced, the selector switch, depending upon the number of operating components 13 contained in the record, will have advanced to a position engaging one of the intermediate contacts 159 of the set 179, and, if the switch is permitted to remain in such position as, for instance, that illustrated in Figure 5 of the drawings, the switch will not be in proper position to commence the control sequence when the record is again reproduced. It has been, therefore, provided for returning the selector switch to an initial or starting position automatically at the termination of the record. To this end the terminals of the set 177 with the exception of the end terminal 160 are connected in series.

A switch 195 is also provided and this switch is adapted to be closed whenever the pick-up device is conditioned to commence the reproduction of the record.

In the illustrated embodiment, the record 11 is in the form of a disk and the pick-up device is carried on an arm 201 swingably supported to move across the disk record while the switch 195 is operatively connected with the arm 201 in such a way that whenever the arm 201 is moved to raise the pick-up device from the record, the switch 195 will be closed. The switch 195 is connected in a series circuit including the switch 169, the power source 187, the contacts of the set 177, and the solenoid 163. The shorted contacts

of the set 177 being connected to one end of the solenoid coil 163 and the contactors 157 and 158 being connected to the switch 195 which is connected through the switch 169, and the power source to the other end of the coil 163 so that when the arm 201 is raised in order to either reset the device 15 to a position for starting the reproduction of the record, or to enable the record to be removed from its turn-table, the switch 195 will be closed. This will complete a circuit through the solenoid 163, and the armature 165 will be actuated to turn the ratchet wheel. Instead of moving only once to advance the contactor 155 to the next adjacent terminal 159, as in the case where the switch is operated by the operating frequency 13 in the record, the switch 195 is held in closed position but the armature, is moving downwardly, under the influence of the spring 167, will permit the switch 169 to close and re-establish the circuit through the solenoid 163. Consequently, the armature will again be turned in a counter-clockwise direction and will continue to make and break the circuit at the switch 169 and reciprocate the pawl 171 until the ratchet wheel 173 is turned to a position in which the contactor 155 of the set 177 reaches the terminal contact 160 at which time, the solenoid circuit will be broken because the terminal 160 is not connected in the circuit as are the other terminals of the set 177.

When the contactor 157 engages the isolated terminal 160, the arm 155 will be in such a position that the contactors 158 will engage the contact of the series 177 and 179, which is connected in the control circuit to be actuated when the first control frequency, in actuating the armature 165, will cause the contact 158 of the set 179 to engage the first terminal at the proper instant.

Obviously the switch 195 does not necessarily have to be mounted for operation by the movement of the arm 201 but may be actuated in any other suitable way as, for instance, by forming the switch as a push button for manual operation in response to the movement of a switch used to control the driving means, which shifts the record past the pick-up device 15. It is also possible to provide for shifting the switch arm 155 to any desired position at any time by isolating one of the terminals of the set 177 to thus cause the arm 155 to stop opposite said isolated terminal. Other control circuits for setting the switch arm to a predetermined position will suggest themselves to those skilled in the art whereby, should the switch arm 155 be shifted or held from shifting in order to synchronize the rotary switch with the record in order to bring the switch into step, should it for some reason or other get out of step with the record during the playing of the same.

The system illustrated in Figure 6 of the drawings is adapted to utilize a plurality of operating frequency impulses in order to set the switch arm 155 to a desired positon. The operating frequency impulses are formed as a succession of impulses, which are impressed on the record at the conclusion of the recorded sound frequency or sensory effect as indicated at 13' in Figure 6 of the drawings. The switch 185 in this system is connected in series with the power source 187, the solenoid coil 163 and the terminal set 177, all of the terminals of which set are connected together with the exception of the terminal 162, which, in the illustrated embodiment, is next adjacent the final terminal of the set but which, if desired, may be any of the terminals of the set opposite which it is desired to stop the arm 155. A switch 196 is also provided and this switch is adapted to be closed just before the reproduction of the record commences. This switch may be arranged for operation in any suitable or convenient manner and may be formed as a manually operable push button, or for operation by the starter switch that controls the mechanism for moving the record past the pick-up device but it is preferred to form the switch as illustrated so that the same is closed momentarily when the arm 201 is positioned to engage the pick-up device 15 with the initial portion of the record in commencing the reproduction thereof. The switch 196 is connected in series with the power source 187 and the solenoid 163. As the record is reproduced, this solenoid 163 will be periodically actuated by the operating frequencies 13 of the record, the actuation taking place through the system including the transformer 94, the filter 25, the amplifier 23 and the tuned relay 21 and the time-delay relay 189. Consequently, the switch arm 155 will be progressively advanced and at the conclusion of the record will occupy a position opposite one of the intermediate terminals 159. At the end of the record, the series of operating frequencies 13' will cause the switch to be rapidly advanced, there being enough impulses to ensure that the arm 155 is carried into position opposite the free terminal 162, at which point movement of the arm in response to the energization of the relay 189 will stop because the terminal 162 is not connected in the circuit including the switch 185 closed by said relay. The switch arm will remain in such position until the switch 196 is closed, at which instance, the solenoid circuit will be completed and will cause the arm to progress to a position such that, when the solenoid 163 is energized by the first operating frequency 13 of the record, it will be moved into engagement with the terminal 159 that is connected to the first of the external circuits 181 to be actuated. It will be noted that the succession of operating frequencies 13 is utilized to move the arm 155 to a position just short of the initial position after which the switch 196 is actuated to bring the switch arm into the initial position. In Figure 5, on the contrary, the actuation of the switch 195 is utilized to bring the switch arm 155 directly to the initial position.

In Figure 7 of the drawings, there has been illustrated a system wherein a single operating frequency, at the termination of the record, is used in place of the series of impulses 13' to turn the switch arm 155 to a predetermined position, the final operating frequency in such case having a characteristic wave form different from that employed in the operating frequencies 13.

In the system shown in Figure 7, the contacts 159 of the series 177 are, with the exception of the initial and final terminals 160, connected together and the so-connected terminals are connected in a series circuit including the switch 169, a switch 203, the power source 187, and the coil 163, the inter-connected terminals being connected to one contact of the switch 169, the other contact of the switch being connected to one terminal of the switch 203, the other terminal of said switch being connected to the power source 187, the other side of the power source being connected to one end of the coil 163, the other end of which is connected to the contactors of the terminal set 177. The coil 163 and power source 187 are also connected in series with the switch

185 so that the switch 185 operates in parallel with the switch 203 and the inter-connected contacts of the set 177 upon the coil 163 and the power source 187 so that either closure of the switch 185, or closure of the switch 203 with one of the contactors 157, 158 engaging one of the inter-connected terminals, will energize the coil 163. The switch 203 is of the toggle type, that is to say, is provided with yielding means 205 which operate to hold the switch in either open or closed position. The switch 185, however, is normally urged by means of the spring 186 toward open position so that the switch is opened by the spring 186 except when the relay coil 189 is energized. Interlocking means 207 is also preferably provided between the switches 203 and 185 so that, when the switch 185 closes, the switch 203 will be opened. The switch 203 may be closed by means of the solenoid 209 which may be connected directly to the output of the amplifying system 23 or may be connected to the output of the system through an intermediate relay similar to the relay 21 and power source similar to the power source 191 employed in connecting the relay 189 to the output of the amplifying system 23. The relay 189 is connected in series with a power source 191 and a switch 109, which switch is operated by the coil 119 of the relay 21, said coil 119 being connected to the output of the amplifying system 23. This system is adapted for turning the switch arm 155 to a predetermined setting such as the initial or starting position when a single operating frequency 13'' occurs in the record, said operating frequency 13'' having a different wave characteristic or frequency from that of the operating frequencies 13. The relay 209 is responsive only to the operating frequency 13'' while the relay 189, through the relay 21, is responsive only to the operating frequencies 13. Consequently, as the record moves past the pick-up device 15, the relay coil 189 will be energized each time the pick-up device encounters one of the operating frequencies 13, the coil 109 remaining inactive.

It will be noted that should the switch 203 be closed, when the first operating frequency 13 energizes the relay 189, the closure of the switch 185 in response to an operating frequency 13, the pawl 171 will advance the ratchet 173 a distance sufficient to move the contacts 157 from terminal 159 to the next adjacent terminal 159. Thus, as the record progresses, the various circuits 181 will be actuated successively. At the conclusion of the record, the arm 155 will have been advanced to a position intermediate the end positions. The final or switch-setting frequency 13'' will actuate the solenoid 209 to close the switch 203, the switch, on account of its toggle construction, will remain closed until opened by the actuation of the relay 189 in response to a later operating frequency 13. As the switch 203 closes with the contactors 157 engaging one of the interconnected terminals 159 of the set 177, the coil 163 will be energized to turn the ratchet wheel 173. As the armature 165 moves to accomplish this, the switch 169 is caused to open and break the circuit, de-energizing the coil 163 and permitting the armature 165 to return to its normal position under the influence of the spring 167, thus reclosing the switch 169 and again energizing the relay so that as long as the switch 203 remains closed and the contactor 157 engages one of the intermediate terminals 159 of the set 177, the arm 155 will continue to advance. As soon as the contactor 157 reaches the isolated contact 160 of the terminal set 177, the circuit, including the switch 203 and the switch 169 will be opened and the coil cannot thereafter be energized through said circuit to advance the switch arm 155. It will be noted that as the contactor 157 engages the final terminal 160, the contactor 158 at the other end of the switch arm will engage the initial terminal of the set 177 and this is the reason for isolating the initial and the final terminal. Obviously the switch arm will be caused to stop in any desired position by simply isolating the terminal 159 of the set 177 at the desired stopping point. As the record continues to play, or if the record is repeated, the first operating component 13 to engage the pick-up device will energize the coil 189, will open the switch 203 and will advance the switch arm 155 into position engaging the contactor 158 with the first terminal 159 next adjacent to the isolated terminal 160.

As an alternative arrangement, the switch 203 may be formed simply as a normally open switch similar to the switch 185 instead of as a toggle switch as shown, and the interconnecting arm 207 omitted. With such an arrangement, the device-setting recording 13'' may be extended so that the coded frequency initiated in the relay 209, when the pick-up device 15 engages the recording 13'', will be continued for an appreciable period and will hold the switch 203 in closed position maintaining the switch circuit in operation long enough to permit the contactor arm 155 to be advanced to the desired position.

It should be understood that the relay parts 163, 165 and 169 operate extremely rapidly when the switch 203 is closed to turn the arm 155 so that the resetting impulse initiated in the system by the device-resetting recording 13'' is not necessarily unduly prolonged, in fact, the effect produced by the recording 13'' on the pick-up in the modified arrangement need only prevail for a few seconds.

It is also desired to direct attention to the possibility of utilizing the invention in the control of a system incorporating the so-called telegraph relays, which respond to coded vibrations initiated in the system, that is to say, each relay may be calibrated to respond only to a definite sequence of relatively long and short impulses, or to relatively long and short gaps between impulses.

Relays of this character may be incorporated in the device-operating system in place of the relay 21 and the device-operating recordings 13 formed in the record in such a way as to provide a coded series of relay-operating impulses upon the system so that any desired one of the calibrated relays will respond to its proper coded impulse initiated by the coded vibrations on the record.

The present invention has many practical applications. It may be incorporated with a picture-display device in order to deliver a lecture or suitable music, and, at the same time, cause the picture displayed by the device to change at the proper time during the lecture or accompanying music. This is accomplished simply by having the picture-changing mechanism actuated by the relay 21, that is to say, whenever the operating component occurs in the record 11, the picture will be changed.

The picture-display device may be of any type, for instance, the ordinary automatic stereopticon or slide-projector comprising devices for presenting a series of slides or pictures in position

for display, or may be a still-film projector, that is to say, a device employing cinematograph film having pictures photographed in the successive frames of the film and mechanism for advancing one frame at a time and allowing each picture frame to remain in display position until the picture-changing mechanism is again actuated to advance the next frame into displaying position.

The apparatus and method of the invention may also be used in art museums to actuate picture-illuminating means in conjunction with the reproduction of a lecture concerning the pictures, which lecture may be delivered or broadcast from a centrally located loud speaker or speakers. The pictures being successively illuminated in order to render them highly visible as they are described during the progress of the lecture.

The invention may also be utilized to effect a practical automatic demonstration of any mechanical device requiring demonstration, as, for instance, in a shop window or elsewhere, in conjunction with the delivery of a lecture or explanatory talk, the operation of the demonstrated device being controlled through the relay or relays 21 in order to occur at the proper time during the course of the lecture. The control of the operation of the device being demonstrated and the lecture both originate from the pick-up 15 or its equivalent.

In the projection of talking-moving pictures, it is frequently necessary, in order to obtain dramatic effects, to dim the lights of the theatre, to vary the volume of sound emitted by the loud speakers, or to control other effect-producing devices at intervals during the visual or picture sequence. Such control operations may be accomplished automatically, by means of our invention, by impressing upon the sound track of the cinematograph film an operating frequency component at intervals and utilizing this component in accordance with the invention heretofore described in order, by means of the relays 21, or their equivalent, to actuate a control device for dimming the theatre lights, increasing the amplification of the system through which the sounds are broadcast, or controlling other devices for producing sensory effects during the progress of the picture sequence.

In accomplishing the volume control, it is preferable to utilize suitable switch means for progressively increasing or decreasing the amplification in order to effect the control gradually. With this type of switch, it is preferred to utilize two relays 21, one relay sensitive to an operating component having one frequency for advancing the switch, the other relay being sensitive to an operating component having a different frequency. By applying a succession of operating components of one frequency, on the sound track, the volume control switch may be progressively advanced to an extent at any time during the progress of the picture of the sequence and by interposing operating components of the other frequency, the volume control may be reduced by progressive steps at any time during the projection of the picture.

It is also possible to actuate warning signals and perform other control functions such as the starting of auxiliary projectors at intervals during the progress of the talking picture in response to actuating components impressed directly on the sound track and without interrupting the sound or picture sequence. Such warning signals may be located in the manager's office, the box office, or at other locations in the theatre in order to advise the manager or the box office as to the progress of the picture being displayed. Operating components impressed on the sound track may also be utilized to warn the operator of the projection machine at intervals in order that he may take proper action to insure the projection of the successive reels at the proper time, that is to say, near the end of the first reel, the sound track may be arranged to give a "make ready" warning so that the next reel may be mounted in a second machine ready for projection or may be made ready for mounting in the same machine if only one is used in the theatre, and an operating component may be used to automatically start the second machine in operation at the proper time.

Numerous other useful applications will suggest themselves to those familiar with the practical aspects of the projection of talking pictures in particular and the operation of devices in conjunction with the reproduction of sound generally.

It is thought that the invention and numerous of its attendant advantages will be understood from the foregoing description and it is obvious that numerous changes may be made in the form, construction, and arrangement of the several parts without departing from the spirit or scope of the invention, or sacrificing any of its attendant advantages, the forms herein described being preferred embodiments for the purpose of illustrating our invention.

What is claimed is:

1. The method of making a record which consists in the magnetization of a magnetizable strip in accordance with a vibrational component representing a sensorial sequence, and independently magnetizing said strip in accordance with a device-operating vibration.

2. The method of making a record which consists in magnetizing a magnetizable material in accordance with a device-operating vibration and superposing thereon a vibrational component representing a sensorial sequence.

3. The method of making a record in a magnetizable material which consists in variably magnetizing said material by means of lines of force representing a modulated audio frequency, and superposing on said material other lines of force representing a device operating vibration.

4. The method of making a record in a magnetizable material which consists in variably magnetizing said material while the same is in motion by means of lines of force representing a modulated audio frequency, and superposing on said material other lines of force representing a device operating vibration.

5. The method of making a record in a magnetizable material which consists in subjecting said material to magnetic lines of force, some of which are produced in accordance with variations representing a device-operating vibration.

6. The method of making a record in a magnetizable material which consists in subjecting said material to magnetic lines of force, some of which are produced in accordance with variations representing a device-operating vibration, and others of which correspond to a sensorial sequence.

SAMUEL E. ADAIR,
ALEXANDRA JENKINS,
Administratrix of the Estate of John Elliott Jenkins, Deceased.