

Nov. 2, 1948.

A. FUSCHI

2,452,743

SYMPHONIC INSTRUMENT

Filed Dec. 14, 1942

6 Sheets-Sheet 1

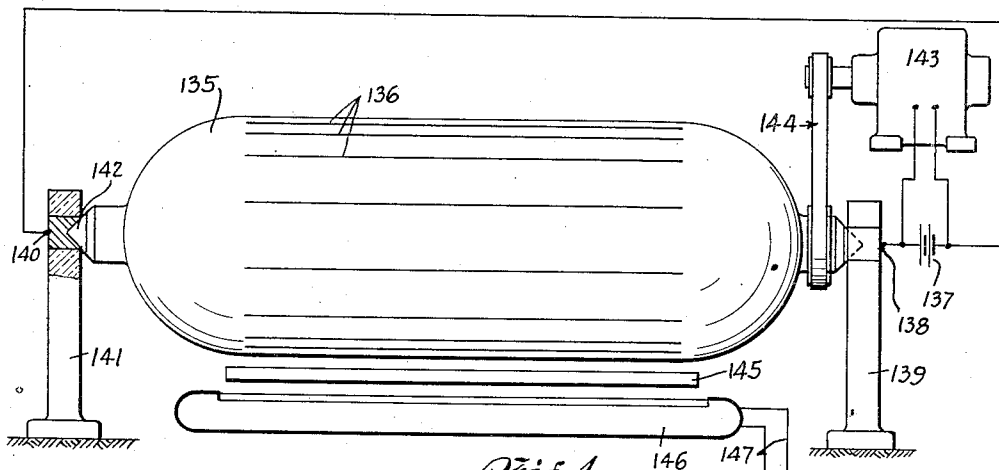


Fig. 1.

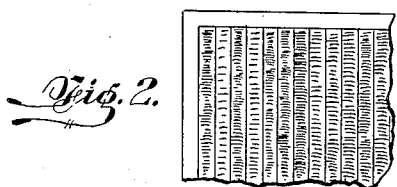


Fig. 2.

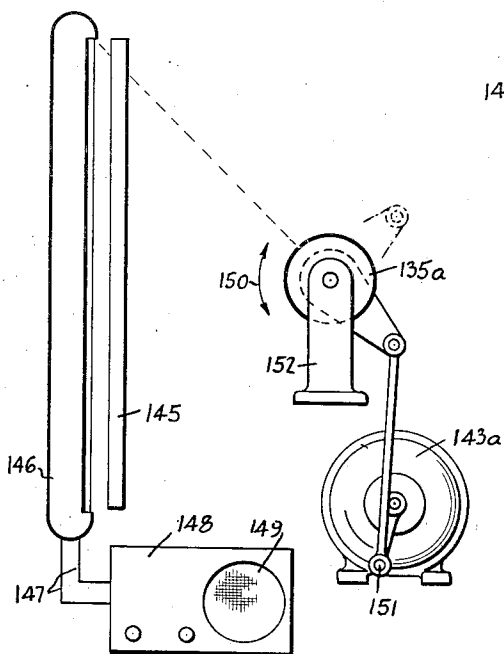


Fig. 3.

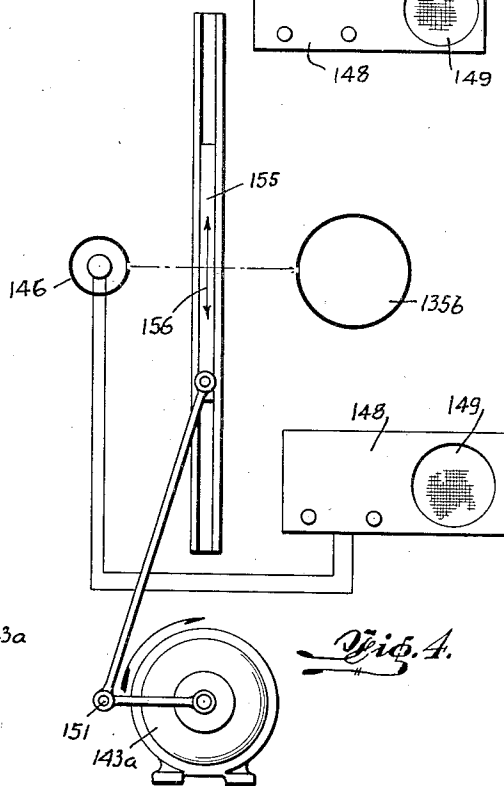


Fig. 4.

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6 Sheets-Sheet 2

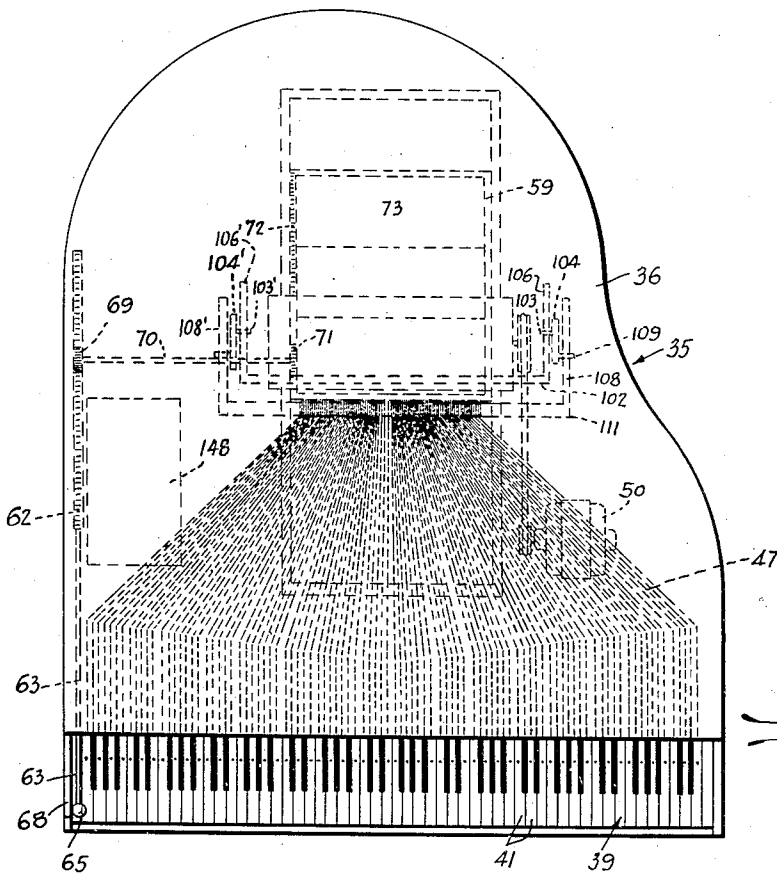


Fig. 5.

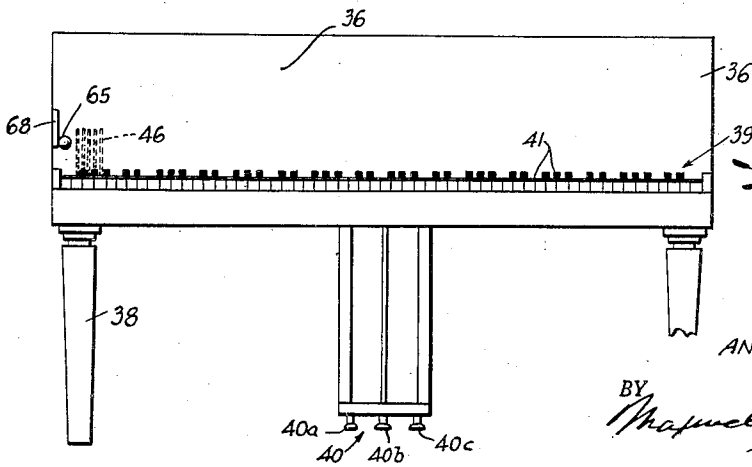


Fig. 6.

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6 Sheets-Sheet 3

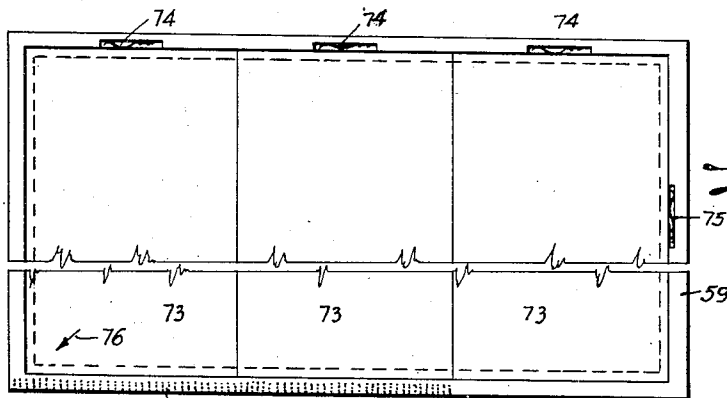


Fig. 7.

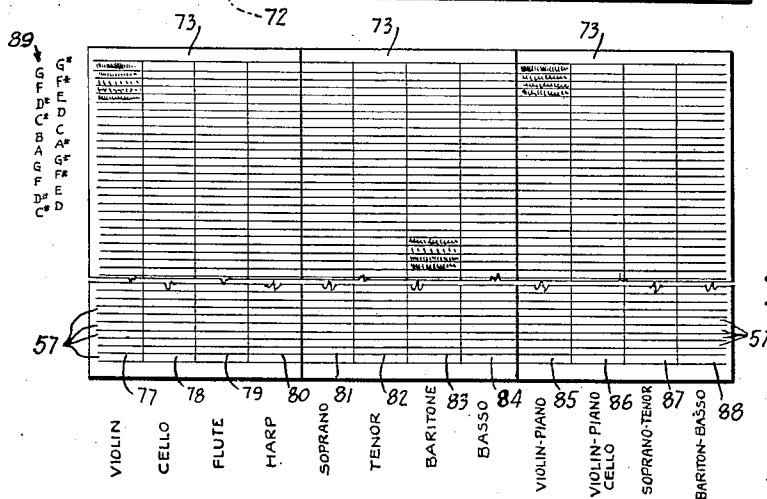


Fig. 8.

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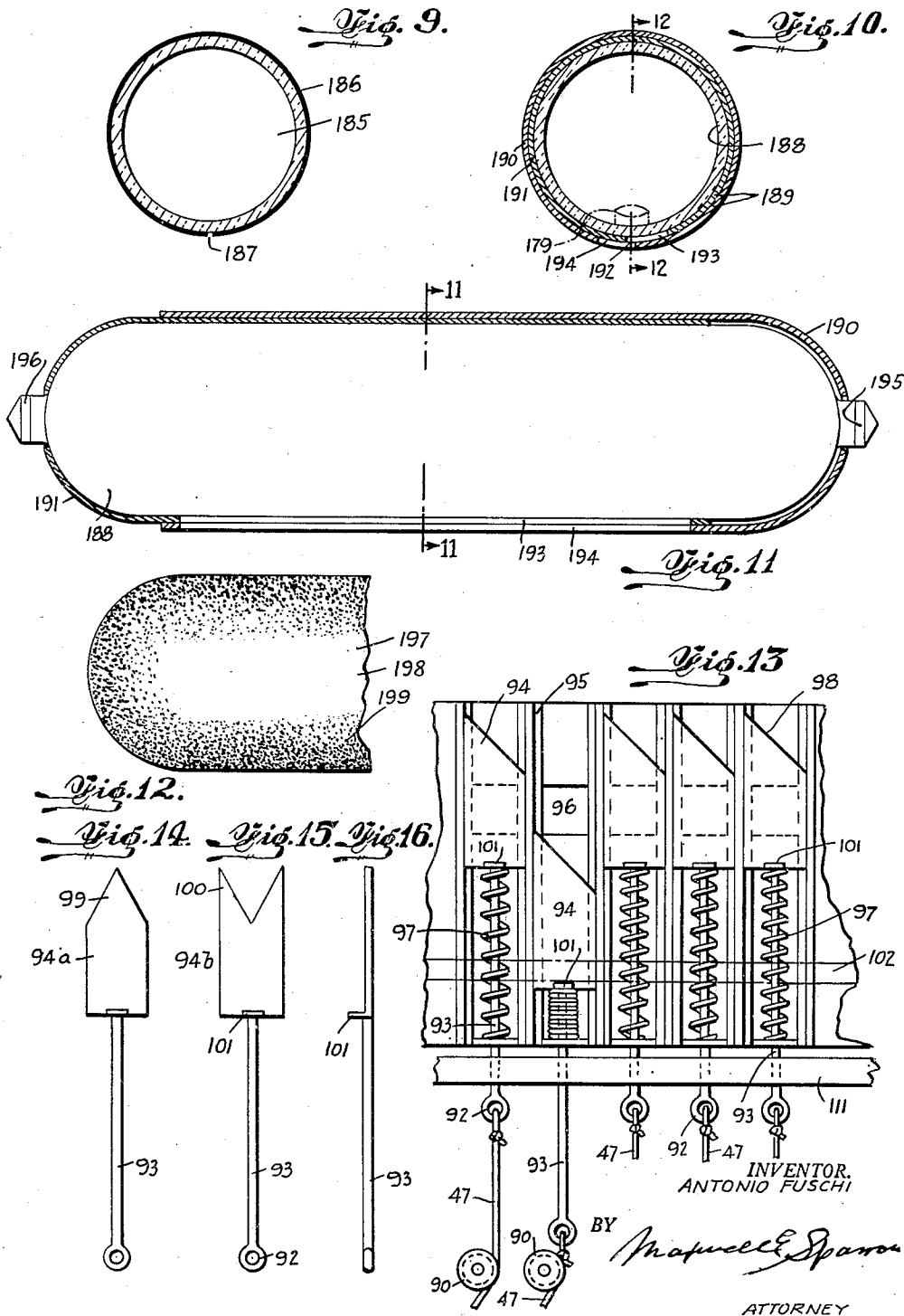
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6 Sheets-Sheet 5

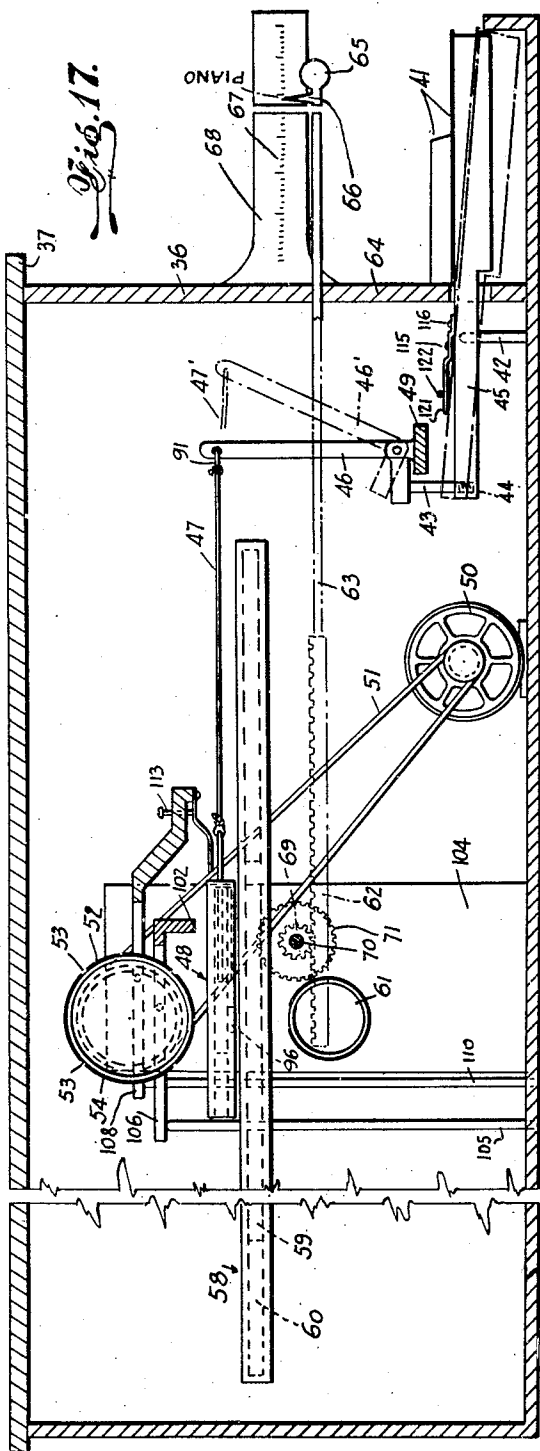
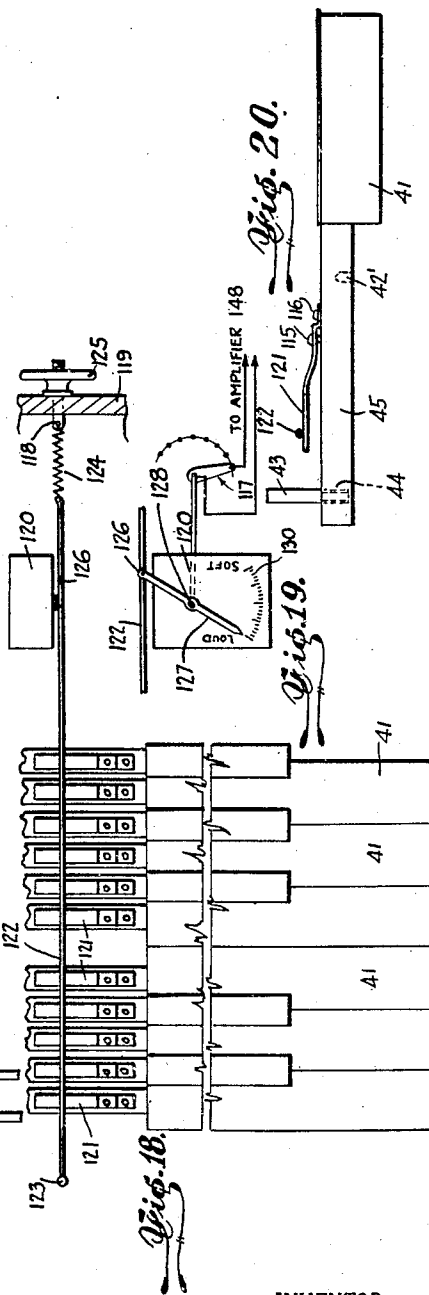


Fig. 19.

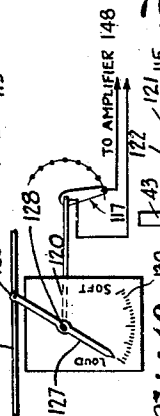
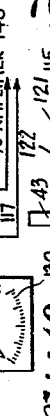


Fig. 20.



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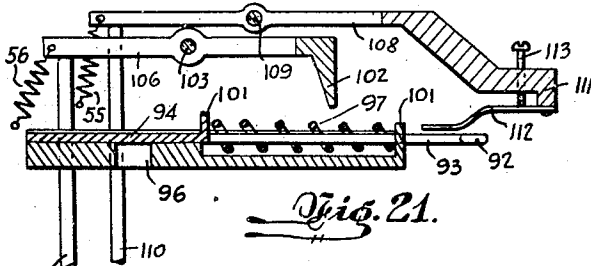


Fig. 21.

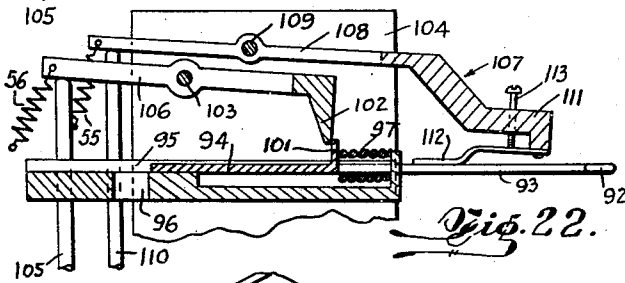


Fig. 22.

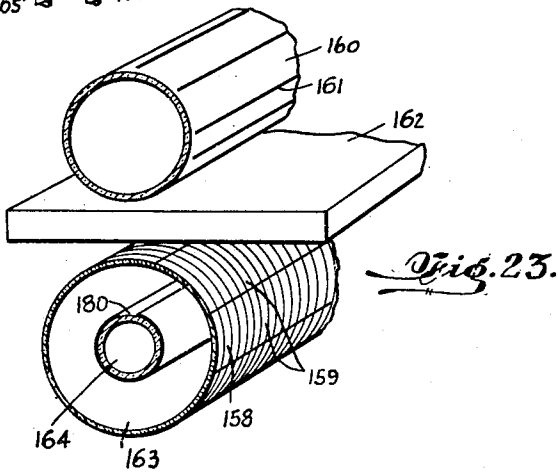


Fig. 23.

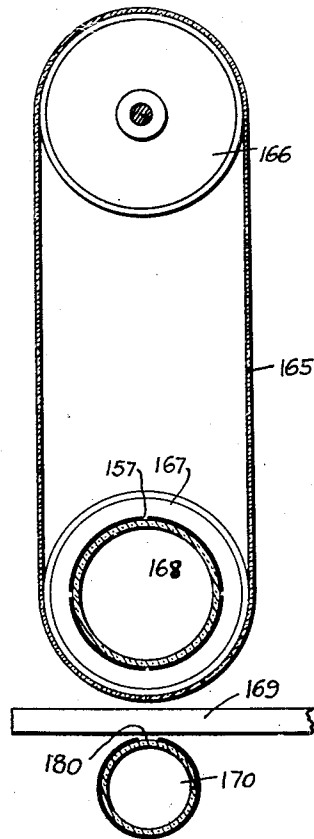


Fig. 24.

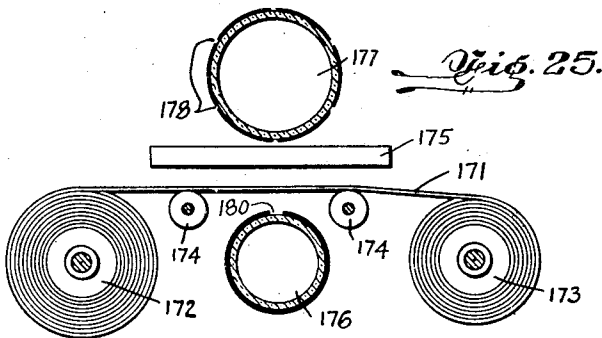


Fig. 25.

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UNITED STATES PATENT OFFICE

2,452,743

SYMPHONIC INSTRUMENT

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Application December 14, 1942, Serial No. 469,023

4 Claims. (Cl. 84—1.18)

1

This invention relates generally to musical instruments and more particularly to the kind in which musical tones or notes are produced in an amplifier-loudspeaker unit by the action of light upon a light sensitive cell, through the intermediary of a translucent instrumentality having photographically recorded thereon the sound waves to be reproduced.

It is an object of the present invention to provide a keyboard instrument which through manipulation of its keys will reproduce with fidelity and accuracy and in any desired sequence simple and complex sounds corresponding to sound waves photographically recorded on a translucent member, the latter member being interposed between a light source and a light sensitive cell, the sounds being produced through a sound transforming and amplifying unit.

It is a further object of the present invention to provide an instrument of the aforesaid character wherein a combination of intelligent sounds may be efficiently produced by manual operation of the keys of the keyboard.

Another object of the present invention is to provide a keyboard instrument which will produce sound effects identical with those of any instrument, combination of instruments, vocal or combination of vocal utterances, or any combination of vocal utterances and instruments.

It is a still further object of the present invention to provide a keyboard instrument which will so faithfully reproduce sounds recorded on a translucent member, that even a trained ear may not distinguish the same from the original sounds which were recorded; and by which the sequence in which these sounds are produced may be varied at the will of the operator of the keys.

Yet another object of the present invention is to provide a musical keyboard instrument by and through which the operator thereof who may be a mediocre or ordinary player may obtain the tonal quality and value of a perfect instrument in the hands of a skilled musician, and of combining the tones originally produced by the musician to produce any known composition by manipulation of the keys of the keyboard.

It is another object of the present invention to provide a musical keyboard instrument employing a translucent sound track having recorded or reproduced thereon in separate bands respectively notes of the chromatic scale produced by the skilled originating performer, and which notes by manipulation of the keys a person, less skilled, may reproduce, and in sequence of any musical composition.

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It is yet another object of this invention to provide an instrumentality wherein the switch from single instrument, single voice, orchestration or other multiple, sound effects may be accomplished with a minimum loss of time and without the interruption of the sound effects during such change.

It is a still further object of the invention to provide a musical instrument of the above kind which may be easily manipulated and which contains a minimum of parts, thereby considerably reducing the possibility of break downs.

Still further objects of this invention are to provide novel light sensitive cell means and to interpose a novel shutter system between the light source and the light sensitive cell for shutting off the sound tracks not desired.

Another object is to provide means whereby a single relatively small photo electric tube may be employed and influenced through the manipulation of any of the eighty-eight keys of an organ or piano keyboard.

Another object of the present invention resides in method and means to provide a master record from which economical copies may be made by which the original notes or tones may be reproduced through a keyboard instrument of the aforementioned character, such provision being accomplished by recording on film the chromatic scale as rendered by vocalist or instrument player or both simultaneously, cutting from the negative film, small strips or bands each of which carries a note of the chromatic scale, securing these strips or bands upon a transparent plate in chromatic scale order, thus forming a sound or tone track, and printing copies from this plate. Thus, each band of the track constitutes a single note of the chromatic scale arranged in predetermined sequence, and embodies the true tonal quality and individuality of the artists and of the instrument played, so that any person capable of operating the keyboard instrument may reproduce the same in any desired sequence of musical composition.

A further object is to provide a flat rigid plate containing a plurality of tracks, each track made up of bands each having a photographic record of a chromatic scale note of simple or complex quality or tone and the bands arranged in predetermined sequence or chromatic scale order.

Yet another object is to provide a photographic sound record for a keyboard instrument of the aforementioned type, which is very inexpensive, which occupies relatively small space, having the advantage of reducing the instrument to a short length; which is easily removable for replacement

purposes, and which is capable of providing a great number of changes through the keyboard of the instrument, and method for producing the same.

A further object is to provide in an instrument of the aforementioned type, a photographic sound record upon which the sound bands are so arranged as to avoid cuts in the sound waves between adjacent bands and to thereby avoid any possible "clicks" which might otherwise be due as a result thereof.

This invention accordingly consists in the features of construction, combination of parts and in the unique relations of the members and in the relative proportioning and disposition thereof; all as more completely outlined herein.

To enable others skilled in the art so fully to comprehend the underlying features thereof that they may embody the same by the numerous modifications in structure and relation contemplated by this invention, drawings depicting certain forms of the invention has been annexed as a part of this disclosure, and in such drawings, like characters of reference denote corresponding parts throughout all the views, of which:

Fig. 1 is a diagrammatic view of part of a musical instrument embodying the invention, including rotating intermittent light source;

Fig. 2 is a diagrammatic partial view of a sound track plate employed in the invention;

Fig. 3 is a diagrammatic view of a reciprocating or oscillating light source employable in a modified form of the invention;

Fig. 4 diagrammatically illustrates a reciprocating or oscillating sound plate employable in a further modified form of the invention;

Fig. 5 is a top plan view of a musical keyboard instrument incorporating the invention;

Fig. 6 is a front elevational view of Figure 5;

Fig. 7 is a top plan view (partly broken away) of a frame employable in the invention for holding sound record plates.

Fig. 8 is a top plan view (partly broken away, of adjacently disposed record plates;

Fig. 9 is a transverse sectional view taken through a light source or lamp and its light-emitting slit employable in the invention, the surface of the lamp being covered with an opaque material, but leaving one or more light-emitting slits or slots;

Fig. 10 is a sectional view taken through line 11—11 of Fig. 11, showing a light source similar to Fig. 9, but utilizing two metal covers, instead of a coating, thus providing means for adjusting the width of the slot;

Fig. 11 is a cross-sectional view taken through line 12—12 of Fig. 10;

Fig. 12 is a partial top plan elevation of a light sensitive electric cell showing the surface gradually intensified from the slotted opening to provide a gradual sound effect rather than the staccato produced by a light sensitive tube having just a sharply outlined slot;

Fig. 13 is a partial top plan view of the shutter device;

Figs. 14—16 represent modified forms of shutters employable in the invention;

Fig. 17 is a cross-sectional view (partly broken away) taken through the operating mechanism of the musical instrument shown in Fig. 1;

Fig. 18 is a diagrammatic view (partly broken away) showing a sound controlling means operatable by the keyboard;

Fig. 19 is a front elevational view of the indicating device shown in Fig. 18;

Fig. 20 is a side elevational view of one of the keys illustrated in Fig. 18;

Fig. 21 is a detail view partly in section showing the sound track shutter in inoperative position;

Fig. 22 is a detail view partly in section showing the sound track shutter in operative position;

Fig. 23 is a diagrammatic view of a sound track cylinder employable instead of the aforementioned sound track plate in a modified form of the invention;

Fig. 24 illustrates partly in section a further modification of the sound producing mechanism, utilizing a continuous or endless film containing therein the sound track; and

Fig. 25 is a still further modification of the invention showing the sound track film mounted on spools movable selectively backwards and forwards.

Referring now more particularly to Figs. 5, 6 and 17 of the drawings, there is indicated by the numeral 35, the musical instrument in general and comprising the box or housing 36 and a cover 37, legs 38, keyboard 39 and pedals 40, all conventional in a grand piano.

The keys 41 of keyboard 39 are conventionally mounted as indicated at 42 (Fig. 17), and are provided at their extreme ends with pins 43 threaded into the key extensions 45 by means of threads 44, thus providing for necessary adjustments. Each pin 45 engages with a bell-crank lever 46 to which is attached a flexible cable 47 operating the light valve or shutter device 48. An electric motor 50 may be located within cabinet 36 and by means of drive belt 51 rotatively operates a light source cylinder 52 which may have on its outer surface an opaque coating or covering 54 in which are located a plurality of openings or slits 53. Cylinder 52 is mounted on support 58 fixed to the instrument 35. Support 58 carries a track 60 in which is slidably mounted the sound track frame 59 (Fig. 7). Below support 58 is the stationary light sensitive electric cell 61. The sound track frame 59 is slidably moved within the track 60 by means of a toothed rack 62 attached to rod 63 protruding through the front board 64 of housing 36. Rod 63 terminates in a handle or knob 65. Mounted on rod 63 is also an indicator 66 working in conjunction with a scale 67 mounted on a bracket 68. The scale 67 will indicate to the operator which musical instrument or voice is being played at any particular time. The toothed rack 62 is in engagement with a small pinion 69 mounted on a shaft 70, which shaft also carries the larger gear 71 in engagement with the teeth 72 (Fig. 7) on the underside of the sound track frame 59. As seen in Figs. 7 and 9 plates 73 each carrying a plurality of sound tracks may be employed and are held within the frame 59 by means of springs 74, 75, thus forcing the sound track plates into one corner of frame 59 as indicated by arrow 76. It is understood that any reasonable number of plates 73 may be removably mounted in frame 59 and that the latter may be of any reasonable size.

As clearly shown in Fig. 8, plate 73 is divided into a plurality of sound tracks or sections indicated in the first plate by the numerals 77, 78, 79, 80. These sound tracks or sections carry sound records of certain musical instruments or voices.

For example, in the first plate 73, sound tracks 77, 78, 79, 80 represent the tones respectively, of a violin, cello, flute, and harp; in the second plate

73, sound tracks 81, 82, 83, 84, represent the voice tones, respectively of soprano, tenor, baritone, basso; and the third plate 73, sound tracks 85, 86, 87, 88, represent the tones, respectively, of piano, violin, piano and cello, soprano and tenor, baritone and basso. Each sound track is divided into a plurality of bands 57, each band carrying a photographic sound wave or impression of a note of the chromatic scale and arranged in predetermined sequence. Each sound track is preferably provided with eighty-eight bands, portions or sections to cover the maximum number of notes of a full chromatic scale, such as G, G $\sharp$, F, F $\sharp$, etc., for piano, and as indicated by numeral 89 in Fig. 8. A more complete explanation will follow hereinafter.

Interposed (as before mentioned) between the light source 52 and the sound or tone track frame 59 is the shutter or light valve mechanism 48, a portion of which is enlarged and illustrated in Fig. 13. Each key of the keyboard controls a shutter 94 through a flexible cable 47. Cables 47 are trained over pulleys 96. One end 91 of cable 47 is secured to the bell-crank 46 (Fig. 17), while the other end of cable 47 is secured to the loop 92 of the rod 93 of shutter 94. As illustrated in Figs. 13, 21, and 22, each shutter 94 rides in a track 95 which is provided with openings 96 located directly between the light source 52 and the light sensitive electric cell 61. Normally these shutters 94 are held in closed position by a compression spring 97 and are operated by the keys 41 through the medium of respective bell-crank levers 46, mounted on a transverse strip 49. The shutters 94 may be provided with an inclined surface or slanting free edge 98 extending substantially from one side thereof to the other, or may be pointed with slanting free edges as indicated at 99 for shutter 94a (Fig. 14), or may be provided with a plurality of tongues 100 providing a V-shaped opening as shown for shutter 94b (Fig. 15). Each shutter 94 has an extended lug 101 which may be brought into engagement with the transverse member or strip 102. Transverse member or strip 102 is swingably mounted by means of a pin 103 to bracket 104 (Fig. 5) to which is also fixed support 58 (Fig. 17).

Transverse member 102 is connected at one end to lever 106 and has at its other end an extension 106' by which it is swingably mounted through pin 103' to bracket 104' (Fig. 5). Transverse member 102 extends sufficiently to engage any of the extended lugs 101 and is operated by the push rod 105 from pedal 40c. When pedal 40c is pressed downwardly by the player, thus carrying the push rod 105 to press lever 106 with the transverse member 102 downwardly as indicated in Fig. 23, all shutters 94, open at that particular instant, will be held in open position by engagement of transverse member 102 with lugs 101 of such open shutters 94, as long as pedal 40c is depressed by the player and thus freeing the player's fingers to continue playing other notes of the musical composition. In other words, the shutters open at said particular instant may be maintained so, thereby permitting the rays from the light source passing through the bands of the sound track exposed by the open shutters to remain impinged upon the light sensitive cell, thus causing the notes or tones recorded in said bands to be sustained until the pedal is released.

To avoid, if desired, the sudden release of all shutters when the transverse member 102 is released, a braking or friction device 107 (Fig. 22) may be utilized, the latter comprising lever 108

fulcrumed at 109 to the bracket 104 and an extension 108' fulcrumed at 109 and openable by means of a push rod 110 controlled by foot pedal 40a. The device 107 thus operated, also comprises a transverse member 111 (substantially co-extensive with transverse member 102) on which are mounted a plurality of springs 112, each spring engageable with a rod 93. The controllable pressure members or springs 112' by manipulation of pedal 40a, will in turn control the speed with which the open shutters 94 will return to their normally closed positions, the greater the pressure exerted by pedal 40a the less the speed of return of the opened shutters. It can be readily understood that by exerting sufficient pressure upon the opened shutters, the latter may be completely retarded. The tension of each spring 112 is controllable by individual set screws 113. Springs 55, 56, respectively, urge beams 102, 111 into inoperative position shown in Fig. 21.

It is advisable to control the volume of the sound produced by the instrument through volume controlling means generally indicated by the numeral 120 (Fig. 19), such as a rheostat 117 which is operated by individual springs 121 mounted respectively on the keys 41 by securing means 116, the screw 115 being employed for adjusting the tension on spring 121. These springs 121 press against a flexible cable 122 fixedly mounted at one end 123 to the instrument while the other end of cable 122 terminates in a spring 124 secured to member 118 mounted through bracket 119 disposed within the instrument. The tension of spring 124 may be controlled by adjusting means comprising the rotatable element 125 threadedly engaging the threads 129 on the extension of member 118. The cable 122 engages the lever arm 127 at 126, which arm 127 controls electrically the volume of the amplifier device 148 by means of shaft 128, the shaft 128 being the arm of the rheostat 117. The principle of this device resides in the fact that if one key 41 of the keyboard is operated, the spring 121 will not exert as great a pressure against the cable 122 as that as if a plurality of keys 41 are operated. Thus, for example, ten keys 41 being played will cause the indicating lever 127 to move further towards the "soft" position (scale 130) thus automatically cutting down the volume of the instrument, substantially equivalent to the volume of the amplifier of say, that of one or two keys.

The scale 130 is calibrated such that if every key after the first one is depressed the pointer 127 will move one degree from "loud" to "soft." This scale is an aid in making the adjustments of cable 126. The volume may be independently controlled by pedal 40b, the latter being connected to the amplifier unit 148 by any suitable means for the purpose.

Reference will now be made to Figs. 1, 3, 4, 23, 24 and 25, which show modified forms of light sources. The light source 135 is completely opaque, except for a plurality of slits 136. The electric current for the light source is supplied by a source of electric power 137, one terminal of which connects with one end of the light source 135, as at 138, by means of bracket 139, while the other terminal 140 of the said power source terminates in the bracket 141, thus contacting with terminal 142 of the light source 135. Power supply 137 also supplies the rotor 143, which by means of a set of pulleys and belt 144 rotates the light source 135. At 145 is indicated diametrically the sound track frame, while 146

diagrammatically indicates the light sensitive electric cell which is connected by means of conductors 147 to an amplifying unit 148 having a loudspeaker 149. The shutter device has been omitted from Fig. 1 for clarity. In Fig. 3, the light source 135a does not completely rotate, but is actuated in reciprocal movement, as indicated by the double arrow 150, by the rotor 143a having a crankshaft 151. In this case, the light source is mounted in the bracket 152.

In Fig. 4, both the light source 135b and the photo-electric cell 146 are stationary, while the sound track 155 moves back and forth, as indicated by the double arrow 156.

Fig. 23 illustrates a further modified form of the sound producing mechanism in which the rotating light source 160 is again provided with a plurality of slits 161, the light passing through a shutter device 162 and through a cylindrical record 163 having a plurality of sound tracks 158, each provided with the bands 159 similar to bands 57 (Fig. 8). The light sensitive electric cell 164 is mounted within cylindrical track 163. Record 163 is only rotated for bringing into use the various tracks as selected for playing. Shutter device 162 comprises eighty-eight shutters as hereinbefore described with relation to the preferred embodiment.

In Fig. 24, the sound track 165 is in the form of an endless film, trained over an upper reel 166 and over a transparent lower reel 167. The light source 168 having the transparent slits 157 is mounted within the transparent lower reel 167, the light thus passing through the reel 167, film 165, shutter mechanism 169, to the light sensitive cell 170 having the light admitting slot or slit 180.

As shown in Fig. 25, the sound track film 171 may be wound around two spools 172, 173, from either one of which it may be wound or unwound at will. Guide rolls 174 keep the film 171 in its proper constant relation between the shutter mechanism 175 and the light sensitive cell 176. The intermittent light in this instance, is furnished by the light source 177 having the slits 178. In Figs. 23, 24, 26, the sound record is stationary during operation of the apparatus, and is only moved to place another sound track in operation.

Referring to Fig. 9 the light source 185 is covered with an opaque material 186, such as a coating of paint, lacquer, etc., and is provided with one or more light-emitting slits 187, this figure being a transverse section taken through the light source 185 and its slit 187. In the event it is desired to adjust the size of a light-emitting slit, a light source 188 (Figs. 10 and 11) is provided with two close-fitting metal shells 189, which are slidably disposed with relation to each other such that the outer shell 190 and the inner shell 191 form a slit 192 by adjusting the inner slit 193 with the outer slit 194 in desired relation to each other. While in Figs. 9 and 10, only one slit is shown, it is understood that a plurality of slits may be provided in like manner. At 195, the electric contacts for the illumination of the light source are indicated.

In Fig. 12, the light sensitive electric cell 197 has a transparent portion 198 which gradually becomes darker as indicated at 199, thus gradually changing in light transmitting intensity and thereby effecting a change in the sound transmitted to the electric cell 197 by the sound producing mechanism.

It is to be understood that any suitable lens or

prism may be employed in cooperation with the light source to increase the intensity of the light to more effectively act upon the sound record and light sensitive cell. This is well known in the art. Such a lens is indicated by the numeral 179 in Fig. 10.

For a further understanding of the invention reference is again made to Figs. 7 and 8. If for example, a note range scale for six voices, namely, basso, baritone, contralto, mezzo-soprano, tenor and soprano, is taken, the complete normal note range of the chromatic scale for the six voices comprises forty-six notes, including sharps or flats. As is well known, the complete chromatic scale for piano comprises eighty-eight notes.

The plates 73 illustrated in Fig. 8 are divided into a plurality of sound or tone tracks 77, 78, 79, 80, etc., each track comprising eighty-eight bands, each band being represented by the numeral 57. Thus each track represents the number of bands required for the complete chromatic scale of the eighty-eight piano notes controlled by the keyboard of the piano. Now, where it is desired to reproduce the complete chromatic scale of the piano, all eighty-eight bands of a track would be used. Thus, in track 85 there would be photographically recorded the complete chromatic piano scale of eighty-eight notes. Now, the normal chromatic scale of, say the violin, is less than eighty-eight notes, so that since in sound track 77, there are eighty-eight bands, the remaining bands may be utilized for recording thereon, those notes of another instrument, such as, piano, which come within a range different from that of the notes of the violin. So that, if for example, the scale of the violin notes recorded in sound track 77, runs from three notes below middle C upwards thus taking in about from fifty-six to sixty notes in its chromatic scale, and therefore, using up only from fifty-six to sixty bands for violin, the remaining bands below middle C in sound track 77 may be used to record notes of the piano other than the notes recorded for the violin. This arrangement has many advantages, for example, the player in reproducing a musical selection or composition containing separate violin and piano notes, may sustain the violin note or notes by depressing the sustaining pedal 40c and continue playing, as an accompaniment piano notes. Again, a sound track of plate 73 may contain the notes of the complete chromatic scale for piano thus utilizing all of the bands 57 in a track, and some of the bands of the same track may also have recorded thereon violin notes, so that when the player during rendition of a musical selection, presses the keys of the keyboard corresponding to the combined piano-violin note bands, the instrument will emit, at that moment, combined piano-violin sounds. Likewise, a single band in a sound track may contain the tone or pitch of a combined piano, violin, flute, cello, etc. note or the note pitch of any desired combination of instruments. Similarly, a sound track of plate 73 may contain separate instrument and voice notes (a note in each band); or the same band may contain the note pitch of a combination of instrument or instruments and voice or voices. Further, in the central portion of a sound track of plate 73, for example, comprising substantially forty-six bands of the track, each band may represent a separate note of a plurality of instruments and/or voices in chromatic scale order. That is, recorded on successive bands (one note on each band) may be the middle C note of baritone, the

C# note of tenor, the D note of flute, the D# note of cello, the E note of violin, the F note of organ, the F# note of harp, the G note of clarinet, the G# note of cornet, the A note of mezzo-soprano, the A# note of soprano, the B note of tenor, and so on; so that if a cord of eight notes is played, it will represent variations in tone quality and produce an effective, aesthetic harmony.

Again, twenty-six successive bands of a sound track may have recorded thereon, respectively, the pronunciations or sounds of the complete alphabetic range, that is, from the letter A to the letter Z, and all in the same pitch, so that an intelligent delivery, such as, a lecture, sermon, speech, etc., may be assembled or organized by manipulation of the keyboard of the instrument. In order to make complete words or expressions, rhythm and time values are to be considered by the manipulator. The operator or manipulator of the instrument may have before him visual representations of the vowels and consonants and above the vowels and consonants musical notes representing the length of playing time of each vowel and consonant which will give the necessary rhythm to make the words understandable as they are being formed.

Now, if on each of five successive sound tracks there is recorded a vowel of the alphabet in chromatic scale order and all the consonants of the alphabet in one pitch, it is believed that a vocal composition may be rendered by the instrument. To further illustrate on one sound track, the vowel "a" is recorded in chromatic scale order, a note on each band, and all of the consonants of the alphabet in one pitch is recorded on the same sound track, each consonant letter on a separate band; on the next sound track, the vowel "e" is recorded in chromatic scale order, a note on each band, and all of the consonants of the alphabet in one pitch is recorded on the said next sound track, each consonant letter on a separate band; and so on, for the remaining vowels. We will now have five sound tracks each track having a vowel recorded in various pitches or sounds and all of the consonants in the same pitch.

To take a more specific example, the chromatic scale of soprano averages from high D to low middle C, containing twenty-nine notes and thus utilizing twenty-nine bands of a sound track for the vowel recorded thereon. The consonants in one pitch will utilize twenty-one bands more on the sound track. The plate upon which these five sound tracks are mounted is shiftable by knob 55 or a suitable arrangement operable by a foot pedal (adjacent pedals 40) may be provided for shifting the plate, to bring the selected sound track under the influence of the light source, shutters, and light sensitive cell. If a song is to be "sung" in soprano through the manipulation of the keyboard by the player, say "Ave Maria" the following play for say, the first word "Ave" would be made. The key of the keyboard corresponding to the proper note on the track sound, having the chromatic scale of the vowel "a," is depressed for such time equivalent to the value of the note (being a quarter value) the key corresponding to the consonant "v" in the same sound track is depressed for about a one-sixty-fourth value giving an accent to the consonant, the plate being then shifted soon after the "v" is played and the key corresponding to the prior note on the said track having the chromatic scale of the vowel "e" is depressed for the time value of the note written by the composer. It is understood that any song may be produced

through the vowels, accent being given to the consonants. The vowels being recorded in chromatic scale order, express the melody as well as the words and in combination with the consonants express the accents and the words.

Although recording on the sound bands 57 in several ways, a very simple means for doing so and which has been found by experiment to be convenient and practical will now be outlined.

The players and vocalists may be assembled in a recording studio supplied with electrical recording apparatus in which film is used for recording. Let it be assumed, that it is desired to record the notes of the chromatic scale of violin.

The recording apparatus is set in operation thus causing the film to travel. The musician plays on his violin the first note of the chromatic scale holding the same for about one-quarter value of note which is recorded on the moving film. The musician rests for about one-eighth or one-sixteenth value of note and then proceeds with playing the second note of the chromatic scale for about one-quarter value of note and then rests for a like period, this being continued until he completes playing the chromatic scale, the film in the meantime moving at a uniform rate. The rest periods or pauses separate on the film the record of the successive notes. The negative when developed, will show fully exposed areas representing those rest periods or pauses, that is, substantially white areas will appear between successive note-recorded areas.

From the sound track or note-recorded area of each note on the negative, a band or strip substantially one-eighth inch or three-sixteenths inch wide and about one-half long is cut.

There will be as many of such bands as there are recorded notes. These bands are secured to, preferably a glass plate, in chromatic scale order from lowest note to highest note, and constitutes the negative from which the track 77 of the plate in Fig. 8 is printed. The bands 57 are the prints of the bands or strips assembled on the said glass plate. The same process is repeated as respects the different instruments for producing each of the other tracks 78, 79, 80, etc. of the plate in Fig. 8. In the case of vocal recording, the singer holds each note for one-quarter value note with a rest period of about one-eighth or one-sixteenth value note, as in the case of recording of the notes of the instruments.

It is understood that combination notes may be made in the same manner. For example, a chromatic scale of two or more singers singing and or instruments playing simultaneously may be recorded on the same band. Singers may sing the same note but with different vowel sounds, such as for example, a tenor may sing the note high C with the vowel sound of "a" and simultaneously, a soprano may sing the same note (high C) with the vowel sound of "e." Thus, it can be seen that a great many variations in quality and harmony may be produced.

The master plate, that is, the plate having secured thereon the negative strips or bands may comprise a plurality of tracks, each track made up of recorded notes of the chromatic scale in accordance with the procedure hereinabove outlined. Since provision is made in each track for eighty-eight bands, the space, in the track in which the chromatic scale of a recorded instrument is less than eighty-eight notes, may be utilized for containing the negative record bands or strips representing notes of another instrument or voice. After the desired number of re-

cordations have been completed and the corresponding negative bands or strips have been assembled and secured to the glass plate to form the master plate, from this master plate (which is the negative) as many prints as desired may be made. The print is mounted on a suitable transparent plate made of glass, plastic composition, paper or other suitable material. Fig. 9 diagrammatically indicates such prints which are removably received in the holder shown in Fig. 7.

It can be readily understood that reproductions or positive prints can be made at very little cost, making replacements inexpensive. Furthermore, it makes possible the attainment of plates having various combinations thereon, at relatively small expense.

Referring to the reproduction of the chromatic scale of the piano, which comprises eighty-eight notes, the negative bands or strips having recorded thereon the successive notes of the chromatic scale are, likewise, secured to the glass plate in chromatic scale order from which the track 35 is produced. The keys of the keyboard of the piano normally representing the notes of the chromatic scale corresponds to the same notes recorded on the bands of track 35, and therefore, controls the selection of the notes to be played, through the means previously described. Thus, piano tone effects may be obtained without the use of piano strings; with the added effect of full tone value, since with a string piano the tone of a note dies down irrespective of how long the key is depressed, whereas, with the instrument made in accordance with this invention, the full tone of the same note may be prolonged as long as the key is maintained in a depressed position.

Although the key may be maintained in depressed position by manual operation, in order to free the finger or fingers of the player for use for other notes while desiring to maintain the full tone of the played note, the means shown in Figs. 21 and 23 are employed for mechanically maintaining the key in depressed position, as hereinbefore described.

Operation

Referring to Fig. 5, which shows a grand piano-like instrument, each key of the keyboard has respective relation to a band of a track, through respective flexible cables and the corresponding shutter mechanism.

Assume that a plate in Fig. 8 has been selected which contains the sound track to be played. This plate is positioned in the holder or frame 59 shown in Fig. 7 and the frame positioned in support 58 (Fig. 17). Let it be further assumed that it is desired to play from track 35 (Fig. 8), that is for a piano composition. Lever 65 (Fig. 17) is moved until the indicator 66 points opposite the indication marked "piano" on the scale 68. This will bring sound track 35 under the revolving light-source cylinder 52. The light sensitive electric cell 61 and the light source 52 are put in operation. The player now operates the keys of the keyboard in a manner performed for a piano-selection, following the notes of the selected musical composition which he desires to play. As a key of the keyboard is depressed in accordance with a note of the musical composition, a corresponding shutter 94 (Fig. 13) is operated through cable 47, permitting the ray of light from light source 52 to pass through the opening 96 and penetrate the band 57 of track 35 upon which the note is recorded, impinging upon the light sensitive cell 61 which influences the sound emis-

sion means (loudspeaker and amplifier unit 148). The particular band 57 thus brought into play has recorded thereon the note corresponding to that represented by the piano-key just depressed.

It is to be noted that the plate or record remains stationary during the playing of a selection, and it is to be understood that where the word "stationary" appears in the claims as regards this plate or record, it is to be interpreted as referring to the plate or record being stationary for a particular selection being played. The opaque rotatable cylinder which houses the light source and which is slitted to provide transparent openings, intermittently directs the light beam from the light source through the plate or record upon the light-sensitive cell.

In the event that the player desires to sustain some of the notes while continuing playing, he depresses pedal 40c which operates bar 102 (Fig. 22) as hereinbefore explained. If he desires to slow the action of a particular note, that is to cause the corresponding shutter to lag to allow the light source to act on the light sensitive cell through the sound track for a longer period of time, he depresses pedal 40a and continues playing. This will cause the sound of the note to diminish gradually.

The volume output of the amplifier-loudspeaker unit is controlled by the volume pedal 40b, as hereinbefore described.

It is to be particularly noted that in all of the above embodiments, the light sensitive cell is immediately adjacent the sound record or track.

It is to be understood that the shutter arrangement may be disposed between the light sensitive cell and the sound record, instead of between the sound record and the light source. (See Fig. 24.)

Furthermore, these arrangements permit the light source and its housing to be disposed close to the sound record; also, for the light source and its housing to be employed common for two light sensitive cells, sound records and shutters. By way of example, only, referring to Fig. 25, a similar arrangement of light sensitive cell 176, sound record 171, shutter 175, may be disposed above light source and slotted housing 177, 178, thereby considerably shortening the space within which these devices are operable.

It will thus be seen that there has been provided by this invention apparatus in which the various objects hereinabove set forth, together with many thoroughly practical advantages, are successfully achieved.

As many possible embodiments may be made of the above invention, and as many changes might be made in the embodiments above set forth, it is to be understood that all matter hereinbefore set forth or shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense.

I claim:

1. In a sound reproducing apparatus a flat, stationary record comprising a sound track having a plurality of adjacently arranged sections each carrying a photographic record of a sound, a rotatable cylinder, a source of light within said cylinder, a light sensitive cell, said cylinder having at least one transparent slit providing means for intermittently directing light from said source through said sections of said sound track and upon said cell, and means for controlling passage of said light through said sections, said controlling means comprising a plurality of shutters one for each of said sections and a plurality of re-

spective keys for actuating said shutters selectively, and sound volume control means operable by said keys, and means for producing sound in accordance with variations in output of said cell.

2. In a sound reproducing apparatus a record comprising a sound track having a plurality of adjacently arranged sections each carrying a photographic record of a sound, a source of light, a light sensitive cell, means for directing light from said source through said sections of said sound track and upon said cell, means for controlling passage of said light through said sections, said controlling means comprising a plurality of shutters one for each of said sections and a plurality of respective keys for actuating said shutters selectively, and sound volume control means operable by said keys, said sound volume control means comprising an electric resistance device, a tensioned member engageable with said keys and connected with said device, and means for producing sound in accordance with variations in output of said cell.

3. In a sound reproducing apparatus a record comprising a sound track having a plurality of adjacently arranged sections each carrying a photographic record of a sound, a source of light, a light sensitive cell, means for directing light from said source through said sections of said sound track and upon said cell, means for controlling passage of said light through said sections, said controlling means comprising a plurality of shutters one for each of said sections and a plurality of respective keys for actuating said shutters selectively, sound volume control means operable by said keys, said sound volume control means comprising an electric resistance device, a tensioned member engageable with said keys and connected with said device, and means for regulating the tension on said member, and means for producing sound in accordance with variations in output of said cell.

4. In a sound reproducing apparatus a record

comprising a sound track having a plurality of adjacently arranged sections each carrying a photographic record of a sound, a source of light, a light sensitive cell, means for directing light from said source through said sections of said sound track and upon said cell, means for controlling passage of said light through said sections, said controlling means comprising a plurality of shutters one for each of said sections and a plurality of respective keys for actuating said shutters selectively, and sound volume control means operable by said keys and comprising an electric resistance device, a resilient element on each of said keys, a tensioned member engageable with said elements and connected with said device, and means for regulating the tension on said member, and means for producing sound in accordance with variations in output of said cell.

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