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MULTIVIBRATOR FREQUENCY DIVIDER CHAIN FOR MUSICAL INSTRUMENT EMPLOYING A MASTER OSCILLATOR WHICH IS STEP FREQUENCY ADJUSTABLE AND A TWIN-T VIBRATO OSCILLATOR

Filed Aug. 26, 1966 2 Sheets-Sheet 1

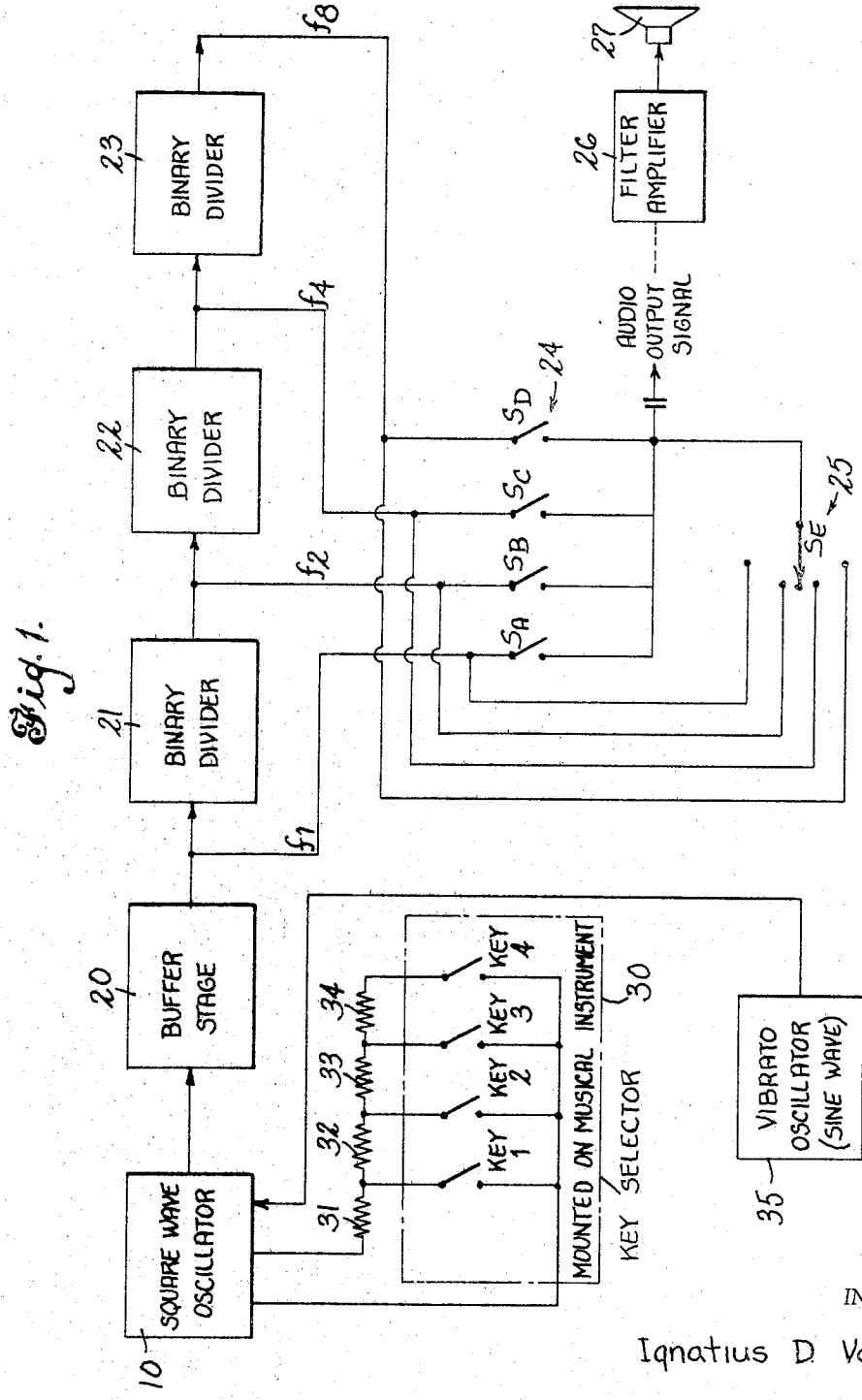


Fig. 1.

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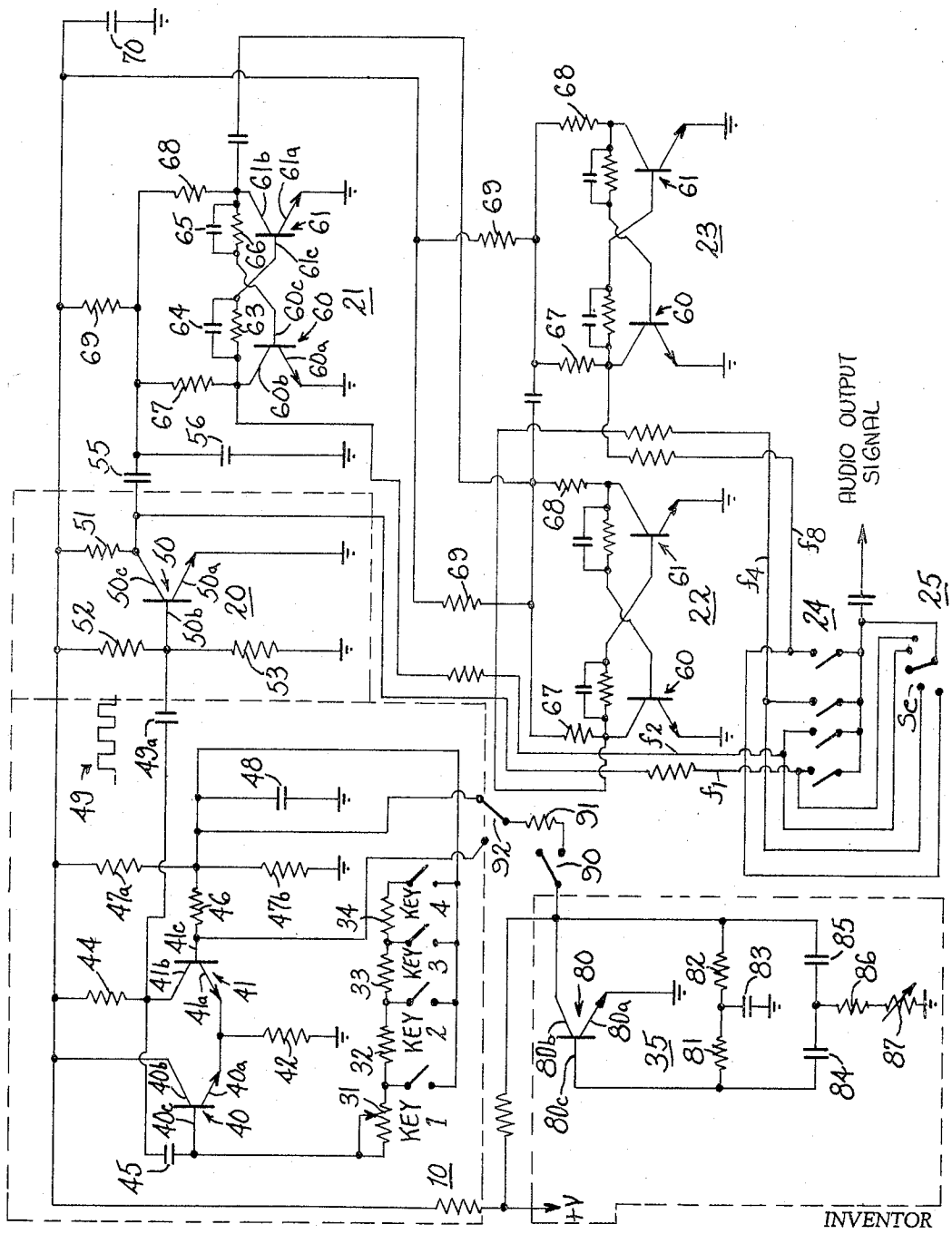


Fig. 2.

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MULTIVIBRATOR FREQUENCY DIVIDER CHAIN FOR MUSICAL INSTRUMENT EMPLOYING A MASTER OSCILLATOR WHICH IS STEP FREQUENCY ADJUSTABLE AND A TWIN-T VIBRATO OSCILLATOR

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ABSTRACT OF THE DISCLOSURE

This disclosure relates to a tone producing system wherein a first oscillator provides a manually selectively variable frequency. The oscillator is arranged to have its signal phase shifted at a predetermined frequency to provide a vibrato effect. The output frequency of the oscillator is further divided to provide musical tones over a wide frequency range.

This invention relates generally to musical instruments and more particularly to a device for providing musical accompaniment for a musical instrument.

In the past there have been disclosed various electronic devices for providing an electronic generated sound to accompany the playing of a musical instrument. The prior art shows these electronic devices as being controlled by the keys of an instrument, such as an accordian. The control keys have been arranged to set the frequency of the sound produced by the electronic device, so as to provide an accompaniment for the melody played on the instrument itself. In order to simulate the vibrato effect of an instrument, there has also been incorporated in the prior art devices means for amplitude modulating the electronic signal provided.

Although such systems have been available for many years, they have not obtained wide acceptance because of the electronic type of sound produced by the device. Furthermore, the prior art devices were quite limited in the frequency range which they could provide, due primarily to the manner in which the electronic sound was generated.

Therefore, to overcome the disadvantages of the prior art as well as to provide an electronic device which emits a sound closely simulating the tonal qualities of the musical instrument itself, applicant has invented a new and improved device.

Accordingly, it is an object of this invention to provide a new and improved device for generating a sound to accompany the playing of a musical instrument.

Another object of the invention is to provide a new and improved device simulating the sound of a musical instrument.

A further object of the invention is to provide a new and improved device for simulating the vibrato effect produced while a musical instrument is played.

An additional object of the invention is to provide a new and improved electronic device for providing music over a wide frequency range to accompany the playing of an instrument.

A further object of the invention is to provide an electronic device which is capable of providing tonal accompaniment simultaneously in two or more different frequency ranges.

Still other objects and advantages of the invention will in part be obvious and will in part appear from the specification.

The invention accordingly comprises the features of construction, combinations of elements and arrangements

of parts which will be exemplified in the constructions hereinafter set forth and the scope of the invention will be indicated in the claims.

For a fuller understanding of the nature and objects of the invention, reference is had to the following detailed description taken in conjunction with the accompanying drawings, in which

FIG. 1 is a block diagram of the device according to the invention; and

FIG. 2 is a schematic diagram illustrating the circuitry for implementing the device according to the invention.

Referring to FIG. 1, there is shown in block diagram form a device for providing an electronic sound to accompany the playing of a musical instrument. At **10** there is shown an oscillator, such as a square wave oscillator, for producing a square wave signal at a frequency f_1. This signal at the frequency f_1 is then transmitted through a buffer stage **20** to avoid loading or interaction of the subsequent circuitry with the oscillator **10**. The signal from the buffer stage **20** is then fed into a first binary divider **21** where the fundamental frequency f_1 is divided by a figure of 2 to provide a signal at a frequency f_2. The frequency f_2 is then fed from the binary divider **21** to the binary divider **22** whereby the frequency f_2 is divided by two, resulting in a frequency of f_4 which is one-quarter of the fundamental frequency of f_1. The signal f_4 is subsequently divided by a third binary divider **23** to provide a signal of f_8 which is one-eighth of the fundamental frequency of f_1.

By means of switches S_a–S_d shown at **24**, any of the four harmonics or combinations of the four harmonics may be selected. It is to be understood that additional binary divider stages may also be incorporated to produce a greater number of different frequency signals. If desired, the harmonics f_1–f_8 may be separately selected by a rotary switch S_e shown at **25**. These signals, noted as the audio-output signals, are then transmitted through a filter amplifier **26** to a loudspeaker **27**.

In order to select the frequency at which the fundamental frequency oscillator **10** is operated, there is provided a key selector **30** which could be mounted on a musical instrument such as an accordion, piano, etc., for controlling the plurality of resistors **31–34** which are coupled in circuit with the square wave oscillator **10**. By depressing the various keys shown at **1–4** in the form of contacts which are actuated by depressing the keys of the instrument, such as an accordion, certain ones of the resistors or combinations of the resistors **31–34**, may be selected to vary the oscillation frequency of the square wave oscillator **10**. A key arrangement of this type is shown in a patent to Martin 2,563,477 issued Aug 7, 1951.

In order to provide the vibrato effect, that is, a quivering effect encountered when listening to a wind instrument, there is provided a vibrato oscillator which produces a sine wave frequency signal at a frequency much less than the frequency of oscillation of the square wave oscillator **10**. This modulating signal is applied to the square wave oscillator **10**, such that a phase shifting of the oscillator signal is caused to occur at the same rate as the frequency of the signal provided from the vibrato oscillator **35**.

In order to implement the block diagram of FIG. 1, reference should now be had to FIG. 2 wherein there is shown in schematic form the circuitry according to the invention. The various blocks shown in FIG. 1 are also shown in FIG. 2, wherein corresponding numbers, i.e. **10**, **20–23**, **30** and **35**, refer to the same device shown in block form in FIG. 1.

The square wave oscillator **10** is constructed in the form of a modified RC time constant multivibrator and comprises two NPN transistors **40** and **41** having emitters

40*a* and 41*a*, collectors 40*b* and 41*b*, and bases 40*c* and 41*c*, respectively. The emitters 40*a* and 41*a* are connected together through an emitter resistor 42 to ground. The collector 40*b* is connected to a voltage source +V and the collector 41*b* is connected through a load resistor 44 to the same voltage source +V. In order to provide the positive feedback signals to sustain oscillations, the collector 41*b* is connected through a capacitor 45 to the base 40*c* of transistor 40. As shown in FIG. 2, there are provided resistors 31–34 which are key-actuated by the key selector 30 mounted on the musical instrument. The resistors 31–34 are coupled to base 40*c* of transistor 40 and are connected through keys 1–4 to the base 41*c* through a resistor 46. To set the voltage bias level at the base of transistor 41, there is provided a voltage divider network comprising resistors 47*a* and 47*b*. There is also provided a by-pass capacitor 48 coupled in parallel with resistor 47*b*. The output wave form from the square wave oscillator 10 is shown at 49 and is coupled through a coupling capacitor 49*a* to the buffer stage 20. The rate of oscillation of oscillator 10 is established by the RC constant which is determined by the value of capacitor 45 and the resistance of the selected resistors 31–34 respectively.

The buffer stage 20 comprises an NPN transistor 50 having an emitter 50*a*, a collector 50*b* and a base 50*c*. The voltage at base 50*c* is set by the voltage divider network, comprising resistors 52 and 53 respectively. The emitter 50*a* is grounded and the collector 50*b* is connected to a load resistor 51 to a source of positive voltage +V. The stage 20 operates as a buffer amplifier to avoid loading or interaction of the subsequent circuitry with the oscillator 10.

The output signal from the buffer stage 20 is then fed into the first binary divider stage 21. The first binary divider stage 21 is then coupled to a second binary divider stage 22 which again divides the signal provided from the buffer stage 20. The last-mentioned divider stage 22 is then coupled to a third divider stage 23 which also operates on the signal provided from the buffer 20 to again divide it by two.

Thus the frequency f_1 is successively divided down by an integer which, in this case, is selected as two. It is to be understood that other divider values may be selected without departing from the spirit and scope of this invention. Inasmuch as the binary dividers are substantially identical in form, they will all be described simultaneously.

The binary dividers 21–23 are in the form of triggered multi-vibrators. They are responsive to the signals provided from the buffer stage 20. The signals from buffer stage 20 are provided to the first binary divider stage 21 through an input capacitor 55 which is in turn shunted by a capacitor 56. The dividers 21–23 comprise transistors 60 and 61 having emitters 60*a* and 61*a*, collectors 60*b* and 61*b*, and bases 60*c* and 61*c*, respectively. Coupled between the collector 60*b* and the base 61*c* are resistor 63 and capacitor 64 which form a commutating network. There is also coupled to collector 61*b* and base 60*c* of transistor 60, another commutating network shown comprising a capacitor 65 and a resistor 66. The collectors 60*b* and 61*b* are coupled through trigger and load resistors 67 and 68 respectively which are, in turn, coupled through a resistors 69 to the voltage source. A high frequency bypass capacitor 70 is provided across the voltage source +V, as shown.

A description of a bi-stable multi-vibrator as utilized herein, may be found by reference to the text "Pulse and Digital Circuits," Millman and Taub, (1956) published by McGraw Hill, and in particular, Chapter 5 of said text.

The binary dividers are coupled together such that they form a chain to provide signals at a frequency of f_2 which is equal to f_1 divided by two, f_4 which is equal to f_1 divided by four, and f_8 which is equal to f_1 divided by eight. These signals may then be combined by the utilization of switches 24 and 25 to provide a combination of, or individual ones of, these signals. In this manner, over three and one-half octaves of tonal accompaniment may be provided.

As mentioned previously, although the dividing chain utilized herein provides division to the base two, division may be accomplished to a different base. For example, in Chapter 11 of the aforementioned text "Pulse and Digital Circuits," there is shown a sixteen binary divider chain modified by feedback techniques to provide a scale of ten binary divider chain. It is therefore to be understood that this invention is not specifically limited to the use of the base two as the divider integer.

As previously disclosed, in order to provide a vibrato effect such as to simulate the playing of a wind instrument, there is shown a vibrato oscillator 35 which comprises an NPN transistor 80 having an emitter 80*a*, a collector 80*b* and a base 80*c*. The emitter 80*a* is grounded and the collector 80*b* and base 80*c* are connected together through twin T-networks comprising resistors 81 and 82, capacitor 83, capacitors 84 and 85, and resistors 86 and 87. These are coupled together to form a twin T phase-shift oscillator which, by virtue of the resistances 81 and 82, capacitors 84 and 85, are made to oscillate at a slow sine wave frequency such as, for example, between 6–18 cycles per second. This signal is then applied to the base 41*c* of transistor 41 of oscillator 10 to phase-shift the output signal provided from the oscillator 10. The modulating signal provided from oscillator 35 will cause the transistor 41 of oscillator 10 to turn on at different times, depending upon the frequency of oscillation of the vibrato stage 35. The vibrato signal is provided through a switch 90 which, in turn, is coupled to a resistor 91 and through a second switch 92. In this manner, the amplitude of the vibrato signal may be controlled.

While it will be understood that the circuit specifications may vary according to the design for any particular application, the following circuit specifications are included for the circuitry of FIG. 2, by way of example only.

All transistors NPN No. MM–2151–2 Motorola.

Resistor 31	Pot. ohms	150
Resistor 32	ohms	15
Resistor 33	do	17
Resistor 34	do	18
Resistor 44	do	2.2K
Capacitor 45	microfarad	.1
Resistor 46	ohms	4.7K
Resistors 47*a*, 47*b*	do	3.3K
Capacitor 48	microfarads	5
Capacitor 49*a*	do	.05
Resistor 52	ohms	120K
Resistor 53	do	10K
Resistor 51	do	4.7K
Capacitors 55, 56	microfarad	.002
Resistors 63, 66	ohms	22K
Capacitors 64, 65	microfarad	.002
Resistors 67, 68	ohms	4.7K
Resistor 69; binary divider 21	do	6.8K
Resistor 69; binary divider 22	do	4.7K
Resistor 69; binary divider 23	do	2.2K
Resistors 81, 82	do	220K
Capacitor 83	microfarad	.7
Capacitors 84, 85	do	.5
Resistor 86	ohms	150
Resistor 87	Pot. ohms	3000
Resistor 91	ohms	330K
In frequency f_1 of oscillator 10	c.p.s	1396.8

It will thus be seen that the objects set forth above, among those made apparent from the preceding description, are efficiently obtained and since certain changes may be made in the above constructions without departing from the spirit and scope of the invention, it is intended

that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the following claims are intended to cover all of the generic and specific features of the invention herein described and all statements of the scope of the invention which, as a matter of language, might be said to fall therebetween.

What is claimed is:

1. In a musical instrument, an oscillator for providing a first signal at a frequency f_1, said oscillator comprising a free-running multivibrator having a resistance-capacitance circuit which determines the frequency f_1, divider means responsive to said first signal for dividing said frequency by a number to provide a second signal at a frequency f_2, and a control unit responsive to the playing of said instrument to control said oscillator in order to set the first signal at a predetermined frequency, said control unit comprising a plurality of resistance elements adapted to be selectively placed in said resistance-capacitance circuit of said multivibrator, said first oscillator comprising first and second amplifying units each having input terminals, said control unit coupled between the input terminals of said amplifying units, and a second oscillator having an output terminal providing a vibrato phase shift signal, said second oscillator having its output terminal coupled to the input terminal of said second amplifying unit.

2. An electronic musical instrument, including a first oscillator, said first oscillator comprising first and second amplifying units each having input and output terminals, energy storage means connected between said input terminals of said first unit to the output terminal of said second unit, a control unit comprising a plurality of resistance means and a plurality of key means for selecting said resistance means, said control unit coupled between said input terminal of said first unit and said input terminal of said second unit, and a second oscillator providing a vibrato frequency shift signal, said second oscillator coupled to said input terminal of said second unit.

3. An instrument in accordance with claim 2, wherein said control unit comprises a plurality of series-coupled resistors and a plurality of key means coupled at one end with each other, said key means coupled at their other ends to said resistors at a point between different ones of said resistors.

4. An instrument in accordance with claim 3, wherein said amplifying units are transistors and wherein said input terminals are base electrodes and said output terminals collector electrodes.

5. An instrument in accordance with claim 2, wherein said second oscillator comprises a twin T phase shift oscillator.

References Cited

UNITED STATES PATENTS

2,128,367	8/1938	Kock	84—1.25
2,563,477	8/1851	Martin	331—144
2,598,790	6/1952	Harrison	331—144
3,286,197	11/1966	Borsattino et al.	331—113
2,545,469	3/1951	Jordan	331—48
3,283,057	11/1966	Campbell	84—1.01
3,358,068	12/1967	Campbell	84—1.01

OTHER REFERENCES

Electronic Musical Instrument Handbook, Crowhurst (April 1962).

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U.S. Cl. X.R.

84—1.01; 331—48, 51, 178, 179