

[54] ENDLESS RECORD AUDIO SIGNAL  
GENERATOR AND MEANS FOR PLAYING  
RECORD

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[58] Field of Search ..... 274/44, 42, 41.6; 84/1.28, 84/1.18, 1.24, 1.01

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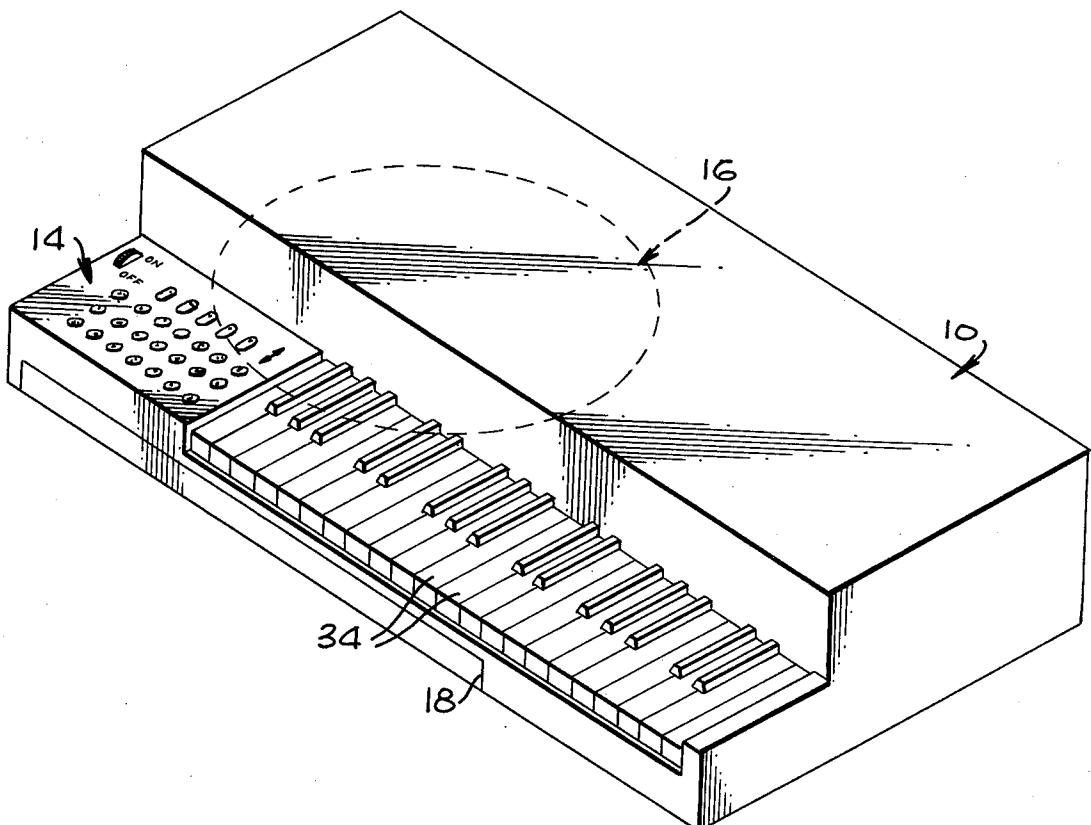
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## [57] ABSTRACT

An organ having a keyboard with levers that can be selectively depressed to play a melody and having a group of accompaniment buttons which can be selectively depressed to play a harmonizing pattern of notes based on a musical chord appropriate to the melody being played on the keyboard. The tones and harmonizing patterns are defined by concentric circular tracks on an optical disc record in the organ. All of the harmonizing patterns include a series of notes in the same meter, such as 4/4 time, and each pattern lasts for one or more complete measures along its 360° length about the record. Each track is re-entrant and all harmonizing patterns begin at the same circumferential position along the track, to allow a musician to change from a first pattern at the end of a measure to a second pattern and be assured of starting the second pattern at the beginning of a measure. The record also includes one or more lead-in tracks containing an accompaniment pattern defining an introduction to a music passage, and one or more endings defining the end of a music passage, the lead-in and ending tracks also extending one measure about the record and positioned in phase with the harmonizing patterns.

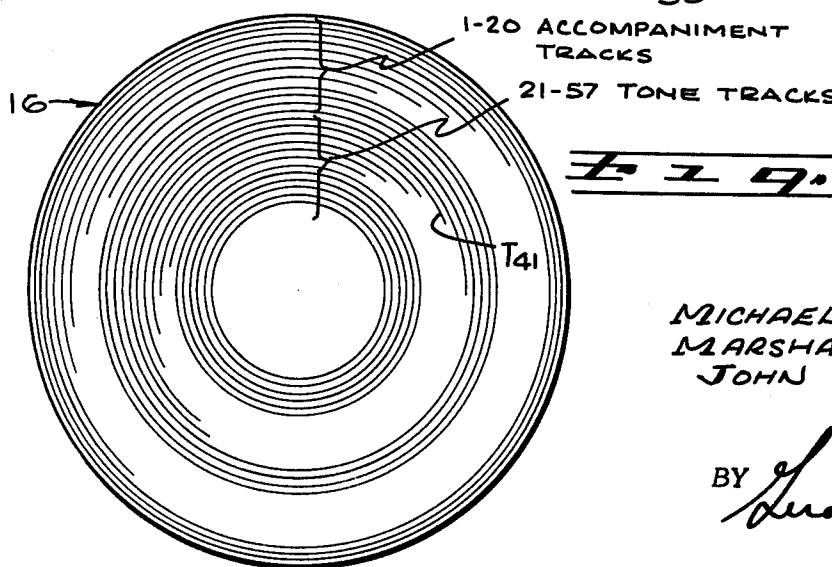
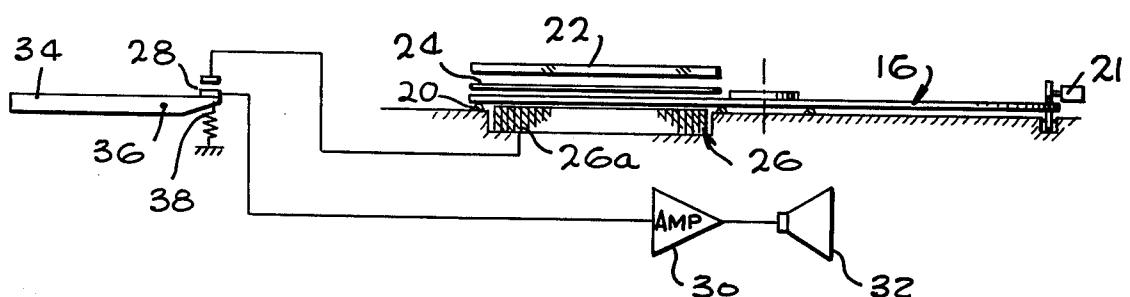
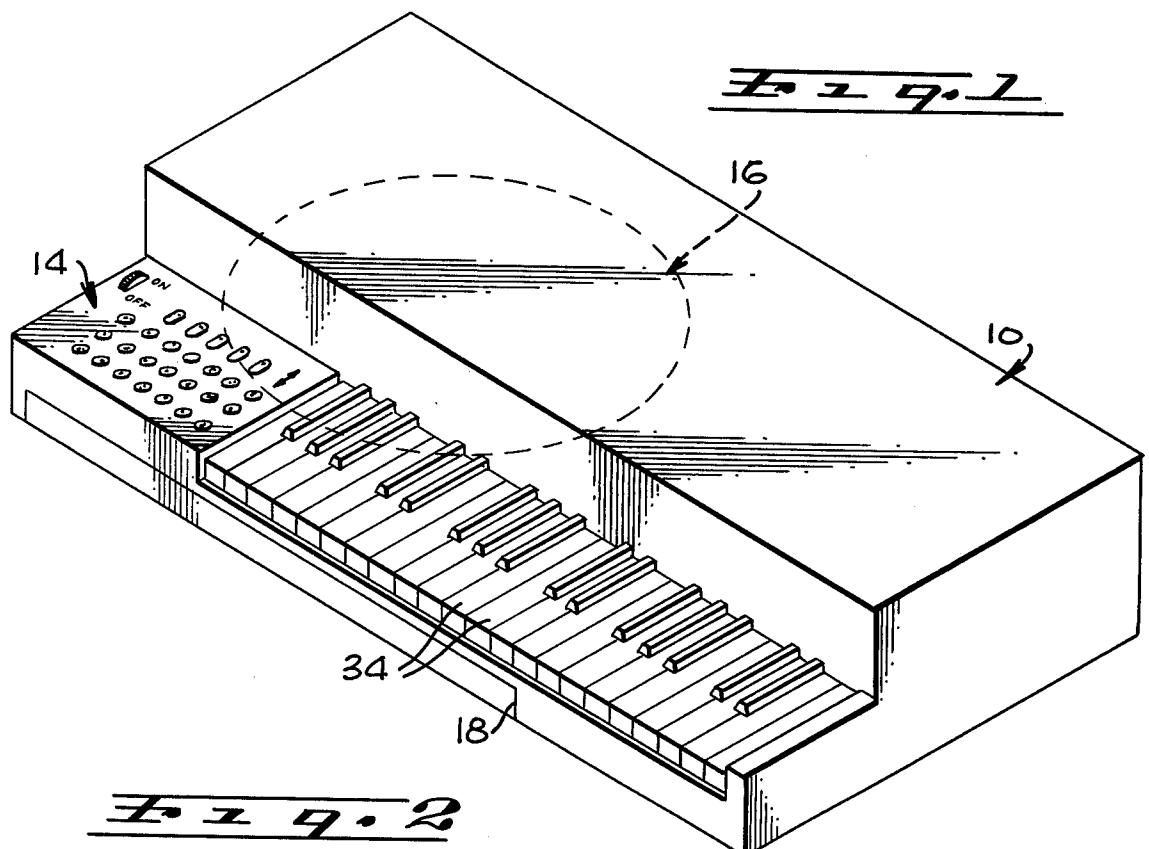
15 Claims, 13 Drawing Figures



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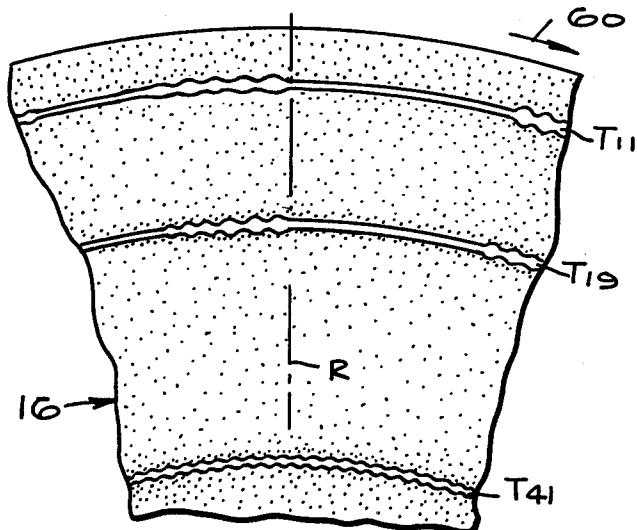
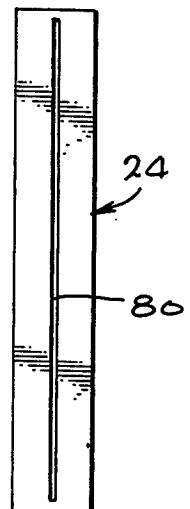
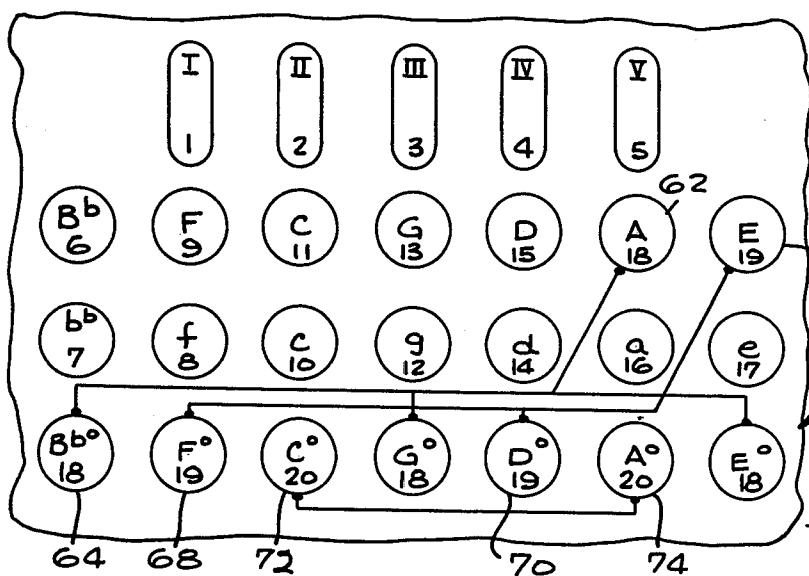
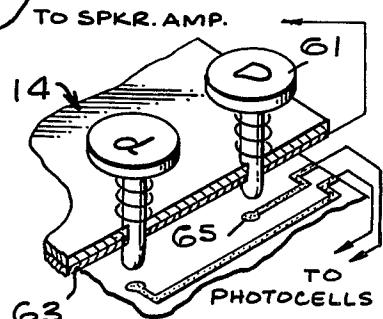
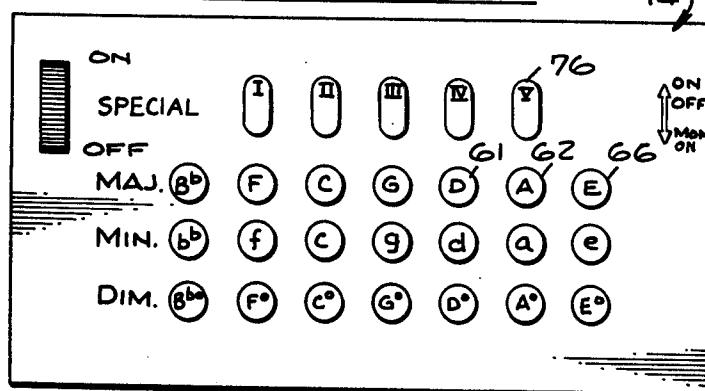
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FIG. 9.4FIG. 9.5FIG. 9.6FIG. 9.7FIG. 9.6

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F 2 9.9

C MAJ.

GUITAR



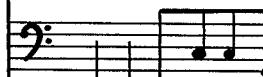
ORGAN



ORGAN



BASS



DRUMS



F 2 9.10

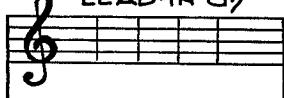
D MAJ.



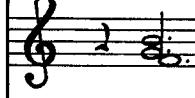
F 2 9.11

LEAD-IN G<sub>7</sub>

GUITAR



ORGAN



ORGAN



BASS



DRUMS



F 2 9.12

C MAJ. ENDING

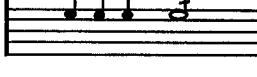
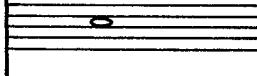
8

8

8

ROLL

F 2 9.13



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## ENDLESS RECORD AUDIO SIGNAL GENERATOR AND MEANS FOR PLAYING RECORD

### BACKGROUND OF THE INVENTION

#### 1. Field of the Invention

This invention relates to musical devices.

#### 2. Description of the Prior Art

Some types of instruments such as accordions and many organs, provide chord keys, the musician depressing one chord button with a finger of his left hand to play a sustained appropriate chord while he plays the melody with his right hand. While a simple chord accompaniment can enhance the melody, this type of accompaniment can quickly become boring, even if the musician can depress the chord button in a rhythmic pattern. One type of accessory which can be used for a more entertaining effect, produces percussion sounds in a rhythmic pattern, such as a castanet sound in a rhumba meter. The musician can select an appropriate meter or beat by turning on one of several switches, and he can then play the melody while the beat keeps repeating. However, even a rhythmic percussion background can become uninteresting after a while, since it does not vary during long music passages.

A music instrument with an accompaniment portion which was relatively easy to play, as by depressing a single button with the left hand of the musician, but which produced accompaniments closely approaching those which might be produced by the left hand of an expert musician or of several musicians in a band, could considerably enhance the music which might be played by a beginning musician. In order to gain wide acceptance, however, such a device must also be relatively simple so that it can be produced at low cost.

### OBJECTS AND SUMMARY OF THE INVENTION

An object of the present invention is to provide an organ which is simple to construct and easy to play, and which enables the production of music with an artful and relatively complex accompaniment.

Another object is to provide a record which can be used in an organ to produce accompaniment with an entertaining rhythmic pattern and in distinctive but appropriately changeable keys.

Still another object is to provide an organ which can play prerecorded accompaniment patterns, which enables a wide variety of prerecorded patterns to be played.

In accordance with one embodiment of the present invention, an optical disc record is provided which includes harmonizing tracks that can accompany a wide range of melodies. Each of the harmonizing tracks contains a pattern of notes based on a particular chord, such as might be played by several musicians in a band who are accompanying a solo instrument. All of the harmonizing tracks are in the same meter, are played at the same tempo for a particular record speed, have a duration of one measure, extend 360° about the record, have re-entrant paths, and begin at the same circumferential position about the record. As a result, the musician can change from a first harmonizing track which is based on a first musical chord to a second harmonizing track based on a second chord at any time, such as at the end of a measure and be assured of maintaining the "beat" and timing. The record also includes one or more lead-in tracks, each of which contains a pattern of notes defining an introduction to a music

passage, and one or more ending tracks that contain a music pattern defining endings to a music passage.

Due to the fact that each harmonizing track contains a pattern of notes based on a musical key or chord rather than a sustained chord, one note in the corresponding chord on which the pattern is based can be deleted without its deletion being noticeable. This allows one or more of the harmonizing tracks that represent a pattern based on a major chord (actually a dominant seventh chord, but indicated as a major chord on the keyboard) to also be used as the track for patterns based on one or more diminished seventh chords. As a result, a record with fewer tracks can be used to play harmonizing patterns based on many major and diminished chords.

The novel features of the invention are set forth with particularity in the appended claims. The invention will be best understood from the following description when read in conjunction with the accompanying drawings.

### BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of an organ constructed in accordance with the invention, for playing a record shown in phantom lines;

FIG. 2 is a simplified elevation and schematic view of the organ of FIG. 1, showing a mechanism for playing one note on the keyboard thereof;

FIG. 3 is a simplified plan view of the record of FIG. 1;

FIG. 4 is a partial view of the record of FIG. 3 showing several tracks thereof;

FIG. 5 is a plan view of the slit shown in the mechanism of FIG. 2;

FIG. 6 is a plan view of the accompaniment switch assembly of the organ of FIG. 1;

FIG. 7 is a partial perspective view of the accompaniment switch assembly of FIG. 6;

FIG. 8 is a diagrammatic view of the accompaniment switch assembly of FIG. 6, showing a portion of the circuit connections thereof;

FIG. 9 is a musical notation of the harmonic pattern defined by a track of the record of FIG. 4;

FIG. 10 is a musical notation of the harmonic pattern defined by another track of the record of FIG. 4;

FIG. 11 is a musical notation of a lead-in track of the record of FIG. 4;

FIG. 12 is a musical notation of an ending track of the record of FIG. 4; and

FIG. 13 is a musical notation of another ending track of the record of FIG. 4.

### DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 illustrates an organ 10 with a melody keyboard similar to that of a piano, and with an accompaniment section 14 for producing sounds that can accompany a melody played on the melody keyboard. All of these sounds are produced electronically by an optical disc type record 16, the record being installed through a slot 18 that is normally closed by a cover. As shown in FIG. 2, the record is mounted to rotate on two concentric rings of pads 20 and is driven by a motor 21 to revolve at a rate such as one revolution every two seconds. A lamp 22 shines light through a slit member 24 and through the record and turntable to a row of photocells 26. Each photocell such as cell 26a is con-

ected to a switch 28 which can carry currents generated by the cell to an amplifier 30 that is connected to a loudspeaker 32. The switch 28 is closed when the musician presses on a piano-like key or switch member 34 which pivots about an axis 36 against the force of a spring 38.

FIG. 3 is a simplified illustration of the record 16 which defines the sounds that can be played by operating various switch-closing members. A record of the type shown in FIG. 3 can be used which has 57 concentric tracks that are numbered  $T_1$  through  $T_{57}$ . The thirty-seven radially innermost tracks, which can be labeled  $T_{21}$  through  $T_{57}$  are tone tracks which define a substantially constant tone. A portion of one of these tracks  $T_{41}$ , which represents the 440 cycles per second note middle A, is shown enlarged in FIG. 4. The track  $T_{41}$  is represented by a transparent line defined by opaque borders, the transparent line having 880 variations or oscillations in width along the  $360^\circ$  length of the track, for a record which rotates once in two seconds. In other words, the track is a ring-like area of variable average opacity along its length (if the average is taken along a length equal to the width of the slit in member 24). The track can represent the sound of a violin, flute, or any of a variety of instruments and may even represent the rapid picking characteristic of a mandolin, but it nevertheless is a substantially constant note. The other of the 37 tone tracks are identical to track  $T_{41}$  except that they represent pitches spaced one semi-tone apart from each other, as in a musical scale. Each of the tone tracks is sounded when a corresponding pianoboard key is depressed.

Most of the 20 accompaniment tracks  $T_1$  through  $T_{20}$  represent patterns of sounds which are useful for accompanying a melody produced by the tone tracks. Five of the accompaniment tracks represent special sounds such as an introduction or ending measure for a melody in a particular key, or a rhythmic pattern, applause, yelling, or the like, which has no particular key. However, the other 15 accompaniment tracks, which may be referred to as the harmonizing tracks, represent a pattern of musical notes based on a particular musical chord for providing a highly entertaining musical accompaniment to a melody played on the melody keyboard.

FIG. 6 illustrates the accompaniment section 14 which contains various switches for producing sounds represented on the accompaniment tracks of the record. A top row of five rocker-type switches labeled "SPECIAL" represents the five special effects referred to above. A second row of seven buttons labeled "MAJ." represents seven major chords, a third row labeled "MIN." represents seven minor chords, and a fourth row labeled "DIM." represents diminished chords. The accompaniment section 14 which is illustrated, may be labeled to indicate that the key of C is a "home" position, inasmuch as many melodies are written so that major portions of them may be appropriately accompanied by C major chords. As shown in FIG. 7, each button 61 can be depressed to connect a common conductor 63 to a point 65 on a circuit board, to connect a particular photocell to the loudspeaker amplifier.

FIG. 9 illustrates, in musical notation, the sounds that are represented on track  $T_{11}$  of the record of FIG. 4, and which are produced when the musician presses the top C button of the accompaniment section, this being

the third button in the "MAJ." row. As shown in FIG. 9, the pattern of musical notes may be relatively complex, and it includes sounds produced by a guitar, organ and bass instrument. In addition, a percussion rhythm produced by drums is included. The pattern of notes represented in FIG. 9 is based on the C major chord or scale and in a 4/4 time or meter.

While the C major harmonizing pattern of FIG. 9 is useful for some musical passages, even simple melodies generally require a change in accompaniment key during different passages of the melody. FIG. 10 illustrates the musical notation for the sounds produced when the pattern on the track  $T_{19}$  is sounded. The same instruments are employed so that corresponding notes in the different tracks have the same quality, and the instruments play in a rhythmic pattern identical to the pattern illustrated in FIG. 9 and at the same tempo (number of beats per minute) so the notes have the same speed of rhythmic occurrence. However, every note is raised by two semi-notes, so that the pattern is based on a D major chord. The other tracks of the 15 harmony accompaniment tracks are similarly related, although those representing patterns based on minor chords and some diminished chords have some notes displaced from corresponding major chord patterns. Thus, unlike accordions and some other organs, the harmonizing tracks are not simply sustained chords, but represent a complex rhythm. Also, unlike some special sound effect devices which have been employed with organs, and which utilize a percussion rhythm, the harmonizing tracks produce notes of definite pitches and are based on definite chords or scales, and allow a selection of patterns based on different chords at different passages in a musical composition. The harmony accompaniment tracks  $T_6$  through  $T_{20}$  should all be in the same meter (number of basic beats per measure, such as three in 3/4 time or four in 4/4 time), have the same number of clear beats with the same spacing in each measure (to represent a particular rhythm pattern such as cha-cha or fox trot), have the same relative note patterns and flourishes, if any, represent the same musical instruments, and be in the same tempo (speed) for a given speed of the record.

As is well known, musical compositions are generally divided into musical measures, there generally being three or four beats to a measure. In many cases the end of a musical passage, when it is appropriate to change from a harmonizing accompaniment pattern based on one chord to a pattern based on another chord, occurs at the end of a full measure. In these cases, the new harmonizing pattern should start at the beginning of a measure. When it is appropriate to change to a pattern of another chord in the middle of a measure, the new accompaniment pattern should finish out the measure. In order to accomplish this, it is necessary that all of the harmonizing accompaniments be in phase, or synchronized with each other with respect to the beats in a measure. Referring to FIG. 4, all harmonizing accompaniment tracks, such as tracks  $T_{11}$  and  $T_{19}$  are positioned to begin at points along an imaginary radial line R on the disc record, so that all the harmonizing accompaniments begin at the same circumferential position around the record. It should be understood that where all photocells or other playing heads are located along a substantially radial line, the harmonizing tracks should all be along the same imaginary radial line. However, if the photocells are not positioned along a

radial line, then the beginning of the harmonizing tracks also should not be located along a radius; but they should be located so as to be in phase with each other for the existing placement of the photocells.

It may be noted that there is generally a decay in sound at the end of a measure and a strong beat at the beginning of a measure. Accordingly, when the record turns in the direction of arrow 60, shown in FIG. 4, the end portion of the tracks  $T_{11}$  and  $T_{19}$  lying on the right side of imaginary line R are of substantially constant width, while the leading portion of the track, which lies on the left-handside of imaginary line R has strong oscillations in width.

In playing a complete composition, it is often desirable to provide one or more lead-in measures and one or more ending measures. Accordingly, one of the tracks which is played when the button labeled "I" in the first or "SPECIAL" row shown in FIG. 6, produces a pattern of notes representing a lead-in or introduction to a composition. FIG. 11 illustrates the sounds in a musical composition notation, which produces a lead-in to a melody which is basically in a C major key, that is, a large portion of the melody is appropriately accompanied by patterns based on C major chord. The lead-in is based on a G seventh chord and utilizes only the organ, bass and drum instruments (not the guitar). The lead-in track must be synchronized with the 15 harmonizing accompaniment tracks that are played throughout the rest of the melody, so that a musician who depresses the lead-in button can let up on it at the end of the lead-in measure and immediately depress one of the harmonizing accompaniment buttons, and be assured of beginning the harmonizing accompaniment at the beginning of a measure thereof. Accordingly, the lead-in measure, like the other tracks  $T_{11}$  and  $T_{19}$  shown in FIG. 4, begins at the same circumferential position defined by the imaginary line R. It may be noted that for the particular lead-in shown in FIG. 11, the beginning of the measure (the first beat) is silent. A small lamp that blinks on at the beginning of each measure or other like device activated by the record, can be employed to indicate when the musician can begin playing.

In addition to a lead-in measure, it is sometimes desirable to provide one or more endings. Another one of the "SPECIAL" switches shown in FIG. 6 and labeled "II" plays a track which contains an ending measure. One example of an ending which can be used is illustrated in FIG. 12, this particular ending including only sustained notes and a roll on the drum. FIG. 13 illustrates another ending which can be employed. Of course, each lead-in track should end substantially along the imaginary radial line R of FIG. 4, while each ending track should begin substantially along this line.

The accompaniment section 14 shown in FIG. 6 includes 21 buttons or switches that define harmonizing accompaniment patterns based on particular chords. However, only 15 tracks on the record are provided to play all of these 21 harmonizing accompaniments. Fifteen tracks are sufficient because some of the harmonizing accompaniment tracks are used to produce accompaniment based on more than one chord. The fact that some tracks are used for patterns based on several chords is indicated in FIG. 8, which illustrates interconnections of various circuits, and the different numbered tracks which are played when a particular button is depressed. As shown in this figure, when one button 62

labeled "A" is depressed, the track  $T_{18}$  on the record is played. (Although the button is labeled "A" it is used both when an A major or A seventh chord is required). However, when another key 64 labeled (B flat diminished) is depressed, the same track  $T_{18}$  is played. This is made possible by selecting a pattern based on the A dominant seventh chord, which does not contain the root note (the A note) of the A dominant seventh chord. The remaining portion of the corresponding 10 chord is identical to the B flat diminished seventh chord less its B flat note, so it can be used for patterns based on both the A dominant seventh and B flat diminished seventh chords. (An A major chord includes A, C sharp and E, an A dominant seventh chord includes A, C sharp and E, an A dominant seventh chord includes A, C sharp E and G and a B flat diminished chord includes B flat, C sharp, E and G. The pattern played when the "A" or "B flat diminished" button is depressed is based on a chord which includes C sharp, E and G.)

The track  $T_{18}$  which sounds when the A major and B flat diminished buttons are depressed, also contains notes of the C diminished seventh and G diminished and seventh chords. Accordingly, the buttons labeled 25 G diminished and E diminished also play the track  $T_{18}$ . As a result, the track  $T_{18}$  is played when any one of the four buttons is depressed, and a single track can be used for harmonizing patterns based on four chords. In a similar manner, the E major button 66 plays track  $T_{19}$ , which is the same track played by depression of the F diminished button 68 and the D diminished button 70. The two other remaining diminished chord buttons 72 and 74 which represent the C diminished and A diminished chords sound a single track  $T_{20}$ . Thus, only 15 different tracks are required to play the chord patterns denoted by 21 different buttons.

The special switches or buttons in the first row shown in FIG. 6 can include not only beginning and ending measures, but unusual effects such as applause and percussion patterns that have no identifiable pitches and therefore are not based on any chord. Each switch such as switch 76 has three positions, including an OFF position, an ON position, and a Momentary ON position. When the top of the switch is depressed, the corresponding record track is sounded continuously until the switch is returned to a center or OFF position. When the bottom of the switch is depressed, the corresponding track is sounded only so long as the switch is depressed. Thus, when it is desired to play a special effect for only one measure, the musician presses the button portion of the switch and holds it for only one measure. He can play the effect indefinitely by depressing the top of the switch and leaving it depressed.

The record 16 can be constructed from a sheet of clear plastic containing a photographic emulsion which is exposed from a master record and photographically developed. Of course, a variety of other record types can be used such as cylinders or belts. However, the record should be of the "endless" type so that all of the tracks have re-entrant paths. The tracks which represent sustained notes, such as tracks  $T_{21}$  and  $T_{57}$ , preferably have waveforms that provide a smooth merging between the end of the circular path and the beginning, so that there is no noticeable noise at that location. The harmonizing tracks generally do not have such a smooth merger, since the end of a measure is usually of low volume and the beginning generally represents the

attack of a new note. As previously mentioned, however, the harmonizing tracks should be in phase with each other so that a person does not notice any hesitation or advancement of the beats. Generally, such interruption in the meter is not noticeable if it is less than about one-thirtieth of a second.

In order to achieve high frequency response, the slit member 24, through which light passes, which is shown in FIG. 5, is constructed of a thin sheet of transparent material with a photographic emulsion. All of the photographic emulsion on the slit member is exposed except for a thin slit line 80, so that only a narrow beam of light of a width such as one-thousandth inch passes through the record.

An organ can be provided with many different interchangeable records, each containing a set of harmonizing accompaniments with a different type of pattern to achieve a fox trot, waltz, jazz sound, or other type of effect. Each track on a record can contain more than one measure of a harmonizing pattern but it should contain a whole number of such measures and the different tracks should be in phase with each other with respect to the placement of the photocells or other playing heads. Of course, the record can be played on a variety of organ types, including organs wherein the depressing of a switch opens a light shutter of a playing head that allows light to reach a photocell of the playing head, instead of closing electrical contacts.

Although particular embodiments of the invention have been described and illustrated herein, it is recognized that modifications and variations may readily occur to those skilled in the art and, consequently, it is intended that the claims be interpreted to cover such modifications and equivalents.

What is claimed is:

1. Apparatus for use in generating musical sounds comprising:

an endless record having a plurality of harmonizing tracks with re-entrant paths, each defining a pattern of musical notes in the same meter but based on a different musical chord so that at least some of the notes of each of said tracks have definite pitches, and each track lasting the same whole number of musical measures along the length of its track around the record, so that a change from a first track which is based on a first musical chord to a second track which is based on a second musical chord at the end of a pattern on the first track begins the playing of the second track at the beginning of the pattern thereon.

2. The apparatus described in claim 1 wherein: said record also includes a musical lead-in track defining a pattern of notes which represent an introduction to a musical passage, said lead-in track having the same duration along said record as a whole number of measures at one of said harmonizing tracks.

3. The apparatus described in claim 1 wherein: said record includes an ending track defining a pattern of notes which represents an ending of a musical passage, said ending track having the same duration along said record as a whole number of measures of one of said harmonizing tracks.

4. The apparatus described in claim 1 wherein: said endless record comprises a disc with a plurality of concentric ring-like regions of variable average opacity representing said plurality of tracks, each

of said patterns beginning at a point along the same substantially radial imaginary line on said disc.

5. The apparatus described in claim 1 including: a playing machine including means for turning said record, speaker means, and means including a plurality of manually operable keys for selectively coupling signals representing the sounds defined by said tracks to said speaker means.

6. The apparatus described in claim 1 including: an instrument for playing said record comprising a first plurality of manually operable switches for playing sounds based on different major chords, a second plurality of manually operable switches for playing sounds based on different diminished chords, speaker means for producing acoustical sounds, and a plurality of connector means for selectively coupling said record tracks to said speaker means in response to the operation of said switches; and wherein

a first group of said harmonizing tracks on said record includes a plurality of tracks that each defines musical notes based on different major chords, and at least one track that defines musical notes based on a dominant seventh chord that is devoid of a root note thereof; and

at least one of said connector means is constructed to couple said track which is devoid of a root note of its corresponding chord, to said speaker means both when a predetermined switch of said first plurality of switches is operated and when a predetermined switch of said second plurality of switches is operated, whereby the same record track can be used when a major chord or diminished chord is indicated.

7. The apparatus described in claim 1 wherein: each of said plurality of harmonizing tracks represents the same pattern of the same instruments at the same tempo, but based on a different chord.

8. A musical instrument comprising: an endless record having a plurality of endless tracks, each defining a rhythmic pattern of musical notes based on a different musical chord, so that at least some of the notes in each of said tracks can be sensed by the human ear to have definite pitches; and

playing apparatus including a plurality of playing head means, each responsive to one of said tracks for generating electrical signals representing the rhythmic pattern of musical notes on said track, transport means for moving said record so that said tracks move simultaneously past said playing head means, speaker means, and means including a plurality of manually operable switches for selectively coupling said playing head means to said speaker means; and wherein

each of said tracks represents a pattern of the same tempo as the pattern of the other of said tracks for a given speed of said transport means, and in constant phase relationship with the patterns of the other of said tracks; and

said plurality of playing head means are located with respect to each other so that all of said tracks pass their respective playing head means in phase with each other, whereby when a musician switches to a new track at the beginning or middle of a musical measure, the new track begins at the beginning or

at the corresponding beat, respectively, in the new measure.

9. The musical instrument described in claim 8 wherein:

each of said plurality of tracks contains substantially 5 the same number of corresponding notes, said corresponding notes of different ones of said tracks having substantially the same quality, rhythmic placement with respect to each other, and speed of rhythmic occurrence, but displaced in pitch.

10. The musical instrument described in claim 8 wherein:

said record includes a lead-in track defining a pattern of notes representing an introduction to a melody, said lead-in track being in constant phase relationship with the pattern of said named plurality of tracks.

11. Apparatus for playing by a musical instrument comprising:

a rotatable disc of optically transparent material having at least partially opaque regions defining circular sound tracks, a first plurality of said tracks defining substantially the same pattern of sounds at the same tempo for the same speed of rotation of said disc, but based on a different musical chord, 25 so that at least some of the notes of each of said tracks can be sensed by the human ear to have definite pitches, each of said first plurality of tracks being in substantially constant phase with each other about said disc so that a change from one of 30

said tracks to the other continues the pattern of sounds substantially without delay or advancement of the pattern of sounds.

12. The apparatus described in claim 11 wherein: each of said first plurality of tracks was a beginning part representing the beginning of a musical measure of said pattern of sounds, said beginning parts of said plurality of tracks arranged substantially along an imaginary line radiating from the center of said disc.

13. The apparatus described in claim 12 wherein: at least one of said tracks defines a pattern of musical sounds representing a lead-in to a musical composition which has an accompaniment represented by said pattern of sounds of said first plurality of tracks, the end of said track representing a lead-in lying substantially on said imaginary line radiating from the center of said disc.

14. The apparatus described in claim 12 wherein: at least one of said tracks defines a pattern of musical sounds representing an ending to a musical composition, with a starting part lying substantially on said imaginary line radiating from the center of said disc.

15. The apparatus described in claim 11 wherein: said circular tracks include a second plurality of tracks defining continuous musical notes of different pitches for a particular speed of rotation of said disc.

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