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[54] **ELECTRONIC MUSICAL CONDUCTOR**

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[58] **Field of Search** ..... 84/470, 477, 478, 484, 84/464; 274/46 R, 46 D; 360/79

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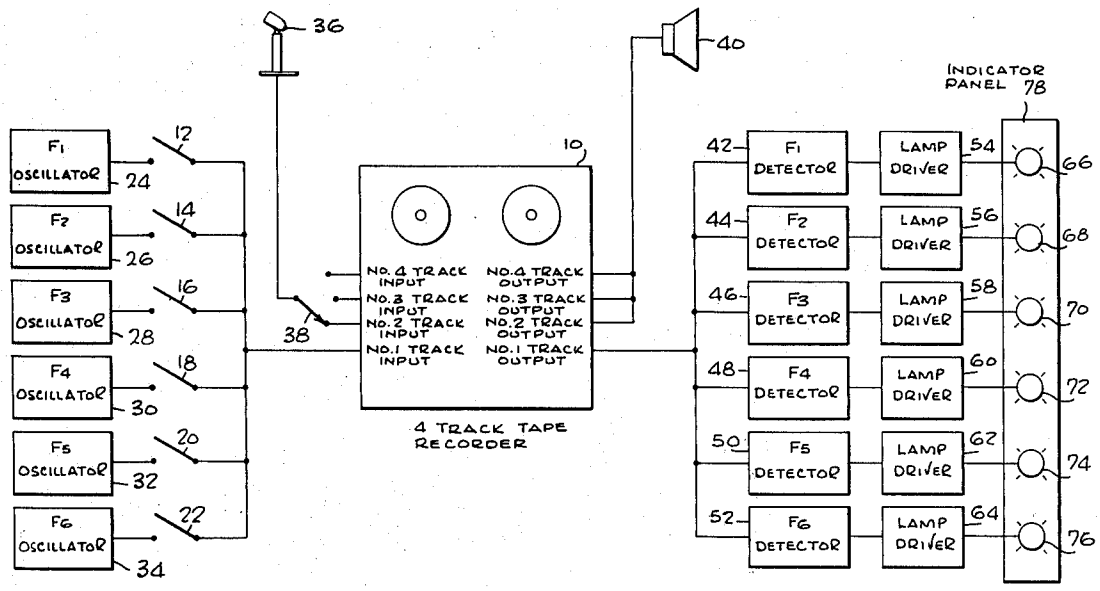
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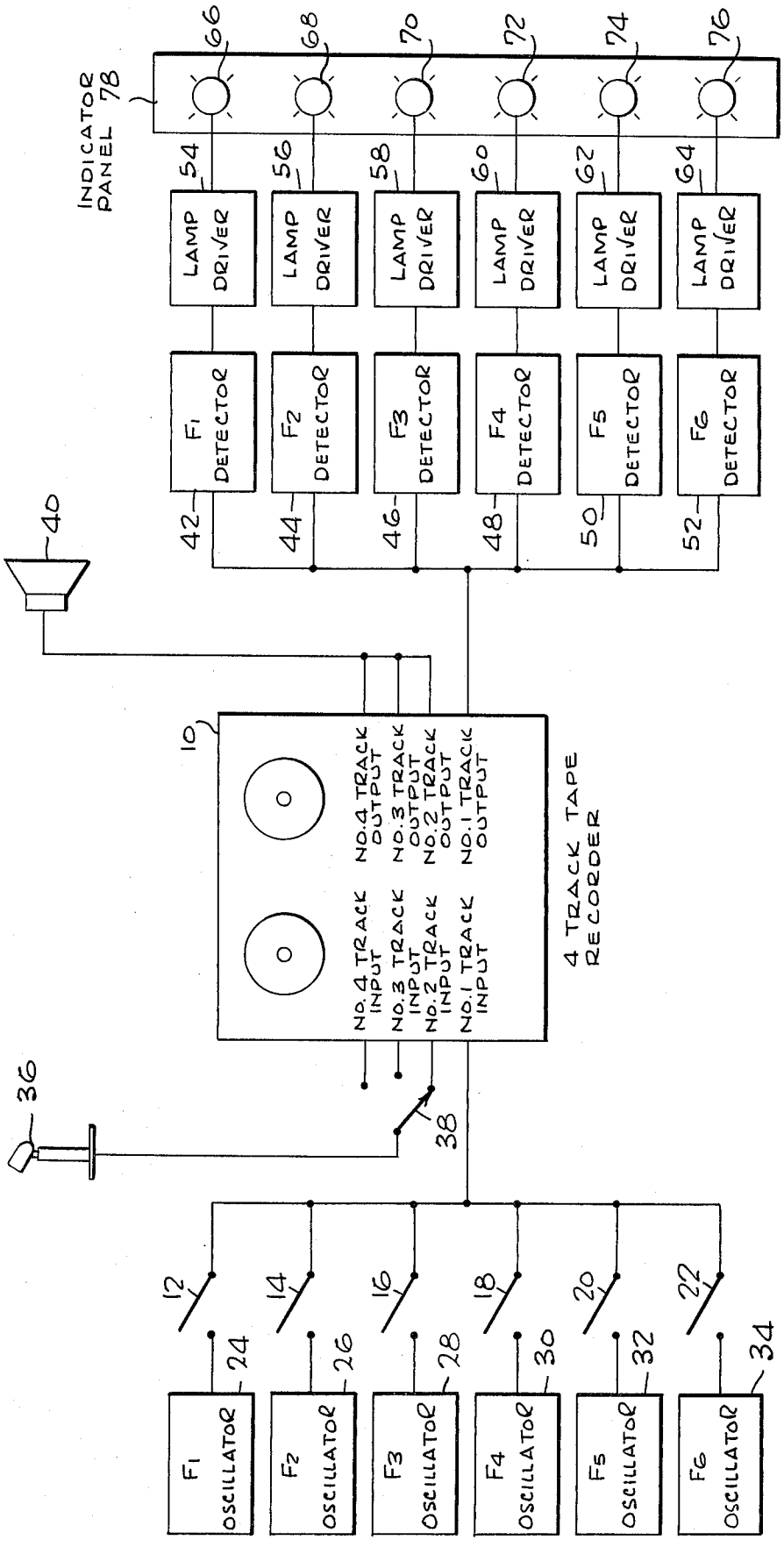
Attorney, Agent, or Firm—Fraser and Bogucki

[57] **ABSTRACT**

An arrangement is provided for generating and recording signals of different frequency corresponding to the different beats in the meter of musical material simultaneously with the recording of the musical material. During playback the signals are detected according to their frequency and are utilized to illuminate individual ones of a plurality of lamps in synchronism with the beats of the musical material as the musical material is played back. The illuminated lamps are used by one or more performers to render a live performance in perfect synchronism with playback of the recorded musical material.

4 Claims, 1 Drawing Figure




INDICATOR PANEL 78
66
68
70
72
74
76
54
56
58
60
62
64
LAMP DRIVER
F1 DETECTOR
F2 DETECTOR
F3 DETECTOR
F4 DETECTOR
F5 DETECTOR
F6 DETECTOR
42
44
46
48
50
52
40
10
NO.4 TRACK OUTPUT
NO.3 TRACK OUTPUT
NO.2 TRACK OUTPUT
NO.1 TRACK OUTPUT
NO.4 TRACK INPUT
NO.3 TRACK INPUT
NO.2 TRACK INPUT
NO.1 TRACK INPUT
4 TRACK TAPE RECORDER
36
38
12
14
16
18
20
22
F1 OSCILLATOR
F2 OSCILLATOR
F3 OSCILLATOR
F4 OSCILLATOR
F5 OSCILLATOR
F6 OSCILLATOR
24
26
28
30
32
34

ELECTRONIC MUSICAL CONDUCTOR

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to mechanical and electronic devices useful in multi-part musical performances.

2. History of the Prior Art

The advancement and sophistication of sound recording techniques have not only improved the quality of musical recordings but have improved the flexibility in using different techniques and effects to make such recordings. For example, it has become common for the performer or performing group to record two or more different parts of particular musical material, with the different part recordings being combined when producing a record, magnetic tape or other recording. The performers may separately record a "foreground" part and several "background" parts, with all of the parts being combined into one final recording. As a result records, tapes and other recording of popular musical performers or groups of performers have a very rich, full and pleasing quality which becomes associated with particular songs or musical arrangements done by the performers.

Problems arise, however, when the same performer or group attempts to render the same performance before an audience. In the case of television it is common practice to simply use the record or audio tape in the audio portion of the broadcast and have the performers pantomime the performance. However realism is often lost when such techniques are used, particularly when the performer's lack of practice or poor sense of timing prevents close synchronism between the performer's lip movements and gestures and the sound which is actually heard. The results can be particularly disastrous in a performance rendered entirely before a live audience. In such situations the disadvantages of combining pantomiming with use of recordings usually dictate that at least part of the performance be live. Obviously the live part of any such performance can only constitute a single part of the performance. As a result the performance often proves to be disappointing to listeners who may be accustomed to listening to the same song done by the performer or group in multiple parts on a popular phonograph record. The obvious solution is to combine a live performance with one or more recordings to produce the multi-part effect. However this is very difficult to do because of the problem of trying to synchronize the live performance with the recordings. Still further problems arise when it is considered that the speed of reproduction of the recordings usually varies somewhat.

Problems of a similar nature arise when the multi-part recordings themselves are being made. Again it may be very difficult to record the second and subsequent parts in perfect or near perfect synchronism with the first part recorded.

The problem of synchronizing a live performance with prerecorded material becomes even more severe in the case of vocalists. Most singers find it very difficult to attempt to listen to one or more prerecorded parts and at the same time sing a different part. In such situations it would be desirable if the singer could sing without regard to the prerecorded parts, yet perform such singing in close synchronism with the prerecorded parts.

There are presently available a number of devices or arrangements for providing an indication of the speed of musical material. However such devices are principally of the metronome type in that they are held to a fixed rate or tempo. Where variations in tempo are possible, such variations are mechanical in nature, and in any event do not allow for material which varies significantly or frequently in tempo. Futhermore such devices are very difficult if not impossible to synchronize with one or more recordings, particularly if the recordings vary in speed.

Accordingly it would be advantageous to provide an arrangement enabling performers to perform in close synchronism with one or more recordings. It would furthermore be advantageous to provide an arrangement which not only allows live performances to be made in synchronism with prerecorded material but which also enables a second and subsequent recordings representing different parts to be made in close synchronism with a first such recording. It would still furthermore be advantageous to provide such an arrangement which provides a readily discernible indication of each individual beat of the meter independent of constant changes in the meter and which is further capable of providing signaling for various effects such as impending meter changes.

BRIEF DESCRIPTION OF THE INVENTION

Arrangements according to the invention generate signals of differing characteristics in response to the individual beats of musical material and record such signals in synchronism with recording of the material. During playback the individual signals are detected and are used to provide indications corresponding to the individual beats of the material in synchronism with playback of the prerecorded material. The performer is thus able to perceive such indications and to thereby render a live performance in synchronism with playback of the prerecorded material. Where multi-part recordings are being made the first part is recorded together with the signals representing the beats. Thereafter the indications provided by the recorded signals are utilized by the performer in recording one or more additional parts. One or more of the recorded parts may then be used during a live performance such as on television or before an audience by having the performer perceive the indications so that his live performance is in synchronism with the playback of prerecorded material. The signals representing the individual beats are generated either in synchronism with recording of material or at will, and in any event are not confined to a fixed tempo.

In one preferred arrangement of a system according to the invention a plurality of push button switches are sequentially closed in synchronism with the beats of musical material so as to record signals of different frequency together with the material. Upon playback the individual signals are detected according to their frequency and are used to illuminate different ones of a plurality of lamps in a sequence which corresponds to the momentary closure of the push button switches and thereby to the individual beats of the prerecorded material. By observing the illuminated lamps the performer is able to render a performance in close synchronism with the prerecorded material as it is being played back. The arrangement thereby "conducts" the performer in synchronism with the prerecorded material.

DETAILED DESCRIPTION

A preferred arrangement of an electronic musical conductor according to the invention is illustrated in the single figure of drawing.

The arrangement includes a multi-track recording device which in this instance comprises a 4-track tape recorder **10.** The tape recorder **10** includes a 4-track tape deck and an amplifier or other electronics necessary to provide signals of nominal amplitude to an output speaker system. The input of the first track of the tape recorder **10** is coupled through a plurality of switches **12, 14, 16, 18, 20** and **22** to a plurality of oscillators **24, 26, 28, 30, 32** and **34** respectively. Each of the oscillators **24, 26, 28, 30, 32** and **34** generates a signal of different frequency, the frequencies in this instance being conveniently designated F_1, F_2, F_3, F_4, F_5 and F_6. The switches **12, 14, 16, 18, 20** and **22** are preferably of the spring-loaded push button type which are normally open and which are closed only so long as depressed.

A microphone **36** is coupled through a selector switch **38** to one of the inputs of the remaining three tracks of the tape recorder **10.** The outputs of these second, third and fourth tracks at the tape recorder **10** are coupled to a speaker system illustrated in the present example as a speaker **40.**

The output of the No. **1** track of the tape recorder **10** is coupled to each of a plurality of detectors **42, 44, 46, 48, 50** and **52.** As described hereafter the various detectors are tuned in response to frequencies at or substantially equal to the frequency of a different one of the oscillators **24, 26, 28, 30, 32** and **34** to the exclusion of other frequencies. The detectors **42, 44, 46, 48, 50** and **52** are coupled through lamp drivers **54, 56, 58, 60, 62** and **64** respectively to a plurality of lamps **66, 68, 70, 72, 74** and **76** respectively on an indicator panel **78.**

When a multi-part recording is to be made the microphone **36** is coupled via the switch **38** to the input of the second track of the tape recorder **10** so as to record musical material on the second track of the tape. At the same time the various switches **12, 14, 16, 18, 20** and **22** are manually closed in synchronism with the beats of the musical material to record short bursts of the signals of different frequencies from the oscillators **24, 26, 28, 30, 32** and **34** sequentially on the first track of the tape recorder **10** and thereby form a sync track.

During playback the recorded sync signals on the first track of the tape recorder **10** are passed to the various detectors **42, 44, 46, 48, 50** and **52.** If the recording on the first track was first begun with a momentary closure of the switch **12,** the detector **42** responds to the resulting signal of frequency F_1 to cause the associated lamp driver **54** to illuminate the lamp **66.** Similarly if the next recorded signal on the first track was provided by momentary closure of the switch **14,** the detector **44** responds to the corresponding signal of frequency F_2 to cause illumination of the lamp **68** via the lamp driver **56.** The various lamps **66, 68, 70, 72, 74** and **76** continue to flash in a sequence determined by the order of closure of the switches **12, 14, 16, 18, 20** and **22** during recording as the recorded material is played back. At the same time the speaker **40** reproduces the prerecorded musical material on the second track of the tape recorder **10.**

By observing the lamps of the indicator panel **78** the performer is able to record a further part on the third track of the tape recorder **10** in perfect synchronism with the previously made recording on the second track. The selector switch **38** is coupled to the input of the third track, enabling the live performance as picked up by the microphone **36** or other appropriate transducer to be recorded on the third track. Following completion of the recording on the third track of the tape recorder **10,** a third part can be recorded on the fourth track of the tape recorder **10** in perfect synchronism with the recordings on the second and third tracks. The selector switch **38** is positioned to couple the microphone **36** to the input of the fourth track. Thereafter the performer performs the third part as he observes the lamps on the indicator panel **78.** The microphone **36** couples the third part for recording in the fourth track of the tape recorder **10.**

As described thus far the arrangement of the invention has been used to record musical material in three parts with the three parts being in perfect synchronism with each other. If the recordings made on the tape recorder **10** are now to be used as background for a live performance, the tape recorder **10** is utilized to play back the recordings made in the second, third and fourth tracks from start to finish, the played-back sound being reproduced by an appropriate transducer such as the speaker **40.** At the same time the performer watches the lights on the indicator panel **78** as he renders a live performance in perfect synchronism with the recorded material.

It has been found that with very little practice the switches **12, 14, 16, 18, 20** and **22** can be manipulated by the individual fingers of one hand to record the beat indicating sync signals during a performance. Although any appropriate arrangement of manually operated switches can be used, it has been found that a gang of six switches of the momentary contact type as used in calculators provides a convenient and effective arrangement. While a total of six switches are provided in the present example, other numbers of switches can be used in accordance with the invention. The presence of six switches provides for use of the arrangement with up to a six beat meter. As a practical matter a meter of four beats or less will be encountered with most musical performances, in which instance the switches **20** and **22** utilizing the frequencies F_5 and F_6 can be used for special effects. While such special effects can comprise any appropriate type of signaling which may be desired, it has been found that the extra switches may be used to great advantage to indicate abrupt changes in tempo such as in the case of a sustain." Other practical uses include an indication of when a particular instrument is to begin playing.

It will be appreciated that with arrangements according to the invention the tempo can be easily changed to correspond with a change in performance, and the meter itself can be changed every measure if necessary. For example, the meter can be changed from a bar of four to a bar of three, then to a bar of two, then back to a bar of four as is required for certain musical compositions.

The various oscillators **24, 26, 28, 30, 32** and **34** can comprise any appropriate circuits for generating signals of different characteristics such as of different frequency in the present example. An example of a circuit which can be used as the various oscillators is the twin T bridge feedback loop sine wave oscillator circuit employing the common **741** type of integrated circuit made by Motorola Corporation, Fairchild Semiconduc-

tor Corporation and Texas Instruments Company. The frequencies of the oscillators should be chosen so as to avoid beat frequency or harmonic interference type problems, but otherwise can assume any appropriate value in keeping with the frequency response of the tape recorder **10** and the other circuit characteristics of the system. In one example of the invention the various frequencies F_1, F_2, F_3, F_4, F_5 and F_6 comprise 300 Hz, 2300 Hz, 4300 Hz, 6300 Hz, 8300 Hz and 10300 Hz respectively.

The tape recorder **10** can utilize any appropriate multitrack tape deck, with one example being the Sony Model 854. The recorder **10** should have at least two tracks, one for the sync signals and the other for at least one recording of musical material. Other than that the recorder **10** can have any desired number of tracks depending on the desired capabilities of the system and the number of parts of a musical performance to be recorded. The frequency response of the tape recorder **10** must be broad enough to handle the various frequencies from the oscillators as well as to record the various parts of the musical material with reasonable fidelity. It is also desirable that the tape recorder **10** be of the type having a speed adjustment. Thus if the prerecorded musical material is not in tune with the live performance, the speed can be increased or decreased to maintain perfect synchronism therebetween.

The detectors **42, 44, 46, 48, 50** and **52** may comprise any appropriate circuits such as active bandpass filters for responding to signals at or near a selected frequency to the exclusion of signals of other frequency. The **741** type integrated circuit referred to above can comprise the detectors when connected to operate as an active bandpass filter. The characteristics of the detectors should be such that they respond in positive and accurate fashion to signals which have been generated by a corresponding one of the oscillators to the exclusion of signals from the other oscillators. At the same time the bandpass characteristics must be broad enough to compensate for minor frequency variations such as may result when the speed of the tape recorder **10** is changed between recording and playback. The various lamp drivers **54, 56, 58, 60, 62** and **64** can comprise any appropriate circuits for driving small lamps such as the commonly used two-stage amplifier in which the lamps are coupled in the collector circuit of the second stage.

While the invention has been particularly shown and described with reference to a preferred embodiment thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the invention.

What is claimed is:

1. A method of rendering a second musical performance in synchronism with the playback of a recorded first musical performance comprising the steps of:

recording the first musical performance as said first performance occurs;

generating a sequence of signals simultaneously with the occurrence of each measure of said first performance, each sequence of signals comprising an ordered set of signals uniquely associated with the order and timing of the beats in each measure as performed;

recording said sequence of signals simultaneously with said recording of said first performance;

playing back said recorded first performance and said sequence of signals simultaneously;

providing an ordered set of indicators to be sensed by the performer of said second musical performance, each of said indicators being actuated by said played back ordered set of signals, whereby each of said indicators is associated with a particular beat of each measure of said first performance; and

rendering said second performance having beats therein in synchronism with said actuated indicators, whereby the beats of said second performance are in synchronism with the order and timing of the corresponding beats of said first performance.

2. The method of claim **1** wherein the step of generating a sequence of signals comprises listening to said first performance as it occurs and manually actuating a plurality of signal generators in predetermined order in synchronism with the occurrence the beats in each measure of said first performance.

3. The method of claim **1** further comprising the step of recording said played back first performance and said rendered second performance.

4. The method of claim **1** wherein said ordered set of indicators are visually sensed by said performer.

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