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[21] Appl. No. 779,958

[22] Filed Nov. 29, 1968

[45] Patented Dec. 1, 1970

[54] **ELECTRONIC CONTROL SYSTEM FOR MUSICAL INSTRUMENT**  
14 Claims, 3 Drawing Figs.

[52] U.S. Cl. 84/1.01, 84/1.17, 84/1.24

[51] Int. Cl. G10h 1/00

[50] Field of Search 84/1.01, 1.03, 1.17, 1.24, (N. O)

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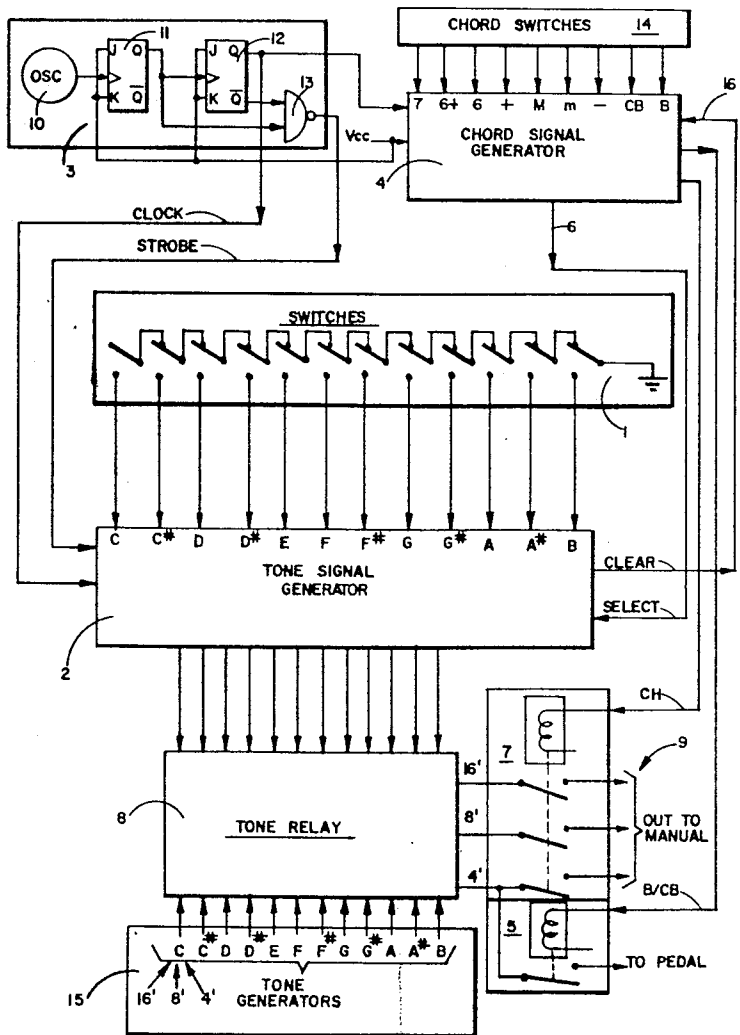
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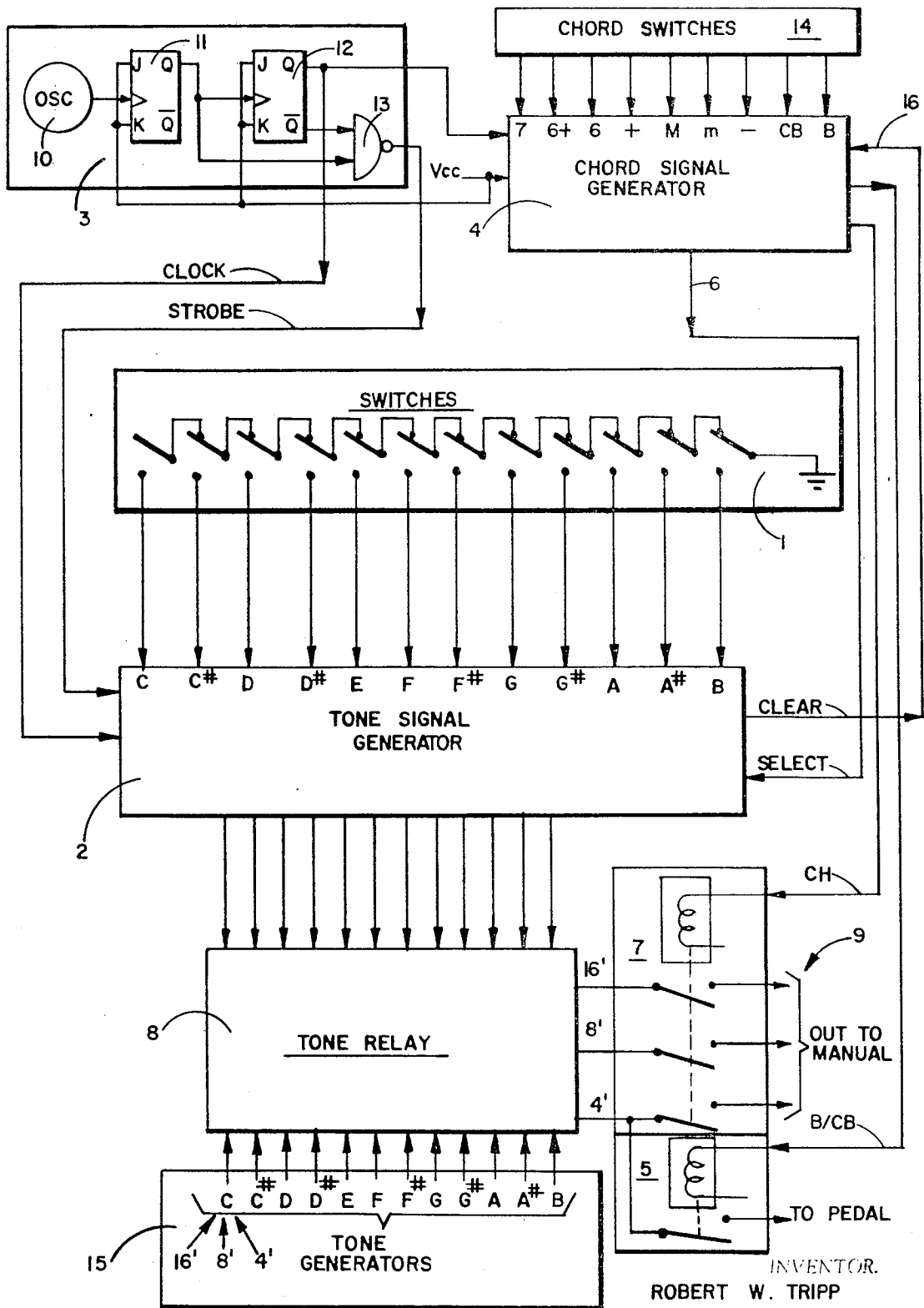
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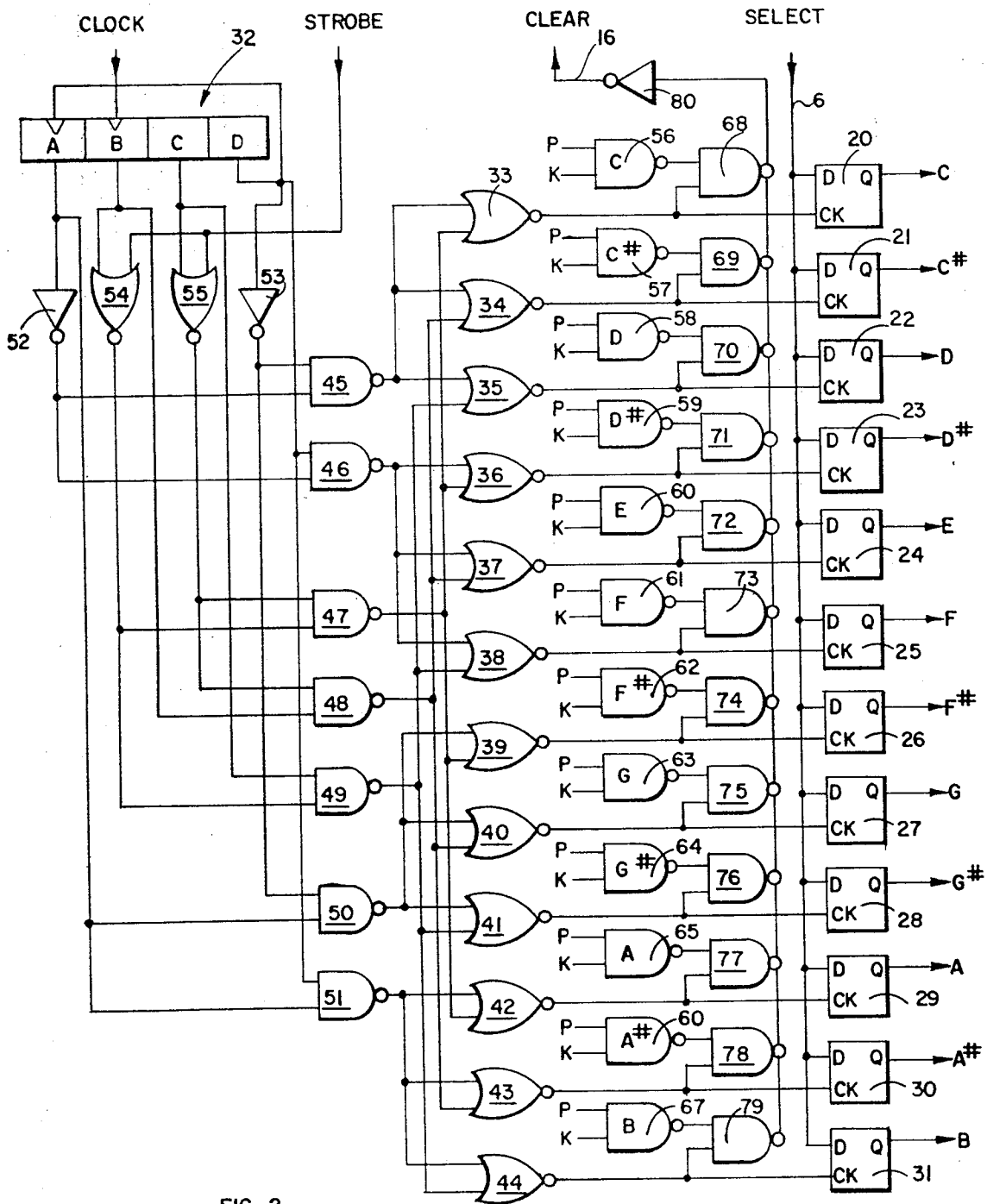
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**ABSTRACT:** Control signals representing selected chords are automatically generated as a function of a selected root tone of the chord by the synchronized operation of two counters and associated logic. When a root tone (musical tone) is selected, for example, by depressing a pedal, the counter associated with chord selection is cleared to zero at the time the decoded count of the tone control counter represents the decoded root tone. The two counters are thereafter counted in synchronism until a new root tone is selected by depressing another pedal and a new synchronism is established. Each time a new root tone is selected, the counters are synchronized with a different counting relationship so that tone selection signals can be generated to represent any selected chord transposed to the new root note. The decoded count of the cleared counter produces selection signals as a function of the type of chord selected, for example, by depressing a key. The selection signals in conjunction with the decoded counting signals from the control counter, enable tone selection signals to be generated by switching devices receiving both signals. The decoded counting signals of the tone control counter represent tones used in forming all chords. When there is coincidence between the chord selection signals and the decoded tone control signals, tone selection signals are generated. The signals are used with relays or equivalent switching devices to select signals from tone generators in producing musical sounds. The system includes logic for storing the bass and counter bass notes of a chord so that the notes can be played at a subsequent time.





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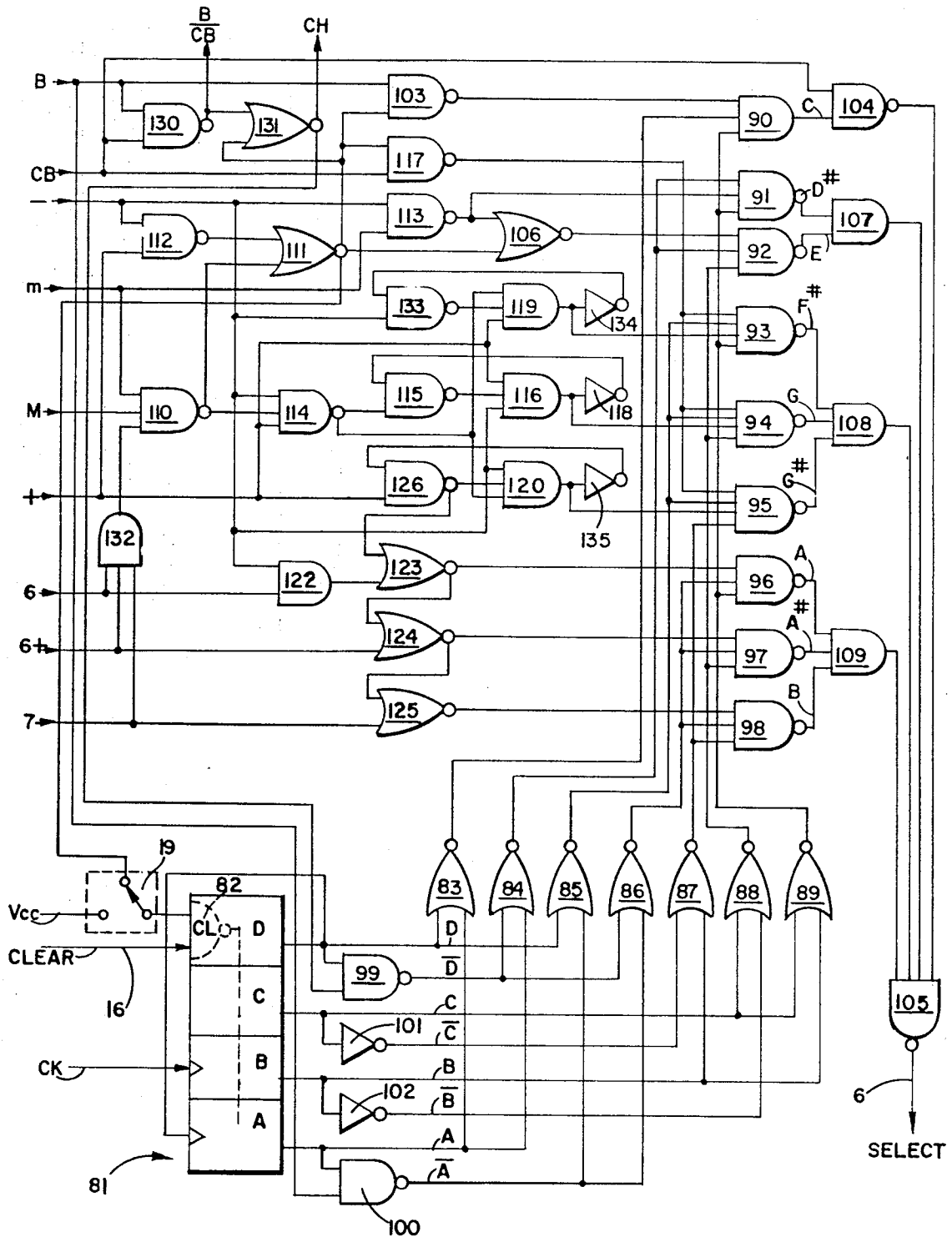


FIG. 3

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# ELECTRONIC CONTROL SYSTEM FOR MUSICAL INSTRUMENT

## BACKGROUND OF THE INVENTION

### 1. Field of the Invention

This invention relates to a system for controlling the sounds generated by a musical instrument such as an electronic organ and more particularly to such a system in which only the type of chord and root tone of the chord need be selected in playing a chord and in which bass and counter bass notes of a chord are stored.

### 2. Description of the Prior Art

Chords are usually described as a composition of tones which blend together when sounded simultaneously. For example, a three-tone chord is described as triad, a four tone chord as a seventh, a five-tone chord as a ninth, a six-tone chord as an eleventh, etc.

Chords are based on a given tone described as the root tone. If a tone in a major or minor scale is selected as the root tone, the resulting chord usually comprises tones of that scale. The most common chords are formed from a diatonic major or minor scale.

If the root tone is the lowest tone of the selected chord, the chord is described as in the fundamental position. If another tone of the chord is the lowest tone, the chord is described as inverted. In one embodiment of the present invention, chords are inverted to maintain the tones of the selected chord within a single octave.

Electronic organs customarily provide not only the base pitch corresponding to that of the piano, i.e., an 8-foot pitch, but also provide harmonically related pitches, i.e., a 16-foot pitch which is one octave lower and a 4-foot pitch which is one octave higher.

In existing chord organs and ccordions, one button is provided for each chord and each bass note. If six chords are provided for each of 12 tones, 72 buttons are required since one button is required for each combination. The proposed control system simplifies the generation of chords by providing separate inputs for the selection of the chord type and the root tone.

In addition, it is desirable to be able to record, or store, the bass and counter bass notes of selected chords so that the notes can be sounded at a later interval. The present invention provides for storing the notes when the chords are sounded. The counter bass tone is defined as an augmented, normal, or diminished fifth of a chord.

The present invention not only provides for selection of chords by depressing a key but also an additional eight chords by simply depressing two keys. Logic interlocks are included for preventing undesired notes from sounding when more than one key is depressed and under other conditions.

## SUMMARY OF THE INVENTION

Briefly, chord control logic in conjunction with a counter generates chord selection signals representing tones of a chord selected by depressing one or more keys.

The root tone (musical note) of the chord is selected by depressing a pedal, or key, which synchronizes the generation of the chord selection signals with the generation of signals representing notes, or tones, used in forming all selected chords. When the signals coincide, output lines representing the tones of a particular chord, are energized.

The signals are used to connect tones from the proper tone generators to the manual or pedal section of, for example, an organ in producing the chord. Output tones from the tone generators are combined by one of those sections for producing the musical sound.

Logic is also included for storing states representing certain notes of a chord, bass and counter bass notes, so that the notes can be replayed subsequently as part of a musical composition without the necessity for a player to remember the notes.

Therefore, it is an object of this invention to provide an electronic control system for a musical instrument having separate chord and root note selection means.

It is another object of this invention to provide means for selecting chords and root notes independently without requiring separate selection means for each combination of the above.

Still another object of this invention is to provide means for storing certain notes of a selected chord for being replayed subsequently as part of a musical composition.

A still further object of this invention is to provide a system in which a plurality of chord buttons can be depressed to select a chord not represented by a single button.

Another object of the invention is to provide interlocking logic for inhibiting certain notes from being played when certain others are selected as part of a chord type.

These and other objects of the invention will become more apparent in connection with the description of the preferred embodiment taken in connection with the drawings, a brief description of which follows.

## BRIEF DESCRIPTION OF DRAWINGS

FIG. 1 is a block diagram of one embodiment of the control system including a schematic representation of a clock signal generator;

FIG. 2 is a schematic diagram of the root note selection portion of the system including coincidence detection means for generating tone selection signals; and

FIG. 3 is a schematic illustration of the chord selection portion of the system including logic for storing bass and counter bass notes.

## DESCRIPTION OF PREFERRED EMBODIMENTS

FIG. 1 shows a plurality of switches 1, operated by the foot pedals or keys of the instrument, corresponding to root tones C through B. Outputs from the switches provide input signals to logic within the block identified as tone signal generator 2, as will be shown in more detail in FIG. 2. The block contains a counter, decoding logic, and coincidence detection logic.

For the particular embodiment shown, it is assumed that the system is applicable to an electronic organ. It should be noted that the system is applicable to other musical instruments using buttons, keys or pedals in generating musical sounds.

When a switch is depressed, or closed, the corresponding input line to the tone signal generator 2 is connected to an electrical ground level. It should be obvious that if two or more switches are closed simultaneously, the note corresponding to the closed switch first in the series controls the root tone of the chord type to be played.

The tone signal generator 2 receives a clock signal from clock generator 3. The clock generator 3 also generates a strobe signal. The clock signal provides counting pulses to the counter in the tone signal generator (See FIG. 2) and the strobe signal is used as an inhibit signal as described in more detail in connection with FIG. 2.

For the embodiment shown, the clock generator 3 is comprised of oscillator 10 which generates triggering signals to JK flip-flop 11. At the trailing edge of each oscillator pulse, flip-flop 11 is triggered so that its Q and  $\bar{Q}$  output frequency is one-half the frequency of the oscillator. Similarly, the Q output from flip-flop 11 provides a triggering input to flip-flop 12 so that the Q and  $\bar{Q}$  output frequency of flip-flop 12 is one-half the frequency of flip-flop 11. The Q output of flip-flop 12 is used as the clock signal for the system. The flip-flops are used to generate a relatively square signal from the oscillator signal. Square signals are preferred for triggering switching devices.

The strobe signal from NAND gate 13 is low (active when the Q output of flip-flop 11 and the  $\bar{Q}$  of flip-flop 12 are high).

Tone signal generator 2 generates a clear output signal on line 16 to chord signal generator 4 for setting the counter (See FIG. 3) in the chord signal generator 4 to an all zero state so that thereafter the counter (See FIG. 3) counts in synchronism with the counter in the tone signal generator 2. The clock signal from the clock generator 3 is used as a counting signal by the counter in the chord signal generator 4.

A plurality of keys, or buttons, 14, similar to the keys represented by switches 1 into tone signal generator 2, provide chord selection input signals 7<sup>th</sup> through diminished (—) to logic within the chord signal generator 4. The keys are different from the FIG. 1 switches in that each key can be independently connected to ground for reasons described subsequently. Keys also provide bass B and counterbase CB input signals to chord signal generator block 4 for sounding certain notes of chords previously played.

Output select signals from chord signal generator 4 provide input signals to tone signal generator 2 on line 6. The select signals representing notes C through B, are generated as a function of the root tone and chord type, bass or counterbass notes selected by a player.

For the particular embodiment shown (See FIG. 2) flip-flops are controlled by select signals from the chord signal generator 4 for generating output signals to the plurality of tone relays 8. The signals are directed to the plurality of tone relays 8 for actuating relays corresponding to notes (tones) of a musical scale.

The outputs from relays 8 provide inputs to select relays 9 comprising relay 7 for switching the 4', 8' and 16' pitch tones to the manual portion of the keyboard (not shown) and relay 5 for switching a pitch tone, for example, a 16' tone, to the pedal portion of the musical system (not shown).

Relay 7 is responsive to a chord CH signal received from chord signal generator 4 and relay 5 is responsive to a bass B signal or a counter bass CB signal received from chord signal generator 4. Amplifiers (not shown), may be provided as required to match the control signals to relays 5, 7 and 8.

The location of the octave range can be set as desired, to produce the most pleasing sound effect. The range need not be from C to B as shown. For example, it could be from F to E.

Tone generators, frequency dividers, relays, manual keyboard and pedal section of an electronic organ are well known to persons skilled in the art. For that reason, details on those portions as well as details on playing instructions for a particular instrument are not included herein. Details on an electric organ to which the system described herein is suitable can be found in a booklet entitled "How Schober Organs Work" by Richard H. Dorf, copyright 1966 by The Schober Organ Corporation.

FIG. 2 shows one embodiment of the tone signal generator 2 comprising flip-flops 20 through 31 having Q outputs representing musical tones C through B, respectively. The D inputs to the flip-flops are generated by the chord signal generator 4 as shown in FIG. 1 and as described in detail in connection with FIG. 3. The CK inputs are generated by the decoded counts of counter 32. When the CK input to a particular flip-flop is high the Q output will be set to the same level as the D input. At the trailing edge of the CK input, the Q output remains in that state until reset. The Q outputs from the flip-flops provide input signals to the relays designated in FIG. 1 as plurality of relays 8.

Counter 32 comprising stages A through D, is operated as a hexbinary counter. Clock pulses from clock generator 3 drive the B stage. The A stage is driven by output pulses from the D stage. The interconnection of the stages A through D for operating the counter in a hexbinary manner is well known to persons skilled in the art.

Counter 32 has 12 counter states which correspond to the 12 notes, or root tones for the embodiment system shown and described. The counting sequence is decoded as shown in the following table:

The decode logic comprises NOR gates 33 through 44 corresponding to the notes C through B, NAND gates 45 through 51, NOR gates 54 and 55, and inverters 52 and 53.

Output signals from NOR gates 33 through 44 provide high signal levels to the CK inputs of the flip-flops 20 through 31 as a function of the output states of counter 32 as indicated in the above table. Two low inputs to a NOR gate result in a high output. Any high input to a NOR gate results in a low output.

Outputs from NAND gates 45 46, 50 and 51 control the selection of groups of three notes (C, C0, D; D0, E, F; F0, G, G0; A, A0, B) as seen by the output connections between the

NAND gates and the NOR gates 33 through 44. Each output of the NAND gates provides inputs to three NOR gates. For example, the output from NAND gate 45 provides inputs to NOR gates 33, 34, and 35.

TABLE I

| Count | B | C | D | A | Decoded notes |
|-------|---|---|---|---|---------------|
| 0     | 0 | 0 | 0 | 0 | C             |
| 1     | 1 | 0 | 0 | 0 | C#            |
| 2     | 0 | 1 | 0 | 0 | D             |
| 3     | 0 | 0 | 1 | 0 | D#            |
| 4     | 1 | 0 | 1 | 0 | E             |
| 5     | 0 | 1 | 1 | 0 | F             |
| 6     | 0 | 0 | 0 | 1 | F#            |
| 7     | 1 | 0 | 0 | 1 | G             |
| 8     | 0 | 1 | 0 | 1 | G#            |
| 9     | 0 | 0 | 1 | 1 | A             |
| 10    | 1 | 0 | 1 | 1 | A#            |
| 11    | 0 | 1 | 1 | 1 | B             |

The inner NAND gates 47, 48, and 49 control the selection of notes within the groups of three notes. For example, NAND gate 47 selects either the C-note in the first group, the D0 note in the second group, the F0 note in the third group, or the A note in the fourth group.

Outputs from NOR gates 54 and 55 with inverters 52 and 53 provide the proper logic levels to the NAND gates 45 through 51. NOR gates 54 and 55 receive inputs from the B and C stages and a strobe input. The strobe is generated by clock generator 3 as shown in FIG. 1. The strobe signal is used to inhibit the outputs from NOR gates 54 and 55 during a count transition in counter 32.

The strobe signal may not be necessary in an ideal system. However, the transition from one count to another in a practical system requires a finite time. During the transition period, the counter 32 output may be in a state which could cause a false count to be decoded. The strobe signal is driven high during the transition period so that the outputs from the NOR gates 54 and 55 are held low until the new counter states are entered and are stable. Low outputs from the NOR gates set NAND gates 47, 48, and 49 high so that all the NOR gates 33 through 44 are held low during the transition period. Without the strobe signal, a NOR gate output could be set high by a transition state and could cause a tone relay to be erroneously actuated.

NAND gates 56 through 67 representing notes C through B receive signals from the plurality of switches 1 as shown in FIG. 1. The NAND gates are shown with P and K inputs representing either a pedal or key input. Normally the inputs to the gates from the switches 1 are high. However, when a particular key or pedal is depressed its input to the connected NAND gate is low and the output of the gate is set high.

NAND gates 68 through 79 receive inputs from NAND gates 56 through 67, respectively, and from NOR gates 33 through 44, respectively. When both inputs to one of the NAND gates 68 through 79 are high, its output is low thereby indicating that the count in counter 32 is decoded as the tone selected when a player depressed a certain key. A low output signal from the NAND gates 68 through 79 is inverted by inverter 80 and is used as a clear signal into the chord signal generator 4 as shown more specifically in FIG. 3.

By way of illustration, assume a pedal (P) or key (K) input to NAND gate 56, representing a C-note, is low. The output from the gate 56 is set high. As soon as counter 32 reaches a count of all zeros (count zero equals note C) both inputs to NAND gate 68 are high and its output is driven low. As a result, counter 81 (See FIG. 3) is cleared to all zeros by the clear signal from inverter 80, and counter 81 is synchronized with counter 32 so that when a count representing a C-note occurs in counter 32, it also occurs in counter 81.

As another example, assume that an F-tone is selected by depressing the pedal for providing a low input to NAND gate 61. The output from NOR gate 38 is driven high when the A

and B stages of counter 32 are zero and the C and D stages are a logical one. As shown by table 1, that counter state corresponds to a count of five and the F-note.

At the coincidence between a high output from NAND gate 61 and NOR gate 38, NAND gate 73 is driven low. The inverted output from inverter 80 clears counter 81 to all zeros corresponding to the F-note (count) in counter 32. In effect, the key of C of counter 81 (all zeros) is transposed to the key of F.

As a result of being able to transpose from one key note to another by synchronizing counters 32 and 81 as described above, the necessity for providing 12 tone selection buttons for each chord type is eliminated. The advantages of reducing the number of buttons, etc., is further described and illustrated in connection with FIG. 3.

FIG. 3 shows the portion of the system used in selecting the particular type of chord to be generated at the selected root tone. In other words, the FIG. 2 portion of the system provides for the selection of a root tone, and the FIG. 3 portion provides for selection of a chord type in that root tone. In addition, the FIG. 3 system includes logic for storing the bass and counterbass notes of the selected chords so that the notes can be sounded subsequently.

The chord signal generator 4 of FIG. 3 comprises the hexbinary counter 81, NOR gates 83 through 89 for decoding the counts, NAND gates 99 and 100, and inverters 101 and 102 for providing the proper logic levels to the NOR gates 83 through 89 as required for decoding certain counts. The NAND gates 99 and 100 also receive inputs from chord CH line and the bass B and counterbass CB lines as will be described subsequently.

NAND gates 90 through 98 receive the outputs from NOR gates 83 through 89 and inputs from the additional logic gates between the chord, bass and counterbass input lines (— through 7<sup>th</sup>, B, CB) for generating signals to representing musical notes of a selected chord type.

Hexbinary counter 81 receives the clear signal from inverter 80 for setting all stages of the counter to zero. NAND gate 82, shown dotted, is included in the particular counter used in the counter embodiment shown for drive purposes. The gate 82 provides inputs to each stage of the counter so that each stage is simultaneously cleared. The dashed line from the gate indicates the internal connections.

The counter is identical to counter 32 described in connection with FIG. 2 and the counts are decoded as shown in table 1, except that certain notes C0, D and F are not used in the system embodiment shown and described. As a result, decode logic for the excluded notes is not required.

If switch 19 is set to connect V<sub>cc</sub> to NAND gate 82, the counter is cleared as previously described. If switch 19 is in the position shown a bass pedal may be operated without shifting the chord root tone. For example, after a chord button has been depressed, the counter 81 maintains its synchronism with counter 32 even if a bass pedal is being depressed, if the switch 19 is in the position shown.

Outputs from NOR gates 83 through 89 provide high inputs to AND gate 90 and NAND gates 91 through 98 as a function of the state of counter 81. Gates 90 through 98 are labeled by the notes corresponding to the decoded counts of counter 81. For example, the C-note is decoded when the D and A counter stages are low for driving NOR gate 83 high. At the same time, the output from NOR gate 89 is high since the C and B stages are low. The counter therefore corresponds to a zero count (0000). The output from NAND gate 103 is driven high when a chord or the bass button (not shown) is operated.

The output from AND gate 90 (C-note), when decoded as described above, provides a high input to NAND gate 104. Since the counter bass CB line is normally high, the output from NAND gate 104 is low for a decoded C-note. The output is inverted by NAND gate 105 to provide a high output selection signal to the tone signal generator 2 shown in FIGS. 1 and 2.

For the example assumed, the counters 32 and 81 would previously have been synchronized so that the CK input to flip-flop 20 would be high during the time the output from NAND gate 105 is high so that the Q output from the flip-flop 20 is set high for actuating a C-tone relay in the tone relay block 8.

The above example was described in terms of any chord. For the particular embodiment being described and shown, it is possible to select one of seven chords comprising major (M), minor (m), augmented (+), diminished (—), 6<sup>th</sup>, 6<sup>th</sup>, augmented, and 7<sup>th</sup>. It is also possible to sound bass and counterbass notes, as previously described. Counterbass notes correspond to the augmented, normal and diminished 5<sup>th</sup> notes of a chord. The bass notes correspond to the root note of a chord.

It should be pointed out that additional chords can be selected by the simultaneous operation of two chord buttons (represented by chord types, M, m, etc.). For example, if the minor chord button, m, is depressed with the 6<sup>th</sup> augmented (6+) button, a minor seventh chord (C, D0, G and A0) is selected.

For an additional example, assume that a major chord (M) in the key of C is selected, the C-, E- and G- notes would be required. The generation of the C-note has previously been described. The E-note selection signal is generated when the B and D stages are logical ones and the A and C states are logical zeros. Under those conditions, NOR gate 84 is driven high, as shown in FIG. 3. However, NOR gate 84 is also used in the generation of the D0 note. Therefore, an additional input to NAND gate 92 (E) is required to prevent both inputs from being sounded. NOR gate 88 is driven high by the C and B states for the assumed example. As a result, NAND gate 92 has two high inputs.

Since a major chord button was depressed, the M input to NAND gate 110 would be low, driving the output high. A high input to NOR gate 111 sets its output low.

NOR gate 106 receives a low output from NOR gate 111. The other input to NOR gate 106 from NAND gate 113 is also low since both its inputs from —, and m are high for the assumed example. Therefore, NOR gate 106 is high. The output from NAND gate 91 is inhibited by the low output from NOR gate 113.

Since all inputs to NAND gate 92 are high, its output is driven low and the output from AND gate 107 is driven low. A low output from AND gate 107 drives the output from NAND gate 105 high for generating a signal representing the E-note.

A G-note, the normal 5<sup>th</sup> of the C-chord, would similarly be generated through NAND gate 94 and AND gate 108.

The output from NAND gate 114 is driven low by the high output from NAND gate 110 since its other inputs from minus (—) and plus (+) are high. The output from NAND gate 115 is driven high by the low output from 114. The outputs from AND gates 119 and 120 are driven low by the low output from NAND gate 114 for inhibiting the selection of notes F0 and G0 simultaneously with the selection of the G-note. A high output from NAND gate 115 with high signals from the + line, and the — line provide all high input signals to AND gate 116 for driving the output from NAND gate 94 low when its other inputs are high. The output of NAND gate 117 is high when a chord button has been pushed. The other high inputs are derived from decoded counts in counter 81 from NOR gates 85 and 88. Since the output of NAND gates 94 is low, the output from AND gate 108 is low and the output from NAND gate 105 is driven high for generating the G-note signal.

The Q output from flip-flop 27 is set high when the count in counter 32 coincides with the generation of the G signal from NAND gate 105. The Q output is set at the trailing edge of the CK signal.

The storage feature of the system is provided by inverters 118, 134, and 135, which invert the outputs from NAND gates 116, 119 and 120 and use the inverted outputs as inputs to NAND gates 115, 133 and 126 for holding the outputs from the gates high.

For the above example, involving a G-note, the high output from AND gate 116 is inverted by inverter 118 for providing a low input to NAND gate 115. As a result, the input to NAND gate 94 from AND gate 116 is held high until one of the other inputs to AND gate 116 is changed.

Subsequently, if it were desired to sound the counterbass note of the major C-chord, the CB button would be depressed and the output of NAND gate 117 would be set high. Since the output of NAND gate 116 would still be high, a G-note (CB of major C-chord) would be sounded.

In addition, the output from NAND gate 130 would be set high for actuating a counterbass/bass relay included within selection relay block 9. The chord signal from NOR gate 131 would be low since its input from NAND gate 130 would be high. If a chord button is depressed without a bass or counterbass, the CH signal is high and the chord relay of block 9 is actuated.

NAND gate 126 and 133 are used in the selection of the augmented (+) and diminished (-) chords. When the augmented button is depressed, the output of NAND gate 126 is driven high and the output of AND gate 128 is driven high for generating a signal from NAND gate 95 which represents a G0 note. The note is stored by the action of inverter 135 as previously described for the G-note.

A similar description also applies for generating and storing the F0 note from NAND gate 93.

As indicated by the logic interlock between AND gates 116, 119 and 120, if the augmented and diminished chord buttons are depressed simultaneously, none of the CB-notes will sound. Only one counterbass note can be sounded at any one time. The same inhibition applies, for example, if the major and the diminished buttons are depressed simultaneously. Undesired combinations of tones which would be produced by operating incorrect combinations of buttons are prevented from being sounded.

When either the diminished (-) or the 6<sup>th</sup> chord button is depressed, the output of AND gate 122 is driven low and the output of NOR gate 123 is driven high if its other input from NAND gate 126 is also low. If the diminished chord is selected, four notes are sounded. The A note represented by NAND gate 96 completes the chord.

If either the 6<sup>th</sup>, 6<sup>th</sup>+, or 7<sup>th</sup> buttons are depressed individually, the output from AND gate 132 goes low and the major chord is sounded in combination with A, A0, or B depending on which of the buttons was depressed. However, if an additional chord button such as -, minor, or + is depressed, a combination of notes resulting in a new chord would be sounded. For example, if the minor (m) is combined with 6+ the minor 7<sup>th</sup> chord (C, D0, G, A0) will be produced.

NOR gates 123, 124 and 125 provide an interlocking feature for preventing adjacent of the notes (G0, A, A0 and B) from being sounded simultaneously. The output from NAND gate 126 is used to inhibit NOR gate 123. Likewise an output from NOR gate 123 will inhibit NOR gate 124 and an output from NOR gate 124 will inhibit NOR gate 125.

For example, if the 6<sup>th</sup> button is depressed, the output from NOR gate 123 is driven high and the output of NOR gate 124 is held low.

If the CB-button is depressed, the output from NAND gate 104 is driven high to inhibit the generation of a bass note. The output from NOR gate 131 is driven low and the output from NAND gate 99 is driven high. The high output from NAND gate 99 drives the outputs from NOR gates 84 and 86 low for providing an inhibiting input to NAND gates 91, 92 and 96, 97, 98, respectively. As a result, only NAND gates 93, 94, and 95 can be actuated to sound a previously stored counterbass note. Relay 5 (FIG. 1) is actuated by the CB output signal from NAND gate 130 so that the proper pitch of the counterbass note is provided to the pedal section of the musical instrument.

Subsequently, if a B button is depressed, the output from NAND gate 100 is driven high for driving the outputs of NOR gates 85 and 86 low. The low output from NOR gates 85 and

86 provides inhibiting inputs to NAND gates 93, 94, 95 and 96, 97, 98, respectively. In addition, NAND gate 130 is driven high for driving the output of NOR gate 131 low and for driving the output of NAND gate 99 high. As a result, the outputs of NOR gates 84 and 86 are driven low for inhibiting NAND gates 91, 92, and 96, 97, 98, respectively. Therefore, only AND gate 90 can be actuated for sounding a bass note. Relay 5 is actuated as indicated above by the output from NAND gate 130.

If the bass or counterbass buttons are operated with any of the chord buttons, only the bass or counterbass tones are sounded. If a chord button is depressed, when either the bass or counterbass button is depressed, the output from NAND gate 130 is high and counter 81 is not inhibited. Under those circumstances, the input to NAND gate 99 from NOR gate 131 would be high and relay 7 of the tone relays 9 would be actuated by the CH signal from NOR gate 131.

If either the minus (-) or m button is depressed, the output from NAND gate 113 is driven high for sounding D0 through NAND gate 91. The output from NOR gate 106 would be driven low to inhibit the output from NAND gate 92.

Although the invention has been described and illustrated in detail, it is to be understood that the same is by way of illustration and example only, and is not to be taken by way of limitation. The spirit and scope of the invention is limited only by the terms of the appended claims.

I claim:

1. An electronic control system for a musical instrument comprising:
  - first means for selecting a root tone of a musical chord type;
  - second means for selecting a musical chord type;
  - first counter means for generating first cyclical signals representing tones;
  - second counter means for generating second cyclical signals representing tones;
  - means responsive to said first means and said first cyclical signals for generating a synchronizing signal for setting said second counter means to a predetermined count at coincidence between said cyclical signal and said selected root tone;
  - means responsive to said second means and said second cyclical signals for generating signals representing tones of the selected chord type having said root tone; and
  - means for detecting coincidence between said first cyclical signals and said chord signals for selecting musical tones of said selected chord.
2. The combination recited in claim 1, wherein said second means comprises means operated independently for selecting said musical chord type and operated in combination for producing additional chords in excess of the number of chords selected by operating said means independently.
3. The combination recited in claim 1 including means for storing a counter bass note of a selected musical chord type, and means for accessing said stored note.
4. The combination recited in claim 3 including means for inhibiting the generation of signals representing other notes while a particular counter bass note is being accessed.
5. The combination recited in claim 3 and further including means for generating a signal representing the bass root tone of a selected musical chord and means for inhibiting the selection of all other notes while said bass tone signal is being generated.
6. The combination in claim 1 including means for inhibiting the generation of said first cyclical signals during the transition period between the counts of said first counter means.
7. The combination recited in claim 1 including means for rendering the root tone selection means inoperable while the chord-type selection means is operable.
8. A system for controlling the selection of musical notes in a musical instrument comprising:
  - root tone selection means;
  - tone signal generating means;

coincidence detection means for determining coincidence between a tone signal and a selected root tone for generating a synchronizing signal;  
chord-type selection means;

first means responsive to said synchronizing signal and said chord selection means for generating signals representing tones of a selected chord type in said selected root tone; and

second means responsive to said generated signals and said tone generator means for producing musical tones corresponding to musical notes of said selected chord type in said selected root tone.

9. The combination recited in claim 8 wherein said root tone selection means includes:

counter means having 12 counts and means for decoding the counter states and for sequentially generating signals representing each of said notes; and

said first means responsive includes second counter means for being set to a predetermined count upon receipt of each synchronizing signal.

10. The combination recited in claim 9 wherein said first means responsive further includes means for decoding the count of said second counter means and means for generating signals representing tones within said selected chord type as a function of the coincidence between said decoded count and the chord type selected by said chord-type selection means.

11. The combination recited in claim 8 including means for storing the bass and counterbass note of each selected chord type for being replayed independently of said selected chord.

12. The combination recited in claim 11 including means for inhibiting playing of all counterbass notes except the selected counterbass note.

13. The combination recited in claim 12 including means for inhibiting playing of said bass note when a counterbass note is being played.

14. The combination recited in claim 8 including means for inhibiting generation of signals representing notes exclusive of said selected chord except when two or more chords are selected simultaneously.

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