

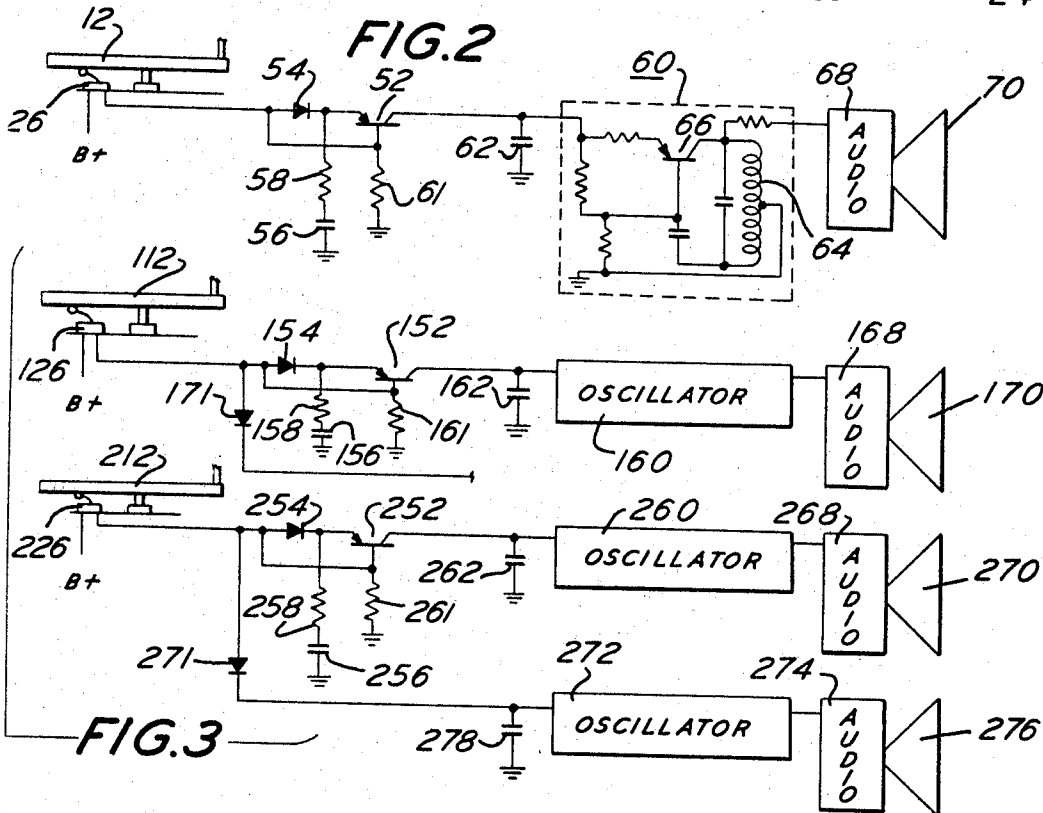
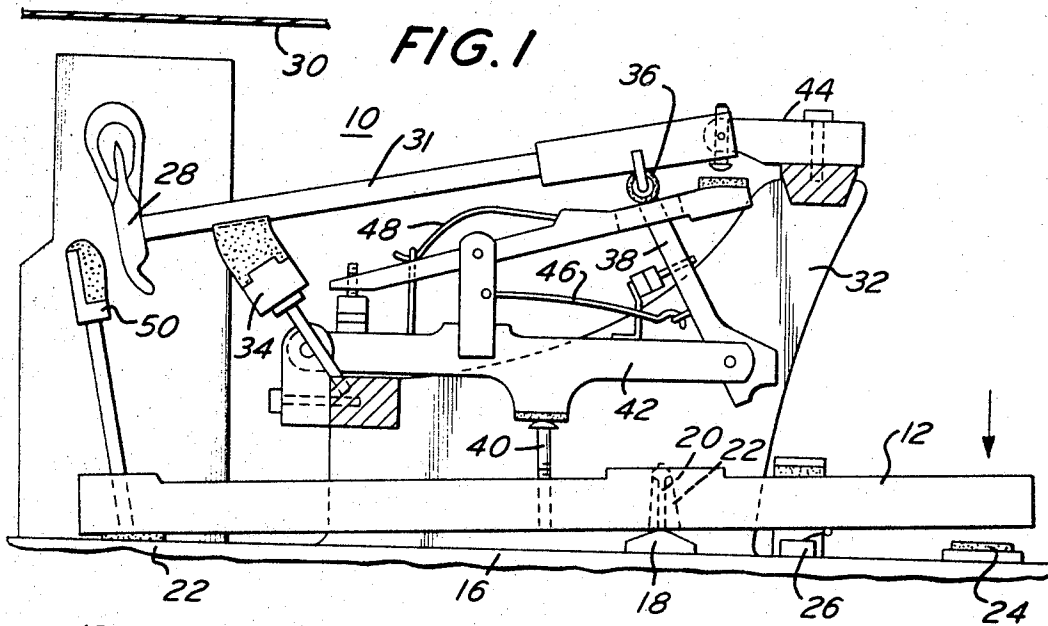
July 1, 1969

J. MARKOWITZ

3,453,371

MUSICAL INSTRUMENT WITH TIME DELAY CHARACTERISTICS

Filed Nov. 29, 1965



INVENTOR
JEROME MARKOWITZ
BY *Seitz & Honda*
ATTORNEYS.

1

3,453,371

MUSICAL INSTRUMENT WITH TIME DELAY CHARACTERISTICS

Jerome Markowitz, Allentown, Pa., assignor to Allen Organ Company, Macungie, Pa., a corporation of Pennsylvania

Filed Nov. 29, 1965, Ser. No. 510,243

Int. Cl. G10h 1/00

U.S. Cl. 84-1.01

7 Claims

ABSTRACT OF THE DISCLOSURE

Apparatus for creating the tonal sound of two musicians simultaneously playing the same musical composition on separate instruments. The instruments may be of the same or different types. The sounding of the second musical instrument is initiated shortly after the sounding of the first musical instrument since two musicians simultaneously playing the same musical composition will not be exactly in time with each other.

This invention relates to an electrical musical instrument with time delay characteristics. More particularly, this invention relates to an electronic musical instrument employing two tone sources for each note, one of which sounds regularly in the course of playing the musical instrument and the other of which sounds subsequent to the initiation of the first tone source.

The present invention is concerned with creating the effect of two musical instruments, which may be of the same or different types, simultaneously playing a musical piece. The effect of two instruments is created even though the musical instrument of the present invention is operated by a single person. The overall effect is that of two people playing together on two separate instruments.

When two people play together on two separate instruments, a different overall sound is created which is more than the mere coincident sounding of two notes. There obviously is separation of the tone source giving a stereo quality. But when properly analyzed, the overall sound consists of much more. The real significance of two instruments playing simultaneously is that the notes are not locked together. When two musicians play a rapid passage together, a listener may not be able to distinguish any differences in their timing, but in reality even the finest musicians, if measured in micro-seconds, are far away from each other. Inevitably, one of the musicians is ahead or behind for a measurable amount of time. This effect is especially detectable with percussive sounding instruments, such as plucked or struck strings.

It, therefore, is the general object of the present invention to provide a musical instrument that reproduces the tonal effects of two musicians playing together on separate instruments, but not completely in time. The invention is applicable to many kinds of musical instruments playing in pairs. For example, the instruments could be a piano and piano, a mandolin and mandolin, or a piano and mandolin. The significant feature of the present invention is that even though two tones are produced by a single instrument, the tones are not precisely in time.

2

Moreover, the amount of time difference between the tonal sources may vary from note to note.

Musical instruments capable of producing dual tones have heretofore been proposed. For example, United States Patent 2,250,065 discloses a piano which is capable of simultaneously producing percussive and sustained notes. However, the notes produced by the instrument disclosed in United States Patent 2,250,065 are simultaneously initiated.

In accordance with the present invention, a musical instrument is provided having at least two tone sources per note. The tone sources may be at different or the same operating frequency. When one of the tone sources is operated, such as by depressing the key, the normal type of sound is generated by the source, but the second source remains dormant as long as the key is depressed. However, when the key is released the second tone source sounds. This causes a time delay between the time the first source is heard and the time that the second source is heard, giving the effect of two separate instruments being played from a single keyboard. The first tone source may be either mechanically or electrically produced and the second tone source is electrically produced.

It, therefore, is an object of the present invention to provide a musical instrument capable of producing the effect of two tone sources playing somewhat out of time.

It is another object of the present invention to provide an electrical circuit for initiating a second tone source subsequent to the initiation of a first tone source.

It is still another object of the present invention to provide a musical instrument having at least two tone sources, one of which is delayed in sounding until another tone source has sounded.

It is yet another object of the present invention to provide an electrical delay circuit for preventing the sounding of a second tonal source until after the initiation of a first tonal source.

It is yet another object of the present invention to provide a keyboard type of musical instrument wherein depression of the key initiates a first tonal source and release of the key initiates a second tonal source.

It is still another object of the present invention to provide a keyboard type of string instrument wherein depression of the key mechanically initiates vibration of the string to produce a tonal effect, and release of the key electronically initiates a second tonal source.

It is a further object of the present invention to provide an electronic musical instrument of the keyboard type wherein depression of a key causes a first electrical tone source to sound and release of the key causes a second electrical tone source to sound.

Other objects will appear hereinafter.

For the purpose of illustrating the invention, there are shown in the drawings forms which are presently preferred; it being understood, however, that this invention is not limited to the precise arrangements and instrumentalities shown.

FIGURE 1 is a side elevational view of a standard piano action incorporated in the musical instrument of the present invention.

FIGURE 2 is a schematic diagram illustrating the piano action of FIGURE 1 and the associated electrical circuitry.

FIGURE 3 is a schematic diagram illustrating a second embodiment of the present invention employing a keyboard and associated electric circuitry.

Referring now to the drawing in detail, wherein like numerals indicate like elements, there is shown in FIGURE 1 a piano action designated generally as 10.

As shown, the piano action 10 includes a key 12 supported by the frame 16 for pivotable movement about a balance rail 18. A balance key pin 20 extends through a wedge-shaped hole 22 in the key 12. The head of pin 20 is enlarged and acts as the fulcrum for the key 12. The key frame 16 supports a pair of cushions 22 and 24 adjacent the ends of key 12 to provide a sound deadened limit stop for the movement of the key 12.

Downward movement of the key 12 causes the normally open switch 26 to close. The purpose of switch 26 will become apparent from the description provided below.

The piano action 10 is intended to transmit the downward movement of the key 12 into an upward movement of the hammer 28. Hammer 28 is aligned with a string 30 which will vibrate when properly struck by the hammer 28. Hammer 28 is mounted to the end of hammer shank 31 which is pivotably secured to a frame 32. In its inoperative position, the hammer shank 31 rests on the hammer rest 34. The hammer shank 31 has a hammer shank knuckle 36 associated therewith and rests on a suitable jack 38.

A capstan screw 40 is adjustably threaded in the key 12 adjacent the inner end thereof. The capstan screw 40 transmits the upward rotative movement of key 12 to a support 42 which is pivotably mounted for rotative movement about the frame 32. The jack 38 is pivoted about the opposite end of support 42 so that upward movement of capstan screw 40 causes the jack 38 to force the knuckle 36 upwardly. Upward movement of the knuckle 36 is transmitted to the hammer 28 which then strikes the string 30. A balancier 44 is pivotably mounted for rotative movement about a top flange of the support 42. The balancier 44 guides the jack 38 in its upward movement.

After the hammer 28 strikes the string 30, the jack 38 is biased to its initial position by a repetition spring 46. The balancier 44 is returned to its initial position by a second repetition spring 48. A hammer check 50 is mounted at the end of key 12 to cushion return of hammer 28 after completion of a stroke.

The elements of the action 10 are conventional and form a portion of a grand piano action. This type of action has been described to illustrate one form of the invention, but it will be readily understood by those skilled in the art that other types of piano actions can be used.

When the key 12 is depressed, the hammer 28 strikes the string 30 causing it to vibrate. As is conventional, the string 30 is tuned to a predetermined frequency and produces an audio tone at that frequency. In accordance with the present invention, the string 30 constitutes a tone source.

Depression of the key 12 also causes the switch 26 to close. The key 12 and switch 26 have been diagrammatically illustrated in FIGURE 2. Switch 26 is normally open and when closed, permits the application of a positive voltage to the emitter and base terminal of PNP transistor 52. The positive voltage is applied to the emitter through a blocking diode 54. The application of equal positive voltages to both the base and emitter of transistor 52 prevents the same from conducting because a PNP transistor requires the emitter to be positive with respect to the base in order to sustain conduction. In the circuit shown, the base and the emitter are at the same voltage when switch 26 is closed by key 12.

Closing switch 26 also permits the capacitor 56 to be charged through resistor 58. Capacitor 56 is connected to ground as is base resistor 61.

The collector of transistor 52 is connected to the oscil-

lator 60 and to one terminal of the ground connected capacitor 62. As shown, the oscillator 60 is of the Hartley type and includes a split inductance 64, a transistor 66, as well as associated tuning capacitors and resistances. The operation of a Hartley oscillator, such as the oscillator 60, is well known to those skilled in the art and therefore need not be described in detail.

The output of oscillator 60 is applied to an audio amplifier and wave shaping circuit 68. The circuit 68 amplifies the signal generated by oscillator 60 and modifies the wave form so as to provide the necessary harmonics and overtones that give the tone its characteristics. The electrical signal output of circuit 68 is applied to an audio transducer, such as speaker 70, which transduces it into sound. The circuit 68 and audio transducer 70 are well known to those skilled in the art and therefore need not be described in detail.

From the foregoing, it is apparent that when the key 12 is depressed, the string 30 will sound, but the bias on transistor 52 will prevent the voltage from being applied to oscillator 60. Therefore, so long as the key 12 is depressed, the tone source represented by oscillator 60, audio amplifier and wave shaping circuit 68 and transducer 70 will remain silent. When key 12 is released, the positive voltage from the B+ source will no longer be applied to the circuit. However, the previously charged capacitor 56 will discharge through the resistor 58 and apply a positive voltage to the emitter of transistor 52. Because the base of transistor 52 is now isolated from capacitor 56 by the blocking diode 54, the emitter will be positive with respect to the base and transistor 52 will conduct. Once transistor 52 is in conducting condition, the oscillator 60 will sound and the signal thus produced will be shaped and amplified by the circuit 68 and converted into a tone by the transducer 70. The tone thus produced will be a decaying transitory sound and will continue while capacitor 56 discharges.

As indicated above, the collector of transistor 52 is also connected to a ground capacitor 62. The capacitor 62 is charged by the decaying current from capacitor 56. The capacitor 62 insures that the tone issuing from transducer 70 will fade out smoothly. Thus, as is characteristic with all transistors, the transistor 52 will not conduct when the voltage difference between its emitter and base falls below a certain value. If this condition were allowed to remain unremedied, the tone issuing from transducer 70 would stop suddenly in a manner uncharacteristic of musical instruments. But in the circuit illustrated, the now charged capacitor 62 will discharge when transistor 52 ceases to conduct, thereby ensuring a smooth and uninterrupted fading out of the tone source.

In playing a piano, of which the key 12 represents but one key on an entire keyboard, the normal procedure is to strike and subsequently release the key. Thus, the string 30 will sound first and the tone source generated by the circuitry illustrated in FIGURE 2 will sound sometime thereafter. In both instances, the tone is transitory and decaying in amplitude. The amount of time between the initiation of the first tone source represented by the string 30 and the second tone source represented by the oscillator 60, audio amplifier and wave shaping circuit 68 and transducer 70 will depend upon how quickly the key 12 is released. Invariably, the human element will cause this amount of time to vary. Thus, the overall effects will be that of two instruments playing together but with one of the instruments being slightly behind the other.

The type of tone produced by the electronic circuitry shown in FIGURE 2 is entirely a matter of choice. Thus, the circuitry could be designed to produce a piano tone almost identical with the tone produced by the string 30. It could also be designed to produce the tone of other types of musical instruments which would accompany the piano 30. A still further variation could be a modification of the circuitry shown in FIGURE 2 to produce

a piano tone but at a higher or lower frequency relative to that of the string 30.

The following components may be employed for the circuit illustrated in FIGURE 2. The values are given only for the purpose of illustration and are not to be construed as limiting.

Transistor 52	-----	2N591
Diode 54	-----	1N1693
Capacitor 56	-----	microfarads 150
Capacitor 62	-----	do 5
Resistor 58	-----	ohms 22
Resistor 60	-----	do 5,600

Referring now to FIGURE 3, there is shown another embodiment of the present invention. In this embodiment, both tone sources are electrically generated.

As shown, two key contactors 112 and 212 are schematically illustrated. The keys 112 and 212 represent a portion of a keyboard for the musical instrument. Only two such keys have been illustrated to simplify the description of the invention, but it will be readily appreciated that any number of such keys may be employed.

The key 112 is pivotably mounted so as to close the normally open switch 126 when depressed, and the key 212 is similarly mounted to close the normally open switch 226. Closing switches 126 and 226 permits a positive voltage to be applied to the emitters of transistors 152 and 252 through the blocking diodes 154 and 254. The emitter terminals of transistors 152 and 252 are connected to resistors 158 and 258 which are connected in series with the capacitors 156 and 256. Capacitors 156 and 256 are connected to the ground. The base terminals of transistors 152 and 252 are connected through resistors 161 and 261 to the ground. The collector terminal of transistor 152 and 252 are connected to oscillators 160 and 260. Capacitors 162 and 262 are connected between ground and the collector terminals of transistors 152 and 252. The oscillators 160 and 260 may be of the Hartley type.

From the foregoing, it should be apparent that the circuitry described above is the same as that illustrated in FIGURE 2. The electrical values of the circuit elements are the same. Thus, the transistors 152 and 252 will block the initiating of oscillators 160 and 260 until the keys 112 and 212 are released.

The switches 126 and 226 are also connected to electrical tone generators through the diodes 171 and 271. As shown, the diode 271 is connected to the oscillator 272 which in turn is connected to an audio amplifier and wave shaping circuit 274. The circuit 274 is connected to a transducer 276 which may be a loud speaker. The diode 171 is connected to a similar circuit which is not shown. A capacitor 278 is connected between ground and the anode of diode 271.

When either or both of the key contactors 112 and 212 is depressed, a positive voltage is applied through diodes 171 and 271 to their respective oscillators. The oscillators generate an electronic signal, which is applied to the respective audio amplifier and wave shaping circuits, such as circuit 274, and then transduced into a tone by the transducer 276. The tone signal from transducer 276 is initiated by the depression of key 212. A different tone will initiate from a transducer (not shown) when the key 112 is depressed.

When either the key 112 or 212 is released, the respective transducers 152 and 252 will become conductive and the oscillators 160 and 260 will generate an electronic signal. In accordance with the principles described above, the electronic signal from the oscillators 160 and 260 are applied to the audio amplifier and wave shaping circuits 168 and 268. The output of these circuits is then transduced into tones by the audio transducers 170 and 270.

The key 212 may represent one particular note on an

entire keyboard and the key 112 another note. When key 212 is depressed, the first tone source represented by oscillator 272, circuit 274 and transducer 276 operate to produce a tone. As soon as key 212 is released, the second tone source represented by oscillator 260, circuit 268 and transducer 270 sounds. The same sequence of operation applies to key 112.

As discussed above in respect to FIGURES 1 and 2, the delay in sounding of the second tone source initiated by the release of each key is controlled by the amount of time the key is depressed. It therefore varies in accordance with the manner in which the instrument is played.

The first tone source connected to each key may produce any one of a plurality of tones, such as an organ tone, piano tone, mandolin, guitar, harpsichord, etc. The second of delayed tone source may represent the same or different instruments playing the same notes or different notes slightly behind the first tone source. It has been found that the overall effect is particularly effective when the second tone source is percussive; that is, when the second tone source represents the type of tone produced by a plucked or struck string. The effect described above may be even further enhanced by stereophonically separating the transducers for each tone source.

The present invention may be embodied in other specific forms without departing from the spirit or essential attributes thereof and, accordingly, reference should be made to the appended claims, rather than to the foregoing specification as indicating the scope of the invention.

I claim:

1. An individual operated musical instrument for creating the tonal sound of a plurality of musicians simultaneously playing the same musical composition on separate instruments comprising a plurality of tone generators for each tone, each of said tone generators simulating the sound of a different one of said separate instruments, a contact, means for actuating a first one of said plurality of tone generators in response to actuation of said contact and means for actuating a second one of said plurality of tone generators in response to the deactuation of said contact.

2. Apparatus in accordance with claim 1 wherein said separate instruments are of the same type.

3. Apparatus in accordance with claim 1 wherein said separate instruments are of different types.

4. Apparatus in accordance with claim 1 wherein said first tone generator comprises a piano string actuated by a piano action.

5. Apparatus in accordance with claim 1 wherein there are two of said separate instruments.

6. Apparatus in accordance with claim 1 wherein said means for actuating said second one of said plurality of tone generators comprises a first electronic storage means, means for charging said first storage means when said contact is actuated, means for discharging said first storage means when said contact is deactuated, said first storage means actuating said second one of said plurality of tone generators when said first storage means is discharging, a second electronic storage means, means for charging said second storage means when said first storage means is discharging, means for discharging said second storage means when the discharge of said first storage means ceases, said second storage means actuating said second one of said plurality of tone generators immediately after said first storage means ceases to actuate said second one of said plurality of tone generators.

7. An electronic tone generator comprising a key contact, a first tone generator for producing a tone upon the closing of said key contact, a second tone generator for producing a tone upon the opening of said contact, electronic means intermediate said contact and said second tone generator for interrupting and storing electrical energy flowing to said second tone generator when said key contact is closed and releasing stored electrical energy to

energize said second tone generator when said contact is opened, said electronic interrupter and storage means comprising a transistor, the emitter terminal of said transistor being connected to the cathode of a diode, the anode of said diode being connected to the base terminal of said transistor, a resistor connected in series with a capacitor, said resistor being connected to the emitter terminal of said transistor and said capacitor being connected to ground potential, a second resistor, said second resistor being connected to the base terminal of said transistor and to ground potential, the collector terminal of said transistor being connected to said second tone source.

5

10

References Cited

UNITED STATES PATENTS

2,250,065	7/1941	Koehl	84—1.01
2,305,575	12/1942	Koehl	84—1.27
2,492,320	12/1949	Riggen	84—1.24
3,037,413	6/1962	Markowitz	84—1.24

ARTHUR GAUSS, *Primary Examiner.*

H. A. DIXON, *Assistant Examiner.*

U.S. Cl. X.R.

307—246, 253