

[72] Inventor **David A. Bunker**
Cincinnati, Ohio
[21] Appl. No. **70,677**
[22] Filed **Sept. 9, 1970**
[45] Patented **Dec. 21, 1971**
[73] Assignee **D. H. Baldwin Company**
Cincinnati, Ohio

3,358,069	12/1967	Hearne.....	84/1.03
3,359,358	12/1967	Brand et al.	84/1.01
3,433,880	3/1969	Southard.....	84/1.17
3,439,569	4/1969	Dodds et al.	84/1.26
3,553,334	1/1971	Freeman.....	84/1.03

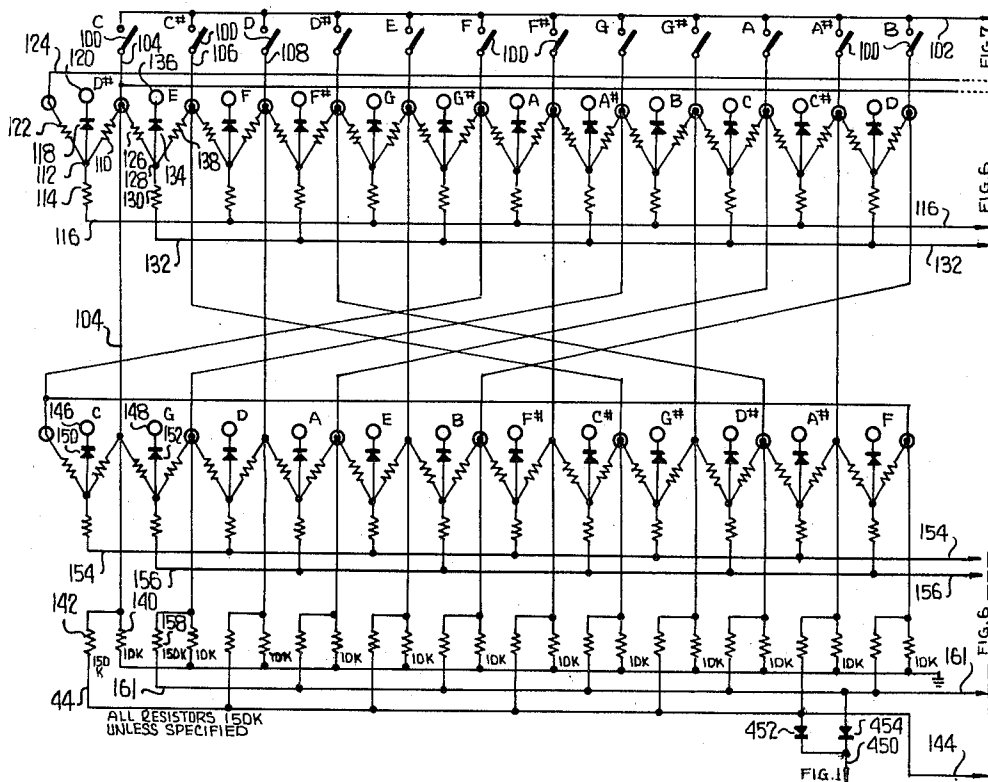
Primary Examiner—Lewis H. Myers
Assistant Examiner—Ulysses Weldon
Attorney—Hurvitz & Rose

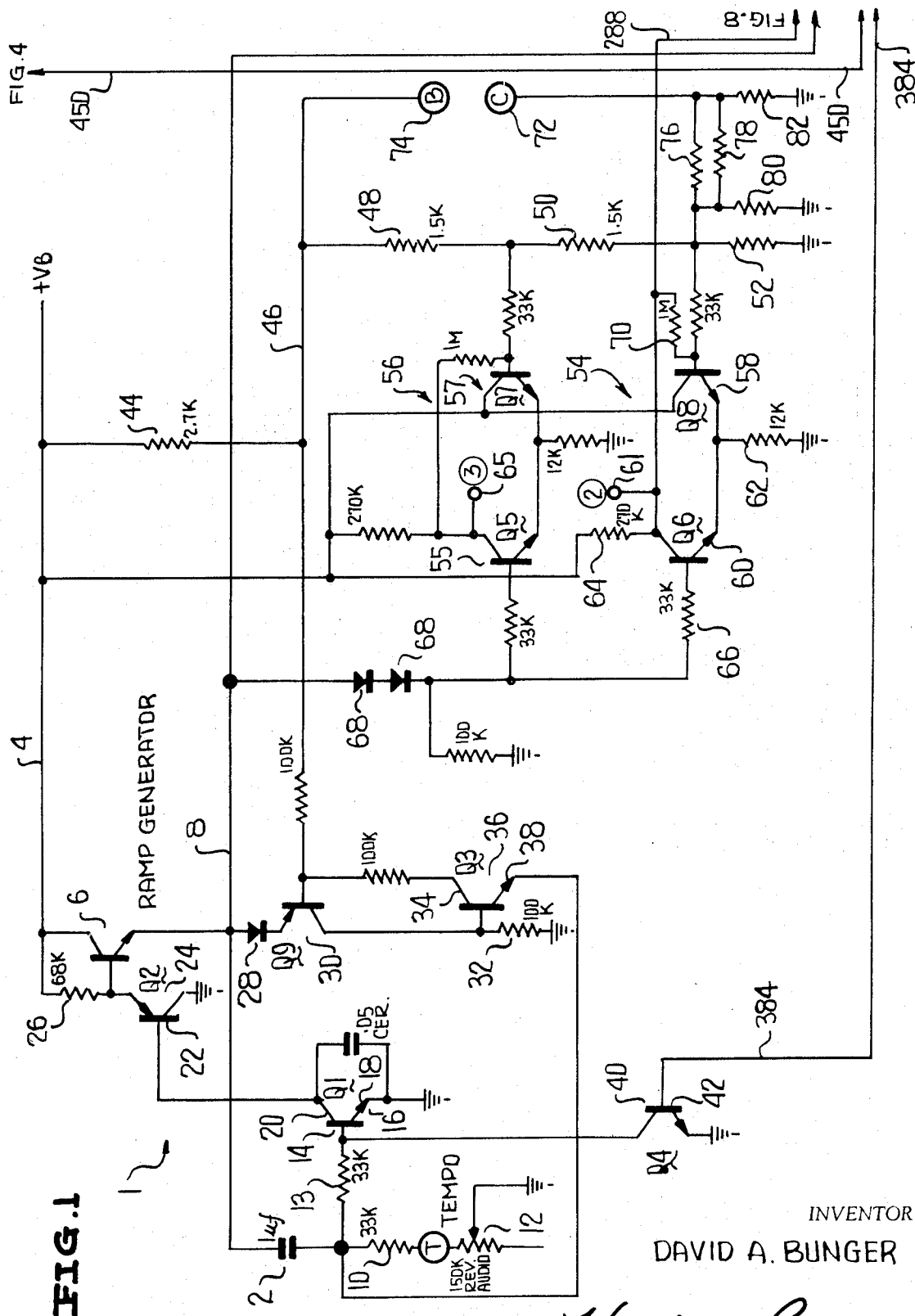
[54] **AUTOMATIC CHORD AND RHYTHM
ELECTRONIC ORGANS**
39 Claims, 8 Drawing Figs.

[52] U.S. Cl. **84/1.03,**
84/1.13, 84/1.17, 84/1.19, 84/1.24
[51] Int. Cl. **G10f 1/00**
[50] Field of Search 84/1.01,
1.03, 1.17, 1.26, 1.01-1.28; 331/173-174

[56] **References Cited**
UNITED STATES PATENTS
3,098,888 7/1963 Tomcik 84/1.17
3,235,648 2/1966 George..... 84/1.03
3,305,620 2/1967 Young..... 84/1.17

ABSTRACT: The system provides a conventional electronic organ with automatic chord accompaniment and/or an automatic rhythm system. Playing of only one note in a selected octave of the lower manual produces proper distribution between pedal and manual root, third and fifth parts of a chord in any one of five rhythms with rhythm percussive effects if desired. The pedal and/or manual notes may be rhythmically pulsed or selectively converted to continuous mode. A touch bar is provided to convert from major to minor chords. Playing of two notes defeats the chord accompaniment. Playing of three notes causes the organ to revert to conventional operation. Playing of a single note always produces a downbeat.





INVENTOR

DAVID A. BUNGER

BY *Humtzy & Rose*

ATTORNEYS

FIG. 2

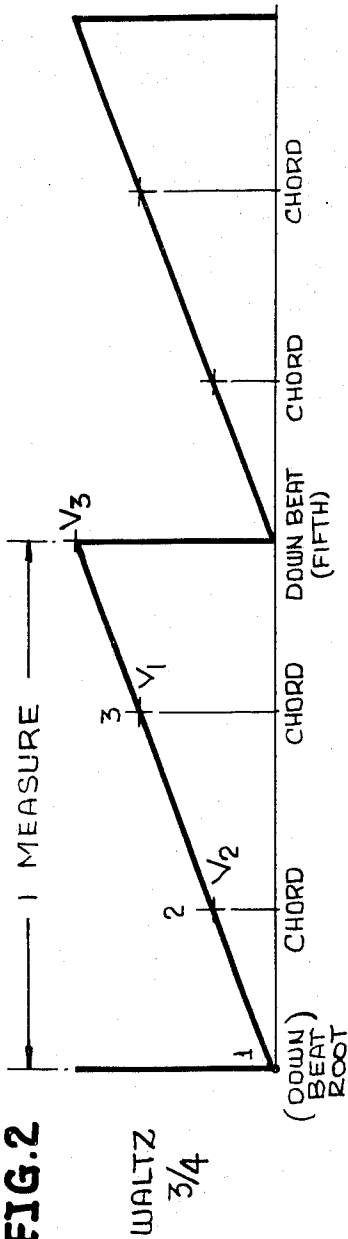


FIG. 3

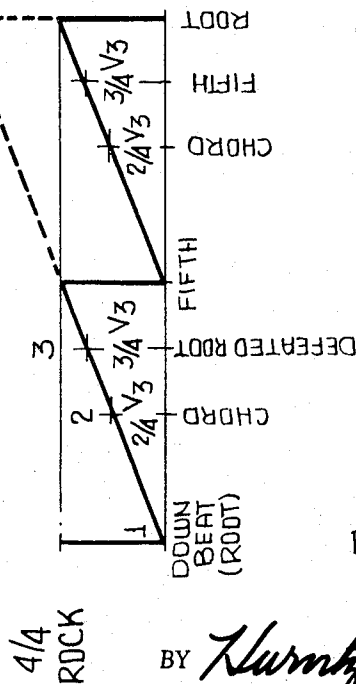
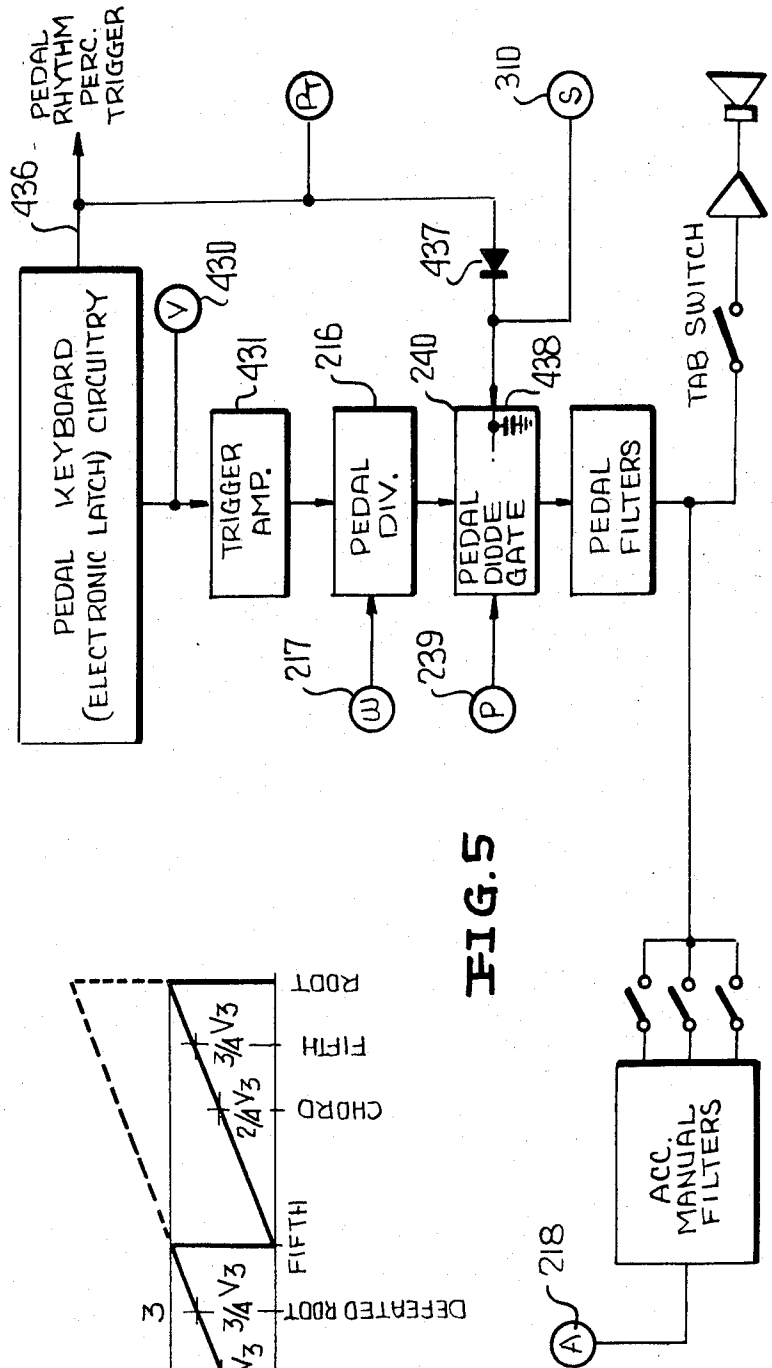


FIG. 5



INVENTOR
DAVID A. BUNGER

BY *Hurwitz & Rose*

ATTORNEYS

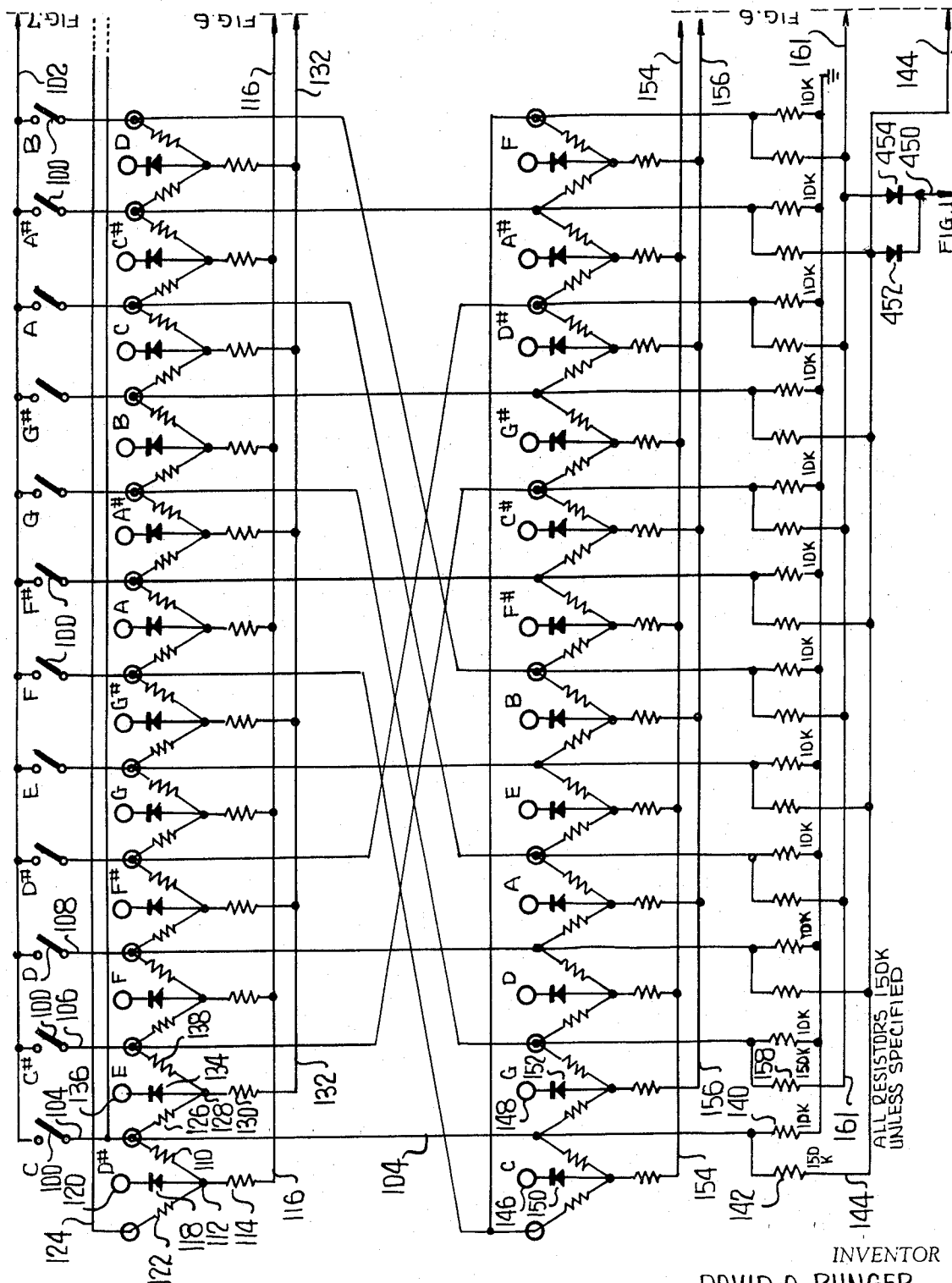
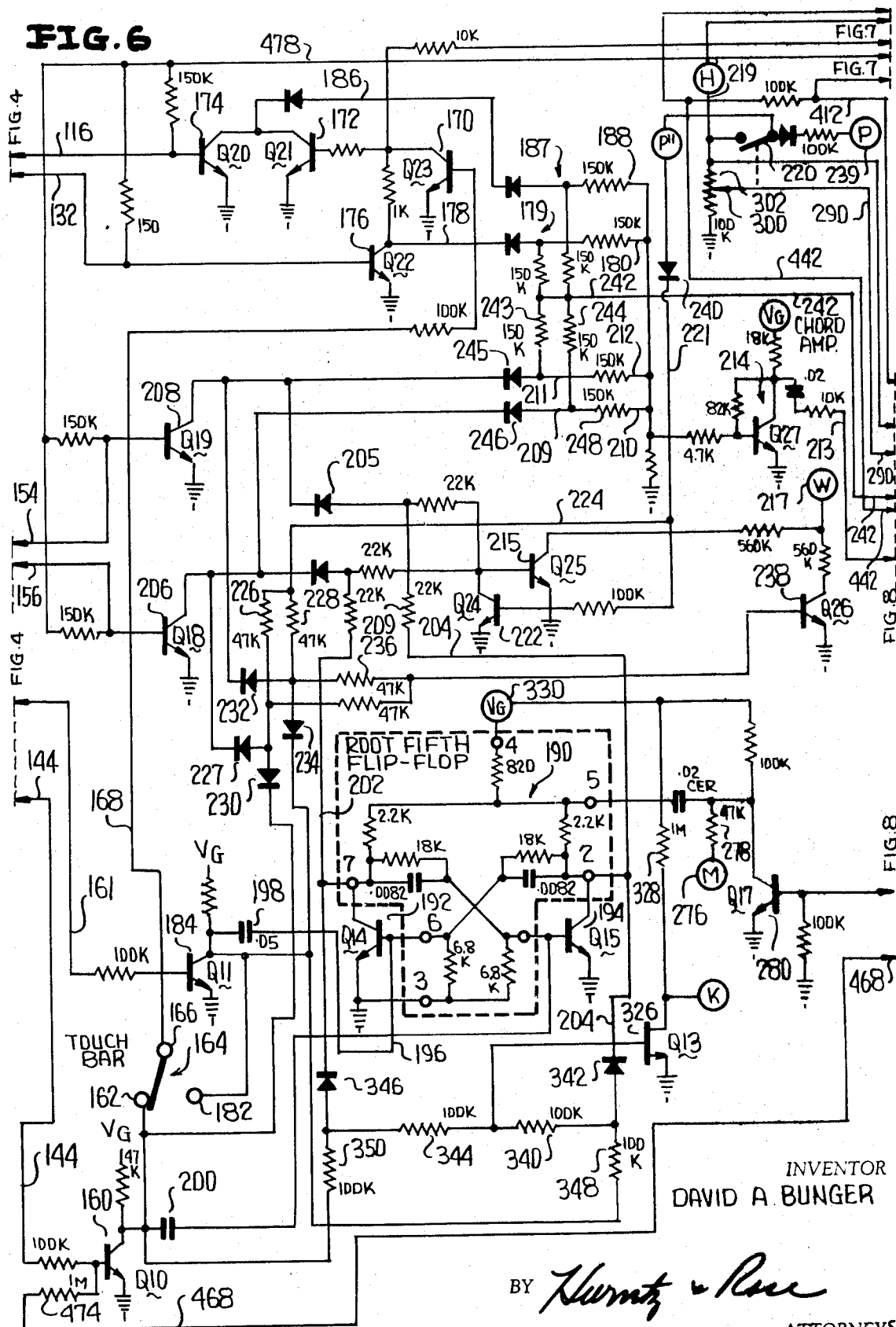


FIG. 4

INVENTOR
DAVID A. BUNGER

BY *Hummer & Rane*
ATTORNEYS

FIG. 6



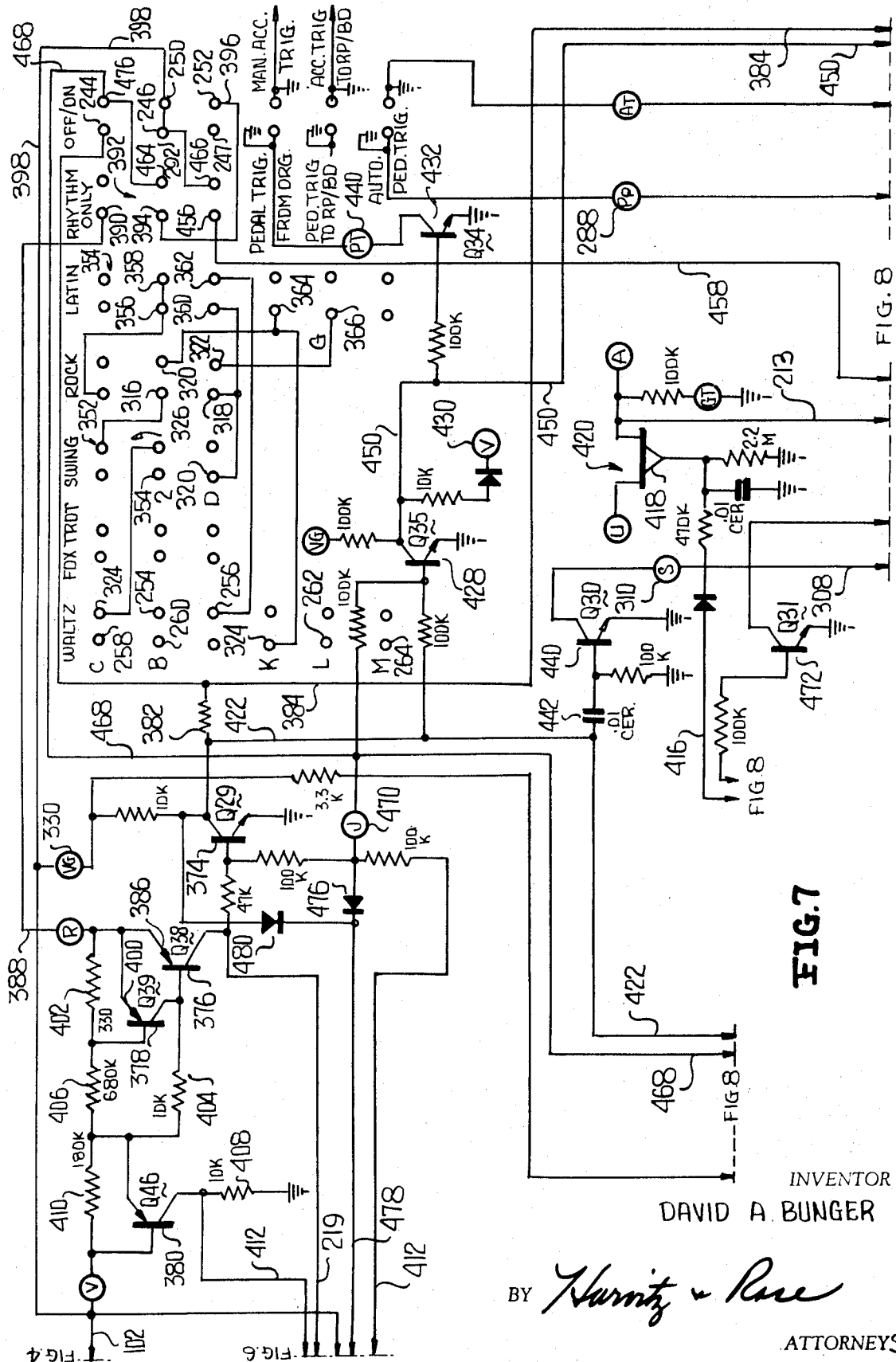


FIG. 7

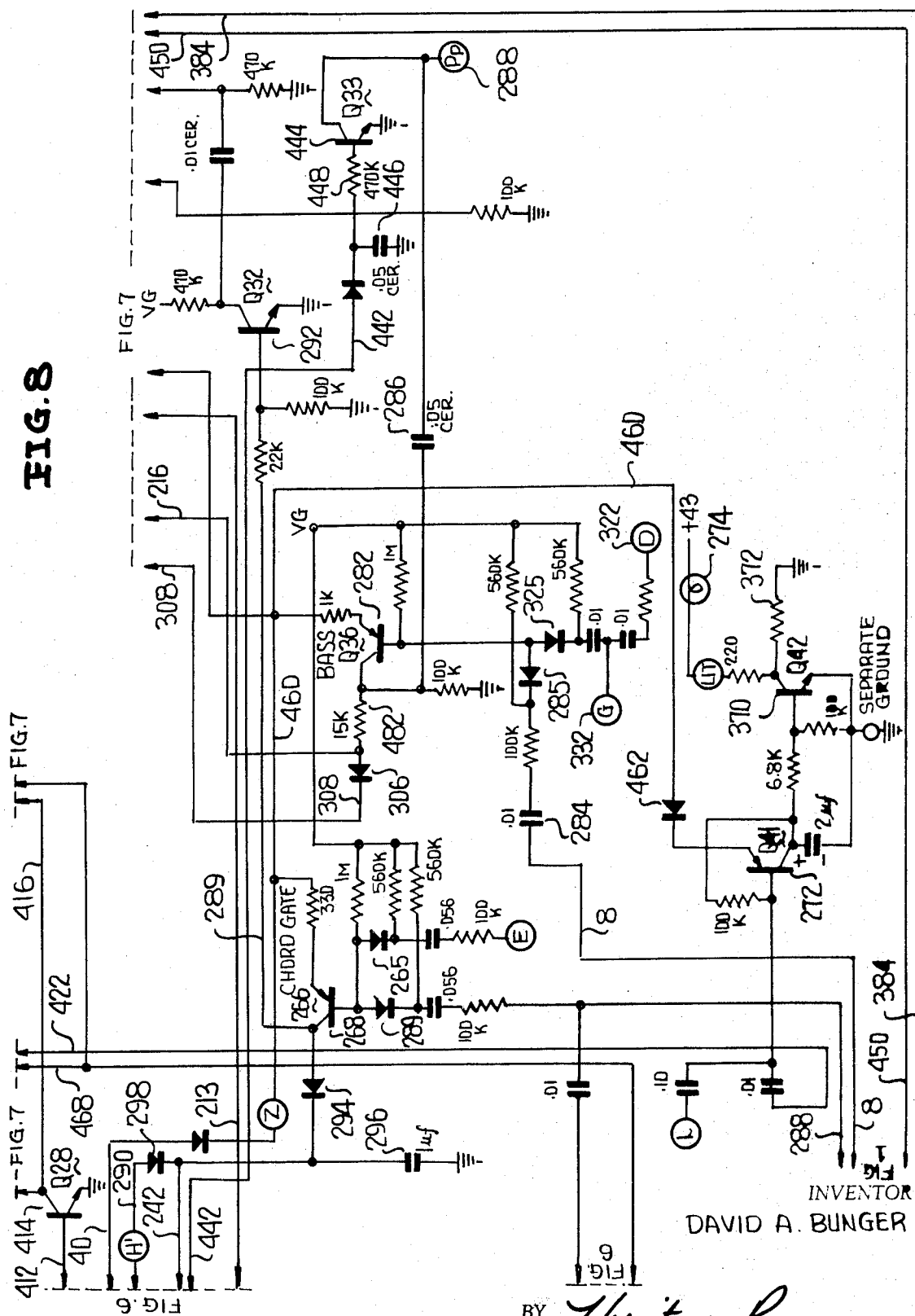
INVENTOR

DAVID A. BUNGER

BY

Harnitz & Rose

ATTORNEYS



BY

Thurnitz & Rose

ATTORNEYS

AUTOMATIC CHORD AND RHYTHM ELECTRONIC ORGANS

BACKGROUND OF THE INVENTION

The present invention relates to a chord organ attachment for conventional electronic organs and an automatic rhythm system which may be employed in conjunction with the chord system or independently thereof.

Automatic chord attachments for conventional organs are known in the prior art. In one such system, upon depression of a key in a selected octave of the lower manual keyboard, the apparatus plays the major or minor diatonic chord of the key depressed; the specific key depressed determining whether the major or minor chord is played. For instance, if the music is to be played in the key of C, major chords result when a C, C sharp or F is played whereas a minor chord is sounded when a D, D sharp or E is played. The pattern repeats with major chords being sounded when F sharp, G and B keys are played whereas minor chords are sounded when a G sharp, A or A sharp is sounded. A touch bar switch is provided for converting at will from the chord normally sounded upon actuation of a given key to the other chord.

Chord organ attachments for conventional organs have validity substantially only for use by a beginner or one who simply wishes to pick out tunes and dress them up musically with chords. Such attachments help particularly the student to learn the sounds of the chords and also permit the student to produce pleasing musical renditions even at a relatively low level of training. Thus it is inconsistent with the level of knowledge of the student who would normally employ a chord organ attachment to require to learn and remember the major and minor diatonic chord progressions for each of the musical keys in which the music may be written so that upon depression of a given key he will know that the touch bar should be depressed to convert from a major to a minor chord, when a major chord would normally be sounded, or convert from a minor to a major chord if a minor chord would normally be sounded.

In the aforesaid system, there is also provided a rhythm generator for sounding the chords and various components thereof at a tempo selected by the student and at one or several different rhythms. The system does not, however, provide for sounding of percussive instruments nor flexibility relative to the length of time the various notes or chords are sounded either in the pedal or manual octaves or permit continuous play of the notes with rhythmic sounding of percussion instruments.

SUMMARY OF THE INVENTION

Briefly describing the main features of the present system, the major chord is always played whenever a key is depressed and if it is desired to play a minor chord a touch bar is depressed to convert to minor chord sounding. There are two main beneficial results flowing from such a system. Most beginner's music is written in the major key and thus it is only occasionally that a beginner will be required to operate the touch bar control. A second feature is that the beginning student, even though somewhat advanced beyond the student described immediately above does, not have to memorize the diatonic chords in each of the various keys in which music may be played. A student known that the major chord is always played unless he presses the touch bar and, therefore, it is only necessary to determine from the music whether the particular chord is to be a major or minor chord.

The above result is accomplished by causing all four possible notes of the chord, the root, fifth and major and minor third parts to appear on separate uses. The major and minor third parts may appear on one or the other of two buses assigned to these frequencies depending upon the root note played. There are provided two gate voltage buses which receive voltages alternatively in accordance with which of the two third part buses has the major third part applied thereto. Transistors sense the voltage bus on which the gating voltage

appears and blocks the amplifier to which the minor third part is applied. When the touch bar is depressed the blocking voltage is removed from the minor third part amplifier and applied to the major third part amplifier.

Normally the chord attachment is operated to provide rhythmic sounding of both the pedal and manual frequencies. This result is accomplished by inserting gates in the circuits between the frequency sources and the audio portion of the audio part of the organ. In accordance with the present invention the gates are opened rhythmically by pulses generated in response to actuation of a key and at subsequent time intervals in the same measure various voltage levels attained by a ramp voltage of a ramp function generator. If continuous operation is to be effected in either or both of the pedal and manual sections of the organ, continuous paths are established through the pedal and manual systems while the pulsing to the percussive instruments is maintained. Thus the pulse generators are not disabled but continuous gating is substituted in the pedal and manual sections for the pulsed gating during automatic rhythm operation.

The system of the present invention provides five basic rhythms which employ pedal toes alternating between the root and fifth notes. It is necessary to provide information which allows the root to be sounded first on closure of a key switch and thereafter to alternate with the fifth part of a chord. A root fifth flip-flop is employed for this purpose with the aforesaid gating voltage buses being employed to establish the flip-flop initially to pass the root frequency on the first downbeat after closure of the key switch.

A single-multiple note detector is found in the prior art to the extent that when a note is played the ramp function generator is placed into operation and when two notes are played the ramp function generator is disabled. In accordance with the present invention if three notes are played the organ reverts to its normal mode of operation. The student can utilize this feature to teach himself the sound of the various chords and the note content thereof. Thus the student can depress a key and hear an entire chord played. He may now select three keys to depress and determine if the chord thus played has the same sound as the chord automatically played by the attachment. In this way the student learns the sounds of the chords and the note content thereof.

Another feature of the invention is that a downbeat is sounded whenever a key is actuated. A fast charge circuit is incorporated in the ramp voltage generator such that whenever a key is released the ramp voltage capacitor is rapidly charged to maximum voltage. Thus as soon as another key is depressed, a downbeat signal is produced by the ramp voltage generator.

As indicated above, rhythm percussion effects are provided by means of percussion trigger gates which sense various conditions on the ramp voltage of the ramp function generator. The circuits are such that base percussive voices are triggered simultaneously with bass notes (root or fifth) and other percussive voices are sounded concurrently with the chords. In the automatic chord type of operation, the percussive sounds are triggered by actuation of a key switch whereas in the automatic rhythm operation the percussive sounds are sounded repetitively irrespective of and independently of operation of a key switch. In this mode of operation the organ keyboard reverts to its normal mode of operation.

The ramp function generator is novel in its simplicity. The generator employs a constant current source for charging a capacitor at a rate determined by the value of a variable resistor. Thus, the tempo of the system may be altered by varying the value of the resistor. Measures from one half second to three seconds are attainable with the circuit described herein but obviously may be made larger or smaller by changing the range of the value of the variable resistor or potentiometer. A transistor switch is employed to sense when the voltage across the capacitor has attained a preselected maximum and to discharge the capacitor. By concurrently shutting off the constant current source the capacitor may be discharged rapidly.

The voltage at which the switch operates to discharge the capacitor has a prescribed value for the waltz and is half that value for all other rhythms in accordance with the present invention. Since the rate of charge of the capacitor is fixed by the constant current source, by reducing the voltage at which said switch operates to one-half that of the waltz, two ramp voltage functions are generated within one waltz measure. Thus, when switching from waltz to other rhythms the measure is not changed but the ramp voltage functions per measure are doubled. Transistor switches are employed to sense when the ramp voltage has attained specific percentages of its maximum voltage and to generate beats when each such precise percentage is achieved. Two such levels are established for instance so that in the waltz function there are three events sensed per measure, downbeat and two further pulses, whereas in all other rhythms up to six beats are provided which may be selectively employed or eliminated in accordance with the particular rhythm function to be generated. The various transistor switches are permanently wired to certain of the gates of the chord organ attachment but are selectively connected to various of the other gates in accordance with the particular rhythm to be played.

One other feature of the invention relates to the fact that whenever a key is depressed, whether properly timed with the prior notes or not, a downbeat is sounded. This feature is achieved by causing the ramp voltage to commence anew each time a key switch is actuated and sensing this event to pulse a downbeat light, sound the bass percussion instruments selected and play the sent note through the pedal section of the organ.

Additional features of the invention relate to eliminating undesirable effects which may be generated at times of switch over from chord to normal play and at times of improper operation of the chord attachment.

It is accordingly a broad object of the present invention to provide a chord organ which always plays the major chord of each tonic note played.

It is another object of the present invention to provide a chord organ attachment for electronic organs in which a major chord is always sounded for each root note played and which provides a touch bar mechanism for converting to a minor chord.

Yet another object of the present invention is to provide a chord organ and automatic rhythm attachment for electronic organs in which pedal percussive voices may be sounded on at least each downbeat and the accompaniment percussive voices may be sounded on at least each second beat of each measure.

It is another object of the present invention to provide a chord organ attachment for an electronic organ, which attachment has an automatic rhythm system which may be employed with the chord organ attachment or independently thereof, and in the former case is key switch actuated and in the latter case is operated continuously.

It is yet another object of the present invention to provide a chord organ attachment for electronic organs, which has an automatic rhythm system component and wherein the chords may be played as rhythmic chords or continuous chords without affecting the operation of automatic percussive voices under control of the automatic rhythm system of the attachment.

It is another object of the present invention to provide an automatic rhythm and chord system attachment for electronic organs in which the root and fifth parts of the chord are voiced in alternation through the pedal section of the organ and the chords are played through the lower manual section of the organ and in which either one or both of the pedal and lower manual notes may be sounded rhythmically or continuously.

It is another object of the present invention to provide a chord and rhythm attachment for an electronic organ wherein when chord operation is employed the rhythm section is operated in synchronism with key operation and wherein when only the rhythm section is to be employed, rhythm operation is independent of key actuation.

Still another object of the present invention is to provide an automatic chord attachment for electronic organs in which when three keys are played in the lower manual octave selected for chord operation the organ reverts to normal operation and the attachment is rendered inoperative.

It is yet another object of the present invention to provide a chord organ attachment for electronic organs which sounds a downbeat whenever a single note in a predetermined octave of the organ is sounded.

It is another object of the present invention to provide various secondary functions in a chord and rhythm attachment for conventional organs which prevent undesirable sounds being generated upon switching between chord and normal operation on the one hand and normal and chord operation on the other hand.

BRIEF DESCRIPTION OF THE DRAWINGS

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

FIGS. 1, 4 and 6-8 taken together provide a schematic wiring diagram of preferred embodiment of the present invention;

FIGS. 2 and 3 illustrate the wave forms occurring in the ramp function generator of the present invention; and

FIG. 5 is a schematic block diagram illustrating the major interconnections between the chord organ and rhythm attachment of the present invention and a conventional organ.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now specifically to FIG. 1 of the accompanying drawings there is illustrated among other things a ramp generator 1 employed to provide automatic rhythm to the rhythm system forming a part of the apparatus of the invention.

The ramp generator employs a charging capacitor 2 selectively charged through a transistor 6 of a constant current source comprising a source of voltage appearing on a bus 4, the NPN-transistor 6 and transistors 16 and 24. Current through transistor 6 is supplied to a bus 8 connected to the upper end of the charging capacitor 2 as viewed in Fig. 1. The lower end of the capacitor 2 is connected to ground via fixed resistor 10 and a variable resistor 12.

The junction of the charging capacitor 2 and the resistor 10 is connected via a further resistor to base electrode 14 of the transistor 16 having a grounded emitter 18 and having its collector 20 connected to a base electrode 22 of transistor 24. The collector of the NPN-transistor 24 is connected directly to ground while its emitter is connected to the base electrode of transistor 6 and to the high-voltage bus 4 through resistor 26.

The bus 8 is connected through a diode 28 to the emitter electrode of a PNP-transistor 30. Collector electrode of the transistor 30 is connected to the ground through a resistor 32. The base electrode of the transistor 30 is connected through a resistor to collector electrode 34 of an NPN-transistor 36 having its emitter 38 connected to the junction of the capacitor 2 and the resistor 10. The base electrode 14 of the transistor 16 is connected via collector-emitter circuit of an NPN-transistor 40 to ground.

Describing now the operation of the circuit thus far described; during periods when the ramp generator is to be maintained inoperative, a voltage is applied to base electrode 42 of the transistor 40 placing the transistor 40 in saturation. Saturation of the transistor 40 substantially grounds the base 14 of the transistor 16 maintaining this transistor in a nonconducting condition, thereby also maintaining the transistor 24 in the nonconducting condition. The voltage of bus 4 is thus applied to the base of the transistor 6 rendering it highly conductive so that capacitor 2 is charged fully at a rapid rate through the resistor 13 and transistor 40. The bus 8, assuming

a voltage of about 16 volts on the bus 4, is maintained at about 12 volts so that the transistors 30 and 36 are conductive due to the bias maintained on the base electrode of the transistor 30 via a voltage divider including resistor 44 to a bus 46 and resistors 48, 50 and 52 to ground.

If now the voltage is removed from the base of the transistor 40, transistor 40 becomes nonconductive, releasing the base 14 of the transistor 16 and a positive potential appears at the base 14 due to current flow through the transistors 30, 36 and resistors 10 and 12. Conduction of the transistor 16 places the transistor 24 into conduction and the transistor 6 is shut off. The capacitor 2 is short circuited through the transistors 30 and 36 which are now saturated. The capacitor discharges until the forward bias across diode 28 is lost at about 1½ volts providing the fly back interval in a conventional ramp generator; that is, saw tooth generator. Rapid discharge results from the low resistance of the discharge circuit and the termination of charging current through the transistor 6.

The voltage on the bus 8 falls until it reaches a shut off potential for the diode 28 occurring at approximately 1½ volts. At this time the transistors 30 and 36 become nonconductive. The voltage now appearing at the base 14 of the transistor 16 is such as to render it partially conductive. The transistor 24 is rendered partially conductive rendering the transistor 6 conductive to an extent determined by the setting of the potentiometer 12.

The constant current through the transistor 6 again charges the capacitor, the adjustment of the slider 12 determining division of the charging current between the resistors 10 and 12 and the base of the transistor 14. The feedback voltage of the transistor 6 is thus determined and in consequence its level of conduction is regulated to charge the capacitor at a fixed rate. The voltage rises linearly due to the constant current operation of the transistors 6, 16 and 24 until it reaches a value equal to two diode drops greater than the voltage on the bus 46. At this time the transistor 30 and thus the transistor 36 are both placed in conduction and the capacitor 2 is again discharged. This operation continues so long as the base of the transistor 40 has a low potential thereon, that is, is substantially grounded. When the base of transistor 40 is again permitted to go positive relative to the emitter of the transistor 40, the transistor 40 saturates and the ramp function is discontinued.

Incorporated in the ramp function generator are two transistor switches which are driven into saturation in sequence in response to different levels of the ramp voltage. The switching on of each of these switches produces pulses providing the basic organ rhythm in conjunction with the pulse produced upon falling of the bus 8 upon discharge of the capacitor 2. Thus, three timing pulses are produced permitting the desired rhythms to be generated.

Referring again specifically to FIG. 1, the two transistor switches are generally designated by the reference numerals 54 and 56 which are identical in operation. The switch 54 comprises an NPN-transistor and a second NPN-transistor 60. Their emitters are connected together and through a resistor 62 to ground. The transistor 58 has its collector connected directly to the bus 4 while the transistor 60 has its collector connected through a resistor 64 to the bus 4. The base of the transistor 58 is connected through a resistor to the junction of the resistors 50 and 52 while the base of the transistor 60 is connected through a resistor 66 and diodes 68, in series, to the bus 8.

At a voltage determined primarily by the relative values of the resistors 48, 50 and 52 (in parallel with additional resistors 76, 78, 80 and 82) the transistor 60 which is normally nonconductive is placed in conduction upon the voltage on the bus 8 achieving a value equal to two diode voltage drops (diodes 68) greater than the voltage at the junction of resistors 50 and 52. When the voltage on the bus 8 does exceed the voltage at the junction of the resistors 50 and 52. By the prescribed amount, the transistor 60 is placed in conduction very rapidly due to positive feedback through resistor 70 to transistor 58 and the

effect of the common connection to ground through resistor 62. The sudden drop in potential at the collector of transistor 60 provides a second pulse of the desired rhythm.

The switch 56 as stated above is identical with the switch 54, employed left and right transistors 55 and 57 as viewed in FIG. 1, but the switching voltage is determined by the voltage at the junction of the resistors 48 and 50 and thus is at a higher voltage than the voltage at which the switch 54 operates.

Reference is made to FIG. 2 of the accompanying drawings which illustrates the ramp function of a rhythm generator in the waltz mode of operation. The specific mechanisms for responding to the various pulses are not discussed at this point but simply the operation of the rhythm system. During waltz mode operation, the resistors 48, 50, 52 et al. determine the precise voltages in which the switches 54 and 56 fire and these voltages are selected respectively at one third (V_2) and two thirds (V_1) of the maximum ramp voltage amplitude designated in the diagram as V_3 , which appears on lead 46. The ramp voltage, starting from its lowest value on the bus 8, rises until it equals two diode drops greater than the voltage at the junction of the resistors 50 and 52. At this point the switch 54 operates and the voltage on the collector of the transistor 60 falls quickly to produce a negative spike. At a voltage on bus 8 equal to two diode drops greater than the voltage V_1 , the switch 56 is triggered so that a negative pulse is produced at the collector of the transistor 55. Subsequently the voltage of the bus 8 rises to a value 2 diode drops greater than V_3 to trigger transistors 30 and 36 and produce discharge of the capacitor 2 thus terminating the sawtooth wave.

In the waltz mode of operation each ramp function is employed as a single measure of music because the rhythm for such music is fixed at three beats to the measure. The reason for this is apparent. In other forms of music, however, for instance swing, fox trot, rock & roll and Latin, a minimum of four and as many as six beats are required per measure. Thus the present invention must provide a means for changing the beats per measure when changing from the waltz mode of operation to any other mode.

Referring again to FIG. 1, when the system with which the rhythm generator is employed is in any rhythm mode other than waltz, terminals 72 and 74 are shorted placing resistors 76 and 78 in parallel with the series resistors 48 and 50 and placing resistor 82 in parallel with all of the resistors 48, 50, 76, 78, 52 and 80. As a result of the change in the resistance divider network between the bus and ground, the voltage V_3 which produces triggering of the transistors 30 and 36 and therefore discharges the capacitor is made equal to one-half of the voltage (see FIG. 3) at which triggering occurs for the waltz rhythms illustrated in FIG. 2. Also the V_2 and V_3 voltages occur at one-half and three-fourths of V_3 , respectively. Since the charging time of the capacitor 2 is linear and the amplitude at which the capacitor is discharged is one half of the amplitude in the waltz time, precisely two ramp voltages are produced within the same length of time as a single ramp voltage is produced for the waltz. Thus the measure length, or specifically, the tempo, does not change when switching from waltz to any of the other rhythms but the available rhythm content of the measure is materially altered.

As will be indicated subsequently, the voltage on the base of the transistor 42 is under control of the notes in the appropriate octave of the lower manual with which the chord organ is associated. Specifically, when a key is not played the transistor 40 is saturated but when a key is depressed the transistor 40 is turned off and maintained off so long as the key is depressed.

Referring now specifically to FIG. 4 of the accompanying drawings, there is illustrated the key circuits for affecting the various gating functions required to connect to the chord circuits of the present invention the various frequency sources of the organ required to produce the key selected chord. The circuits are associated with a separate contact on each of the keys of a specific octave of the lower manual of the main chord. These contacts, which are generally designated by the

reference numeral 100 in FIG. 4, have adjacent thereto in the drawing, an indication of the root note of the chord to be produced by depression of each key. A voltage is normally developed on a bus 102 connected in common to the stationary contact in each of the keys 100 while movable contacts of each of these keys is connected to a distinct bus 104, 106, 108, etc.

The bus 104, for instance, is connected through a resistance 110 to a junction point 112. Junction point 112 is connected through a resistor 114 to a bus 116 on which the minor third part of the chord is to appear, alternatively the minor third or the major third depending upon which of the root keys 100 is depressed. The junction point 112 is connected through a diode 118 to a D sharp frequency source 120. The junction point 112 is also connected through a resistor 122 to a bus 124 connected through the B key 100 to the bus 102.

The lead 104 is also connected through a resistor 126 to a junction point 128. The junction 128 is connected through a resistor 130 to a bus 132 on which appears major or minor third parts of a chord depending again on which of the keys 100 is depressed. The junction point 128 is further connected through a diode 134 to frequency source 136 for the note E for the particular octave under consideration. The junction point 128 is also connected through a resistor 138 to the bus 106 which is connected through the C sharp key to the bus 102.

Continuing with the description of the circuitry associated with the key 100, the bus 104 is connected through a resistor 140 to ground and through a resistor 142 to a bus 144. A voltage appears on the bus 144 or a corresponding bus 161 depending upon which of the keys 100 is depressed and serves to provide an indication to the chord system as to which of the notes appearing on the leads 154 and 156 is the root and which is the fifth part of the chord and to which of the notes appearing heads 116 and 132 is the major or minor third part of the chord. The lead 104 is connected in a manner identical with the connections to the sources 120 and 136 to additional frequency sources 146 and 148. The source 146 is the C note source for the particular octave under consideration while the source 148 is the G note source for the same octave.

Whenever a key 100 is closed, for instance the key C, a high voltage is applied to the lead 104 which forwardly biases the diodes 134 and 118 related to major and minor sources 136 and 120, respectively, and corresponding diodes 150 and 152 related to the root-fifth sources 146 and 148, respectively. In consequence, communication is established between the sources 120 and 136 and the buses 116 and 132 respectively and the sources 146 and 148 and buses 154 and 156 respectively. The buses 154 and 156 are root-fifth buses to which the sources 146 and 148 are gated. If a C note is played the root frequency appears on bus 154 and the fifth part frequency appears on bus 156. Their functions may be reversed if some other key is played. For instance, if the note G is played, the G note is the root whereas when a C is played the G note is the fifth part of the chord and the functions of buses 154 and 156 are reversed.

It should be noted that although the frequency sources in the upper row of the FIG. 4 are designated at times by different reference numerals from the signal source in the lower row, these sources where they are designated by the same note are the same source. For instance, the source for the note G in the upper row of sources is the same source as that designated by the reference numeral 148 in the lower row of sources.

The composite of the various sources, keys, diodes, etc., provide an octave of square wave frequencies from the main organ and these frequencies are applied to a set of 24 diode gates. Whenever one of the keys 100 is closed, a positive voltage is applied to a group of 4 of the gates; in the case of the note C, these being the gates including the diodes 118, 134, 150 and 152, respectively. The application of high voltage to the gates opens the gates and permits the frequencies with which the gates are associated to play through to their respec-

tive buses and subsequently, as will be indicated later in the specification, to various transistor rates and amplifiers in the main body of the chord system.

As previously indicated, a primary object of the present invention is to provide major/minor chord logic such that a beginning student may readily select a major or minor chord without a high degree of knowledge of the chords or more specifically without having to learn and remember the major and minor chord progressions and the musical key in which the music is written in order to make such a major to minor chord transformation. In accordance with the present invention the system is programmed to always play a major chord. A touch bar is provided adjacent the 12 keys of the selected lower manual such that if a student wishes a minor chord he merely depresses the bar and a minor chord is automatically played regardless of the root frequency of the chord.

Referring now specifically to FIG. 6 of the accompanying drawings, the circuits necessary for such a selection are illustrated. Assume for purposes of illustration that a C chord is to be played and initially the student does not depress the touch bar so that a C major chord is played. Upon depression of the C note in FIG. 4, high voltage appears on the bus 144 and is applied to the base of a transistor 160 having a grounded emitter and a collector DC coupled to a stationary contact 162 of a touch bar switch 164. When the touch bar is not depressed the contact 162 is contacted by movable contact 166 of the touch bar switch 164 and connected via a lead 168 to the base of a transistor 170. Upon application of high voltage to the base of the transistor 160 the voltage at its collector falls and the transistor 170 is turned off so that the voltage at the base of a transistor 172, connected to the collector of the transistor 170, rises. The transistor 172 goes into conduction and reduces the voltage at the collector of a transistor 174, the collectors of the transistors 172 and 174 being connected together. Thus the collector of transistor 174 is shorted to ground and rendered inoperable. The base of the transistor 174 is connected to the lead 116 and thus when a C note is played it carries the D sharp note, the minor third part of the chord.

It should be noted that a transistor 176 has its collector connected to the collector of the transistor 170 so that when the transistor 170 is turned off, as in the above example, high voltage is applied to the collector of the transistor 176 and rendered capable of conduction. The base of the transistor 176 is connected to the major third part, bus 132 of the key selection matrix, and therefore the major third part of the chord is played through and appears on a lead 178 connected to the collector of the transistor 176. The bus 178 is connected through a diode-resistor gate 179 to a further lead 180. If positive voltage is applied to the junction of the diode and resistor forming gate 179, signals can pass.

If the touch bar is depressed, its movable contact 166 is connected to a minor chord terminal designated by the reference numeral 182. The minor chord terminal is connected to the collector of a transistor 184 having its base connected to the lead 161. In the example given, the lead 161 is not energized since none of the keys with which this bus is associated have been depressed. In consequence, the voltage appearing at the collector of the transistor 184 is high and the transistor 170 is turned on. High voltage is removed from the collector of transistor 176 and thus the note E, the note on the bus 132, is blocked. The transistor 172 however has a low voltage applied to its base and therefore it is turned off and a high voltage appears at the collector of the transistor 174. The transistor 174 therefore plays through and the D0 note, appearing on the bus 116, is transmitted via a bus 186, and thence through a diode-resistor gate 187 to a further bus 188.

Thus, by actuation of the touch bar switch 164, the student is able to shift from the major to the minor chord of the C chord.

The other situation which may exist relative to major-minor chord selection is when a note is played relative to which a voltage appears on the lead 161 rather than on the lead 144.

This occurs for instance, when the root frequency is the note G rather than the note C. When the note G is depressed, a voltage appears on the lead 161 and the transistor 184 is placed in conduction while the transistor 160 remains nonconductive. Also when the note G is played the frequency of the major third part B appears on the lead 116 whereas the minor third part appears on the lead 132. Thus the major and minor third part's positions on the leads 116 and 132 are reversed relative to the situation when the root frequency is the note C. The note B, the major third part, is applied to the base of the transistor 174. Since, the transistor 160 is nonconductive, the transistor 174 is conductive and the note B, the major third part, plays through. If now the touch bar is depressed, the transistor 170 is rendered nonconductive. The transistor 174 is also rendered nonconductive blocking the major third part of the chord and the transistor 176 is rendered conductive and plays through the minor third part of the chord, that is the note A0.

It is apparent that the transistors 160 and 184 carry the information relative to the base and fifth notes and in consequence may be employed to select the appropriate transistor 174 or 176 to gate through the major or minor third part of the chord as desired.

The information available at the transistors 160 and 184 also indicates which of the frequencies available on the leads 154 and 156 is the root frequency and which is the fifth part of the chord, this information being essential relative to certain of the rhythms provided in the organ. For instance, and reference again is made to FIG. 2, the sequence of notes played for a waltz at the various intervals during the measure are the root, chord, chord in the first measure and fifth, chord, chord in the second measure. The root and fifth frequencies are played alternately on the downbeats and the full chord is played on each of the second and third beats. In rock music, see FIG. 3, the root frequency is played on the downbeat, a chord is played at the 1/4 and 3/4 measures, the third beat (3/8 measure) is suppressed, and the fifth part of the chord is played at one-half and seven-eighths measure (fourth, sixth beats). The various rhythms available in the apparatus of the invention are tabulated below in table I. In table I it will be noted that the waltz, and this of course has been discussed relative to FIG. 2, contains three beats per measure providing the three-fourths time. All of the other rhythms are based on two ramp voltages per measure and are based on six beats per measure. These six beats are not used in all rhythms. In table I below the six possible beats are indicated immediately above the row for waltz by the numbers 1-2-3 and repeating 1-2-3 horizontally across the page. For the Fox Trot, only four beats are employed, the first and second beats of each of the two ramp voltages per measure with the third beat of each ramp voltage being suppressed. Swing employs the same basic rhythm as the fox trot but in addition the root and fifth notes are played through the pedal channel at the second and fourth beats.

TABLE I

Pulse	(1)	(2)	(3)	(1)	(2)	(3)
Waltz	Root	Chord	Chord	Fifth	Chord	Chord
Fox trot	do	do	do	do	do	do
Swing	do	(Root chord)	do	do	(Fifth chord)	do
Rock	do	Chord	do	do	Chord	Fifth
Latin	do	do	(Root chord)	do	do	(Fifth chord)

The time relationship between the pulses are as follows:

Waltz	(1)-2	8 units)
	2-3	8 units) 1 measure
	3-1	8 units)
All other rhythms	1-2	6 units)
	2-3	3 units)
	3-1	3 units)

It is apparent from the table that it is essential to proper operation of the organ that the circuitry provide signals indicating the buses on which the various parts of the chord appear for each chord played.

Referring again to FIG. 6, the aforesaid information is available from a flip-flop generally designated by the reference numeral 190. The flip-flop is conventional in configuration and employs a transistor 192 and a second transistor 194. The base of the transistor 192 is connected via a lead 196 and a.c. coupling capacitor 198 to the collector of the transistor 184. Similarly the base of the transistor 194 is a.c. coupled through a capacitor 200 to the collector of the transistor 160.

Upon depression, for instance of the key C, high voltage applied to the bus 144 triggers the transistor 160 so that its collector falls and a negative pulse is applied through the capacitor 200 to the base of the transistor 194. The transistor 194 is turned off and the transistor 192 is turned on due to the cross coupling between the collectors and bases of the two transistors. This is apparent from the drawings. If, on the other hand, the root frequency is G, high voltage appears on the lead 161, the transistor 184 is turned on and the transistor 192 is forced into a non-conductive condition while the transistor 194 is turned on. Thus, the flip-flop 190 is set with transistor 192 conductive if the control voltage appears on the lead 144 and with the transistor 194 conductive if the control voltage appears on the lead 161.

The transistors 192 and 194 have their collectors connected via leads 202 and 204 respectively to the collector circuits of transistors 206 and 208 respectively. The base of the transistor 206 is connected to the bus 156 and the base of the transistor 208 is connected to the lead 154. Thus, when the note C is played, the transistor 208 has the root frequency applied to its base and the transistor 206 has the fifth part of the chord applied to its base, this being the note G. However, if the note G is the root note, the transistor 206 has the root frequency applied thereto and the transistor 208 has the fifth part of the chord, the note D, applied thereto. If now the note C is played and high voltage appears on the lead 144, thereby turning the transistor 194 off. The voltage on the lead 204 connected to the collector of the transistor 194 via resistor 203 and diode 205 is high and high voltage is applied to the collector of the transistor 208 so that the transistor 208 plays through the root frequency. The transistor 206 however has a low voltage applied thereto due to the conduction of the transistor 192 of flip-flop 190 and the fifth part of the chord does not play through at least initially when the key is first depressed. Subsequent events cause the flip-flop to switch back and forth so as to select the root and fifth part of the chord as required to provide the rhythm desired by the system.

The signals on the collectors of the transistors 206 and 208 are applied via diode-resistor rates 209 and 211, respectively, to buses 210 and 212 respectively. It will be noted in FIG. 6 that the four buses or leads 180, 188, 210 and 212 are connected together to the base of a chord amplifier, generally designated by the reference numeral 215 and from the collector of the chord amplifier are connected via lead 213 to a ter-

terminal 216, FIG. 7, which applies the signals to the accompaniment manual filters 218 illustrated in FIG. 5. The accompaniment manual filters are a part of the standard organ.

As will be explained subsequently the diode-resistor gates 179, 187, 209 and 211 are pulsed on the second beat and at times (waltz, Latin) the third beat of each measure or half measure to permit passage of the chord frequencies to the chord amplifier and subsequently to the organ manual filters.

Whenever transistors 206 or 208 are operative signals are also 2 to the base of a transistor 215 having its collector connected to a terminal 217 of FIGS. 5 and 6. The terminal 217 in

FIG. 6 connects the root and fifth frequencies to a pedal divider 216 (see FIG. 5) located in the organ on the accessory board. The pedal divider 216 divides the frequency supplied thereto by a factor of 2 thus providing a pedal frequency corresponding to the root note. In the examples given above the notes would be the note C or the note G at the pedal frequencies. As will be explained subsequently, the pedal notes are pulsed by application of pulses to a pedal diode gate 240, FIG. 5, via a terminal 310. The terminal 310 has pulses applied thereto from base trigger transistor 282 of FIG. 8. The transistor 282 is always triggered on downbeat and selectively triggered on the second or third beat depending upon the rhythm selected.

In accordance with the present invention the pedal root frequency may be sounded continuously at the discretion of the player. This selection is effected by a switch 220 which when closed applies a positive voltage via lead 221 and diode 240 to the base of a transistor 222 having its collector connected to the base of the transistor 215. When the switch 220 is closed the transistor 222 is saturated and clamps the base of the transistor 215 to ground thereby blocking transmission of signal therethrough. The voltage applied to the base of the transistor 222 via the lead 221 is also supplied via leads 221 and 224 to resistors 226 and 228. The resistor 226 is connected to the junction of diodes 227 and 230, the diode 227 being connected to the collector of the transistor 206 and the diode 230 being connected to the collector of transistor 160. The resistor 228 is connected to the junction of two diodes 232 and 234; the diode 232 being connected to the collector of transistor 208 and the diode 234 being connected to the collector of transistor 184.

Taking now the example above where the note C has been played and the switch 220 is closed, a positive voltage is supplied to the base of the transistor 160. Its collector is clamped at about ground potential and the junction of the diodes 227 and 230 is held just slightly above ground so that the diode 227 is reverse biased and cannot pass signals. On the other hand the transistor 184 is not conducting, diode 234 is reverse biased and therefore the junction of the diodes 232 and 234 is at a voltage determined by the lead 224 and signals may be transmitted through the diode 232. As previously indicated the root note when C is played appears on the lead 154 and therefore at the base of the transistor 208. Thus the root note may be transmitted through the diode 232 and resistor 236 to the base of a transistor 238. The terminal 217 is connected in the collector circuit of transistor 238 and therefore the root note C is applied to the terminal 217 in FIG. 5 and subsequently to the pedal divider 216. The fifth part of the chord is blocked out of the pedal circuit by grounding of the junction of diodes 227 and 230 in the above example.

It is apparent that so long as the switch 220 is closed the condition set forth above subsists and so long as the ramp generator is operating (i.e., a key is depressed) a continuous pedal signal is supplied to the pedal divider and subsequently to the speakers of the organ.

The switch 220 when closed connects high voltage lead 219 to a terminal 239 in FIGS. 5 and 6. The terminal 239 thus receives a continuous voltage and maintains the pedal diode gate 204 open so that the pedal note sounds continuously.

It will be noted that the transistors 174 and 176 are unaffected by the above so that the third part of the chord is played conventionally. Also although the fifth part of the chord is blocked out of the pedal circuit due to the grounding of the junction of the diodes 227 and 230, the fifth part and also the root part of the chord still play through to the accompaniment manual via the chord amplifier 214. Specifically, a further lead 242 applies a gating voltage, derived from a lead 290 via diode 298, via a resistor 244 and diode 246 to the collector of the transistor 206 and resistor 243 and diode 245 to the collector of transistor 208. The fifth part of the chord then modulates the junction of the resistor 244 and diode 246 and the root frequency modulates the junction of diode 245, resistor 243 so that these modulating frequencies are applied to the base of the chord amplifier 214. Thus, the root, third and fifth

parts of the chord appear at the chord amplifier 214 and are played through the accompaniment manual while only the root part of the chord is played through the pedal as a sustained note.

The pulsing of the signals applied to the transistor 214 to introduce rhythm into the accompaniment manual section is now described. Referring now specifically to FIGS. 7 and 8 of the accompanying drawings, the circuits for effecting rhythmic servicing of the lower manual and pedal frequencies is illustrated. The operation of the system relative to a waltz is initially described. In this configuration ON-OFF switch 244 is in the ON position so that contact 246 is connected to contact 247 and contact 250 is connected to contact 252. All other push buttons are up except the waltz push button which has contact 254 connected to contact 256, has contact 258 disconnected from contact 260 and has contact 262 connected to contact 264. The contact 258 is connected to the terminal 72 in FIG. 1 and the terminal 260 is connected to the terminal 74 also in FIG. 1. The terminal 254 is connected to terminal 65 (collector of transistor 55) of FIG. 1. The terminal 256 is connected to terminal E and through various resistors and capacitors and a matrix diode 265 to a base electrode 268 of a chord gate transistor 266 of FIG. 8. Terminal 262 is connected to terminal L of FIG. 8 which is connected through a coupling capacitor to a base of a transistor 272, the downbeat light gating transistor; the light being designated by the reference numeral 274. The terminal 264 of the waltz switch is permanently connected to a terminal M of FIG. 6 connected through a resistor 278 to the collector of a transistor 280. Thus when the waltz switch is depressed the contacts 254 and 256 are shorted and the voltage appearing at the collector of the transistor 55 of the ramp generator is connected to the base of the chord gate transistor 266. Also the L and M terminals are connected together so that the tempo light is driven from the collector of the transistor 280.

Assuming that a key is depressed, the voltage on the lead or bus 8 suddenly falls and a pulse is directed via the bus 8, coupling capacitor 284 and matrix diode 285 to the base electrode of base trigger transistor 282, turning this PNP-transistor on temporarily due to the capacitive coupling of the bus 8 to the transistor 282 through the capacitor 284. When transistor 282 fires on downbeat, a pulse is coupled through capacitor 286 to a terminal 288 which is connected to drive a selected member of the rhythm percussion board of the main organ. Specifically, the player may select bass, drums, cymbals, or other bass percussive instruments. The pulse appearing at the terminal 288 actuates the gates necessary to permit sounding of the fundamental and the harmonics representative of these various voices.

Pulsing of the amplifier 282 also pulses a terminal 310 of FIGS. 5 and 7 via diode 306 of FIG. 8. The pulse on terminal 310 passes the root frequency on the first and alternate downbeats through the pedal circuit via pedal divider 216 and pedal diode gate 240. On the second and alternate downbeats the fifth part of the chord is gated through the pedal diode gate 240. Thus on each downbeat the bass percussion voices are sounded and the root and fifth parts of the chord are sounded in alternation.

Continuing, the voltage on the ramp generator now begins to rise and reaches a level established at transistor 60 so that the transistor 60 now fires and the voltage on its collector falls. This voltage which appears on bus 288 is capacitively coupled to the base of the transistor 280 and via matrix diode 289 to the base of the transistor 266.

As previously indicated, the waltz rhythm is root, chord, chord-fifth, chord, chord. The pulse at the base of the transistor 266 produces a positive pulse on a lead 289 which is applied to the base of a transistor 292. The transistor 292 triggers an accompaniment rhythm percussion board of the main organ to provide sounds such as snare drums, brush, block, etc. on each second beat of each waltz measure. The collector of the transistor 266 is also connected through a diode 294 to the junction of a sustain capacitor 296 and a lead 242. The capacitor 296 has its other terminal grounded and the lead

242 is connected via lead 290 and a diode 298 to slider 300 of a potentiometer 302 connected to high voltage terminal 219.

The setting of the slider 300 determines the voltage on the lead 290 and thus the minimum voltage on the lead 242. Upon conduction of the transistor 266 the capacitor 296 is charged to full voltage, approximately 16 volts, and the gates 179, 187, 209 and 211 are fully opened and apply the three notes of the chord to the chord amplifier at maximum amplitude. Assuming that lead 290 is at some lesser voltage, the capacitor voltage decays to the voltage of lead 290 less the drop across diode 298 and the amplitude of the chord decays to the level determined by the voltage on lead 290. If no voltage is maintained on lead 290, the decay is rapid to no amplitude and thus no sound.

Thus at pulse time V_2 a chord of initially maximum amplitude is played through the lower manual and decays at a rate and to an amplitude selected by the student.

It should be noted that if the full value of the resistor 302 is inserted in the charging circuit of capacitor 296, the gates 179, etc. are turned fully on and, therefore, the lower manual notes of the organ play continuously. It has previously been seen that continuous pedal operation may be achieved while pulsing of the lower manual notes was affected. It is now apparent that complete flexibility of continuous play of one part of the organ with pulsing of another part, pulsing of both parts or continuous play of both parts is available.

Continuing with the operation of the system in waltz mode, it will be noted that the terminal 65 of the ramp generator of FIG. 1 is permanently connected to the terminal 254 of the waltz switch and in waltz operation is connected to the terminal 256 permanently connected to the E terminal. The E terminal is connected to the base of the transistor 266 so that upon conduction of the transistor 55 a negative pulse is applied to the base of the transistor 266 to render it conductive. Thus the notes to the chord amplifier are again pulsed. The bass gate comprising the transistor 282 is not pulsed at either the V_1 or V_2 beats, since the bass notes are to play only upon the downbeat which is sensed on the lead 8 at the V_3 beat. The next measure which is achieved after the voltage on the bus 8 exceeds the voltage on the bus 46 by two diode drops, begins when the voltage on bus 8 falls to approximately $1\frac{1}{2}$ volts, which produces the negative pulse on bus 8 necessary for the operation of the base trigger transistor 282, and simultaneously produces a positive pulse at the collector of transistor 60 which is capacitively coupled to transistor 280, whose firing changes the state of the flip-flop 190 so that the fifth frequency will be played through the pedal part of the organ. The sequence of the second measure as to the second and third pulses is the same as in the first measure and therefore the desired frequency components of the various beats are achieved.

Referring now specifically to various other rhythms of the organ, the rock rhythm is now considered. The rock switch is depressed and the terminal 316 of the rock switch is connected to terminal 318 and terminal 320 is connected to terminal 322. Under these conditions, with the waltz switch now up, the pulses on terminal 65 of the ramp generator are applied to a contact 324 of the waltz switch via the contact 254. These pulses are applied through the upper right contacts generally designated by the reference numeral 326 of the swing switch and thence to the contact 316 of the rock switch. The contact 318 is wired to a contact 320 of the swing switch which is also permanently wired to a terminal 322 of FIG. 8 which is connected in the bass circuit of the bass gate transistor 282. The terminal 320 of the rock switch is connected to terminal 324 of the waltz switch which is permanently connected to a terminal K in FIG. 7 of the drawings. The terminal K is directly connected to the collector of the transistor 326 which is also connected through a resistor 328 to high voltage terminal 330. The terminal 320 is also connected to the terminal 322 of the rock switch when the rock switch is depressed and thus is connected to a terminal G in FIG. 8. Terminal G is connected via matrix diode 325 to the bass circuit of the transistor 282 of the base switch amplifier.

In the rock type of rhythm in the first half-measure, the root and chord are played at the time of the first and second pulses respectively, and during the second half-measure fifth-chord-fifth are played in that sequence. The third beat in the first half-measure must be suppressed in the pedal circuit. The transistor 326 has its bass connected through a resistor 340 and diode 342 to the collector of the transistor 194 and through a resistor 344 and diode 346 to the collector of transistor 192. It should be noted that the junction of the resistor 340 and diode 342 is connected through a resistor 348 to the collector of transistor 184 and the junction of resistor 344 and diode 346 is connected through a resistor 350 to the collector of transistor 160. In consequence, during each first half-measure the transistor 326 is turned on and via the K & G contacts in FIGS. 6 and 8, respectively, grounds the junction of two capacitors 332 and prevents any pulse that is applied to terminal 322 from triggering transistor 282 during the interval that transistor 326 is turned on. During the second half-measure, however, due to switching of the flip-flop 190, the transistor 326 is rendered nonconductive and releases the junction of the two capacitors 332 so that the third pulse of the ramp voltage cycle maybe transmitted through the transistor to affect the desired pulsing. It should be remembered that the third voltage pulse is connected to the terminal 322 in the base of the transistor 282 through the rock and waltz switches.

The fox trot mode of operation is next considered. In the fox trot only the first and second pulses of the ramp generator are employed to play through root chord fifth chord in each measure. It should be noted that in the fox trot mode no connections are made to the switch and the switch is present due to the mechanical interlocks between the various switches that prevents more than one switch being depressed at one time. Thus depression of the fox trot switch merely releases any previously depressed rhythm switch. Under these conditions the terminal 254 of the waltz switch on which the third pulse of the ramp voltage generator appears although connected through various switch contacts of the waltz and the swing switches eventually deadens in the Latin rhythm switch and therefore is not connected to any portion of the circuit. Thus the bass gate including transistor 282 and the chord gate including transistor 266 are pulsed only on the first and second pulses, respectively. The transistor 282 is permanently connected to the bus 8 and the transistor 266 is permanently connected to terminal 61 of the ramp generator. The chord gate 266 is under control of the transistor 60 and the bass gate 282 is under control of the bus 8.

Turning now to the swing mode of operation, the swing switch which is generally designated by the reference numeral 352 is depressed interconnecting contacts 354 and 320 thereby applying the voltage appearing at the collector of the transistor 60 of the ramp generator to the terminal 320 which is wired to the terminal 322 connected in the base of the transistor 82.

The operation of the swing mode is essentially the same as in the fox trot with one exception. Due to the connection of the second pulse in each half measure to the base of the transistor 282 the terminal 310 or the S terminal of FIG. 7, which is connected to the pedal diode gate 240 in FIG. 5, is pulsed on every second note. Therefore, in addition to the rhythm of the fox trot; that is, root chord fifth chord, the root and fifth notes alternatively are played through the pedal circuit at the second and fourth beats of the rhythm.

The Latin rhythm is similar to but at twice the frequency of the waltz rhythm. Specifically, in the waltz each ramp is equal to one measure whereas in the Latin rhythm there are two ramp voltages per measure. The structure of the frequency content of the pulses is the same except on the last beat of each half-measure. In the Latin rhythm during the third beat of each half-measure the chord is sounded through the accompaniment manual while the root and fifth parts of the chord are sounded through the pedal in alternation.

Referring again to the switches of FIG. 7, the Latin switch is generally designated by the reference numeral 354. When the

Latin switch is depressed its contacts 356 and 358 are connected respectively to contacts 360 and 362. The contact 360 is connected to the terminal 320 of the swing switch and therefore is connected to the terminal 322 in the base of the transistor 282 while the contact 362 is connected to the terminal 256 of the waltz gate which is connected to the terminal E in the base of the transistor 266 and thus receives the third beat of each ramp as does the terminal D. Also when the Latin switch is depressed its terminal 364 is disconnected from the terminal 366 and thus the G and K terminals are disconnected.

The transistor 266 now receives the second pulse of each beat by direct connection to transistor 60 and also the third pulse of each beat via the terminal E. The bass gate 282 receives the first pulse of each ramp by direct connection to bus 8 and receives the third pulse of each ramp via the terminal 322. Thus in the Latin mode, the root frequency is played through the pedal circuits on the odd down beats and the third beat of each measure. The fifth frequency is played through the pedal circuits on the fourth beat and the sixth beat of each measure. The chord is played through the manual circuits on the second, third, fifth and sixth beats of each measure due to application of the voltage V_1 to the terminal E and thence to the transistor 266. The flip-flop 190 is switched during the first and fourth beats due to the action of the transistor 280 so that on the second half-measure the play is fifth-chord-chord with the fifth also being gated through the pedal gate on the third beat of that half-measure.

The diodes 265 and 289 in the bass circuit of manual trigger transistor 266 and diodes 285 and 325 in the base circuit of the pedal trigger transistor 282 comprise a diode switching matrix which by appropriate routing of signals permits selection of the application of various beats to various rhythm sections of the system. This matrix may be expanded as desired to provide accompaniment for various other desired rhythms.

Mention should be made of the downbeat tempo light 274 and its operation during various operations of the system. During the waltz operation the terminal L is connected to the terminal M through the contacts 262 and 264 of the waltz switch. Thus, whenever the transistor switches 30 and 36 are rendered conductive and discharge the capacitor 2 for the fly-back operation on the sawtooth voltage, the transistor switch 60 is rendered nonconductive and a positive pulse is applied to the base of the transistor 280. This pulse produces conduction of the transistor 280 which as indicated is employed to set the flip-flop 190. Concurrently the transistor develops a negative going pulse on terminal L. The negative pulse on terminal L is applied to the base of the transistor 272 rendering it conductive and turning on transistor 370 which now turns on the tempo light. The transistor 370 is shunted by a resistance 372 which maintains a sufficient current through the light 274 to maintain it just below illumination temperature. Thus, a large current is not required through the transistor 370 to produce illumination the lamp and rapid operation is achieved. The transistor 280 is rendered conductive whenever the ramp voltage falls and in the waltz operation this is in the beginning of every measure. Therefore the tempo light operates at the beginning of each measure.

During operations of all other rhythms, the L terminal is connected to the K terminal connected in the collector circuit of the transistor 326 via contact 262 and 324 of the waltz switch. Thus the tempo light is now driven by the transistor 326 which is rendered conductive as previously indicated only at the beginning of each measure, due to the off state of one of the transistors 60 or 184 and the conduction of either transistor 192 or 194. Thus the light 274 is illuminated on every other ramp voltage only and then only when the pedal root note is played; that is, the first note of the measure.

As previously indicated it is a feature of the present invention to render the chord attachment of the present invention inoperative if two notes are played in the selected octave of the lower manual and to revert to normal organ operation if three notes are played in the selected octave of this lower manual. The rationale is that if two notes are struck it is an error but the organ does not know which note was supposed to

be struck. If three notes are struck a full chord has been played and therefore the player wishes to take over control of the chord effects himself or herself.

The circuits for accomplishing the above results comprise transistors 374, 376, 378, and 380. The transistor 374 is rendered conductive whenever a single note is played and has its collector connected via a resistor 382 to a bus 384 which is connected to the base 42 of the transistor 40. Whenever a single note is played the voltage of the collector of the transistor 374 goes negative and the sustaining voltage is removed from the base 42 of the transistor 40 causing the transistor to shut-off at the start of each note played.

If a key is depressed for only a short interval and another key depressed rapidly, a downbeat will still sound. Upon release of a key the transistor 374 again becomes nonconductive, the transistor 40 saturates and the capacitor 2 is charged at a rate faster than the fingers can hit a new key. Therefore upon the second depression of the same key, a downbeat is produced.

Returning to the two and three note detector circuits, emitter 386 of transistor 376 is connected to a bus 388 which is connected through an upper terminal 390 of a rhythm only switch 392 to middle terminal 394 of the switch and via a lead 396 to terminal 252 of the ON-OFF switch 244 which when depressed connects the terminal 252 to the contact 250 which in turn is connected to a high voltage 398. The bus 398 is connected to the terminal 330 to which high voltage, roughly 16 volts positive, is applied. Emitter 400 of transistor 387 is connected to the emitter 386 of transistor 376 and the base of the transistor 378 is connected through a resistor 402 to the voltage bus 388. The base and collector of transistors 376 and 378 respectively are connected together and through a resistor 404 and resistor 406 of the junction of the base of the transistor 378 and the resistor 402. The emitter of the transistor 380 is connected to the junction of the resistors 404 and 406 while its collector is connected to ground through resistor 408. Its base is connected to the lead or bus 102 to the key switches of the selected octave of the lower manual and is also connected through a resistor 410 to a junction of the resistors 404 and 406.

The operation of the circuit is such that when a single note is pressed enough current flows through the resistors 402 and 406 via lead 102, switch 100 to ground to turn on the transistor 376 and thus apply a positive voltage to the base of the transistor 374 and turn it on. When two keys are depressed a sufficient current flows through the resistor 402 to turn on the transistor 400 which now shorts the base to emitter circuit of the transistor 376 turning off the transistor 376. When the transistor 376 is off the transistor 374 is also rendered nonconductive, the transistor 40 is now conductive and therefore the ramp voltage cannot be generated. If a third key is depressed the same action as when two keys are depressed occurs but at this time the transistor 380 is also rendered conductive. Upon the transistor 380 being rendered conductive a positive voltage appears at its collector which is transmitted via a lead 412 to the base electrode of a transistor 414. Upon becoming conductive the transistor 414 shorts bus 416 to ground which is connected to gate terminal 418 of a FET 420. The FET is rendered conductive and connects a terminal U through the FET to the terminal 216 which is connected to the terminal A in FIG. 5. As previously indicated terminal A is connected through the accompaniment manual filters to the organ to the speaker system via the tab switches. The terminal U has applied thereto all of the lower manual notes of the organ.

Thus when a single note is played the circuits of the present invention operate in the manner as programmed by the organist. If two notes are depressed the circuits are rendered inoperative and if three notes are depressed then standard organ operation is effected by connecting the terminal U to the accompaniment manual filters.

It should be noted that the collector of transistor 374 is also connected via a bus 422 to the tempo light control, more specifically the base of the amplifier 72. Thus, whenever a key is depressed a light is turned on. The connections of the ter-

minals M, K and L being employed primarily for the subsequent downbeats rather than the first downbeat.

Various secondary functions of the circuits of the present invention are required to provide proper operation relative to certain block-out and transient features. For instance, there is provided a transistor 428 having its base electrode connected to the lead 422 and thus to the collector of the single note detector transistor 374. When the single note detector amplifier 374 is on the transistor 428 is off and applies a high voltage to a terminal 430 which is connected to the terminal V of FIG. 5. The high voltage applied to the terminal V is connected to trigger amplifier 431 of the pedal keyboard of the conventional organ. The high voltage applied saturates the trigger amplifier and prevents playthrough from the pedal keyboard during chord operation.

The collector of the transistor 428 is also connected to the base of transistor 432 so that when the voltage on collector 428 is high the transistor 432 is turned on and shorts to ground terminal 440 bearing the notation in a circle P_T which also appears in FIG. 5. The terminal P_T is connected to lead 436 having thereon the trigger pulse to the pedal rhythm percussion section of the organ and is also connected through a diode 437 to the input to the pedal diode gate 240. The pedal diode gate 240 has a capacitor 438 therein which serves the same function relative to the pedal circuit as the capacitor 296 of FIG. 8 serves relative to the lower manual notes. The grounding of the point P_T upon conduction of the transistor 432 prevents the accidental operation of the pedal keyboard from effecting the pedal rhythm percussion section or the charge on the capacitor 438. The diode 437 isolates the P_T circuit from the trigger circuit of the base trigger gate 282 in FIG. 8. Thus the bass trigger on terminal S maintains control of pulsing of the pedal diode gate 240 in spite of accidental operation of the pedal keyboard.

Another feature of the present invention deals with a problem related to changeover from chord to normal operation. If a student is playing the organ in a chord mode and then immediately switches into normal operation by pressing three keys, a chord on his own, a residual charge on the capacitor 438 can produce problems. The signal on terminal 217 disappears from the pedal divider 216 but a signal may be generated almost immediately at the pedal keyboard so that there may be a short interval during which the signal at the pedal keyboard may be gated through the pedal diode gate: due to the residual charge on the capacitor 438. The duration of such mode would be short but would be quite audible and therefore must be prevented.

To prevent this problem, whenever the single note detector, transistor 374, is turned off, a high voltage is applied to the base of the transistor 440 connected to the lead 422. The collector of the transistor 440 is connected to the terminal S so that when transistor 40 is turned on upon discontinuance of operation of transistor 374, the terminal S is shorted to ground and the capacitor 438 is discharged. It should be noted that the coupling from the lead 422 to the transistor 440 is through a capacitor 442 so that the transistor 440 is only transiently conductive and does not interfere with normal operation of the S terminal.

Another problem which may arise in the apparatus of the present invention is as a result of the student inadvertently playing two keys and then shifting his fingers so as to sustain the one key but not the other. Such an operation produces problems in the root fifth flip-flop. When two notes on the keyboard are played, two conditions can exist. Either both of the transistors 160 and 184 have a positive voltage applied thereto or only one of these transistors has a positive voltage applied to its base. In the case where both of the transistors have a high voltage applied to their bases, the condition of the flip-flop is unknown since a negative pulse is transmitted substantially simultaneously to both of the transistors 192 and 194 rendering both of them conductive. Release of one of the keys causes the voltage on the collector of this transistor to rise suddenly. However, the root fifth flip-flop 190 is responsive only to negative pulses and, therefore, the release of the

one key when the two buses are initially positive has no effect. The same condition prevails if only one of the transistors 60 or 184 is rendered conductive by pressing two keys. If the key that is eventually selected removes the positive voltage from the one transistor that was conductive then the sudden rise in voltage at its collector does not affect the flip-flop.

Under these conditions there is no information available to the root fifth flip-flop switch it to the proper downbeat key. The transistor 428, in addition to its control of the terminal V, is employed to overcome this problem. When two keys are played, transistor 374 is off, as previously explained, and therefore the transistor 428 is conductive and its collector is grounded. The collector of the transistor 428 is connected via a lead 450 and diodes 452 and 454 respectively to the buses 144 and 161. When two notes are played and the transistor 428 is conductive the buses 144 and 161 are grounded and cannot effect the transistors 160 and 184. When the second note is released so that only one note is sustained, the transistor 428 becomes nonconductive to the same time that the transistor 374 becomes conductive and the buses 144 and 161 are released so that the proper bus may go positive and render its associated transistor 160 or 184 conductive; producing a negative pulse at its collector to properly set the flip-flop 190.

Another difficulty which may arise in the operation of the system is where the player is playing chords himself; that is, playing three notes in the selected octave of the lower manual at the same time. A player does not normally release all three keys at one time and a base note may come through during that interval. Specifically, if one note is held longer than the other notes, the circuits normally do not react quickly enough to place the transistor 374 into conduction before the third note is released. However, trigger pulses are developed which often trigger an automatic pedal function through the operation of the transistor 282. It will be remembered that transistor 282 upon the downbeat couples a signal through capacitor 286 to the automatic pedal trigger terminal 288 which is designated as the terminal P_P . This trigger produces an automatic pedal function in the percussion section resulting in an undesirable effect particularly since it is untimed and unrelated to the music being played.

The aforesaid problem is overcome by connecting a signal from the collector of the three-note-sensing transistor 380 appearing on the lead 412 via a lead 442 to the base of a transistor 444. When the transistor 380 becomes nonconductive, when any one of the three notes is released, a capacitor 446 in the base circuit of the transistor circuit 444 is charged and turns on the transistor 444 for a time interval dependent upon the value of the capacitor 446 a resistor 448 in its discharge circuit through the base of the transistor 444. Conduction of the transistor 444 grounds the terminal 288 and therefore prevents a pulse from playing through to the pedal percussion section. The time constant of the capacitor circuit 446-448 is approximately a quarter of a second, after which the system reverts to normal operation.

The above forms a complete description of the operation of the continuous chord and chord rhythm operation of the system. There is now considered the operation of the systems as a rhythm only system and reference is initially made to FIG. 7 of the accompanying drawings. Under this condition of operation, the rhythm only switch 392 is depressed and all other switches are released except, of course, the ON-OFF switch which is also in its down position and one of the rhythm switches. Under these circumstances contact 394 of the switch 392 is connected to a contact 456 connected to a lead 458. The contact 394 of the switch 392 is connected via a lead 396, closed contacts 250 and 252 of the ON-OFF switch 242, and the lead 398 to the high voltage supply terminal 330. High voltage is applied to the lead 458 connected to a bus 460 which supplies emitter-collector current to the transistors 266, 282 and through diode 462 to the emitter of the transistor 272. The switch 292 has another set of contacts 464 and 466 which when closed connect high voltage on the terminal 466 to the terminal 464 and via a lead 468, to a terminal 470, to

the base of a transistor 428, and through a resistor 474 to the base of the transistor 160 in the control circuit of the flip-flop 190.

The voltage at the terminal 470 applies a positive potential to the base of the transistor 374 and maintains this transistor on thereby turning off the transistor 40 and permitting the ramp generator to run free. The voltage at the terminal 470 also turns on the transistor 414 which grounds the gate electrode of the FET 420 and permits the normal manual accompaniment to play through the FET from the terminal U.

The signals from the chord organ as such must be disabled and this is accomplished by the voltage at the terminal 470 which is applied through a diode 476 to the base of the transistor 174, the base of the transistor 176, and the bases of the transistors 206 and 208. This voltage is sufficiently high to drive each of these four transistors into saturation and thus prevent any of the locally derived signals from coming through.

It should also be noted that a diode 480 is connected between the collector of the transistor 374 and the line 478. The diode 480 is employed to apply a high voltage to a lead 478 whenever the transistor 374 is not conducting. When transistor 374 is not conducting no note should play through the chord part of the organ. This condition may occur when no note has been struck in which case there would not be a frequency applied to any of the transistors 174, 176, 206 or 208. This condition may also occur when either of the transistors 378 and 380 are operating indicating that two or three notes have been played. Under these circumstances, signals are applied to the aforesaid transistors and if not blocked may play through. However when the transistor 374 is off high voltage developed on its collector is conducted via diode 480 to the lead 478 again saturate the transistors 206, 208, 174 and 176 so that they cannot pass signals.

During the rhythm only operation, the trigger pulses to the percussion section must come through the trigger amplifier 282 but must not effect the terminal 310 since during normal operation the pedal diode gate is under control of the pedal trigger from the pedal keyboard. Therefore when the system is in the rhythm only mode of operation, high voltage is applied to produce saturation of transistor 472 to short to ground the junction of the diode 306 and resistor 482 to prevent triggering signals from reaching terminal 310. The resistor 482 between the diode 306 and the collector of the gate 282 isolates the collector from the short circuit and permits signals to be transmitted to the terminal 288 connected to the automatic pedal trigger circuit for tympany effects, etc.

As previously indicated the lead 468 is connected to the base of the transistor 160 via a resistor 474. The purpose of this connection is to insure that upon closure of the rhythm only switch 392 the selected rhythm will start on the downbeat.

When the transistor 374 is turned on, the voltage on the lead 422 falls and couples a negative pulse to the base of transistor 272 causing the tempo light 274 to light. The voltage on the lead 468 causes saturation of the transistor 160 and sets the flip-flop with the transistor 194 turned off and the transistor 192 on. When voltage appears on the leads 468 and 422, voltage also appears on the lead 384 and as previously indicated the ramp generator begins to operate, or more particularly, the voltage on the bus 8 suddenly falls for the first rhythmic pulse or downbeat. Thereafter pulsing of the light is determined by the rhythm selected, i.e. waltz, rock, etc.

The system is described as providing only root, third and fifth parts of a chord. Seventh and sixth parts of the chord may also be provided. Additionally the pedal and chord continuous play controls may be ganged so that when the continuous play of the pedal is called for the slider 300 is moved to the top of resistor 302 and full voltage is maintained on the lead 290.

While I have described and illustrated 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.

I claim:

1. In a musical instrument for playing a chord of a diatonic scale upon activation of a control for producing the root tone of the chord comprising:

a plurality of controls each for producing a different tone upon activation thereof,

an equal plurality of leads on each of which may be applied different tone signals of one octave of the diatonic scale, signals of

a pair of buses each selectively connectable to a different plurality of said leads,

means responsive to activation of each of said controls for connecting one of said buses to that lead of its associated leads on which appears the major third part of the chord of the root tone selected by the activated control and for connecting the other of said buses to that lead of its associated leads on which appears the minor third part of the chord determined by the actuated control,

means responsive to actuation of each of said controls for generating control signals indicating which of said buses has the major third part of said chord applied thereto, an output circuit,

a selectively operable means having a first condition and a second condition, and

means responsive to said control signals to couple to said output circuit the one of said buses to which said major third part is applied when said selectively operable means is in said first condition and to couple to said output circuit the other of said buses when said selectively operable means is in said second condition.

2. The combination according to claim 1 wherein said selectively operable means is normally in one of said conditions.

3. The combination according to claim 1 wherein said selectively operable means comprises a player actuable touch bar biased to maintain its first condition.

4. The combination according to claim 1 further comprising means responsive to actuation of two of said controls to prevent generation of said control signal.

5. For use with an electronic organ having a set of keys corresponding to the notes of a musical scale, a chord organ device comprising a plurality of leads at least equal in number to the notes in an array of adjacent notes of the organ keyboard, means responsive to actuation of any one of the keys corresponding to said adjacent notes of the electronic organ to pass to a different one of said leads for each such key the major third part of the chord having as the root note the note selected by actuation of a specific key and to pass to another and different lead for each such key the minor third part of the chord selected by actuation of said key, a pair of signal buses, means connecting said leads to said buses such that a major third part of a chord appears on one of said buses and a minor third part of a chord appears on another of said buses for each note played, means for developing a control signal indicating the bus on which said major third part is developed, an output circuit, and gate means responsive to said control signal for connecting said bus on which said major third part appears to said output circuit.

6. The combination according to claim 5 further comprising a switch having a stable and a second state, and wherein said means for connecting includes means responsive to said switch in said stable state.

7. The combination according to claim 6 comprising further means at least responsive to said switch in said second position for connecting the said output circuit and the bus having the minor third part thereon.

8. The combination according to claim 5 further comprising means for developing a pulsed voltage at a predeterminable tempo, said gate means including means for effecting said connection only upon receipt of each such pulse.

9. The combination according to claim 8 wherein said means for developing includes means for varying the length of said pulse voltage from a minimum duration pulse to a continuous voltage.

10. The combination according to claim 8 wherein said

means for developing comprises means for selecting a voltage continuously variable between a maximum and a minimum value,

means upon actuation of a key to cause said voltage to rapidly rise to said maximum level and thereafter decay to the selected voltage,

said gate means connecting signals to said output circuit at an amplitude determined by said voltage.

11. The combination according to claim 8 further comprising means for disabling said means for developing upon concurrent actuation of two keys in said octave.

12. The combination according to claim 5 further comprising means responsive to actuation of three keys in said octave to disable said attachment.

13. The combination according to claim 5 wherein said electronic organ includes means for producing pedal and manual percussion voices and wherein said attachment includes means for sounding selected pedal percussion voices immediately upon actuation of one of said keys.

14. The combination according to claim 5 wherein said attachment includes a rhythm section, said rhythm section having a ramp voltage generator for producing a voltage which varies as a saw tooth function with time to provide a ramp portion increasing at a prescribed rate from a minimum voltage to a maximum voltage and a flyback portion which returns rapidly to the minimum voltage from said maximum voltage, means responsive at all times to actuation of any one of said keys in said octave to immediately initiate a flyback of said ramp voltage, and means responsive to flyback of said voltage to sound said root note.

15. The combination according to claim 14 wherein said ramp voltage generator includes a capacitor, means for maintaining said capacitor fully charged, means responsive to actuation of a key for rapidly discharging said capacitor, means for recharging said capacitor at a prescribed rate while said key is depressed and means for rapidly charging said capacitor upon release of the key.

16. The combination according to claim 14 comprising a second pair of buses, means responsive to actuation of any one of said keys in said one octave to develop the root note of the selected key on one of said buses and the fifth part of the chord of said root note on the other of said buses, means responsive to each flyback of said ramp voltage to alternatively and repetitively connect said buses on which said root and fifth note appear to said output circuit, said means being responsive to said control voltage to initially connect said bus on which said root note appears to said output circuit.

17. The combination according to claim 16 wherein said output circuit is the pedal circuit of said organ.

18. The combination according to claim 5 comprising a second pair of novel buses, means responsive to actuation of any one of said keys in said one octave to develop the root note of the selected key on one of said buses and the fifth part of the chord of said root note on the other of said buses, and means responsive to said control signal for connecting said bus on which said root note appears to said output circuit.

19. In a system for controlling the rhythmic accompaniment provided a player-controlled musical instrument, a source of repetitive ramp voltage wave forms which vary between a minimum and a maximum voltage level, means for deriving a sequence of pulses in response to said ramp voltage attaining preselected voltage levels of said repetitive ramp wave forms, means responsive to selected pulses for generating sounds of diverse character, a plurality of player-controlled means for selecting musical tones to be played, means normally maintaining said ramp voltage at a maximum value,

means responsive to actuation of a single of said player-controlled means to return said voltage to minimum value, and thereafter repetitively produce said ramp voltage wave forms so long as said player-controlled means is actuated, said means for deriving a sequence of pulses producing a downbeat pulse upon said ramp voltage returning to minimum value, and

means responsive to at least a first of said downbeat pulses to sound the tone selected by said player-controlled means.

20. The combination according to claim 19 further comprising a visual tempo indicator and means responsive to at least every other downbeat pulse to actuate said visual indicator.

21. The combination according to claim 19 wherein said source of ramp voltage source comprises a capacitor and wherein said means responsive to actuation of a single of said player-controlled means comprises,

means for maintaining said capacitor charged to said maximum voltage, and means for rapidly discharging said capacitor upon actuation of a single player-controlled means.

22. The combination according to claim 21 further comprising means responsive to concurrent actuation of at least two player-controlled means for rendering inoperative said means for discharging.

23. The combination according to claim 22 further comprising means responsive to concurrent actuation of three of said player controlled means for disabling said means responsive to selected pulses for generating sounds.

24. The combination according to claim 19 wherein said sources of ramp voltages comprises a capacitor and wherein said means responsive to actuation of a single of said player-controlled means comprises,

means for maintaining said capacitor charged to said maximum voltage, and means for disabling said means for maintaining and for concurrently discharging said capacitor upon actuation of a single player-controlled means.

25. The combination according to claim 19 wherein said source of ramp voltage wave forms comprises, a capacitor, a constant current source for charging said capacitor, means in series with said capacitor and said current source to control the charging time of said capacitor, switch means rendered conductive upon voltage across said capacitor obtaining a preselected maximum value to discharge said capacitor and rendered nonconductive upon the voltage across said capacitor obtaining a preselected minimum value,

means responsive to flow of capacitor discharge current through said switch means for terminating current flow through said constant current source only so long as said switch means conducts said discharge current, and control means having a normal condition rendering said means responsive to actuation of said switch means inoperative to terminate current flow through said constant current source whereby to maintain said capacitor fully charged.

26. The combination according to claim 25 wherein said means responsive to actuation of a single control of said player-controlled means comprises, means for disabling said control means whereby said constant current source is rendered nonconductive.

27. The combination according to claim 19 including a plurality of pedal percussion voices, means for selecting various of said voices to be sounded, and means responsive to said downbeat pulse to sound said selected pedal percussion voices.

28. The combination according to claim 27 further comprising means for disabling said system upon actuation of three player-controlled means for disabling said system and means responsive to actuation of said means, for dis-

abling for preventing sounding of the pedal section of the organ.

29. The combination according to claim 27 including a plurality of manual percussion voices, means for selecting various of said manual percussion voices to be sounded, and means responsive to various beats of said sequence of pulses other than said downbeat pulses to sound said selected manual percussion voices.

30. The combination according to claim 19 further comprising means for selectively disabling said means for normally maintaining said maximum value of voltage whereby said source of repetitive ramp voltages cycles automatically to produce repetitive ramp voltages.

31. In a system for alternatively producing rhythmic accompaniment provided a player-controlled musical instrument or independently establishing said rhythm,

a ramp voltage generator comprising capacitor,

means for charging said capacitor at a fixed rate,

discharge means responsive to the voltage across said capacitor attaining a selectable maximum voltage to discharge said capacitor to a minimum value,

control means normally operable to render said discharge means inoperative to discharge said capacitor.

means responsive to actuation of a player controlled means for rendering said control means ineffective so long as a player-controlled means is actuated, and

switch means independent of said player-controlled means for selectively rendering said control means ineffective.

32. The combination according to claim 31 including a plurality of

selectable pedal percussion voices, and

means for sounding selected ones of said pedal voices at prescribed intervals of discharge of said capacitor.

33. In a musical instrument for playing a chord of the diatonic scale upon actuation of a control for producing the root tone of the chord comprising,

a plurality of leads,

an equal plurality of two input OR gates,

a first pair of buses,

means connecting each of said OR gates between a different source of a tone of the diatonic scale of a predetermined octave and one of said buses,

means connecting each said lead to receive a gating voltage thereon upon actuation of an organ control,

each of said lead being connected to an input of two different ones of said OR gates such that upon generation of a gating voltage thereon the major and minor third parts of the chord whose root tone is selected by the organ control appear each on a different one of said busses,

a second pair of buses,

each bus of said second pair of buses being connected to receive gating voltage from a different plurality of said leads such that a first of said second pair of buses receives said gating voltage when a first of said first pair of buses receives said major third part of said chord and a second of said second pair of buses receives said gating voltage when a second of said first pair of buses receives said major third part of said chord,

an output circuit, and

means responsive to said gating voltage on said second pair of buses for selectively applying to said output circuit the major third part of said chord.

34. The combination according to claim 19 wherein said organ has pedal circuits including pedal generator means for producing pedal frequencies, means for voicing frequencies generated in the organ and pedal gate means for gating pedal frequencies to said means for voicing frequencies,

said system comprising,

means responsive to actuation of a single player-controlled means for preventing transmission of signals produced by said pedal generator means through said pedal gate means.

35. The combination according to claim 34 further comprising control means actuable in response to actuation of three of said player-controlled means for disabling said system, and

means responsive to deactivation of said control means for preventing transmission of signals produced by said pedal signal generator means through said pedal gate means.

36. In an electronic organ,

a keyboard having a multioctave array of keys,

an array of tone generators, one tone associated with each of said keys,

an electronic gate associated with each of said tone generators,

a separate normally open key switch closable in response to actuation of each of said keys,

means responsive to actuation of any one of an array of said keys, and to consequent closure of a responsive key switch, for applying oncoming voltage to the electronic gates in series with only and all of those of said tone generators representing one of a major and minor chord corresponding musically with the actuated key for all said octave of said keys.

37. The combination according to claim 36, wherein is included a player operable control for applying in response to said actuation said oncoming voltage to the gates in series with those of said tone generators representing only and all of the other of said major and minor chord, said minor chord corresponding musically with the actuated key for all of said array of keys.

38. The combination according to claim 37, wherein is further provided means responsive to actuation of any three or more of said keys for applying said oncoming voltage only to gates corresponding with said three or more of said keys.

39. In a rhythmic accompaniment system for an electronic organ,

a source of ramp signal having normally a predetermined level above a reference value,

an array of keys on an organ keyboard,

means responsive to actuation of one of said keys for reducing said ramp signal to said reference value substantially instantaneously, and thereafter causing said ramp to slowly rise linearly to said predetermined level, while said key remains actuated, and

means responsive to release of said one of said keys for causing said ramp to rise substantially instantaneously to said predetermined level,

means responsive to said reduction of said ramp signal to said reference value for calling forth a first tone signal and

means responsive to attainment by said ramp signal of predetermined levels for calling forth at least one further signal.

* * * * *