Jan. 26, 1960 J. M. HANERT 2,922,329

ELECTRICAL MUSICAL INSTRUMENT WITH MULTIPLE UTILIZATION OF TONE SIGNAL SOURCES

Filed Feb. 2, 1956 3 Sheets-Sheet 1

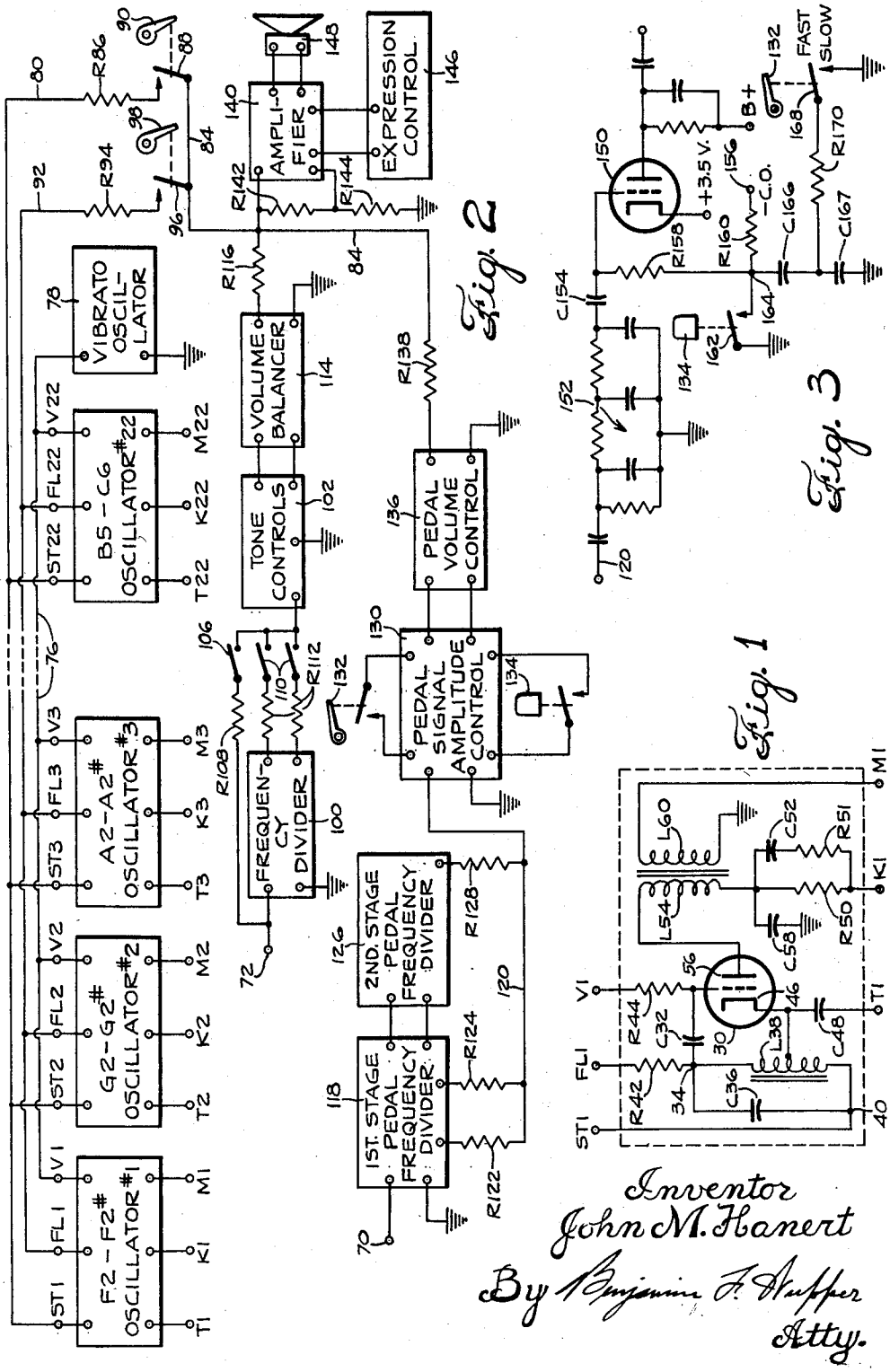


Fig. 2

Fig. 3

Fig. 1

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Filed Feb. 2, 1956 3 Sheets-Sheet 2

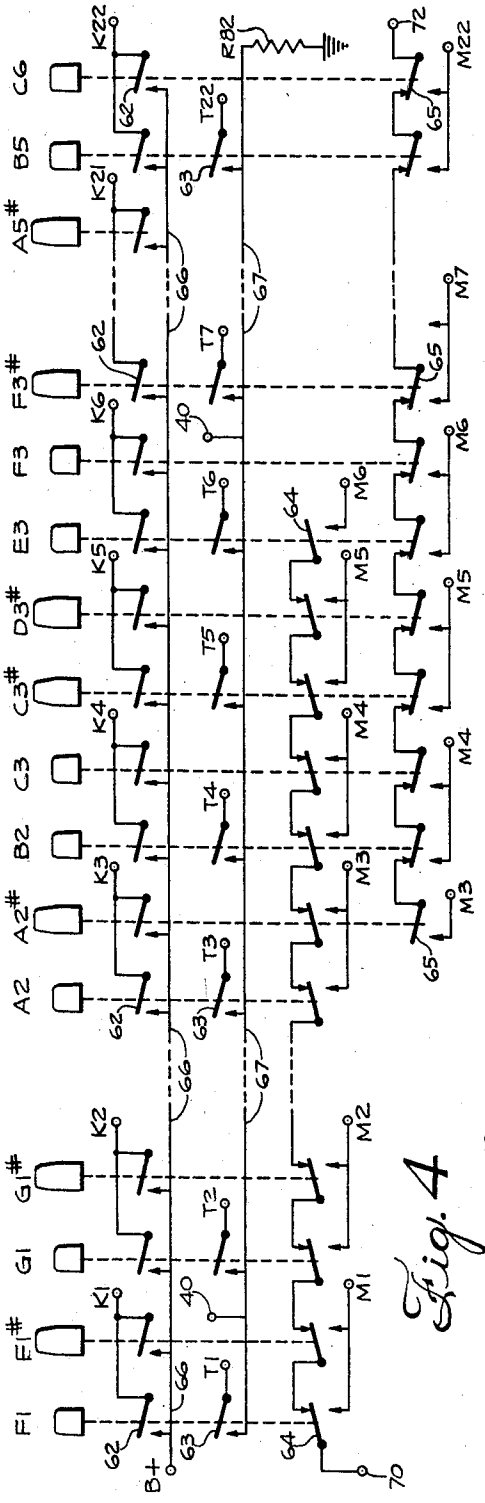


Fig. 4

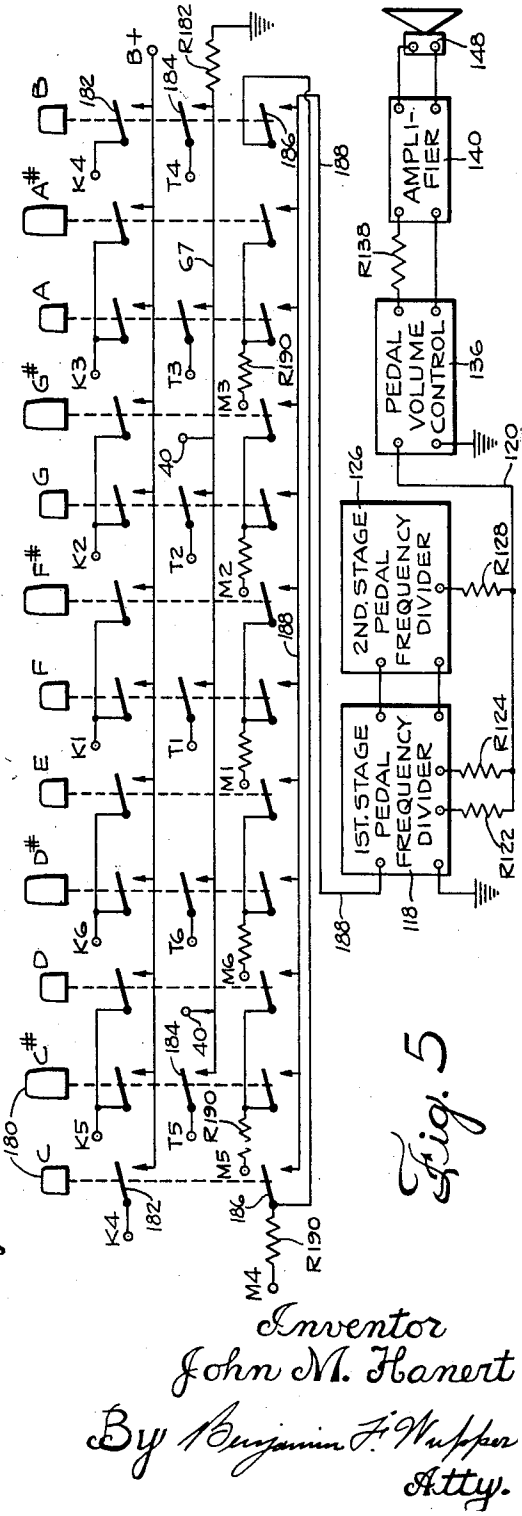


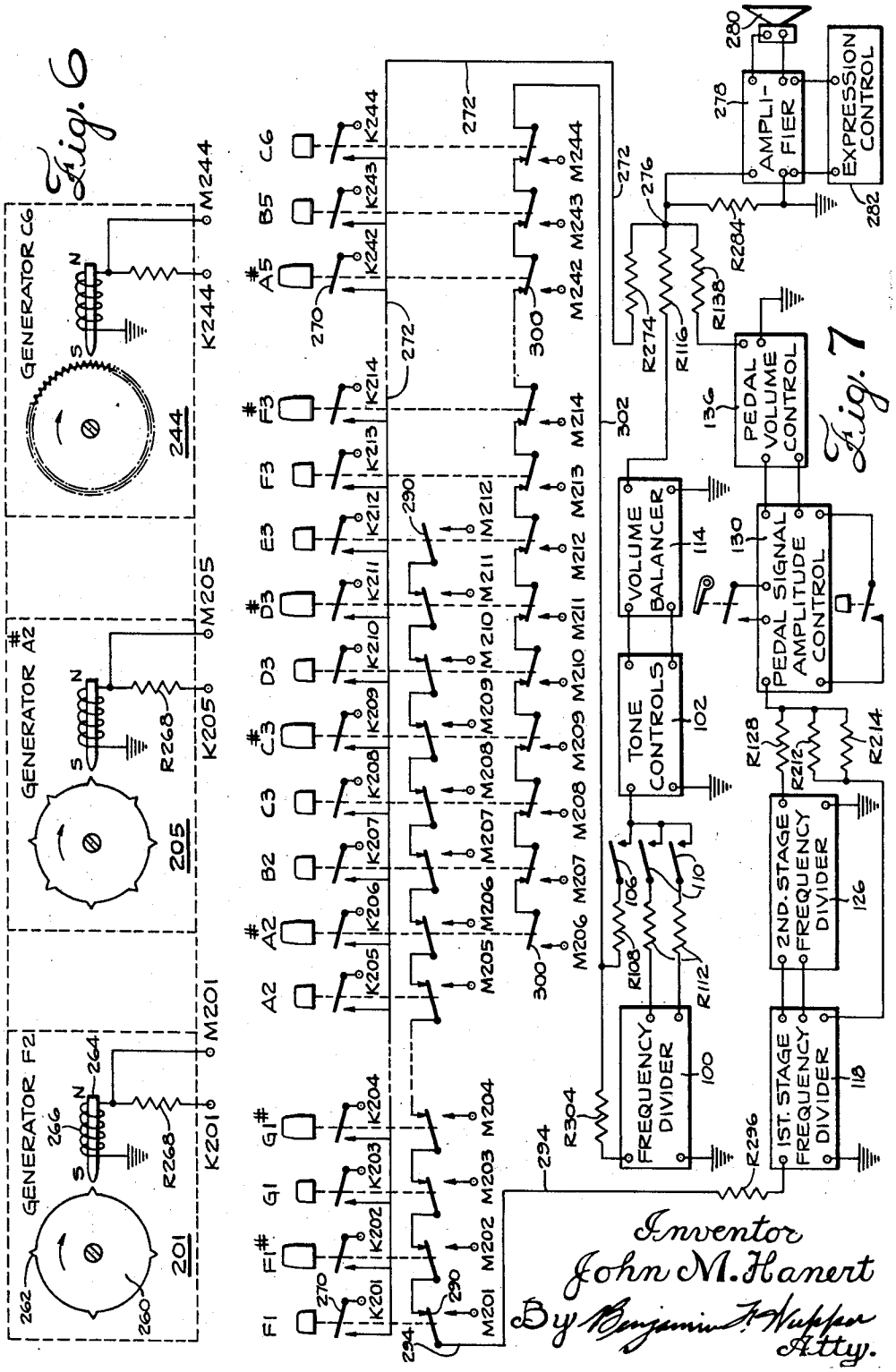
Fig. 5

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ELECTRICAL MUSICAL INSTRUMENT WITH MULTIPLE UTILIZATION OF TONE SIGNAL SOURCES

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2,922,329

ELECTRICAL MUSICAL INSTRUMENT WITH MULTIPLE UTILIZATION OF TONE SIGNAL SOURCES

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Application February 2, 1956, Serial No. 563,048

4 Claims. (Cl. 84—1.12)

The invention relates generally to electrical musical instruments, and more particularly to an instrument of the electronic organ type, which is extremely simple in construction and may be manufactured at low cost.

It is thus the primary object of the invention to provide an electronic musical instrument having a wide range of musical possibilities, but which is nevertheless of very simple construction so that it may be very economically manufactured.

Another object is to provide an electronic musical instrument having a plurality of tone signal generators, which employs at least an octave of pedals, and in which the frequency of the pedal tone signals is derived from the generators which supply the tone signals for the manuals.

Another object is to provide an electrical musical instrument in which the range or gamut of the instrument is extended beyond the range of the tone signal generators by the use of frequency dividers.

A further object is to provide an electrical musical instrument in which the lowermost octave of keys of the manual are effective to operate control switches connected in parallel with the control switches operated by the keys of the second lowermost octave of keys.

A further object of the invention is to provide an electrical musical instrument employing electro-mechanical tone signal generators in which keys of the manual determine the pitch of bass tones in addition to controlling the production of accompaniment tones.

A further object of the invention is to provide an electrical musical instrument in which improved means are provided to accent the melody tones of a composition being rendered.

A further object is to provide an improved electrical musical instrument of the organ type in which a single signal generator is employed not only to provide a signal corresponding to its nominal pitch but also optionally to control the operation of a frequency divider to provide a signal of related pitch.

Other objects and advantages will become apparent from the following description, reference being had to the accompanying drawings in which:

Fig. 1 is a schematic circuit diagram of one of the oscillators used as tone signal generators;

Fig. 2 is a schematic wiring and block diagram of the complete musical instrument, with the exception of the keys and switches operated thereby;

Fig. 3 is a schematic wiring diagram of the pedal decay control means and control tube;

Fig. 4 is a schematic wiring diagram of the key operated switches and circuits associated therewith;

Fig. 5 is a schematic circuit diagram of a modified form of the invention, wherein an octave of pedal controlled switches are employed;

Fig. 6 diagrammatically illustrates a modified form of tone signal generating means; and

Fig. 7 is a schematic circuit diagram of a modified

form of the invention employing the tone signal generating means of Fig. 6.

The instrument comprises a plurality of tone signal generating oscillators #1 to #22 herein illustrated as extending from the range F2 to C6, each oscillator being capable of operating at either of two adjacent semitone frequencies, and, as will hereinafter more fully appear, is capable of playing pedal notes in the range F1 to G2♯, as well as in the octave below this octave.

The oscillators are of similar construction except for variations in values of components to cause their operation at the required frequencies. Each of the oscillators, of which respresentative oscillators are shown by blocks in Fig. 2, is of the construction shown in Fig. 1, and comprises a triode **30** having its grid connected through a capacitor C32 to a terminal **34** at one end of a parallel resonant circuit comprising capacitor C36 and inductance L38. The other terminal **40** of the resonant circuit is connected to an output terminal ST1 from which string-like tone signals are derived. Flute-like tone signals are similarly derived from terminal FL1, which is connected to terminal **34** through a decoupling resistor R42. A vibrato frequency (approximately 7 c.p.s.) is applied to the control grid from a terminal V1 through a resistor R44. The cathode **46** is connected to a tap on inductance L38 and is also connected to a terminal T1 through a tuning capacitor C48. When the terminal T1 is connected substantially to ground by a key operated switch, as will be described hereinafter, the pitch of the oscillator is lowered by one semitone.

Plate current is supplied from a terminal K1 through a load resistor R50, which has in parallel with it a relatively lower value series resistor R51 and capacitor C52. The plate current flows through resistor R50 and through a transformer primary L54 to the plate or anode **56**. The plate is also connected to ground through the primary winding L54 and a capacitor C58. The secondary L60 of the transformer has one terminal connected to ground and its other end connected to a terminal M1 which forms an output terminal for controlling one or the other of two frequency dividers, as will appear from the circuit diagram, Fig. 2.

In Fig. 4 are shown representative keys the customary manual extending through the range of F1 to C6. Keys F1 to A2 each operate three switches **62**, **63**, and **64**, except that alternate keys are not provided with a switch **63**. Switches **62** for the keys F1 and F1♯ are connected in parallel to the terminal K1 of the F2—F2♯ oscillator #1, and similarly, successive pairs of switches are connected to the "K" terminals of successive oscillators, the number of the oscillator being indicated by the numeral following the letter "K" ("keying"). These switches thus are capable of connecting the "K" terminals to a conductor **66**, which is connected to a terminal B+ of the power supply, so that upon closure of a switch **62** the selected oscillator is supplied with plate current. Switches **63**, associated with alternate keys, are connected to the terminals T1, T2, T3, etc., of oscillators **1**, **2**, and **3**, etc., and thus are operative to lower the frequency of oscillation by one semitone. Switches **64** are adapted to be operated by each of the keys F1 to E3, inclusive.

It will be noted that the switches **64** are break-make switches, and that adjacent pairs of their make contacts are connected to the terminals M1, M2, M3, etc., of the oscillators **1**, **2**, **3**, etc.

The switch **64** for the F1 key is connected to a terminal **70** which supplies a controlling signal to a pedal bass tone frequency divider, as will appear from Fig. 2. In view of the fact that the switches **64**, together with their normally closed contacts, are connected in series, it will be clear that only the lowest of a plurality of depressed keys will be effective to supply a signal from its oscil-

lator terminal "M" to the input terminal 70 of the frequency divider. The make contacts of switches 64 for lowest octave of keys F1 to G1♯ are connected in pairs to the terminals M1 to M6, respectively, and the make contacts of switches F2 to E3 are likewise connected respectively to the same terminals M1 to M6 of the oscillators Nos. 1 to 6. This doubling-back of the two lowermost octave keys with respect to the effect of operation of the switches 64 is of peculiar advantage in playing the instrument.

Keys A2♯ to C6, in addition to operating switches 62 and 63 (and switches 64—from A2♯ to E3) operate switches 65, which like the switches 64 are break-make switches and are connected in series when in unoperated condition. Switch 65 for key A2♯ operates only to make contact with the terminal M3 of the No. 3 oscillator. Switches 65 for the keys B2 and C3, upon operation, engage contactors connected to the M4 terminal of the No. 4 oscillator. Similarly, in pairs the switches 65, upon operation, make contact with the terminals M5 to M22 of oscillators Nos. 5 to 22, respectively. Switch 65 for the key C6 is connected to a terminal 72 which, as hereinafter will appear, is the input terminal of a frequency divider for obtaining octave coupler effects.

A conception of the overall construction and functioning of the instrument may best be obtained by reference to Fig. 2, which shows oscillators 1, 2, 3, and 22, as representative of the complete set of 22 oscillators employed as the tone signal generating system of the instrument. It will be noted that all of the "V" terminals of the oscillators are connected by a conductor 76 with a vibrato oscillator 78 which may be of any well known type operating at a frequency of approximately seven cycles per second, and which is preferably coupled to the oscillators 1 to 22 in the manner shown in my prior Patent No. 2,645,968. The terminals 40 of all of the oscillators 1 to 22 are connected to a common conductor 67 (representatively indicated in Fig. 4) which is connected to ground by load resistor R82 and the "ST" (string) terminals of all the oscillators are connected to collector conductor 80, and are adapted to be connected to a collecting conductor 84 through a decoupling resistor R86 upon closure of a switch 88, manually operated by a tablet 90. Similarly, all the "FL" (flute) terminals of the oscillators 1 to 22 are connected to a common conductor 92 which may be connected to the collector conductor 84 through a decoupling resistor R94 upon closure of a switch 96, by a manually operated tablet 98.

The signals appearing at terminal 72 (Figs. 2 and 4), which are of a pitch corresponding to the highest of a plurality of depressed keys within the range A2♯ to C6, are impressed upon input terminals of a (halving) frequency divider 100. The signals appearing on the terminal 72 may be coupled directly to tone controls 102 on closure switch 106, which is connected to the terminal 72 through a decoupling resistor R108. The output of the frequency divider 100 which is at a frequnecy one-half that of the input frequency may be coupled to the tone controls upon operation of either or both switches 110, which are connected to the output of the frequency divider by decoupling resistors R112. If but one of the switches 110 is closed, the amplitude of the suboctave output of the divider 100 will be relatively low, whereas if both switches 110 are closed the amplitude of the suboctave signal will be substantially higher than the unison signals transmitted through switch 106. Of course, switches 106 and 110 may be operated in any desired combination. The tone controls 102 are coupled to a volume balancer 114 which is in turn coupled to the collector conductor 84 by a decoupling resistor R116.

The low frequency signals supplied to the terminal 70 upon depression of any of the keys F1 to E3, are impressed upon a pedal frequency divider 118 which may be of the construction shown in my aforesaid Patent 2,645,968. Some of the signal impressed upon the terminal 70 is amplified by the amplifying stage of the frequency divider, and is impressed upon a conductor 120 through a decoupling resistor R122. The output of the divider, which has a frequency one-half that of the input frequency, is also impressed upon the conductor 120 through a decoupling resistor R124. The halved frequency in the output of the divider 118 is also supplied to a second pedal frequency divider stage 126, and the output of this divider stage, which has a frequency one-fourth that of the signal input on terminal 70, is supplied to the conductor 120 through a decoupling resistor R128. The conductor 120 thus is effective to couple the outputs of the two frequency divider stages to a pedal control tube circuit 130 which is provided with the decay control circuit means 132 and a control pedal 134. This pedal control tube and associated circuitry 130 (shown in detail in Fig. 3) has its output coupled to an adjustable pedal volume control 136, and the output of the latter is connected to collector conductor 84 through a decoupling resistor R138. It will be apparent that, if desired, switches may be provided to connect the resistors R122, R124, and R128 to the conductor 120, to vary the quality of the bass tones, but ordinarily this addition will not be of much value.

The signals impressed upon conductor 84 are supplied to an amplifier 140, the signal appearing across a load resistor R142, which is connected in series with a grounded resistor R144. An expression control means 146 of any suitable construction is coupled to the amplifier 140 to vary the degree of amplification, and the output of the amplifier 140 is supplied to a speaker 148.

The pedal control tube 130 and associated circuitry may be of the form shown in Fig. 3, which illustrates how the signals appearing on conductor 120 are transmitted to the input terminals of a triode 150 through a low pass filtering mesh 152 and capacitor C154. The control grid of this triode is normally connected to a terminal 156 of the power supply upon which the potential is maintained at a negative value, substantially as to cut off the tube 150, its connection being through a voltage divider comprising a grid resistor R158 and a resistor R160 connected in series between the grid of the triode and the terminal 156.

When the control pedal 134 is depressed, it closes a switch 162 which connects the junction 164 of resistors R158 and R160 to ground, thereby removing the cutoff bias on the grid of triode 150, enabling this tube to conduct at the desired maximum amplitude. Depression of the key also causes charging of capacitors C166 and C167 so that upon opening of the switch 162 these capacitors may be recharged through the resistor R160 which is of relatively high value, thereby to cause a rather gradual decrease in the potential on the control grid of triode 150, resulting in a gradual reduction in amplitude, or decay, of the signal. The rate of decay may be slowed by closing a switch 168 by a decay control 132, thereby connecting the junction between capacitors C166 and C167 to ground through a relatively low value resistor R170.

Assuming that the instrument is in the form of a one manual organ, the player has at his disposal the possibility of a great variety of musical and tonal effects. The accompaniment tones are automatically produced upon depression of all the keys and the player may select whether he wishes a string quality or a flute quality tone, or both, by the operation of tablets 90 and 98. In addition to this known means for producing musical tones, the player has available, by depressing a single pedal 134 to energize the control tube 150, and thereby cause transmission of the signals produced by the pedal dividers 118 and 126 to the output system. The tone signals thus transmitted to the output system will be suboctavely related to the frequency generated by the oscillator corresponding to the lowest of the depressed

keys within the range of keys F1 to E3. Thus the key normally controlled by the little finger of the left hand will determine the pitch of the bass tone signal produced, provided the depressed key is within the two octave range at the lower end of the keyboard.

Depression of the keys in the range A2♯ to C6 will cause a signal corresponding to that of the highest key of the group depressed to be impressed upon the input terminals **72** of the divider **100**. Depending upon which of the switches **106** and **110** are closed, a signal corresponding to the pitch of the highest depressed key or a signal one octave lower (or both) will be supplied to the tone controls **102**, and hence to the output of the instrument, there to be translated into sound. By this means the melody of the selection rendered may be readily accented (by prior adjustment of volume balancer **114**) because in most musical selections the melody is carried by the highest of a number of keys in the treble register which are depressed at the same time.

The player may therefore, with the little finger of his right hand, carry the melody and at the same time play accompaniment effects with the remaining fingers of the right hand. At the same time, the left hand may be employed to play counterpoint or other accompaniment, and by the little finger, or the lowest key depressed, preselect the pitch of the bass tone to be sounded whenever the bass pedal **134** is depressed. The player thus has at his command essentially the resources of a two manual organ with pedals.

In fact, the musical resources are greater than that of a two manual organ, because of the provision of the means whereby the solo tone selected by the operation of the switches **65**, and appearing upon the input terminal **72** of the divider **100**, is, or well may be, of an entirely different quality than either the string or flute signals derived directly from the oscillators. The quality may be readily made of a woodwind type so as clearly to stand out from the string and flutelike accompaniment tones. However, it should be noted that the highest key depressed within the range of keys A2♯ to C6, in addition to controlling the production of the solo tone, also controls the sounding string or flute tones, or both, depending upon the operation of tablets **90** and **98**.

Organists versed in pedal technique may prefer not to have the pedal tones selected by the keys of the manual, but instead would rather have the instrument provided with a pedal clavier of at least one octave of pedals for controlling the bass tones. The instrument may have a pedal clavier, shown in Fig. 5 of the drawings, in which event the switches **64** and associated circuits shown in Fig. 4, and the pedal tone amplitude control **130** and control tube **150** shown in Figs. 2 and 3, would not be required. In Fig. 5, such of the parts as have previously been described, bear the same reference characters as the corresponding parts of the prior figures.

The pedal board comprises twelve pedals **180**, each of the pedals operating a switch **182**, which may respectively connect the "K" terminals of the oscillators **1** to **6** to the B+ terminal so as to supply plate current to the oscillators. It will be noted that the switches **182** for the C and B oscillators are connected to terminal K4; the C♯ and D pedal operated switches **182** are connected to the terminal K5; the D♯ and E pedal operated switches **182** are connected to terminal K6; the F and F♯ switches **182** are connected to terminal K1; the G and G♯ pedal operated switches **182** are connected to terminal K2; and that the A and A♯ pedal operated switches are connected to the terminal K3. By doubling back in this manner the number of oscillators required is reduced by at least three, without any noticeable sacrifice in performance.

In addition, alternate pedals C♯, D♯, etc., are connected to operate switches **184** to connect terminals **T5**, **T6**, **T1**, **T2**, **T3**, and **T4**, which tune the correspondingly numbered oscillators to a pitch one semitone lower than that to which they are normally tuned, by connecting their "T" terminals to a conductor **67** which is connected to ground through a load resistor **R182**. Each of the pedals **180** also operates a switch **186** to connect the "M" terminals of the oscillators to an output conductor **188**. It will be noted that switches **186** for the pedals C and B are connected to the M4 terminal through a resistor **R190**. The C♯ and D pedals operate switches **184** and are similarly connected to the terminal M5; the switches **186** operated by the pedals D♯ and E are similarly connected to terminal M6; the switches **186** operated by pedals F and F♯ are similarly connected to terminal M1; the switches **186** operated by pedals G and G♯ are connected to terminal M2; and the switches **184** operated by pedals A and A♯ are similarly connected to the terminal M3. The output conductor **188** is connected to the first stage pedal frequency divider **118**, which is in turn coupled to the second stage frequency divider **126**. Output signals from the first stage **118** at octavely and sub-octavely related pitches, are supplied to conductor **120** through resistors **R122** and **R124**, and similarly a signal three octaves below the frequency of the signals derived from oscillators **1** to **6**, are impressed upon conductor **120** through decoupling resistor **R128**, and supplied to a pedal volume control **136** which may be adjusted so as to have the intensity of the bass tones in balance with the intensity of the tones derived from the other sections of the instrument. It will be noted that no pedal control tube (shown in Fig. 3 and indicated by the block **130**, Fig. 2) is required.

This modified instrument is played in the same manner as that described with reference to Figs. 1–4, except that the player plays the bass notes predominantly on the pedals and the instrument thus may be played in the usual manner by the trained organist. The cost of the latter instrument is, however, somewhat greater than that shown in Figs. 1–4, because of the addition of the pedal clavier.

In the further modified form of the invention shown in Figs. 6 and 7, individual tone signal generators capable of producing highly complex tone signals are employed. These generators may be of the rotating or vibratory type with capacitative or electromagnetic pickup, but are herein shown as rotary generators providing signals of substantial amplitude at frequencies which are reliably constant. Generators **201**, **205**, and **244**, are illustrated in Fig. 6 as representative of the forty-four, more or less, generators which may be employed, depending upon the desired gamut of the instrument.

Each of the generators comprises a tone wheel **260** having a plurality of sharply pointed projections **262** on its periphery. These projections pass by closely adjacent the wedge-shaped end of a pickup core **264** which is preferably permanently magnetized and is surrounded by a pickup coil **266** one end of which is grounded, and the other end of which is connected directly to an output terminal M201 and to another output terminal K201, the latter through a decoupling resistor **R268**. The construction of the generators and the drive therefore is preferably the type shown in the patent to Laurens Hammond No. 1,956,350, except for the fact that the generators in said patent were designed for producing sine wave outputs, whereas the present generators are designed to produce complex tone quality output signals. The number of projections **262** on the tone wheels **260** of successive octaves may be progressively doubled for successive octave groups.

Each of the playing keys F1 to C6 upon depression operates a switch **270** to connect the respective terminals K201—K244 to a signal collector conductor **272**. The resistors R268 are of sufficiently high value to prevent excessive "robbing." The conductor **272** is connected through a relatively low value resistor **R274** to an input terminal **276** of an amplifier **278** which, in turn, is coupled to a speaker **280** and has the degree of its amplification controlled by an expression control **282**. The

input terminal 276 is connected to the other input terminal and to ground through a load resistor R284. Thus, when any one or group of keys F1 to C6 is played, a tone signal, or signals, will be supplied from the selected generators 201 to 244 to the output system of the instrument.

In addition to operating the switches 270, the keys F1 to E3, for example, operate break-make switches 290 which, when no key is depressed, are connected in series. Upon operation of any of the keys or group of keys the switch 290, associated with the lowermost key depressed, completes a circuit from the "M" terminal of its associated generator to a conductor 294, which is coupled, through a relatively low value resistor R296, to the first stage 118 of a frequency divider, the output of which is coupled through resistors R212 and R214 to a pedal signal amplitude control 130. The latter is constructed and operated in the manner previously described in the form of the invention shown in Figs. 2 and 3. Other portions of the pedal signal output circuit are similar to those previously described. Corresponding reference characters have been applied to corresponding parts and the description thereof will not be repeated.

Keys A2♯ to C6 operate additional switches 300 respectively which are break-make switches connected in series and which are adapted to complete circuits from the "M" terminals of generators 206 to 244 respectively, to a collector conductor 302. Due to the series connection of these switches only the switch 300 associated with the highest of a number of keys depressed at one time will be effective to supply a signal from its associated generator to the collector conductor 302. The collector conductor 302 is connected through a relatively low value resistor R304 to the input of a frequency divider 100 which is connected to the output system of the instrument in the same manner as previously described with respect to Fig. 2, and the corresponding parts have had corresponding reference characters applied thereto and a description thereof will not be repeated.

In playing the instrument shown in Figs. 6 and 7, the results are substantially equivalent to those obtainable in playing the instrument in Figs. 1 to 4. It will be noted that although the forty-four electromagnetic generators are required as compared with the twenty-two oscillators required for the instrument of Figs. 1 to 4, the key operated switches 63 are not required, and that the electromagnetic generators of Fig. 6 are not subject to drifting in frequency and are much more durable than the vacuum tube oscillators.

All forms of the invention have the advantage that the tone signal generators perform a multiple function in supplying signals not only for the tone corresponding to a depressed key but also supply signals for the operation fo the frequency dividers whereby it is possible to play a score of music automatically emphasizing the highest note being played, and in the form of the invention shown in Figs. 1 to 4, also automatically emphasizing the lowest note played whenever such emphasis is desired. In this way the musician has at his command an instrument in which the melody, treble embellishments, and bass tone may be played, thus effectively performing the function of at least two players using instruments of the prior art whether electrical or mechanical. By selective operation of the switches 106 and 110 sub-octave coupler effects may be obtained which are very useful in enhancing the interest of music when the instrument is used for the rendition of certain types of selections.

While I have shown and described a particular embodiment of my invention, it will be apparent to those skilled in the art that numerous modifications and variations may be made in the form and construction thereof, without departing from the more fundamental principles of the invention. I therefore desire, by the following claims, to include within the scope of my invention all such similar and modified forms of the apparatus disclosed, by which substantially the results of the invention may be obtained by substantially the same or equivalent means.

I claim:

1. In an electrical musical instrument having an output system including an electro-acoustic translating means, the combination of a plurality of electrical generators providing complex musical tone signals of pitch corresponding to the semitone intervals of the tempered musical scale throughout a range of at least three octaves, a plurality of playing keys, a first switch operable by each of said keys to cause transmission to the output system of a signal from an associated generator, a first frequency divider apparatus, second switches operable respectively by each of at least the lowermost octave of keys to cause transmission to the frequency divider apparatus of a signal from the generator associated with the lowest of a plurality of operated keys within said lowermost octave range, a second frequency divider apparatus, third switches operable respectively by the keys of at least the highermost octave of keys to cause transmission to the second frequency divider apparatus of a signal from the generator associated with the highest of a plurality of operated keys within said highermost octave range, means to couple the output of the first frequency divider apparatus to the output system, and means to couple the output of the second frequency divider apparatus to the output system.

2. In an electrical musical instrument having an output system including an electro-acoustic translating means, the combination of a plurality of electrical generators providing complex musical tone signals of pitch corresponding to the semitone intervals of the tempered musical scale throughout a range of at least three octaves, a plurality of playing keys, a first switch operable by each of said keys to cause transmission to the output system of a signal from an associated generator, a frequency divider apparatus, second switches operable respectively by each of at least the two lowermost octave of keys to cause transmission to the frequency divider apparatus of a signal from the generator associated with the lowest of a plurality of operated keys within said lowermost two octave range, a signal collector, third switches operable respectively by the keys of at least the two highermost octave of keys to cause transmission to the signal collector of a signal from the one of said generators associated with the highest of a plurality of operated keys within said two highermost two octave range, means to couple the output of the frequency divider apparatus to the output system, and manually variable impedance quality and amplitude control means coupling the signal collector to the output system, whereby one generator may supply two tone signals to the output system, the tone signals being of different quality or amplitude or both.

3. In an electrical musical instrument having an output system including an electro-acoustic translating means, the combination of a plurality of electrical generators providing complex musical tone signals of pitch corresponding to the semitone intervals of the tempered musical scale throughout a range of at least three octaves, a plurality of playing keys, a first switch operable by each of said keys to cause transmission to the output system of a signal from an associated generator, a signal collector, second switches operable respectively by the keys of at least the highermost octave of keys to cause transmission to the signal collector of a signal from the one of said generators associated with the highest of a plurality of operated keys within said highermost octave range, and means coupling the signal collector to the output system whereby the generator of the highest of a plurality of concurrently depressed keys within said high octave range will supply an additional tone signal to the output system, thereby to cause the acoustic energy or tone quality of the tone produced under the

control of said highest key to exceed the acoustic energy or differ in tone quality from the individual tones controlled by other concurrently depressed keys.

4. In an electrical musical instrument having an output system including an electro-acoustic translating means, the combination of a plurality of electrical generators providing complex musical tone signals of pitch corresponding to the semitone intervals of the tempered musical scale throughout a range of at least three octaves, a plurality of playing keys, a first switch operable by each of said keys to cause transmission to the output system of a signal from an associated generator, a signal collector, second switches operable respectively by the keys of at least the lowermost octave of keys to cause transmission to the signal collector of a signal from the one of said generators associated with the lowest of a plurality of operated keys within said lowermost

octave range, and means coupling the signal collector to the output system whereby the generator of the lowest of a plurality of concurrently depressed keys within said low octave range will supply an additional tone signal to the output system, thereby to cause the acoustic energy or tone quality of the tone produced under the control of said lowest key to exceed the acoustic energy or differ in tone quality from the individual tones controlled by other concurrently depressed keys.

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