Feb. 21, 1961 J. M. HANERT 2,972,273

POLYPHONIC PERCUSSION CONTROL APPARATUS

Filed March 12, 1958

2 Sheets-Sheet 1

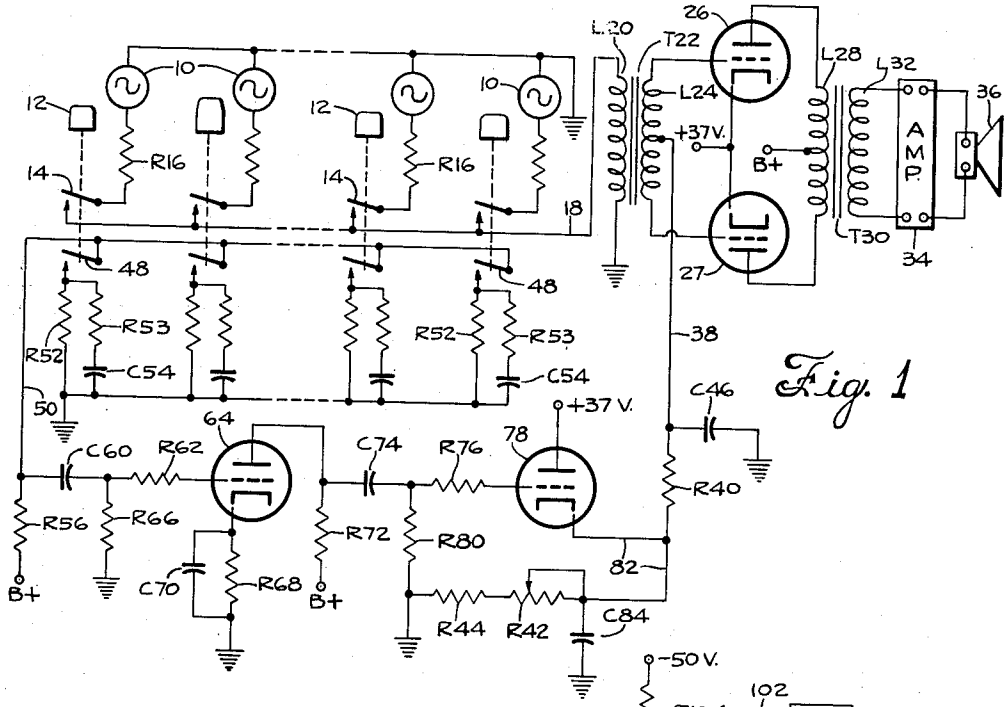


Fig. 1

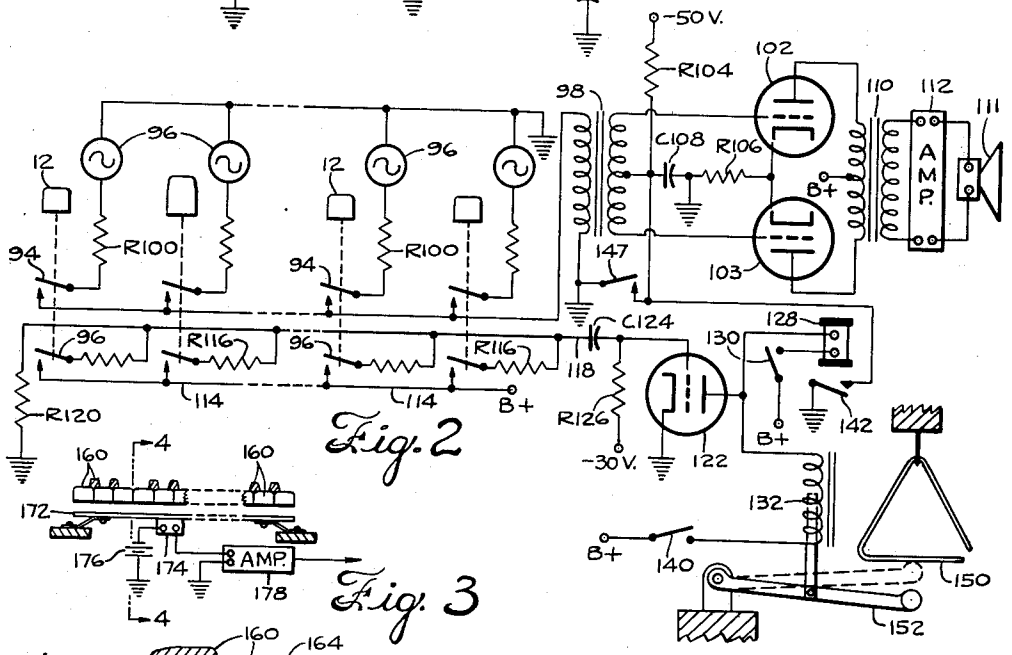


Fig. 2

Fig. 3

Fig. 4

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2 Sheets-Sheet 2

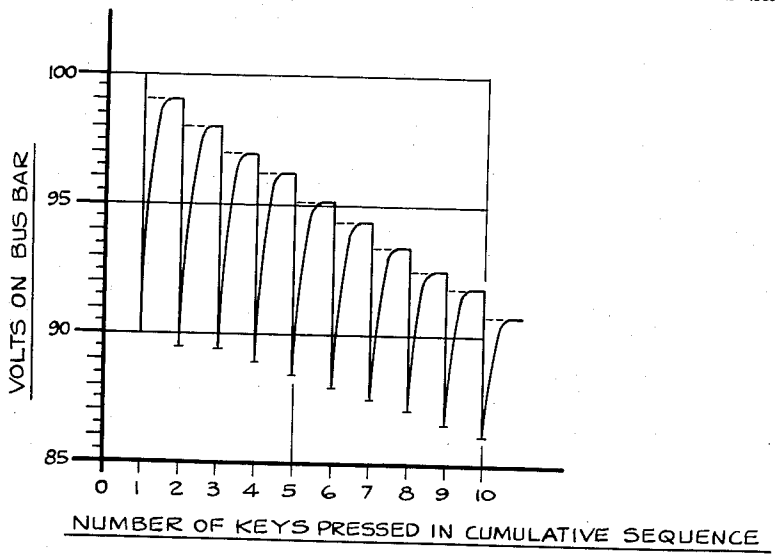


Fig. 5

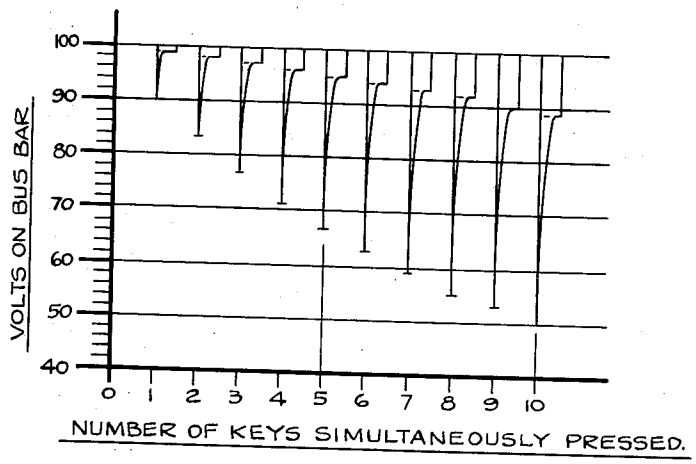


Fig. 6

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POLYPHONIC PERCUSSION CONTROL APPARATUS

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18 Claims. (Cl. 84—1.26)

The invention relates generally to polyphonic percussion control apparatus for incorporation in electrical musical instruments of the polyphonic type. More particularly, the invention relates to improvements in circuitry, whereby a percussion intensity envelope of a tone will be produced upon the depression of a playing key, irrespective of whether other keys are being held depressed at the time.

In earlier conceived inventions for controlling the sounding of a tone with a percussion intensity envelope, such as disclosed in applicant's prior application Serial No. 203,070 now abandoned, filed December 28, 1950, of which this application is a continuation in part, some of the forms of the invention therein disclosed required that, in order to produce the tones with percussion intensity envelopes, the keys had to be played in a staccato, or detached manner, and in others the percussion intensity envelope was produced not only upon depression of a key while other keys were depressed, but also upon release of the highest of a plurality of keys which had been depressed. Both modifications had some disadvantages as well as advantages, depending upon the manner in which it was intended to control the sounding of tones with a percussion intensity envelope.

The present invention constitutes an improvement upon the form of invention disclosed in said application wherein the tone intensity percussion envelope is produced upon depression of a key even though one or more other keys are in depressed position.

It is therefore the primary object of the present invention to provide percussion intensity envelope control means, for an electrical musical instrument, in which the percussion envelope is produced upon depression of any key despite the fact that other keys are being held depressed at the time.

A further object is to provide a percussion tone intensity envelope control means which is responsive to effect the production of a percussion tone even though a number of other keys have been depressed and are held in depressed position, and even though a number of keys are simultaneously depressed. In the latter instance a percussion chord may be sounded accurately to simulate chimes, bells, marimbas, guitar tones, and the like.

Other objects of the invention will appear from the following description, reference being had to the accompanying drawing in which:

Fig. 1 is a schematic circuit diagram of one of the preferred forms of the invention.

Fig. 2 is a schematic circuit diagram which shows a desirable variation in circuitry for obtaining the producton of tones with percussive intensity envelopes.

Fig. 3, is an elevation of a keyboard (partly in section), and associated mechanism disclosing a further modification of the invention.

Fig. 4 is a vertical sectional view taken on line 4—4 of Fig. 3.

Fig. 5 is a graph indicating the amplitudes of the voltages produced, for the energization of the percussive envelope control circuitry, upon operation of a number of keys played in cumulative sequence, and

Fig. 6 is a similar graph of the energizing voltages impressed upon the percussive envelope control circuitry when a number of keys are depressed simultaneously.

In general, there are two somewhat different aims to be accomplished in controlling the production of tones with percussive intensity envelopes, depending upon whether the instrument in which such circuitry is employed, namely, whether the instrument is of the monophonic type capable of producing but one signal at a time or whether the instrument is of the polyphonic type capable of producing simultaneously a number of tone signals, i.e. chords.

The present invention is particularly adapted for use in instruments of the latter type, namely, polyphonic electrical musical instruments.

Referring to Fig. 1 the electrical musical instrument is illustrated as comprising a plurality of electrical tone signal generators **10** which may generate tone signals of simple sine wave form but, preferably, of complex wave form. A plurality of playing keys **12** are effective upon depression to close switches **14** to complete circuits through decoupling resistors R16 from the generators **10** to a signal collecting conductor **18**, and hence to the primary L20 of an output transformer T22. The secondary L24, of this transformer has its end terminals connected to the control grids of triodes **26** and **27**. It will be noted that the other terminal of the input winding L20 is grounded and that the other terminals of the tone signal generators **10** are likewise grounded so that closure of any of the switches **14** will result in impressing a tone signal on the primary winding L20. The anodes of triodes **26** and **27** are connected to the terminals of the primary L28 or an output transformer T30. A center tap of the primary L28 is connected to a B+ terminal of the power supply while the cathodes of these triodes are connected to a +37 v. terminal power supply. The secondary L32 of the transformer T30 is coupled through an amplifier **34** to a speaker **36**.

As so far described, depression of any key **12** would result in transmission through the control triodes **26** and **27**, transformer T30 and amplifier **34** to the speaker **36**. However, the grids of control triodes **26** and **27** are connected by a conductor **38**, resistor R40, potentiometer R42, and resistor R44 to ground thus effectively biasing these triodes to cutoff by virtue of the fact that the cathodes of these triodes are maintained at a +37 v. potential. A capacitor C46, connected between the conductor **38** and ground, is effective to limit the rate of attack by filtering the high frequency transients.

The control of the intensity envelope control triodes **26** and **27** is effected by the operation of switches **48**, respectively closed by depression of the keys **12**, to apply a negative pulse to a conductor **50**. The switches **48** complete circuits between the conductor **50** and ground through parallel resistors R52 and R53, the resistor R53 having capacitor C54 in series therewith.

The value of the resistor R52 is preferably approximately ten times as great as that of the resistor R53. For example, resistors R52 and R53 may have values in the order of 10 megohms and 1 megohm, respective, while the capacitor C54 may have a value of .001 mfd. The conductor **50** is connected to a B+ terminal of the power supply through a resistor R56 which may have a value of approximately .1 megohm.

It will be pointed out hereinafter that irrespective of of whether one or several of the keys **12** are depressed (despite the fact that several other keys are held depressed at the time) will produce a negative pulse upon the conductor **50**. This pulse is transmitted through capacitor C60 and current limiting resistor R62 to the grid

of a triode 64. A grid return resistor R66 is connected between the junction of capacitor C60 and resistor R62 and ground.

The cathode of triode 64 is connected to ground through a self-bias resistor R68 having a bypass capacitor C70 in parallel therewith. Another current is supplied from a B+ terminal of the power supply through a load resistor R72. The output signal of triode 64 is transmitted from its anode through a capacitor C74 and current limiting resistor R76 to the control grid of an amplifying and rectifying triode 78. The junction of capacitor C74 and resistor R76 is connected to ground through a grid return resistor R80. The anode of triode 78 is connected to a +37 v. of the power supply, and its cathode is connected to ground by means of conductor 82 and a capacitor C84, as well as through series connected resistors R42 and R44.

The operation of the circuitry shown in Fig. 1 may be well understood by reference to Figs. 5 and 6. When any one of the keys 12 is depressed it, of course, closes a switch 14 to supply the tone signal from its generator 10 to the primary L20 of transformer T22. At the same time, due to the closure of its switch 48, a negative pulse is impressed upon the conductor 50. The decrease in potential on the conductor 50 upon such occurrence is indicated in Fig. 5 showing that the normal potential, 100 volts on the conductor 50, is rapidly reduced to 90 volts due to the discharge of its associated capacitor C54 through the low value resistor R53. However, this capacitor is rapidly discharged and the potential on conductor 50 rather rapidly rises to a value of approximately 99 volts due to current flow through the relatively high value resistor R52. Thus, a negative pulse is transmitted through capacitor C60 and resistor R62 and impressed upon the control grid of triode 64.

Due to this pulse the triode 64 becomes non-conducting and the voltage on its anode increases to provide a pulse transmitted through capacitor C64 and resistor R76 to the control grid of triode 78, rendering the latter temporarily conductive and causing a substantial increase in the potential on its cathode and hence upon conductor 82, which increase in potential is conducted through resistor R40 and conductor 38 to a center tap on the secondary L24 of transformer T22. This positive pulse also is effective to charge capacitor C46 which also acts as a filter to remove high frequency transients which might otherwise be applied to the control grids of triodes 26 and 27. As a result the potential on these triodes will rise at a rate determined mainly by the time constant of capacitor C46 and resistors R40 (although the capacitor C84 also has some effect) and, as a result, the triodes 26 and 27 are substantially instantaneously rendered conductive of the signal impressed upon the secondary L24 of the transformer T22. The mentioned components have a very short time constant, so that for practical purposes, the pulse may be considered as instantaneously applied to the grids of the triodes 26 and 27, although the fact that high frequency transients are filtered by virtue of the presence of the capacitor C46, and that this capacitor is being charged at the time, prevents the potential on the control grids from rising so rapidly that undesired audio frequency transients are not produced.

It will be apparent from the graph of Fig. 5 that as a number of keys are depressed (and held depressed) in cumulative sequence the potential on conductor 50 will be progressively reduced because of the successive discharge of their associated capacitors C54 to produce a sharp negative pulse adequately sufficient to be transmitted through the triode 64, 78 and their associated components to produce a rapid increase in the potential on the control grids 26 and 27. As is apparent from Fig. 5, the potential on the conductor 50 drops rapidly and then rises more or less gradually to a value determined by the relative values of resistors R16 and R56 operating as a voltage divider. Although the potential upon the conductor 50 as a result of successive depression of a number of playing keys is progressively decreased, the negative pulses, as above mentioned, are sufficiently great to insure reliable operation of the pulse controlled circuitry.

Referring to Fig. 6 which indicates the drop in potential upon conductor 50 when a number of keys are simultaneously depressed, it will be clear that upon the simultaneous depression of any number of keys, from 1 to 10, a decided negative pulse will be impressed upon the conductor 50 so that the percussion envelope control circuitry will be operated in a reliable manner.

It will be noted after the single key or any number of keys up to at least 10 are depressed, the potential on the conductor 50 drops to a certain value, less than 100 v., and then rapidly rises to the normal potential of +100 v.

From the foregoing, it will appear that a potential will be applied to the control grids of triodes 26 and 27 every time one or a number of keys are depressed and that this voltage will be retained on these grids as long as the capacitor C46 remains charged to a potential above the cutoff bias value, and that the discharge of the condenser will thus cause gradual decay of the output signal of the instrument. The capacitor C46 is discharged through resistors R40, R42, and R44, and the rate of such discharge may be varied by adjustment of the potentiometer R42.

A modified form of the invention is shown in Fig. 2 wherein it is illustrated as producing the percussion effect either by solenoid operated hammer of another type mechanical musical instrument or by providing, as in the previous embodiment, for the application of a pulse to the control grids of a pair of push pull output control tubes. In this modification each of the keys 12, upon depression, closes two switches 94 and 96 preferably in the order named. Switch 94 is effective to connect a musical tone signal generator 96 to a matching transformer 98 through a decoupling resistor R100. The signal is thus transmitted to the control grids of triodes 102 and 103. The center tap of the secondary of transformer 98 is connected to a terminal −50 v. through a resistor R104 so that these triodes are normally biased beyond cutoff because their cathodes are connected to ground through a common self-bias resistor R106. The center tap of the transformer secondary winding is also connected to ground through a capacitor C108 which corresponds generally to the capacitor C46 in the previously described embodiment shown in Fig. 1. The plates of triodes 102 and 103 are connected in push pull to the primary of an output transformer 110, the center tap of which is connected to a B+ source of voltage. The secondary winding of transformer 98 is coupled to a speaker 111 through an additional amplifier 112 provided with the usual tone and expression controls.

Each of the switches 96 has one pole connected to a conductor 114 which is connected to a B+ terminal of the power supply while the other terminal of each of these switches is connected through a resistor R116 to a conductor 118. The conductor 118 is connected to ground through a resistor R120 which is of high value relative to that of each of the resistors R116. Conductor 118 is connected to the grid of a triode rectifier 122 through a blocking capacitor C124. The triode rectifier 122 is normally biased beyond cutoff by connection to a −30 v. terminal through a grid resistor R126. Plate current for the triode 122 may be supplied either through a relay coil 128 upon closure of a switch 130 or may be supplied through the winding of a solenoid 132 upon closure of a switch 140, the switches 130 and 140 each having one pole connected to a B+ terminal. One contact of the switch 142, which is part of the relay 128, is connected to ground while the other pole thereof is connected to the center tap of the secondary of transformer 98.

With switch 130 closed, when any of the keys is depressed the closure of its associated switch 94 results

in impressing a tone signal across the primary of transformer **98**. In addition, a positive pulse is transmitted through capacitor **C124**. The time constant of the mesh comprising capacitor **C124** and resistor **R126** is very short so that the triode **122** conducts but momentarily and the relay switch **142** is likewise closed briefly, placing the grids of the control triodes **102, 103** at ground potential. Thus the triodes **102, 103** are rendered conductive of the signal at high amplitude to produce a percussive attack. The charge on capacitor **C108** is removed and therefore the triodes **102, 103** will continue to conduct the signal at decreasing amplitude as the capacitor **C108** is recharged from the negative bias terminal −50 v. through resistor **R104**. Therefore, the operation of any one of the keys, irrespective of whether other keys are depressed at that time, will cause the tone to sound with a percussive envelope.

If desired, a switch **147** may be provided which, when closed, maintains the grids of the triodes **102** and **103** at ground potential. Under these conditions the tones will sound in a customary sustained manner at a sustained intensity determined by the usual volume control. Also, whenever desired, the switch **140** may be closed to cause operation of the solenoid **132**, the plunger of which may be connected to the hammer of any percussive instrument, such as the musical steel triangle **150**, which is suitably suspended above a hammer **152** connected to be operated by the plunger of the solenoid **132**.

The time constant of **C124** and **R126** is made very short in order to resolve the pulses due to opening one of the contacts **96** and closing of another of these contacts when playing from one key to another in a legato manner. Theoretically, the positive and negative pulses generated thereby might cancel each other to produce no transient if the closing and opening of these switches occurred at exactly the same instant. By the use of a very short time constant, and also due to the momentary unavoidable wiping effects of the contacts, a usable pulse is obtained with reasonable reliability.

It is to be noted that whenever a playing key is released, a negative pulse will be generated, but this pulse will have no effect upon triode **122** because its grid is already maintained at a plate current cutoff potential. Thus the percussive effect is obtained only by the depression (and not the release) of a playing key. This effect, however, will be obtained even though other keys are being held depressed. Thus the musician may obtain a series of percussive tones even though he employs a legato playing technique.

In playing the instrument of the kind shown in Fig. 2 the musician has means available for producing a variety of musical effects by operating the switches **130, 140**, and **147** in various combinations. For example, assuming those of these three switches not mentioned as closed, are open, the following effects may be obtained:

(1) With switch **147** closed the instrument played will perform in the manner of a customary organ;

(2) With switches **140** and **147** closed the instrument will produce the customary organ tones accompanied by the percussion mechanical instrument tone of the steel triangle or the like;

(3) With switches **130** and **147** closed, the instrument will perform as in a customary organ because the center tap on the secondary transformer being already connected to ground by the switch **147** closure of the relay switch **142** will not change the performance;

(4) With all three switches closed the instrument will perform as in (2) above, the customary organ tones and the mechnical percussion tones will be produced;

(5) If all three switches are open no sound will be produced upon playing the keys because the control tubes **102, 103** are biased beyond cutoff by their connection to the −50 v. terminal of the power supply;

(6) If only switch **140** is closed only the mechanical percussion tone from the steel triangle **150** will be sounded;

(7) If only the switch **130** is closed, the tone produced will be a percussion tone of organ quality;

(8) If the switches **130** and **140** are closed, the organ percussion tone will be sounded together with the percussion tone from the steel triangle.

The musician thus has available the ability to employ these various effects in the rendition of a selection so as to add variety and interest to the music.

The object of the invention may also be accomplished by the apparatus disclosed in Figs. 3 and 4. In these figures the keys **160** are resiliently mounted on supports **162** and provided with sound deadening upstops **164** and downstops **166** carried in a suitable keyboard frame channel **168**. Each of the keys has a hammer **170** resiliently secured thereto so arranged that when the key is depressed the hammer will engage a plate or bar **172** associated with a microphone or vibration pickup **174**, of an electromagnetic or electrostatic type, which is powered by a battery **176** and the output of which is supplied to an amplifier **178**. This amplifier corresponds to either the triode **64** of the embodiment shown in Fig. 1 or the triode **122** of the embodiment of Fig. 2 and may be coupled to the output of the instrument in either of the manners shown in Fig. 1 or Fig. 2.

It will be understood that the keys **160**, in addition to energizing the microphone **174**, close switches such as the switches **14** in Fig. 1 to couple the signal generator to the matching transformer such as transformer **T22** of Fig. **1** and **98** of Fig. 2.

As a key is depressed it first closes the switch to connect the signal to the matching transformer and thereafter its hammer strikes the plate **172** to energize the microphone or vibration pickup **174** and thus provide the pulse required for initiating the operation of the percussion intensity envelope control means, in the same manner as described above with reference to Figs. 1 and 2.

It will be readily apparent to those skilled in the art that, in some of the following claims, reference to "negative peak voltage" is not limited to the provision of an intensity envelope control circuit in which a negative pulse is required, but that by simple changes of the circuitry, the latter may respond to a positive peak voltage, as for instance, by applying a controlling voltage to the cathodes of the control tubes **26** and **27** instead of to the grids of these triodes, or by interposing a phase or polarity reversing tube.

While I have shown and described particular embodiments 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. An electrical musical instrument of the polyphonic type capable of producing percussion tone effects, comprising a plurality of electrical musical tone signal generators, a manual comprising a plurality of playing keys, an output system including electrical pulse sensitive unitary means for producing tones having a percussion type intensity envelope, means operable by the playing keys respectively to couple the generators to the output system, a conductor coupled to the input of said unitary means, a source of electrical energy, an electrical impedance coupling said conductor to one terminal of the source, a plurality of individual impedance means associated respectively with the keys, each of said individual impedance means having one terminal coupled to the other

terminal of the source, and switches respectively operable by the keys to couple the other terminals of said impedance means to said conductor, whereby upon depression of keys percussion tones producing electrical pulses will be impressed on said conductor irrespective of whether other keys are in a depressed condition.

2. The combination set forth in claim 1 in which each impedance means comprises a first resistor, and a second resistor and a series capacitor connected in parallel with the first resistor.

3. The combination set forth in claim 2 in which the second resistor has a value substantially lower than that of the first resistor.

4. The combination set forth in claim 1 in which, upon operation of the playing keys, the impedance means connected in the circuit by the operation of the playing keys, cause a changed voltage division resulting in producing pulses when the keys are operated in cumulative sequence.

5. The combination set forth in claim 1 in which the pulses produced on the conductor by the cumulative depression of a number of keys have successively lower peak voltage values, and in which the pulse produced upon depression of another key while holding a plurality of other keys depressed is of sufficient peak voltage to cause reliable operation of the unitary percussive intensity envelope tone producing means.

6. The combination set forth in claim 1 in which the impedance means which are connected in the circuit by the playing keys comprise individual resistors.

7. The combination set forth in claim 1 in which the means for producing the electrical pulses comprises a microphonic element, and in which each of the keys is provided with means to produce a mechanical shock to the microphonic element thereby to cause the latter to generate a pulse.

8. The combination set forth in claim 1 in which the unitary percussion intensity envelope producing means includes an electromagnetically operated percussion sound producing instrumentality.

9. The combination set forth in claim 1 in which said unitary percussion intensity envelope producing means includes a rectifier having input and output circuits, and in which the output circuit of the rectifying means includes means for supplying a potential to a terminal of said unitary means initially of such value to cause the signal supplied thereto to be conducted through the output system at maximum amplitude, and includes a resistance capacitance circuit for gradually reducing the potential on said terminal of the tone intensity envelope producing portion of the output system, to cause gradual decay in the intensity of the tone produced.

10. An electrical musical instrument of the polyphonic type capable of producing percussion tone effects, comprising a plurality of electrical musical tone signal generators; a manual comprising a plurality of playing keys; an output system including unitary means for producing tones having a percussion type intensity envelope; means operable by the playing keys respectively to couple the generators to the output system; rectifying means; circuit means coupling the output of the rectifying means to the percussion intensity envelope controlling means to energize the latter upon transmission of an electrical pulse through said rectifying means; a conductor coupled to the input of said rectifying means; a source of electrical energy having one terminal connected to said conductor; an impedance element included in said connection between said terminal and said conductor; impedance means respectively associated with each of the keys; and means respectively operated by the keys to connect said impedance means between said conductor and the other terminal of said energy source, whereby upon depression of a key an electrical pulse will be impressed on said conductor irrespective of whether other keys are in a depressed position.

11. In an electrical musical instrument, having tone signal generators, and means for producing percussive type tones, the combination of a manual comprising a plurality of keys, an output system including tone intensity envelope control means having a terminal the potential of which is determinative of the amplitude of the tone signals transmitted through the output system, means respectively operable by the playing keys to couple the tone signal generators to the output system, a plurality of impedance means, a source of potential, means operable by the keys respectively to connect the impedance means between the terminals of the source of potential thereby to produce pulses, electromagnetic means, means responsive to the pulses to provide current for the energization of at least one of the electromagnetic means, means responsive to the energization of one of the electromagnetic means to apply a potential to said terminal of the tone intensity envelope control means to cause transmission of the tone signal supplied thereto by the generators through the output system at high amplitude, decay circuitry means coupled to said terminal for causing a gradual change in the potential on said terminal to a value such that the tone signals are not transmitted through the output system, means operable by another of said electromagnetic means to actuate a mechanical musical sound producer, and switch means manually operable to render either or both of said electromagnetic means effective.

12. In an electrical musical instrument, means for producing percussive type tones, the combination of a plurality of generators of electric musical tone signals, a manual comprising a plurality of keys, an output system including tone intensity envelope control means having a terminal the potential of which is determinative of the amplitude of the tone signals transmitted through the output system, means respectively operable by the playing keys to couple the tone signal generators to the output system, a plurality of impedance means, a source of potential, means operable by the keys respectively to connect the impedance means between the terminals of the source of potential thereby to produce pulses, electromagnetic means, means responsive to the pulses to provide current for the energization of the electromagnetic means, means responsive to the energization of the electromagnetic means to apply a potential to said terminal of the tone intensity envelope control means of value such as to cause transmission of the tone signals through the output system at high amplitude, decay circuitry means coupled to said terminal for causing a gradual change in the potential on said terminal to a value such that the tone signals are not transmitted through the output system.

13. In an electrical musical instrument of the polyphonic type having means for producing a percussion effect upon depression of a key irrespective of whether other keys are depressed at the time, the combination of a plurality of electrical musical tone signal generators, a manual comprising a plurality of playing keys, an output system including tone intensity envelope control means, the latter having a terminal the potential of which determines the amplitude of a signal transmitted through the output system, means operated by the keys to couple the generators respectively to the output system, a source of electrical potential of such value that when impressed upon said terminal will cause the transmission of the tone signal supplied to the output system at high amplitude, switches respectively operated by the playing keys to produce an electrical pulse and thereafter to maintain a supply of constant voltage, a conductor common to the switches of all of the keys to receive the pulses and to have the potential thereon maintained upon closure of one of the key operated switches, electronic means responsive to the application of a pulse to said conductor effectively to couple the potential source to said terminal of the tone intensity control means, a

fixed voltage of such value that when applied to said terminal prevents transmission of the signal, and resistance means connected between said terminal and said fixed voltage source operable gradually to change the potential on said terminal to a value which renders said tone intensity control means ineffective to transmit the tone signals supplied thereto.

14. An electrical musical instrument of the polyphonic type capable of producing percussion tone effects, comprising a plurality of electrical musical tone signal generators; a manual comprising a plurality of playing keys; an output system including unitary means for producing tones having a percussion type intensity envelope; means operable by the playing keys respectively to couple the generators to the output system; rectifying means; circuit means coupling the output of the rectifying means to the percussion intensity envelope controlling means to energize the latter upon transmission of an electrical pulse through said rectifying means; a conductor coupled to the input of said rectifying means; a source of electrical energy having one terminal connected to said conductor; a plurality of impedance means respectively associated with the keys; and means respectively operated by the keys to connect said impedance means between said conductor and the other terminal of said energy source, whereby upon depression of a key an electrical pulse will be impressed on said conductor irrespective of whether other keys are in a depressed position.

15. An electrical musical instrument of the polyphonic type capable of producing percussion tone effects, comprising a plurality of electrical musical tone signal generators; a manual comprising a plurality of playing keys; an output system including unitary means for producing tones having a percussion type intensity envelope; means operable by the playing keys respectively to couple the generators to the output system; rectifying means; circuit means coupling the output of the rectifying means to the percussion intensity envelope controlling means to energize the latter upon transmission of an electrical pulse through said rectifying means; a conductor coupled to the input of said rectifying means; a source of electrical energy having one terminal coupled to said conductor; an impedance included in said coupling between said terminal and said conductor; impedance means respectively associated with each of the keys; and means respectively operated by the keys to couple said impedance means between said conductor and the other terminal of said potential source, whereby upon depression of a key an electrical pulse will be impressed on said conductor irrespective of whether other keys are in a depressed position.

16. In an electrical musical instrument of the polyphonic type for producing percussion tone effects, the combination of a plurality of electrical musical tone signal generators, an output system comprising an amplifier and speaker, said amplifier having a terminal the potential of which determines the degree of amplification thereof, a plurality of keys, means respectively operated by the keys to cause the generators to transmit tone signals to the output system, a conductor, a rectifier having its input coupled to said conductor, means coupling the output of the rectifier to said terminal of the amplifier, a source of electrical energy, an electrical impedance connecting said conductor to one terminal of the source, a plurality of individual elements associated respectively with the keys, each impedance element having one terminal connected to the other terminal of the source, and switches respectively operable by the keys to connect the other terminals of said impedance elements to said conductor.

17. In an electrical musical instrument of the polyphonic type for producing percussion tone effects, the combination of a plurality of electrical musical tone signal generators, an output system comprising an amplifier and speaker, said amplifier having a terminal the potential of which determines the extent of amplification thereof, a plurality of keys, means respectively operated by the keys to cause the generators to transmit tone signals to the output system, a conductor, means coupling the conductor to said amplifier terminal, a source of electrical energy, an electrical impedance connecting said conductor to one terminal of the source, a plurality of individual impedance elements associated respectively with the keys, each impedance element having one terminal connected to the other terminal of the source, and switches respectively operable by the keys to connect the other terminals of said impedance elements to said conductor.

18. In an electrical musical instrument of the polyphonic type for producing percussion tone effects, the combination of a plurality of electrical musical tone signal generators, an output system comprising an amplifier and speaker, said amplifier having a terminal the potential of which determines the extent of amplification thereof, a plurality of keys, means respectively operated by the keys to cause transmission of tone signals from the generators to the output system, a conductor, means coupling the conductor to said terminal, a source of electrical energy, an electrical impedance connected between said conductor and one terminal of the source, a plurality of individual impedance elements associated respectively with each of the keys and having one terminal connected to the other terminal of the source, and switches respectively operable by the keys to connect the other terminals of said impedance elements to said conductor.

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