Dec. 19, 1933. C. D. LINDRIDGE 1,940,093

ELECTRIC MUSICAL INSTRUMENT

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FIG. 1

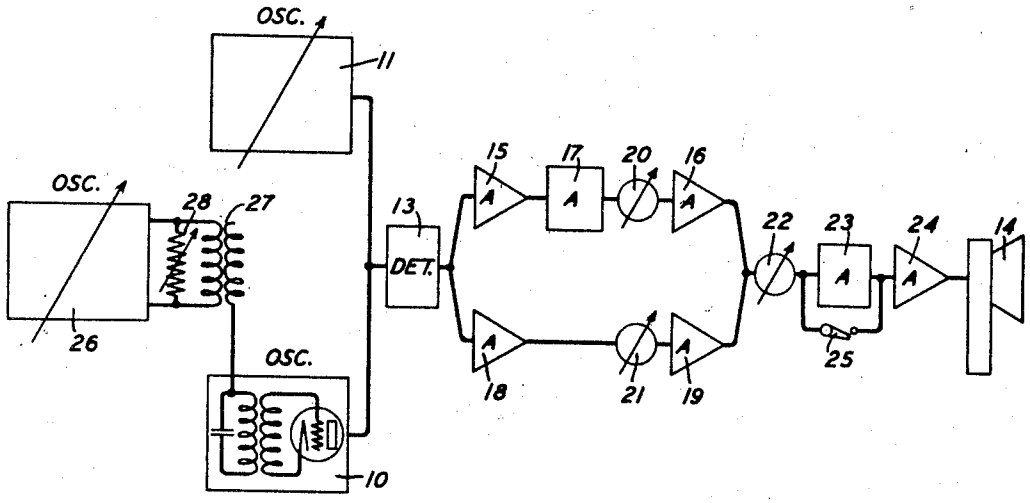
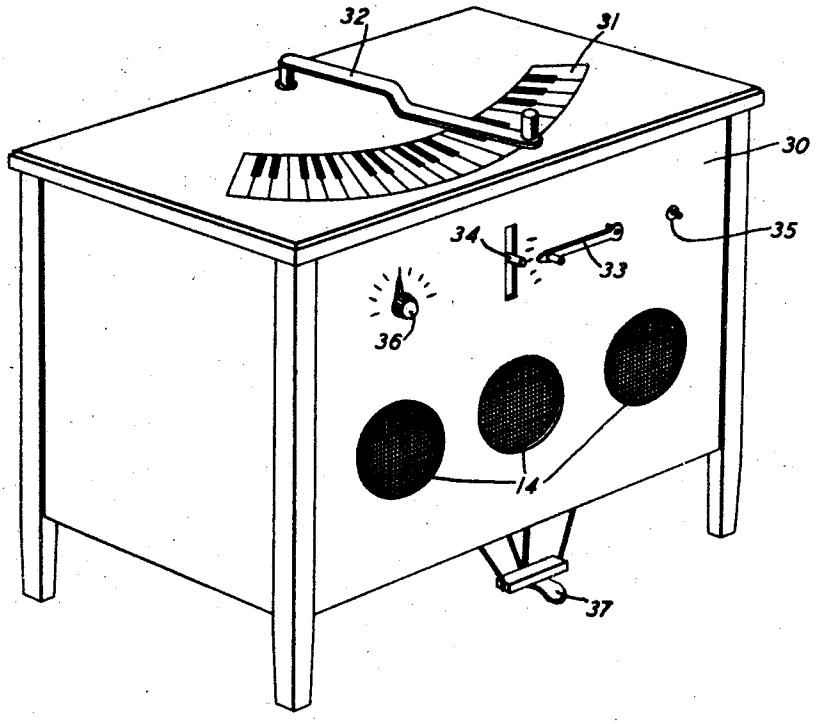


FIG. 2



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ELECTRIC MUSICAL INSTRUMENT

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7 Claims. (Cl. 84—1)

This invention relates to electric musical instruments and particularly to those of the solo type wherein ordinarily but one note is played at a time.

The commonly used solo instruments are divided into three classes; (1) the stringed instruments; (2) the brass-wind instruments; and (3) the wood-wind instruments. With the use of any instrument in any one of these classes the performer must generate the note desired and introduce the expression required for the particular musical composition being played. Expression is introduced by varying the tone and volume and by producing vibrato when required. This last mentioned quality may be defined as a periodic change in pitch on each note played.

The tone quality produced by the commonly used solo instruments is characteristic of the class of instruments in which it is grouped. It is not possible, for example, to produce a string tone by the use of a brass instrument. The limitation which is set by the instrument of the range within which the tone may be changed by the performer constitutes a barrier beyond which the performer cannot go.

Attempts have been made to simplify the process of producing music from an instrument by relieving the performer of the task of generating the note and thus leaving him free to devote his attention to the expression and execution of a number. Such attempts usually have resulted in an electric musical instrument wherein the note is produced by an oscillating electric current of a definite frequency actuating the diaphragm of a receiver. In one form of such an electric musical instrument, the current is obtained from a heterodyne oscillator provided with a means for varying the frequency of the current to give a sequence of notes covering a range comparable to that encompassed by a piano. The currents so produced can be changed in intensity at the will of the performer and modified as to harmonic content by means of overloaded amplifiers to simulate different types of instruments or to secure entirely new tones.

Such electric musical instruments, however, make no provision for uniform tone production independent of volume and make no provision for gradual harmonic accentuation. Without provision for these features the produced music is dull and lacking in interest. They also make no provision for the automatic and readily controllable production of vibrato. Without this latter provision, the performer is greatly restricted in his interpretation of the musical composition.

It is the object of this invention to supply an electric musical instrument which will remedy these defects and give the performer greater freedom in the rendering of a number and place at his disposal improved facilities for musical expression.

In general, the electric musical instrument embodying this invention is comprised of two oscillators forming a heterodyne oscillator, a detector, amplifiers, volume controls and a receiver of the type generally known as a loud speaker. The vibrato is produced by periodically varying the frequency of one of the oscillators of the heterodyne oscillator. This is accomplished by means of a third oscillator, the frequency of which can be varied from about 15 cycles to 40 cycles. The change in tone quality is secured with overloaded amplifiers so disposed with respect to the volume controls and detector in accordance with a feature of this invention that some operate at the constant output of the detector thereby maintaining substantially the same tone quality at all volume levels, while others operate at the varying output of the volume controls and change tone quality with increase in volume level.

For a better understanding of this invention reference may be had to the following specification taken together with the accompanying drawing in which:

Fig. 1 is a diagram showing how the various units are connected together; and

Fig. 2 is a perspective of the cabinet or housing for the instrument showing the location of the controls.

Referring now to Fig. 1, 10 is a fixed oscillator operating at a frequency of about 80,000 cycles and 11 is a variable frequency oscillator which is used with the fixed oscillator 10 to produce a beat frequency according to the heterodyne principle. By means of the variable oscillator 11, beat frequencies corresponding to fundamental notes can be produced covering a range encompassed by a piano. The oscillators may be of the vacuum tube type which is well known in the art and need not be described here.

The outputs of the oscillators are combined in the detector 13, which may be of either the vacuum tube or the crystal type and the combined current is then sent through the amplifiers and tone modifiers to the receiver 14. For high quality instruments a plurality of receivers may

be used each receiver being designed to cover a given frequency range.

The amplifiers used are arranged in three groups, two of which are connected to the output of the detector and the third is connected to the outputs of the two groups through a volume control. In the first of the groups are two distortionless amplifiers 15, 16 and an overloaded amplifier 17 which is used to introduce harmonics into the pure sine wave current produced by the heterodyne oscillators, while the second group contains only the conventional distortionless amplifiers 18, 19. Volume controls 20 and 21 which are merely variable resistances are employed in each group to mix the two currents in any desired proportion or to eliminate one entirely and make the other operative exclusively. By this means different combinations of harmonics can be obtained and one tone quality can be merged into another tone quality. Furthermore, the range of pitch is considerably greater than the range usually obtained in the commonly used solo instruments and many novel and beautiful effects can thus be secured. As the volume control 20 is connected to the output of the overloaded amplifier 17, the latter operates at the constant output of the detector 13 and intermediate amplifier 15 and hence the harmonic content of the current leaving the amplifier 17 is unaffected by subsequent changes in the strength of the current operating the receiver 14.

In the second group is placed the volume control 21 together with the distortionless amplifiers 18 and 19, the object of this group being merely to amplify the output of the detector 13 without changing the harmonic content of the current.

Both groups are then combined in a volume control 22 which is connected to the third group of amplifiers comprising a second overloaded amplifier 23 followed by another conventional amplifier 24. The receiver 14 is connected to the output of the amplifier 24. The overloaded amplifier 23 operates at the varying output of the volume control 22 and therefore changes harmonic content with volume changes. This effect is used chiefly for the tone of the brass instruments and the amplifier may be short-circuited by a switch 25 whenever changes in volume unaccompanied by changes in harmonic content are desired.

Where the complete tone change provided by volume controls 20 and 21 is not required a volume control (not shown) may be inserted in the output of the detector 13. This provides for a modified variation of the degree of overload of the overload amplifier 17.

The foregoing description relates to the generation of a fundamental note and its subsequent modification by my combination of amplifiers and controls to produce the tone of various solo instruments, or to secure novel tones. The notes or tones so produced, however, are perfectly even in pitch and hence monotonous and lacking in beauty. In solo instruments now in use this monotony is eliminated by periodically varying the pitch of the note to secure vibrato. To be effective, the vibrato must be variable in intensity and frequency at the will of the performer. In the instruments now in general use vibrato is produced and controlled with great difficulty and lack of proper control results in detrimental effects to the note and tone generated.

In the present invention, I secure a vibrato effect electrically without any moving parts, which is variable as to frequency and intensity and is under the control of the performer. The means used is a vacuum tube oscillator 26, the frequency of which can be made to vary from 15 to about 40 cycles per second. It may be coupled to either oscillator of the heterodyne oscillators 10, 11 through a coupling 27 which is shown in the drawing for purpose of illustration as a transformer, of which the capacity effect between the coils is used. A transformer is more suitable for use as this coupling than a condenser would be as energy from the oscillator 26 can thus be more readily impressed upon the oscillator 10. The intensity of the current produced by oscillator 26 is regulated by a variable resistance 28 operated by the foot of the performer.

A housing which may be used for this instrument is shown in Fig. 2, although no particular form is required for the operation of the instrument and its design may take any form the builder desires. The amplifiers may, for example, be housed separately.

The oscillator, detector, amplifiers and controls are placed within the cabinet 30 which is about thirty inches long, twenty-five inches wide and thirty inches high. On the top is a semi-circular chart 31 marked off to resemble a piano keyboard. Over the chart is an arm 32 rotating about the center of curvature of the chart and secured to the frequency changing means of the variable oscillator 11 (Fig. 1). This arm and chart are used for selecting the fundamental note. In front of the cabinet is a second lever 33 which operates volume control 22. Lever 34 operates volume controls 20 and 21 but is marked "Quality control" since it is so linked to the volume controls that it increases the resistance in 20 when it decreases the resistance in 21, and vice versa, thereby permitting any desired mixture of the output of the two groups of amplifiers and hence the selection of any tone quality. Switch 25 which cuts in overloaded amplifier 23 for the production of the heavy brass tone is controlled by knob 35.

The vibrato controls are the knob 36 and the foot pedal 37, the former controlling the frequency of the oscillator 26 and the latter its intensity through the resistance 28. The receivers 14 may be placed beneath the cabinet 30 or, if desired, may be located in a separate cabinet (not shown).

What is claimed is:

1. In an electric musical instrument a heterodyne oscillator for producing a current corresponding to a fundamental note and a second oscillator of a low frequency cooperating with the heterodyne oscillator to produce a periodic variation in the current to simulate vibrato in the fundamental note.

2. In an electric musical instrument, a heterodyne oscillator for producing a current corresponding to a fundamental note and a second oscillator of low and variable frequency cooperating with the first oscillator to produce a periodic variation in the current to simulate vibrato in the fundamental note.

3. In an electric musical instrument, a heterodyne oscillator for producing a current corresponding to a fundamental note and a second oscillator of a low frequency cooperating with the first oscillator to produce a periodic variation in the current to simulate vibrato in the fundamental note, the current of said low frequency oscillator being controllable in intensity.

4. In an electric musical instrument, an oscil-

lator of fixed frequency, an oscillator of variable frequency, an oscillator of low and variable frequency, means to combine the fixed frequency oscillator with the variable frequency oscillator to produce a current corresponding to a fundamental note, and means to cause the low and variable frequency oscillator to vary the frequency of one of the other two oscillators to simulate vibrato in the fundamental note.

5. In an electric musical instrument, an oscillator of fixed frequency, an oscillator of variable frequency, an oscillator of low and variable frequency, means to combine the fixed frequency oscillator with the variable frequency oscillator to produce a current corresponding to a fundamental note, and means comprising a transformer, one coil of which is connected to the output of the low and variable frequency oscillator, and one terminal of the second coil is connected to the grid of one of the other oscillators, the second terminal being left open, to couple the low and variable frequency oscillator with one of the other two oscillators to periodically vary its frequency thereby simulating vibrato in the fundamental note.

6. In an electric musical instrument the combination of means for producing a current corresponding to a fundamental note, a current intensity control, means independent of and means dependent upon the intensity control setting for adding harmonics to the current whereby either the wood-wind or brass-wind types of instruments can be simulated.

7. In an electric musical instrument, means for producing a current having a frequency corresponding to a fundamental note, means for controlling the intensity of the current, an overloaded amplifier to introduce harmonics into the current before the current is modified by the current intensity control, and a second overloaded amplifier to introduce harmonics into the current after the current is modified by the current intensity control, each of said overloaded amplifiers being controllable so that one can be made operative to the exclusion of the other thereby permitting tone quality changes in the note either independent of or with current intensity changes.

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