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Hallman, Jr.

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[54] KEYNOTE SELECTOR APPARATUS FOR ELECTRONIC ORGANS

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[21] Appl. No.: **355,291**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 220,068, Jan. 24, 1972, abandoned.

[52] **U.S. Cl.** **84/1.24,** 84/1.01

[51] **Int. Cl.** **G10h 1/02**

[58] **Field of Search** 84/1.01, 1.24, 445

[56] **References Cited**

UNITED STATES PATENTS

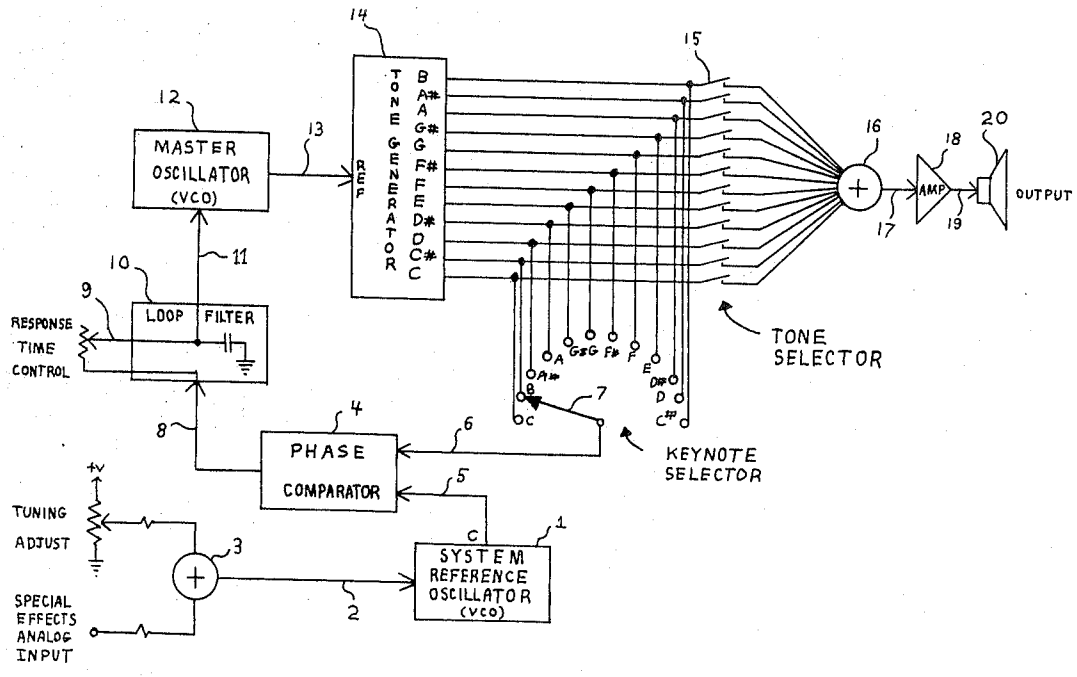
3,023,659	3/1962	Bode	84/445
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3,674,907	7/1972	Derry	84/1.01

Primary Examiner—Richard B. Wilkinson
Assistant Examiner—U. Weldon

[57] **ABSTRACT**

An electronic organ keynote selection apparatus, for selectively altering the key to which the organ is tuned, may be employed in organs utilizing single voltage controlled master oscillator tone generator systems. The apparatus includes a phase locked loop comprising a phase comparator producing a control voltage coupled to a loop filter providing loop stabilization and loop response time control (musical slur speed control) coupled to the voltage controlled master oscillator providing the reference to the tone generator. One input of the phase comparator is connected to an oscillator providing a system tuning reference. the other input to the phase comparator is selectively coupled by switching means (keynote selector) to one of the tone generator outputs thereby establishing a phase lock between the reference oscillator and the selected tone generator output. The instrument keynote is altered when the phase comparator input is changed to a different tone generator output by the keynote selector. A loop response time control provides a means by which the time required for a keynote change may be regulated which provides the musical slur effect to an electronic instrument which here to fore has only been possible with the wind instruments. A new method of playing music results when the keynote selector comprises a standard organ keyboard. With one hand the player strikes a chord on a tone selector keyboard while with the other hand selecting the instrument key on the keynote selector keyboard and regulating the keynote change speed (slur speed), thus providing novel organ musical effects, as well as providing an easier means for playing musical accompaniment since only the chords associated with the key of C are required since these chords may be transposed to chords associated with other keys by the keynote selector. A special effects analog input to the system reference oscillator is provided which may have complex analog signal inputs and in fact this in combination with the keynote selector appropriately manipulated with a hand will provide new musical possibilities to the instrument and composer. Essentially what is provided is a new music synthesizer which offers all the capabilities of the conventional monophonic synthesizer but with new polyphonic capabilities added.

10 Claims, 10 Drawing Figures



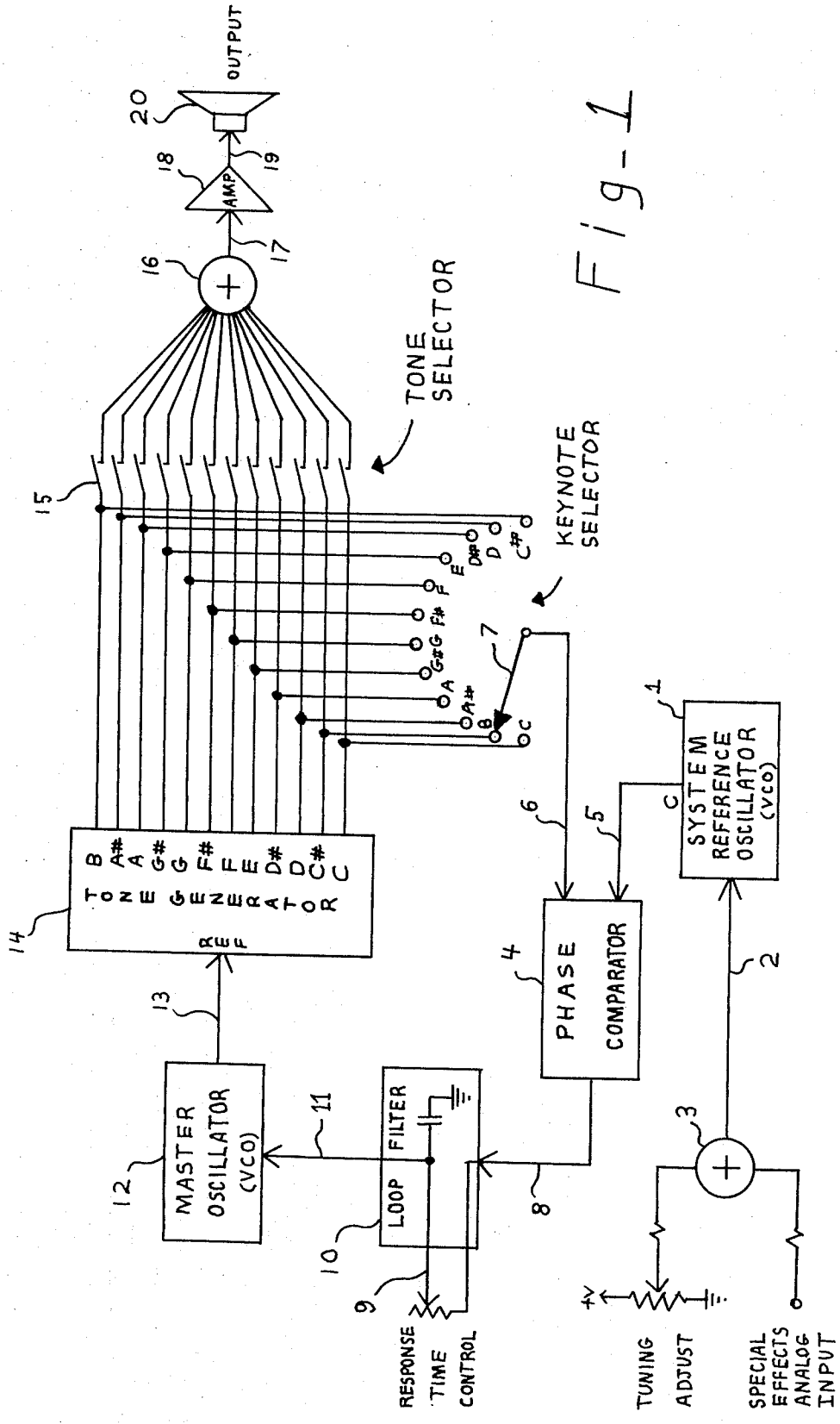

OUTPUT
20
18
AMP
19
17
16
TONE SELECTOR
KEYNOTE SELECTOR
15
7
B
A#
A
G#
G
F#
F
E
D#
D
C#
C
14
TONE GENERATOR
REF
13
MASTER OSCILLATOR (VCO)
12
11
FILTER
LOOP
10
9
RESPONSE TIME CONTROL
8
PHASE COMPARATOR
4
6
5
1
SYSTEM REFERENCE OSCILLATOR (VCO)
2
3
+V
TUNING ADJUST
SPECIAL EFFECTS ANALOG INPUT

Fig-1

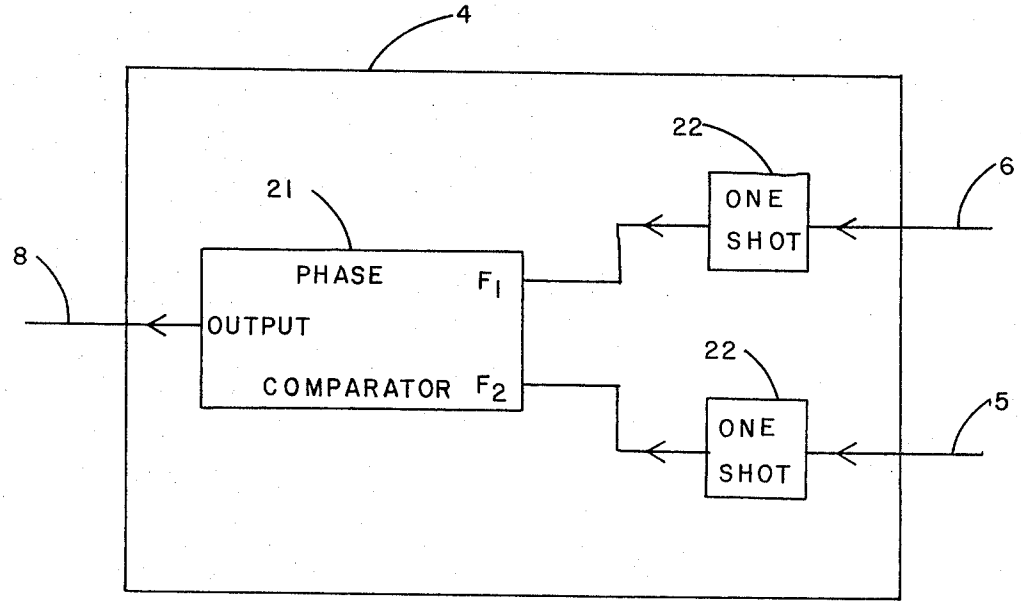


Figure 2

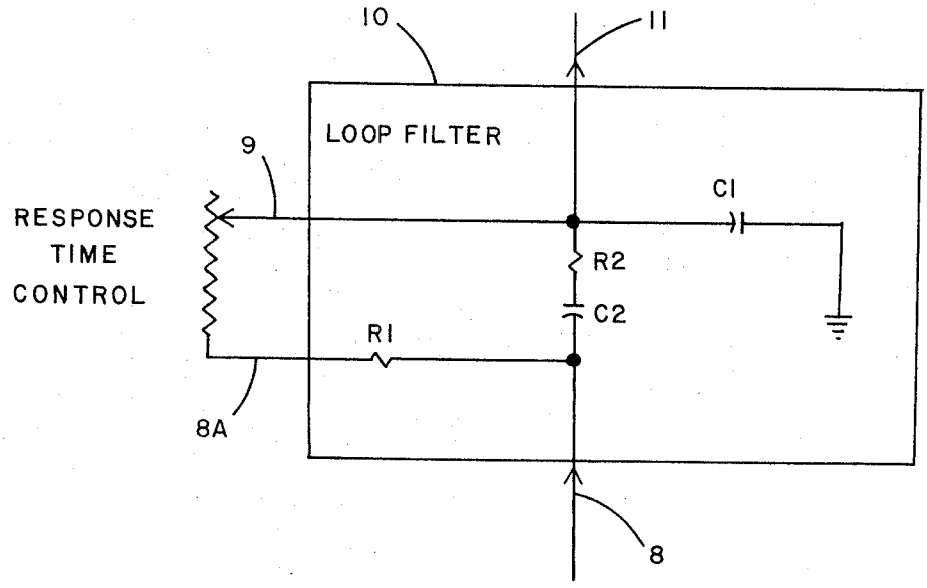


Figure 3

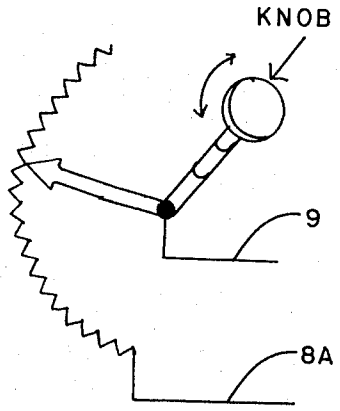


Figure 4

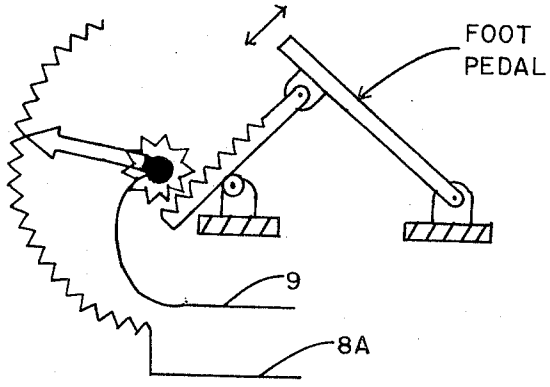


Figure 5

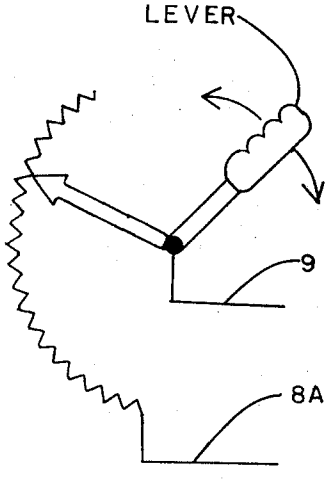


Figure 6

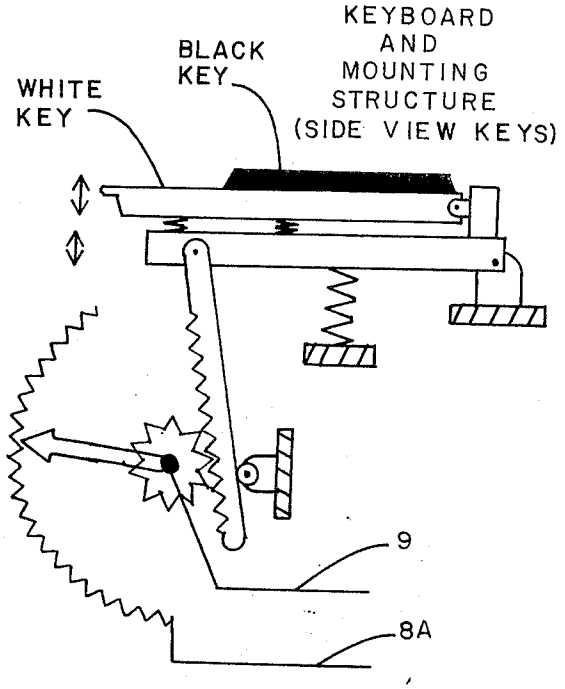


Figure 7

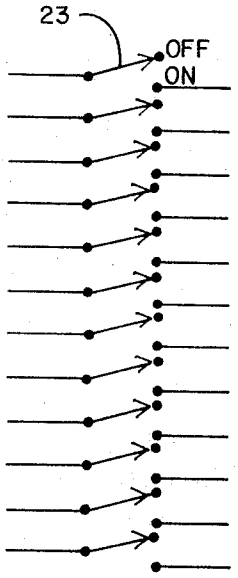


Figure 8

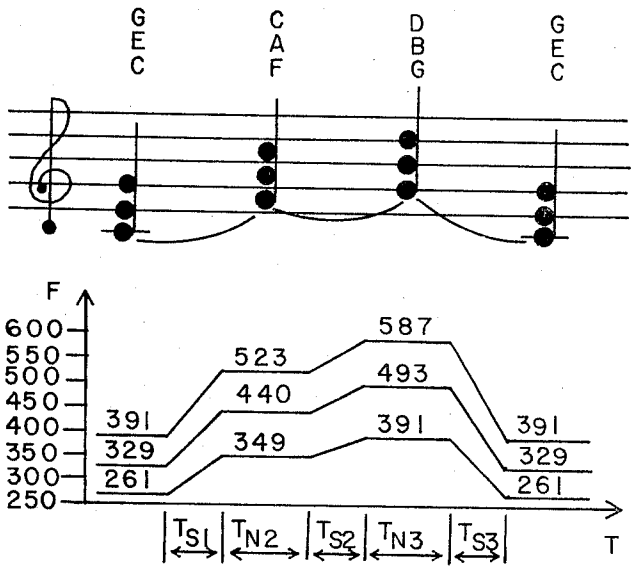


Figure 9

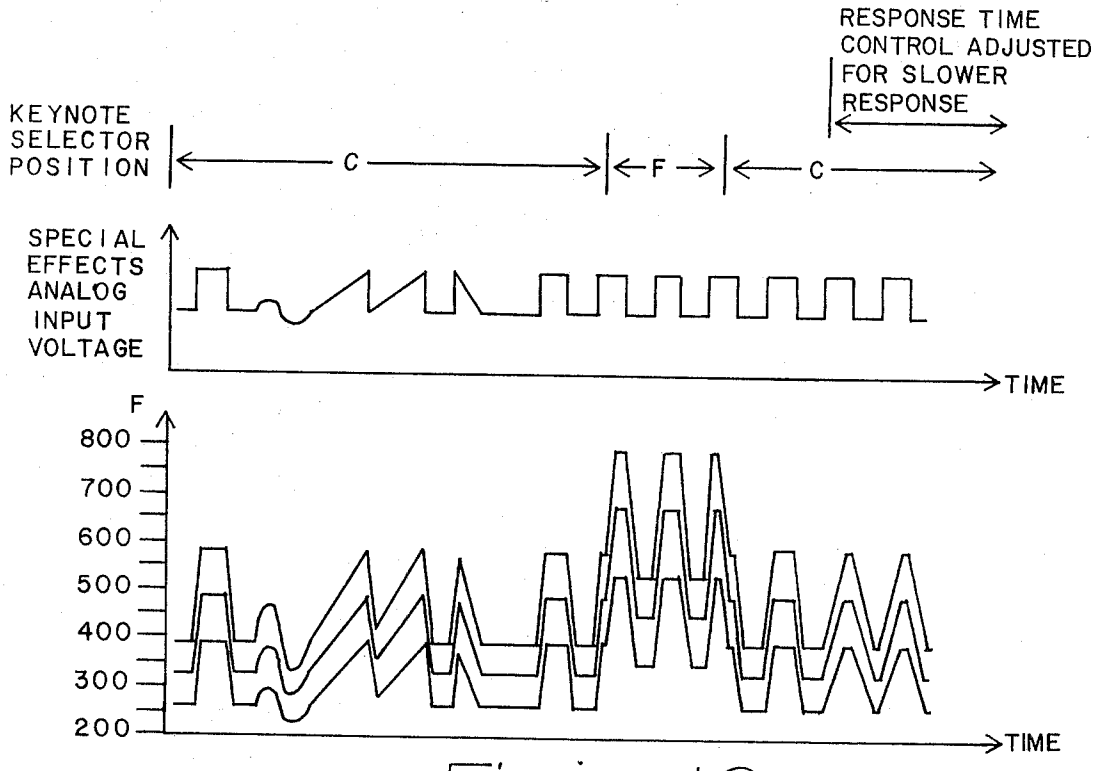


Figure 10

KEYNOTE SELECTOR APPARATUS FOR ELECTRONIC ORGANS

This is a continuation-in-part of application Ser. No. 220,068 filed Jan. 24, 1972 and now abandoned.

SUMMARY AND BACKGROUND OF THE INVENTION

The present invention relates generally to electronic organs and more particularly to keynote selection in the organ.

In the usual keynote changing systems (Hill, U.S. Pat. No. 3,601,518; Aug. 24, 1971) a period multiplier is employed in cascade with reference frequency source to provide for altering the instrument key. This cascade arrangement requires that the reference frequency source produce an extremely high frequency that is uneconomical. In accordance with the present invention on the other hand, the reference frequency source is replaced with a voltage controlled master oscillator operating at a much lower frequency coupled directly to the tone generator system (eliminating the scale transposer section of Hill). The voltage control input to this oscillator is provided by a phase comparator coupled through a loop filter providing loop stabilization and response time control. A system reference oscillator (in addition to the above reference frequency source) provides one input to the phase comparator. The other phase comparator input is provided by the keynote selector switching means connecting to a selected tone generator output (the scale generator must be polyphonic with all notes available simultaneously such as the tone generator presented in Hallman, U.S. Pat. No. 3,702,370, issued 11-7-72, filed 5-19-71). Thus, a phase locked loop is constructed operating in such a manner that the selected tone generator output frequency is forced to be equal to the frequency output of the system reference oscillator.

In the digital keynote selector of Deutsch, Pat. No. 3,610,800 only discrete keynote changes over intervals of one-half step so that no musical slur effect is possible. The present invention on the other hand provides means to change the keynote in steps that may be varied from discrete sounding to smooth sounding which is accomplished by regulating the speed of the keynote transitions by means of a response time control. With fast keynote changes the transition appears discrete but when proper adjustment is made for slow keynote changes then the transitions appear smooth and continuous such as those accomplished by a trombone when the slide is moved slowly. Additionally a polyphonic sound is generated by this effect since several notes may be played in combination as selected by a tone selector and slurred in unison as the keynotes change when the keynote selector is manipulated and the speed of the slur being controlled by a response time control.

In the system provided by Omura, U.S. Pat. No. 3,461,217 bass tones are produced in response to the manipulation of the accompaniment section of the keyboard. The bass tones are again produced in discrete steps and further the system does not operate on the principles of keynote alteration but only sumation and selection of notes from the accompaniment side of the keyboard.

In accordance with the invention a system reference oscillator is provided which may be voltage controlled

to provide manual tuning adjustment and a special analog effects input means. The frequency of this oscillator is usually set to a note within the range of human hearing, but this is just a matter of design choice as will become apparent after consideration of the detailed description of the invention.

In further accordance with the invention, a phase locked loop is provided comprising a phase comparator providing an analog voltage output as a function of relative phase between the outputs of the system reference oscillator and the selected tone generator output provided by the keynote selector switching means. The above analog voltage output is coupled to a loop filter which is essentially a lag compensator but may also provide some lead compensation if wider slur speed control range is desired. Means is provided to adjust the lag time constant thus, providing a response time adjustment to allow the system to provide a fast or slow slur between keynote changes. The loop filter is finally connected to a voltage controlled master oscillator providing the reference frequency to the tone generator thus, closing the loop.

In further accordance with the invention, a special effects analog input is provided on the system reference oscillator which may be frequency modulated by means of a complex analog input signal comprising a squarewave, sinewave, rampwave, trianglewave, or a combination of these providing a periodic or cyclic effect more complex than conventional vibrato. The special effects may be introduced while playing the instrument according to other methods disclosed presently providing novel music exhibiting a mechanical nature and which may be considered or associated with music that has been composed with a computer. The music so produced has a pleasing sound even with an almost random selection of keynote sequences. This effect will undoubtedly provide great interest for the novice players.

It is accordingly a broad object of the invention to provide novel keynote selection means for electronic organs that are highly accurate in pitch but simple in operation.

It is another object of the invention to provide more economical means of keynote selection with an ultra wide range of precision operation while requiring only one system reference oscillator.

It is a further object of the invention to provide a novel music instrument providing a new method of playing musical accompaniment requiring only the chords associated with one keynote to be memorized and manipulated on the keyboard.

It is a further object of the invention to provide a new means of playing music whereby a music instrument is provided with a tone selector keyboard, on which a combination of musical notes may be selected, and a keynote selector keyboard, on which the keynote or keynote changes may be selected, and a response time control, which may be a knob, lever, foot pedal, or lever mechanically connected to the keyboard so that keyboard motion actuates the response time control, for regulating the keynote transition speed.

It is a further object of the invention to provide a new method of playing music whereby a combination of notes may be selected or preset on a tone selector, a keynote change is executed on a keynote selector, while the speed of the keynote change is regulated by means of a response time control. Thus, sweeping musi-

cal effects result which may accompany any musical composition.

It is a further object of the invention to provide another means of entering special analog controlled musical effects for the organ providing new modern music.

The above and still further objects, features and advantages of the present invention will become apparent upon consideration of the following detailed description of one specific preferred embodiment thereof, especially when taken in conjunction with the accompanying drawings, wherein:

FIG. 1 is a diagram of an apparatus providing keynote selection for electronic organs employing a tone generator utilizing a single master oscillator.

FIG. 2 is a diagram showing means to adapt the Breikss phase comparator to the apparatus of FIG. 1.

FIG. 3 is a diagram of a generalized loop filter and response time control for use in the apparatus in FIG. 1.

FIG. 4 is a mechanical embodiment of a response time control employing a knob for actuation for use in the apparatus of FIG. 1.

FIG. 5 is a mechanical embodiment of a response time control employing a foot pedal for actuation for use in the apparatus of FIG. 1.

FIG. 6 is a mechanical embodiment of a response time control employing a lever for actuation for use in the apparatus of FIG. 1.

FIG. 7 is a mechanical embodiment of a response time control employing a keyboard connected to a linkage for actuation for use in the apparatus of FIG. 1.

FIG. 8 is a drawing showing mechanical bistable switches which may replace the momentary switches of the tone selector in the apparatus of FIG. 1.

FIG. 9 is a music score and frequency vs time diagram that may be played on the apparatus of FIG. 1.

FIG. 10 shows some more variables effecting the response of the organ and complex waveform signals which may be introduced into the special effects analog input of FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the accompanying drawings, in FIG. 1, block 1 is a system reference oscillator which is in this embodiment of the invention a voltage controlled oscillator (VCO) with input 2 provided from summing junction 3 with inputs from an instrument tuning adjustment means comprising a potentiometer and a special effects analog input providing an input means whereby special effects may be attached such as vibrato or a special function generator/computer providing sinewave, triangular wave, squarewave, pulses or these in combination. The system reference oscillator 1 is shown as analog programmable i.e., output frequency is a function of input voltage but a system reference oscillator that is digitally programmable may be incorporated into the system without departing form the true spirit of the invention.

The inputs 5 and 6 of phase comparator 4 are coupled respectively to the system reference oscillator 1 and keynote selector 7 selectively, such that phase comparator 4 compares the phase of the signals appearing at terminals 5 and 6 to produce a voltage at its output 8 which corresponds to the difference in phase therebetween. Note that the keynote selector 7 is shown as a rotary switch which has only one arm which assures that the arm is connected to one and only one pole at any given time. A type of switch which connects one and only one tone generator output to the phase comparator is best suited to this invention for the keynote selection since if more or less than one tone generator output is connected to the phase comparator, the phase locked loop will not function properly. For economy in design, it may be feasible if a keyboard is used, to omit the interlocking feature of the rotary switch in favor of leaving the requirement up to the player to push only one keynote selector key at any given time.

A compatible phase comparator is described and diagramed in a magazine article entitled "Shift Register Simplifies Design of Phase Comparator" by Ivars Breikss in Electronics Magazine issue of Jan. 19, 1970. As shown in a figure in the article on page 93, the phase comparator requires narrow pulses at each of the two inputs f_1 and f_2 of which the phase is compared. The pulses occur once per period of the respective frequencies to be compared. One shots may be connected to provide the pulse inputs to f_1 and f_2 in the figure on page 93 and the inputs of the oneshots then correspond to connections 5 and 6 respectively of FIG. 1 in the drawing of one embodiment of the present invention. In the figure of the article by Briekss the terminal marked "output" corresponds to terminal 8 of FIG. 1 in the drawing of the present invention.

Terminal 8 is the input to the loop filter 10 that is coupled to the analog output of the phase comparator 4. The output 11 is a function of input 8 modified according to the transfer function of the loop filter 10. The filter 10, in this embodiment of the invention, is a simple low pass filter, the resistive part of which is adjusted by the response time control connected to input 9 providing a slur speed control effective during keynote changes. The fast slur response corresponds to a short time constant (minimum lag) and a slow slur corresponds to a longer time constant of the loop (maximum lag).

The input 11 to the VCO 12, provided by the loop filter controls its frequency output 13 coupled to the tone generator 14 thus controlling its outputs also. The tone generator 14 outputs are designated by letters corresponding to the twelve notes of the musical scale. Under certain conditions these outputs provide frequencies that correspond to the correct frequencies of the notes designated by the letters: C, C# , D, D # , E, F, F# , G, G# , A, A # , and B. This will become apparent when the invention has been considered in detail. Table I shows the actual note present at each output as a function of the keynote selector 7 switch position which controls which tone generator output is connected to phase comparator 4 input 6. Note the inverted relationship between the letter designations of the outputs of the tone generator and the keynote selector 7, where the B switch position is connected to the C # tone generator output, for example. (see FIG. 1) This is a necessary characteristic of the operation of the phase locked loop. As can be seen from

TABLE I.—TONE GENERATOR OUTPUT NOTES SHOWN AS A FUNCTION OF KEYNOTE SELECTOR SWITCH POSITION WITH THE REFERENCE OSCILLATOR 1 TUNED TO C.

Keynote selector position	Tone generator output											
	C	C#	D	D#	E	F	F#	G	G#	A	A#	B
C	C	C#	D	D#	E	F	F#	G	G#	A	A#	B
C#	C#	D	D#	E	F	F#	G	G#	A	A#	B	C
D	D	D#	E	F	F#	G	G#	A	A#	B	C	C#
D#	D#	E	F	F#	G	G#	A	A#	B	C	C#	D
E	E	F	F#	G	G#	A	A#	B	C	C#	D	D#
F	F	F#	G	G#	A	A#	B	C	C#	D	D#	E
F#	F#	G	G#	A	A#	B	C	C#	D	D#	E	F
G	G	G#	A	A#	B	C	C#	D	D#	E	F	F#
G#	G#	A	A#	B	C	C#	D	D#	E	F	F#	G
A	A	A#	B	C	C#	D	D#	E	F	F#	G	G#
A#	A#	B	C	C#	D	D#	E	F	F#	G	G#	A
B	B	C	C#	D	D#	E	F	F#	G	G#	A	A#

the above TABLE I, the tone generator **14** outputs letter designations actually correspond to the frequencies of the notes designated by these letters only when the keynote selector **7** is set to position C in this example and the system reference oscillator **1** is tuned to C. This is a matter of design choice and it should be understood that other arrangements of connections of the keynote selector **7** and oscillator **1** frequency may be worked out without departing from the true spirit of the invention. Some other arrangements are presented in TABLE II, below:

TABLE II.—KEYNOTE SELECTOR SWITCH DESIGNATIONS SHOWN AS A FUNCTION OF REFERENCE OSCILLATOR 1 OUTPUT NOTE WITH THE TONE GENERATOR 14 OUTPUT NOTES MAINTAINED AS DESIGNATED.

Reference Oscillator Output	Keynote selector switch designations											
	C	C#	D	D#	E	F	F#	G	G#	A	A#	B
C	C	C#	D	D#	E	F	F#	G	G#	A	A#	B
C#	C#	D	D#	E	F	F#	G	G#	A	A#	B	C
D	D	D#	E	F	F#	G	G#	A	A#	B	C	C#
D#	D#	E	F	F#	G	G#	A	A#	B	C	C#	D
E	E	F	F#	G	G#	A	A#	B	C	C#	D	D#
F	F	F#	G	G#	A	A#	B	C	C#	D	D#	E
F#	F#	G	G#	A	A#	B	C	C#	D	D#	E	F
G	G	G#	A	A#	B	C	C#	D	D#	E	F	F#
G#	G#	A	A#	B	C	C#	D	D#	E	F	F#	G
A	A	A#	B	C	C#	D	D#	E	F	F#	G	G#
A#	A#	B	C	C#	D	D#	E	F	F#	G	G#	A
B	B	C	C#	D	D#	E	F	F#	G	G#	A	A#

The frequency of oscillator **1** must be exactly equal to the proper frequency of one of the notes of the scale in order that the organ be tuned to a valid keynote. Also the entire system may be transposed whole octaves without changing any of the above relationships except that the frequency range of the VCO **12** must be adjusted accordingly. With correspondingly wider operating range of VCO **12,** more outputs provided by tone generator **14,** and more keynote selector **7** switch positions, a wider dynamic output range of the organ will result. Another way to extend the operating range of the organ is to add a flip-flop divide by two circuit in series with connection **6.** A flip-flop here will raise the output range (keynote) of the organ one octave. By controlling the effect of this flip-flop (in or out of the circuit) with keynote selector **7,** an additional octave range may be added to the organ without increasing the number of outputs provided by the tone generator **14.** Still other ways will be obvious to those skilled in the art but this does not depart from the true spirit of the invention.

The tone generator **14** outputs may be coupled to keyboard tone selector **15** for summing at summer **16** coupled to the input **17** of amplifier **18** providing an output **19** to loud speaker **20** producing an audio output to the audience.

FIG. **2** shows a compatible phase comparator **4** that may be used in the apparatus of FIG. **1.** In FIG. **2,** phase comparator **21** is identical with the phase comparator shown in a magazine article by Ivars Breikss appearing on page 93 of the Jan. 19, 1970 issue of electronics magazine. In the phase comparator **21** of Breikss the terminal marked "output" corresponds to connection **8** of FIGS. **1** and **2** in the present application. Terminals f_1 and f_2 of Breikss are connected to terminals **5** and **6** via one shots **22** producing compatible negative pulses to the phase comparator of Breikss. The one shots **22** are monostable flip-flops which are set once each period of a periodic squarewave signal produced by the selected tone generator output **6** or the system reference oscillator output **5.**

FIG. **3** shows a more detailed loop filter for use in the apparatus of FIG. **1.** The loop filter **10** in FIG. **1** is a simplified embodiment providing only a relatively narrow range of response time adjustment. Also it is possible to adjust the response control to zero resistance thereby possibly rendering the loop filter ineffective if the source resistance of phase comparator **4** is small which may produce undesirable harmonic content in the tone generator output. The resistor R1 in FIG. **3** will limit this resistance to a minimum value so that the loop filter is always operative. Also some lead compensation may be added as shown by R2 and C2 in FIG. **3** to extend the adjustment range of the response time since better compensation is provided for the phase

locked loop. Resistor R1, the response time control and capacitor C1 form a low pass filter which is a form of lag compensation for the phase locked loop.

FIG. 4 shows how a knob may be attached to the response time control of FIG. 1 so that slur speed may be regulated by turning the knob. FIG. 5 shows the response time control of FIG. 1 adapted to a foot pedal. As the foot pedal is pressed the control is rotated by action of the straight toothed member thus varying the response time control. FIG. 6 shows an embodiment of the response time control of FIG. 1 employing a lever for adjustment. FIG. 7 shows a standard organ keyboard connected to the response time control of FIG. 1 providing means by which the slur speed may be regulated according to a mechanical motion of the keyboard in a similar way that the foot pedal operates the control in FIG. 5.

FIG. 8 shows a group of 12 bistable switches which may replace the momentary tone selector switches 15 of FIG. 1. The switches 15 of FIG. 1 are shown as momentary which operate like the horn button of an automobile horn. When you push the button, a tone generator 14 output frequency is connected momentarily to the output circuits 16, 17, 18, 19, and 20 of the organ until the button is released. These switches may take the physical form of keys of a standard organ keyboard which are normally pressed to sound a tone and released to stop the tone. Twelve such switches are shown but this is just a matter of design since it would be obvious to those skilled in the art that any number of switches may be employed providing the desired number of selectable tones to the output circuits of the organ. As mentioned above, FIG. 8 shows a group of switches 23 which may replace the switches 15 of FIG. 1. Switches 23 are shown bistable, the operation of which is like that of a light switch usually found on a wall for controlling whether a room light is on or off. The switch will stay in the on state until "toggled" back to the off state and vice versa. This operation is a form of latching operation providing "memory" that stores the desired light status of whether the light is wanted on or off. When this type of switch 23 is employed in the organ in place of the type of switch 15, a "memory" is provided which may be preset to connect selected tones to the output circuits of the organ. Thus, a single tone or a group of tones may be selected to sound continuously until the toggle switch or group of switches is turned off. This feature provides the organ the capability of a preset tone or group of tones that can be slurred from one note or notes to another note or notes in polyphonic operation if desired as shown in FIG. 9. FIG. 9 shows the operation of the keynote selector with a sequence of four keynotes while three tone selector switches are toggeled so that the tone generator outputs C, E, and G in block 14 are connected to the output circuits 16, 17, 18, 19, and 20. A musical scale shows the progression while a frequency vs. time plot shows the time spent for each group of notes. The keynote selector starts at C position and is moved to F for time interval T_{N2}. The resulting slur for this keynote change lasts for time interval T_{S1} which may be regulated for longer or shorter time intervals by adjusting the response time control in FIG. 1. As can be seen the performance of the system is polyphonic with all notes well defined in good tune, etc.

For the purpose of this application, a standard organ keyboard is considered to have both white and black keys that operate momentary switches. The standard keyboard may be modified to comprise keys that operate bistable switches providing memory in which case when a key is pressed it latches and stays on until the player pushes up on the key to return it back to the off position. The keyboards are represented this way to allow the operation of the invention to be easily understood with a minimum of complicated drawings. It should be understood that while the invention will work with the keyboards as described, it is more difficult for a player to produce music than if some more exotic keyboard latching scheme is employed such as one that when a first key is pressed it latches until a second key is pressed. In fact, it is desirable if a standard organ keyboard is employed instead of the rotary type switch for the keynote selector 7 that it be a latching type and further it would be nice if it employs an interlocking feature that would prevent more than one key from latching at a given time so that the player doesn't have to worry about the keynote selector requirement that one and only one key be on at any given time. Such interlocking features are known to those skilled in the art and if it is desired to include this in a design it is certainly possible to do so. It is, however, more economical to leave this requirement to the player since it is an easily learned step to operate one and only one key on the keynote selector at any given time.

FIG. 10 is a drawing intended to demonstrate the special analog effects input in FIG. 1 and how this input may be used to frequency modulate the gamut of output notes of the organ. This is similar to vibrato but a much wider range of frequency modulation is possible. When used in combination with the keynote selector and response time control new effects are possible such as will become obvious after considering the following in detail. In FIG. 10 a complex analog waveform is shown as one example of a multiplicity of possible waveform signals which may be introduced into the special effects analog input in FIG. 1. This waveform for the purposes of this example starts with a positive pulse followed by a DC level followed by two positive ramps followed by a negative pulse followed by a negative ramp, followed by a DC level and finally ending with a squarewave, the amplitude of which is adjusted so that the output keynote of the organ alternates in perfect fifths in this example, but other square wave amplitudes may be chosen to suit the preferences of the player or composer. As time increases from left to right the keynote selector in FIG. 1 may be changed from position C to position F and back to position C as shown. The frequency vs. time plot in FIG. 10 shows the output note frequencies of the organ when three tones are selected similar to those in FIG. 9. Note that the output frequencies of the organ follow the analog input voltage in all parts of time except for two notable exceptions. One exception is that the transitions of frequencies or slurs are not discrete instantaneous but smooth changes from one note to the next. The slope of these transitions may be regulated by the response time control which when adjusted for fast response time the transitions are steep approaching discrete keynote changes. As shown, when the response time control adjustment is made slower near the end of the plot shown during the squarewave special effects input the output frequencies of the organ becomes more like a triangle wave which is the effect of more lag in a low pass filter. The second notable exception in which the output frequencies of the organ do not exactly follow the special analog effects input is when the keynote se-

lector switch position is changed. The output response is shown for when the keynote selector is changed from C to F and back to C again. Interesting music may be produced with this effect. For example when the special analog effects input is a square wave of several hertz in frequency with the amplitude adjusted to produce keynote changes in perfect fifths, the keynote selector switch may be switched through a sequence of keynotes almost at random and pleasing music results which sounds like that which may be judged to be composed by a computer in the modern tradition. Other combinations of the input to the special effects analog input and keynote selector will produce many different musical patterns. In fact, a new method of playing music results comprising the application of a complex waveform to the special analog effects input, presetting a combination of tones on the tone selector and playing a sequence of keynotes on the keynote selector.

Another new method of producing music results from the process comprising selection of tones on a tone selector and adjusting the response time control while playing a sequence of keynotes on the keynote selector.

While I have described and illustrated one or two specific embodiments of my invention, it will be clear that variations of the details of construction which are specifically illustrated and described may be resorted to without departing from the true spirit and scope of the invention as defined in the appended claims. For example the system reference oscillator **1** as shown is analog programmable (VCO) but any other programming means may be employed to change its frequency. Also the master oscillator **12** is shown as analog programmable but it may be digitally programmable for example and a phase locked lopp would be constructed using digital techniques which would not depart from the true spirit of the invention as disclosed. Also, another embodiment of the invention may be constructed using hydraulic fluid flow technology without departing from the true spirit of the invention disclosed herein.

What I claim is:

1. A keynote selection apparatus for an electronic organ comprising a reference oscillator producing a reference frequency connected to the first input of a phase comparator producing an analog output voltage connected to a loop filter connected to a voltage controlled master oscillator means connected to a tone generator means providing a plurality of frequency outputs corresponding to the notes of a musical scale connected to a tone selector switching means comprising momentary switches providing means selectively connecting selected tone generator outputs to the audio output of the organ, and said tone generator connected to a keynote selector switching means for selectively connecting one and only one tone generator output to the second input of said phase comparator thereby establishing a phase locked loop means providing a means for forcing the selected tone generator output frequency to be equal to the output frequency of said reference oscillator thereby providing means for altering the tuning of the organ to any keynote at will by manipulation of the keynote selector switching means.

2. A music instrument for playing music comprising the apparatus of claim **1** wherein said keynote selector switching means comprises a keyboard switching means comprising bistable switches in which only one key switch is closed at any given time by the player.

3. A music instrument for playing music comprising the apparatus of claim **1** wherein said tone selector switching means comprising momentary switches replacing said momentary switches with bistable switches which may be selectively preset by the player providing one or more output notes and said keynote selector switching means comprises a keyboard switching means comprising bistable switches in which only one key switch is closed at any given time by the player.

4. A keynote selection apparatus for an electronic organ comprising a special effects analog input connected to summing means producing an output connected to a reference oscillator producing a reference frequency connected to the first input of a phase comparator producing an analog output voltage connected to a loop filter comprising means for phase locked loop stabilization connected to a voltage controlled master oscillator means providing a frequency reference connected to a tone generator means providing a plurality of frequency outputs corresponding to the notes of a musical scale connected to a tone selector switching means comprising momentary switches providing means selectively connecting selected tone generator outputs to the audio output of the organ, and said tone generator connected to a keynote selector switching means for selectively connecting one and only one tone generator output to the second input of said phase comparator thereby establishing a phase locked loop means providing a means for forcing the selected tone generator output frequency to be equal to the output frequency of said reference oscillator thereby providing means for altering the tuning of the organ to any keynote at will by manipulation of the keynote selector switching means, a response time adjustment comprising a potentiometer means connected to said loop filter providing control means for varying the musical slur effect.

5. A music instrument for playing music comprising the apparatus of claim **4** wherein said response time adjustment comprises a knob connected to a potentiometer for easy manipulation by the player.

6. A music instrument for playing music comprising the apparatus of claim **4** wherein said response time adjustment comprises a foot pedal that is for easy manipulation by the player.

7. A music instrument for playing music comprising the apparatus of claim **4** wherein said response time adjustment comprises a lever that is for easy manipulation by the player.

8. A music instrument for playing music comprising the apparatus of claim **4** wherein said response time adjustment comprises a keyboard connected to a potentiometer providing slur speed adjustment means.

9. A new method of playing music comprising the steps of generate a plurality of note signals, select a note signal from the plurality of note signals, generate a reference signal, generate a control signal from the compared selected note signal and reference signal, filter the control signal to produce a slurring effect of the plurality of note signals, and modulate said plurality of note signals with said control signal, thus producing new music.

10. The method of claim **9** wherein said generate a reference signal comprises generate a reference signal and modulate the reference signal with a complex wave signal.

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