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ELECTRONIC MUSICAL INSTRUMENT

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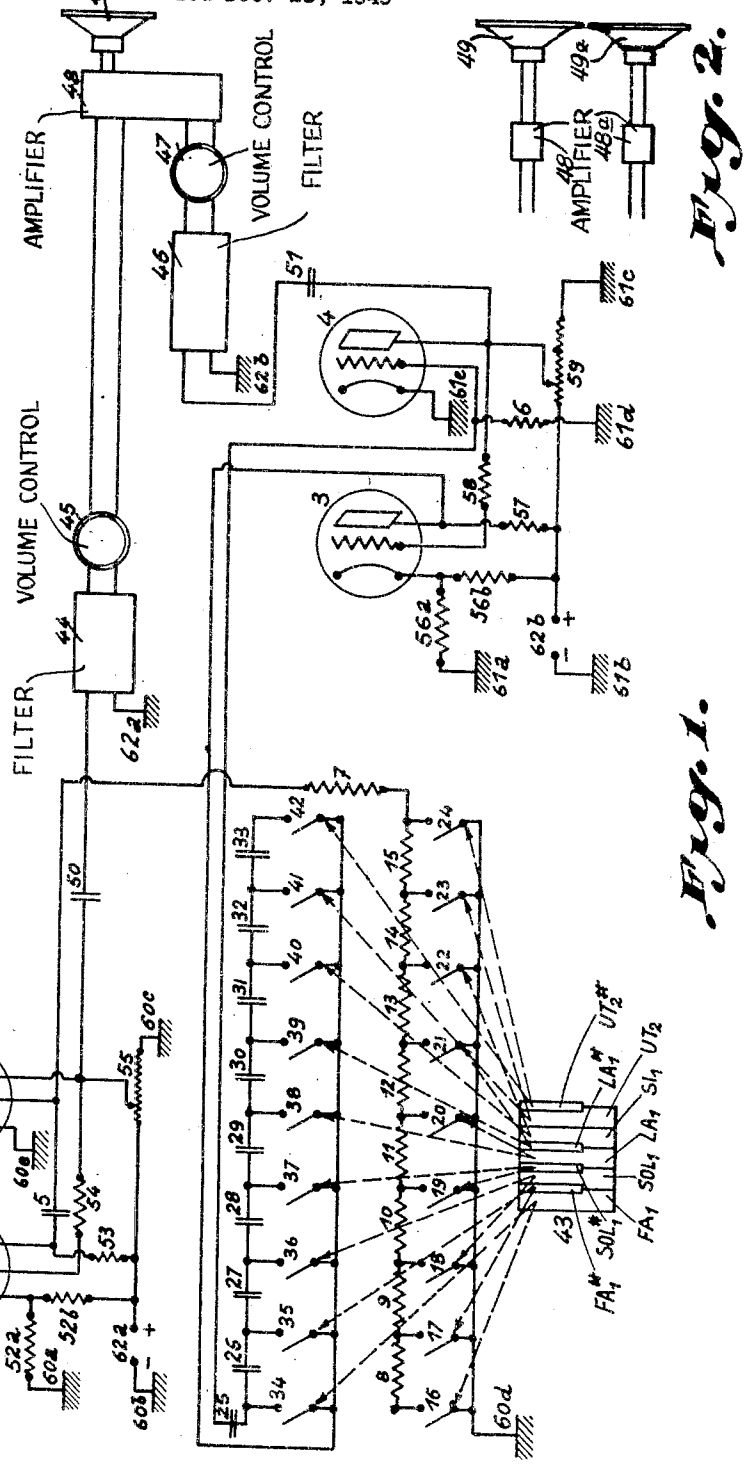


Fig. 2.

Fig. 1.

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ELECTRONIC MUSICAL INSTRUMENT

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The present invention relates to an electronic musical instrument and it has for its object to provide means adapted to emit simultaneously two notes with a single key board.

It is well known that certain types of electronic musical instruments can emit only one sound at a time to the exclusion of all chords, although capable of giving successively all the notes of a scale, these instruments using an electronic oscillator, various suitable constants of which are altered for the different notes.

Generally variation of these constants is obtained by breaking down one of the principal elements of the oscillator (inductance, resistance or capacity) respectively into a series of components (inductances, resistances or condensers) of such value that by connecting an extreme point of the series successively, one after the other, to all the junction points which connect together, from point to point, all the partial elements of this series, all the notes of a scale can be obtained. Generally a key-board is used each key of which controls an electric contact to produce note by note and thus key by key, this successive short circuiting of a more or less large number of partial elements connected in series.

It is known that according to the choice of the partial elements of this series, resistances, inductances or capacities, two principal cases should be considered.

In the first case, where the partial elements of the series are resistances or inductances, when the player depresses simultaneously on several keys of the keyboard, a single note results and this note is the highest of those which are emitted.

In the second case, where the partial elements of the series are condensers, if the player depresses several notes of the keyboard, the lowest note alone remains among the emitted notes.

The present invention consists in controlling by means of the same keys of a single keyboard, two electronic oscillators such as those which have been mentioned, but designed so that one corresponds to the first case aforesaid and the other to the second case.

Such a combination, according to the invention, of two electronic musical instrument units, controlled by the same keyboard and of which one causes the sounding of the highest note emitted, when several keys are depressed, and the other the lowest note, permits the player to produce the following musical effect: if the player depresses a single key the two instruments controlled by the keyboard remain in unison on the same note corresponding to the said key; and the musical effect is that produced by two instrments playing in unison. If the player depresses several keys at the same time one of the instruments controlled by the keyboard continues to play the highest note and the other the lowest note (the musical effect is that produced by two instruments, one giving the highest note and the other the lowest note of the chord played by the player).

It is known that it is easy to vary the timbre of electronic musical instruments; and if the two oscillators controlled by the same keyboard according to the invention are provided with means capable of varying the timbre independently one of the other, the player can with one hand produce as desired the effect of two similar or different instruments playing in unison or chords.

In accordance with the present invention two electronic musical instruments may be controlled by a common keyboard, a pair of electronic oscillators being provided together with key actuated variable resistance and variable capacitance means whereby the frequency of one of said oscillators corresponds to the pitch of the lower of two simultaneously depressed keys and the frequency of the other oscillator is made to correspond to the pitch of the higher of the keys.

The invention will be more readily understood by reference to the accompanying drawings wherein:

Fig. 1 is a wiring diagram of a circuit of a musical instrument constructed in accordance with one embodiment of the invention; and

Fig. 2 is a wiring diagram, similar to that of Fig. 1, but showing another embodiment of the invention.

Referring to the drawings the first oscillator is comprised by two electron tubes **1** and **2** and the second the two electron tubes **3** and **4** as well as circuits comprising resistances and condensers. The elements of the first oscillatory circuit are the condenser **5**, the resistances **7**, **8**, **9**, **10**, **11**, **12**, **13**, **14**, **15**, the output condenser **50**, the cathode resistors **52***a*, **52***b*, the anode resistors **53** and **55**, the grid resistor **54**, the direct current feed source **62***a* and the ground or earth connections **60***a*, **60***b*, **60***c*, **60***d* and **60***e*.

The elements of the second oscillator are the resistance **6**, the condensers **25**, **26**, **27**, **28**, **29**, **30**, **31**, **32**, **33**, the output condenser **51**, the cathode resistors **56***a* and **56***b*, the anode resistors **57** and **59**, the grid resistor **58**, the direct current feed source **62***b* and the earth or ground connections **61***a*, **61***b*, **61***c*, **61***d*, **61***e*.

The reference numerals **16**, **17**, **18**, **19**, **20**, **21**, **22**, **23**, **24** identify switches which put into or out of circuit the resistances **8**, **9**, **10**, **11**, **12**, **13**, **14**, **15**, respectively, while **34**, **35**, **36**, **37**, **38**, **39**, **40**, **41**, **42**, are switches which put into or out of circuit the condensers **26**, **27**, **28**, **29**, **30**, **31**, **32**, **33** respectively.

Reference numeral **44** identifies the harmonic selector and **45** the volume control of the first oscillatory circuit while **46** and **47** indicate respectively the harmonic selector and the volume control of the second oscillatory circuit; in Fig. 1, **48** is the amplifier and **49** the loud speaker, both common to these two oscillatory circuits; whereas in Fig. 2, two separate amplifiers **48** and **48***a* and separate loud speakers **49** and **49***a* are provided one for each circuit; finally **62***a* and **62***b* are the earth or ground connections of the harmonic selectors.

In the drawings **43** represents part of the keyboard of the instrument and only the partial elements which correspond to the keys of this part of the keyboard and to the notes Fa_1, $Fa_1\sharp$, Sol_1, $Sol_1\sharp$, La_1, $La_1\sharp$, Si, Ut_2, $Ut_2\sharp$.

The oscillators **1** and **2**, and **3** and **4**, respectively, are relaxation type oscillators the particular circuits of which are described in detail in U. S. Patent No. 2,563,477 granted on August 7, 1951.

It will be seen from this figure that the resistances such as **7**, **8**, **9**, **10**, **11**, **12**, **13**, **14**, **15**, are the partial elements of the first oscillator and that they can be short circuited to a greater or less number by means of switches such as **16**, **17**, **18**, **19**, **20**, **21**, **22**, **23**, **24** in order to vary the frequency of this oscillator. In respect of the second oscillator the frequency thereof is controlled by the series connected condensers **25**, **26**, **27**, **28**, **29**, **30**, **31**, **32**, **33**. The frequency of this oscillator is then made variable by short circuiting more or less of these condensers by means of the switches **34**, **35**, **36**, **37**, **38**, **39**, **40**, **41**, **42**, the grid resistance of this second oscillator remaining fixed.

The condensers 25, 26, 27, 28, 29, 30, 31, 32, 33, associated with the switches 34, 35, 36, 37, 38, 39, 40, 41, 42 and the resistances 7, 8, 9, 10, 11, 12, 13, 14, 15, associated with the switches 16, 17, 18, 19, 20, 21, 22, 23, 24, have such values that when the switches 34 and 16 are closed by the action of the key Fa_1 the two oscillators together make the note Fa_1. When 35 and 17, controlled by the key $Fa_1\sharp$ are closed, the two oscillators together make the note $Fa_1\sharp$ and so on up to the last key here shown i. e. $Ut_2\sharp$, the depression of which closes 42 and 24 and produces the note $Ut_2\sharp$ simultaneously by the two oscillators.

It should be understood that the notes produced by each of the two oscillators are adjusted in timbre and strength by the elements 44 and 45 for the first oscillator and 46 and 47 for the second oscillator and that they are emitted by the loud speaker 49 (or in Fig. 2, loud speakers 49 and 49*a*) after suitable ampilfication by the amplifier 48 (or in Fig. 2 by amplifiers 48 and 48*a*).

If any two notes of the keyboard are depressed simultaneously, for example Sol_1 and Ut_2, the arrangement operates as follows: depression of the keys Sol_1 and Ut_2 closes the switches 36 and 18, 41 and 23. It will be seen from the drawings that only the closing of 36 is effective for the operation of the oscillator comprising the valves 3 and 4 since any switch closed to the right hand side of 36 produces no variation of the total capacity connecting the anode of valve 3 to the grid of valve 4. This capacity has a value comprising that of the three condensers in series which remain effective i. e. 25, 26, 27. The oscillator 3, 4 thus gives the note Sol_1 which is the lowest of the two notes played as has been described before.

Similarly it will be seen that only the closing of switch 23 has effect on the operation of the oscillator comprising the valves 1 and 2 since any switch closed to the left of 23 applies no variation to the value of the total resistance connecting the grid of valve 2 to earth. This value is represented by the sum of the resistances 15 and 7. The oscillator 1, 2 thus gives the note Ut_2 which is the highest note of those played.

The drawings readily show that any combination of two notes may be produced by means of the arrangement given here by way of non-limiting example as an application of the present invention and that if only one key of the keyboard is depressed the two oscillators emit the same note in unison.

More generally without departing from the field of the invention it is possible to offset the fundamental frequencies of the two oscillators. Such offsetting may be very slight so that the two oscillators play together in unison in the case of single key being depressed, showing a slight beating effect or "voix celeste." This offsetting may again be one or several octaves or any constant displacement desired in order to produce particular musical effects.

In the example shown in Fig. 1 of the drawings the two oscillators are of the same type; the amplifier and the loud speaker in Fig. 1 are common to the two oscillators; and the systems for varying the timbre and the volume are associated with each oscillator. In the arrangement shown in Fig. 2 independent amplification and loud speaker systems are provided for each oscillator.

It is also possible to add to each oscillator an independent system of amplifiers and loud speakers. It is also possible to connect together the outputs of the two oscillators to a single chain or network, comprising a single operative unit for modifying the timbre, a single volume control, one amplifier and one loud speaker.

What I claim is:

1. In a keyboard controlled electronic musical instrument having first and second oscillating systems, and a filter, amplifier and loud-speaker system operatively connected to the output terminals of the first and second oscillating systems to simultaneously emit the highest and lowest notes corresponding to the depressed keys when a plurality of the keys are simultaneously depressed; each of said first and second oscillating systems being of the multi-vibrator type and including first and second electronic tubes each having a cathode, a grid and a plate; said first oscillating system further including a condenser electrically connected between the plate of the related first electronic tube and the grid of the related second electronic tube, a resistance electrically connected between the plate of the second related tube and the grid of the related first tube, a plurality of resistances connected in series to said grid of the related second tube, and a plurality of taps extending in parallel from intermediate points between said series connected resistances to ground and each having a normally open switch therein; and said second oscillating system further including a plurality of condensers connected in series to the grid of the related second tube, a plurality of taps extending in parallel from intermediate points between said series connected condensers to the plate of the related first tube and each having a normally open switch therein, and a resistance electrically connected between the plate of the related second tube and the grid of the first related tube; and a keyboard including a plurality of keys, and means connecting each of said keys to one of the switches in the taps extending from the series connected resistances and to one of the switches in the taps extending from the series connected condensers.

2. In a keyboard controlled electronic musical instrument, the arrangement according to claim 1; wherein a single amplifier and loud-speaker system is employed for the notes emitted by both of said first and second oscillating systems, and first and second filter systems are interposed between the outputs of said first and second oscillating systems, respectively, and said single amplifier and loud-speaker system, said first and second filter systems being operative independently of each other to vary the timbre of the notes emitted by the related oscillating system.

3. In a keyboard controlled electronic musical instrument, the arrangement according to claim 1; wherein each of said first and second oscillating systems has an independent filter, amplifier and loud-speaker system connected to the output thereof, each filter being operative, independent of the other, to vary the timbre of the notes emitted from the related oscillating system.

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