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S. L. KRAUSS

2,806,953

ELECTRONIC OSCILLATOR FOR PRODUCING FREQUENCIES OF MUSICAL TONES

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2 Sheets-Sheet 1

Fig. 1.

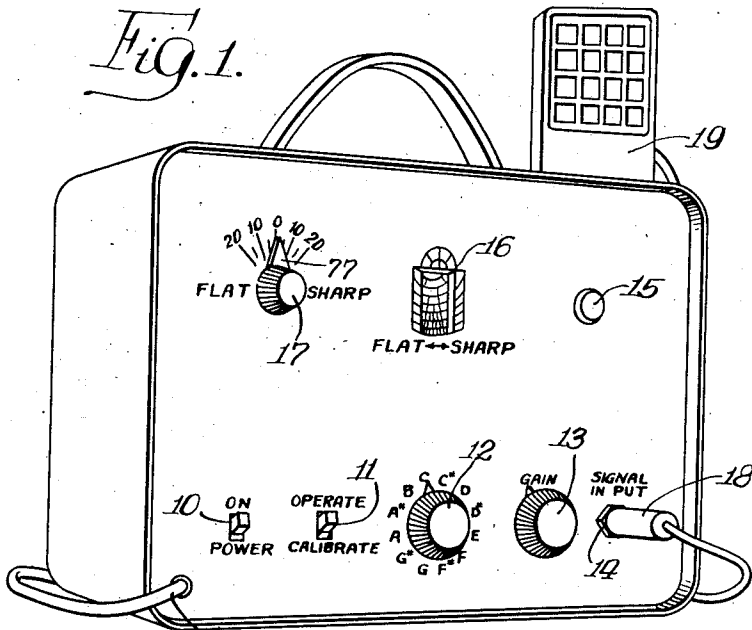


Fig. 2.

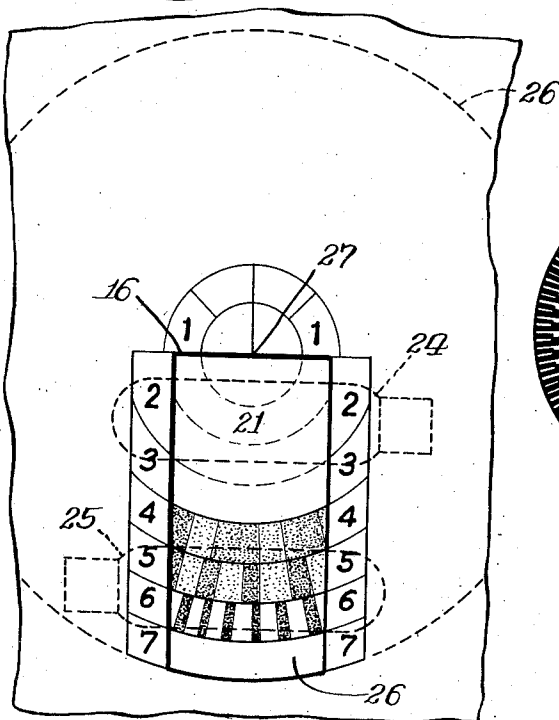
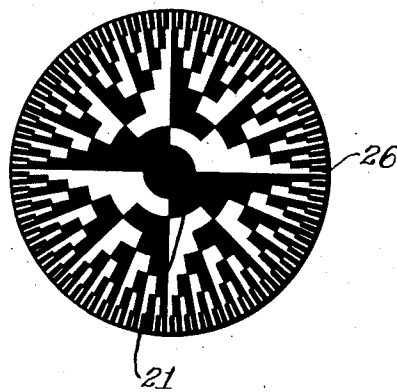


Fig. 3.



INVENTOR.
Serge I. Krauss
BY
Mueller & Aichele
Attys.

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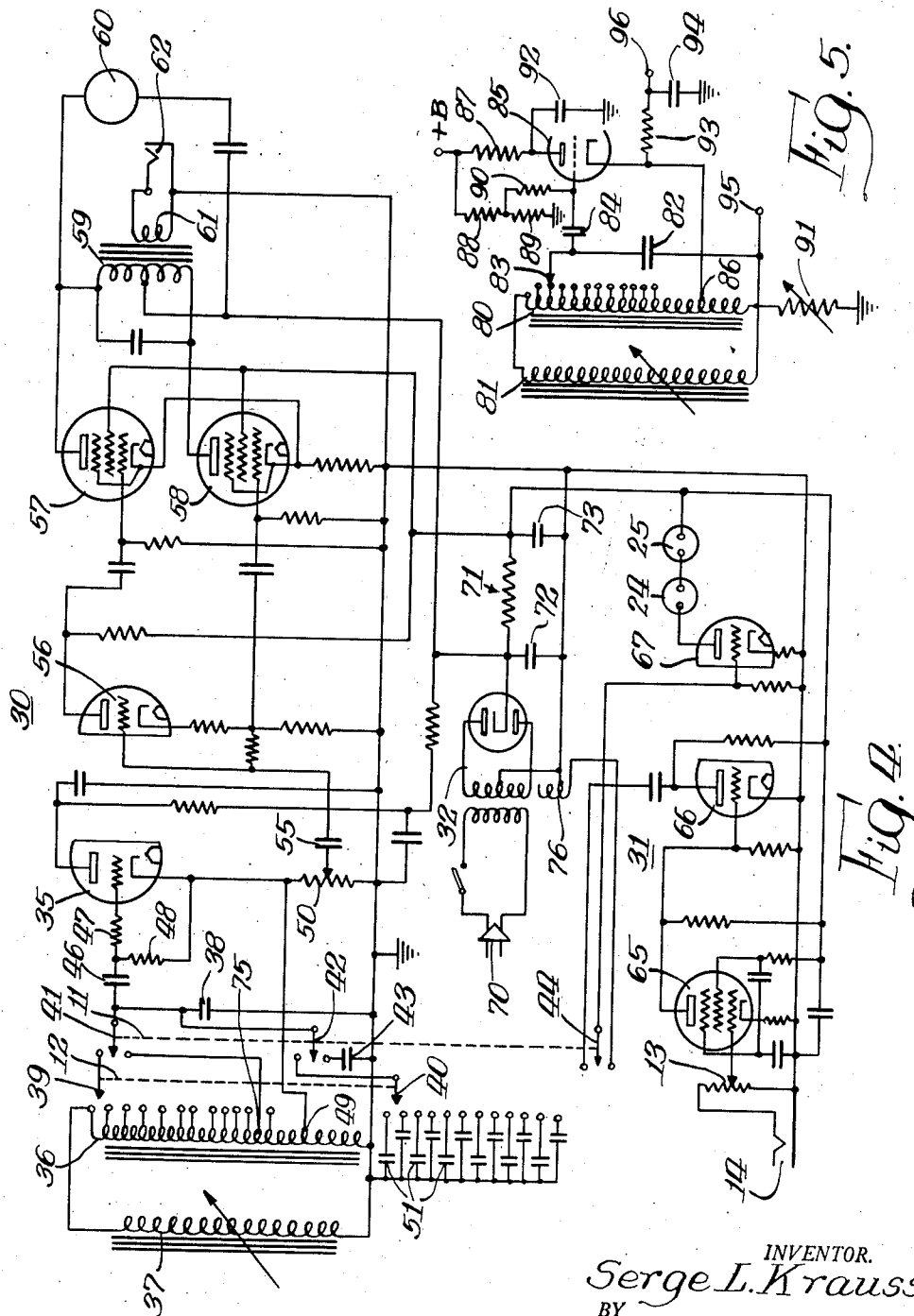
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2 Sheets-Sheet 2



INVENTOR.
Serge L. Krauss,
BY
Mueller & Pichler
Attys.

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ELECTRONIC OSCILLATOR FOR PRODUCING FREQUENCIES OF MUSICAL TONES

Serge L. Krauss, Elkhart, Ind., assignor to C. G. Conn Ltd., Elkhart, Ind., a corporation of Indiana

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9 Claims. (Cl. 250—36)

This invention relates generally to electrical musical instruments and tuning instruments therefor, and more particularly to such instruments having an improved oscillator which provides a plurality of notes of desired frequencies.

Electrical instruments are in common use both for generating musical tones and for providing standard frequencies for tuning musical instruments. In such instruments it usually has been necessary to provide a different oscillator for each tone generated resulting in an expensive unit. Although some instruments have used a single oscillator for producing a plurality of tones, these instruments have been difficult to tune so that the exact frequency of the note can be set at a desired value. Other instruments of this type have required very complicated circuit arrangements which permit tuning of the individual tones and these have not been entirely satisfactory.

Tuning instruments have also been provided for accurately indicating when a tone being played is of the desired frequency. Such instruments have either been suitable for use on only a single tone or have required complicated equipment for providing the different tones within an octave. It is obvious that the use of a single oscillator for providing all the tones of an octave would be highly advantageous for such a tuning instrument since it would reduce the size, cost and complexity thereof.

It is therefore an object of the invention to provide improved musical instruments or tuning instruments therefor having a single oscillator circuit which provides a plurality of different tones such as the twelve semitones within an octave.

A further object of the invention is to provide an oscillator for providing a plurality of musical tones wherein the oscillator can be tuned so that the tones have precise values without affecting the frequency relationship of the different tones produced by the oscillator.

A further object of the invention is to provide an improved musical tuning instrument which accurately generates signals of frequencies related to the frequencies of tones to be checked and gives a visual indication of the deviation of the tones tested with respect to the correct frequencies therefor.

A feature of the invention is the provision of an improved musical instrument including a single oscillator which may be tuned in steps to frequencies related to the musical tones within an octave and which may be further tuned through a narrow range to set the tones at desired values without changing the relation therebetween. The instrument may be used for producing tones such as in an electrical organ, or may be a tuning instrument for giving an indication of the difference of tones produced by a musical instrument from the desired frequencies for such tones.

A further feature of the invention is the provision of an electronic oscillator having a tuned circuit including parallel connected inductors, one of which provides changes of frequency by steps having a predetermined

2

relationship, and the other of which changes the tuning of the oscillator through a narrow range without affecting the relationships of the steps produced by selective connection to the taps of the first inductor.

Another feature of the invention is the provision of a musical tuning indicator including an oscillator turnable in steps to a plurality of frequencies related to the frequencies of musical tones and used to drive a stroboscope disc, and means for applying the frequency of tones to be measured to neon tubes which intermittently illuminate the stroboscope disc to indicate variation of the tone being measured with respect to the frequency of the oscillator.

Still another feature is the provision of a musical tuning indicator wherein the power line frequency may be utilized to calibrate an oscillator in the instrument so that accurate indications are provided.

Further objects, features and the attending advantages of the invention will be apparent from a consideration of the following description when taken in connection with the accompanying drawings wherein:

Fig. 1 illustrates a stroboscopic tuning instrument in accordance with the invention;

Fig. 2 is an enlarged detailed view illustrating the tuning indicator of the instrument;

Fig. 3 illustrates the stroboscope disc used in the instrument;

Fig. 4 is a circuit diagram of the tuning instrument including an improved multiple frequency oscillator; and

Fig. 5 illustrates a second embodiment of the multiple frequency oscillator of the invention.

In practicing the invention there is provided an oscillator for producing a plurality of frequencies related as the musical tones within an octave. These frequencies may be used for comparison with tones from an instrument being tuned. The oscillator includes parallel connected inductors, one of which is tapped to provide frequencies corresponding to the tones within an octave and the other being continuously variable to adjust the test frequencies to desired values. The output of the oscillator is amplified in a first channel and used to drive a synchronous motor. A second channel is provided to which tones from the instrument being tuned are applied. Electrical signals may be provided to the second channel directly from an electrical instrument, or may be provided by a microphone which picks up signals from an instrument of any type. Signals in the second channel are used to energize neon lamps which are positioned behind a stroboscope disc driven by the synchronous motor of the first channel. The disc is marked in a manner disclosed in Patent 2,286,030 to provide standing patterns at various different portions as tones in different octaves are brought into synchronism with the frequency developed in the instrument. The instrument is also arranged so that the fixed frequency of the power supply can be applied to the second channel as a reference for calibration of the oscillator of the instrument. The variable inductor can be adjusted so that the oscillator frequencies are standardized with respect to that of the power supply. The instrument has a calibrated dial coupled to the variable inductor so that changes in tone can be measured, and tuning to a slight amount off from standard values can be provided.

Referring now to the drawings, in Fig. 1 there is illustrated the tuning instrument in accordance with the invention which is provided as a compact unit. The over-all dimensions of the case are approximately 8" high by 9" wide by 6" deep. The front panel includes an on-off switch 10, an operate-calibrate switch 11, a tone selector switch 12, a gain control 13, an input jack 14, a pilot light 15, a window 16 for observing the stroboscope disc, and a calibrate control 17. The input jack 14 is adapted

3

to receive a plug 18 to which is applied the output of an electrical instrument, or the output of a microphone as illustrated at 19 in Fig. 1. Power for the instrument is applied through cord 20. A cover may be provided for the instrument and the cord 20 may be wrapped on the inside of the cover (which is not shown), so that the instrument may be completely enclosed as a portable unit.

Fig. 2 shows more in detail the portion of the front panel including the window for viewing the stroboscope disc 26 (Fig. 3) which is mounted for rotation directly behind the front panel of the instrument. The actual opening is defined by heavy lines and the border is marked to indicate the region of the disc to observe for tones in various octaves. When operating in the lowest octave, the pattern of the disc should be observed in area 21 which is indicated by the number 1 above the window. Octaves 2, 3, 4, 5, 6 and 7 are marked on the sides of the window 16, with the curve of the pattern being indicated by light lines. Behind the disc 26, in the space visible through the window 16, are positioned two neon tubes 24 and 25 which illuminate the window area relatively uniformly. The disc 26 is rotated by a motor supported back of the neon bulbs 24 and 25 and is rotated about an axis aligned with the point 27 at the top edge of the window 16.

The disc 26 may be of known construction and is described in Patent 2,286,030 assigned to the assignee of the present application. The disc may be made of a translucent material with the pattern being formed by an opaque coating thereon. At the region 21 for use at the lowest octave two opaque spaces are provided, and the number of spaces doubles for each higher octave. It has been found to be quite easy to observe the desired octaves and it can be accurately determined when the disc is synchronized with the neon bulb as the pattern in the area being observed appears to stand still. As indicated in Fig. 1 markings are provided under the window 16 indicating that movement of the pattern to the right is caused by a note which is sharp, and movement of the pattern to the left is caused by a note which is flat. This marking will assist one using the tuning instrument to adjust the musical instrument being tuned in the direction so that the apparent motion of the disc is stopped.

Reference is now made to Fig. 4 which shows the circuit of the stroboscopic tuning instrument. Parts shown on Figs. 1, 2 and 3 will be given the same reference numerals and reference will be made to show the relation of the circuit to the structure. The circuit of Fig. 4 includes a first channel 30 shown along the top of the figure and a second channel 31 shown along the bottom of the figure. Power supply 32 provides energy for both channels.

The first channel 30 includes an oscillator which is made up mainly of the triode section 35, inductor 36, inductor 37, and condenser 38. Inductor 36 has a plurality of taps thereon so positioned to provide tuning to the different notes within an octave. Inductor 37 is continuously variable through a relatively narrow range to permit calibration or alignment of the oscillator. The selector switch 12 selectively tunes the instrument to the desired notes as indicated on the front panel. The selector switch 12 may include two separate contacts, with the contact 39 engaging the taps of inductor 36, and the contact 40 making connection to corrector capacitors as will be described more in detail hereinafter. The operate-calibrate switch 11 includes three ganged contacts, the first contact 41 makes connections to the inductor 36, either through the switch contact 39 or to a fixed point. The second contact 42 of the switch 11 connects an auxiliary capacitor 43, and the third contact 44 selectively applies the power supply frequency to the second channel 31 as will be explained.

Considering first the connection and operation of the oscillator for tuning use, the taps on inductor 36 are selectively connected through switch contacts 39 and 41 through

4

condenser 46 and resistor 47 to the grid of the triode section 35. The grid is biased with respect to the cathode by resistor 48. The contacts 39 and 41 also bridge the condenser 38 across a portion of the coil 36, depending upon the position of the switches 11 and 12. Accordingly, the inductors 36 and 37 and condenser 38 form the resonant circuit of the oscillator. The cathode of the triode 35 is connected to a point 49 of inductor 36 on the ground side of the taps for the various frequencies. The portion of the coil between the point 49 and ground is shunted by resistor 50 from which sinusoidal oscillations may be derived. Plate potential is provided for the triode 35 in a well known way.

It may be desired to provide a condenser 51 for each tone to provide an accurate adjustment of the frequency for each position of the switch 12. That is, in the event that the taps of inductor 36 are not positioned accurately to produce the tones desired, correction may be provided by the additional capacitors 51 which are selectively connected by the contact 40 of switch 12 which operates together with contact 39 connecting the taps on inductor 36. The capacitors may not be required if the taps are provided on inductor 36 with great accuracy.

The oscillations derived from resistor 50 are applied through condenser 55 to the triode 56 which may be included in the same envelope with triode 35. Push-pull output waves are derived from the triode 56 and are fed to the two output tubes 57 and 58 which are connected in push-pull. The tubes 57 and 58 feed transformer 59 which energizes the motor 60, which in turn drives the stroboscope disc as illustrated in Fig. 2. The motor 60 is of the synchronous type so that the speed of the disc will be controlled by the frequency of the oscillator. Transformer 59 may have a winding 61 connected to a test jack 62 so that the wave produced by the oscillator may be measured as may be required.

Considering now the second channel 31, signals from the input jack 14 are applied through the gain control 13 to a first amplifier stage 65. Signals from this stage are further amplified in the triode amplifier 66, and when the switch 11 is in the operating (up) position are applied through the switch contact 44 to a further amplifier 67. The output of this amplifier is connected to the neon lamps 24 and 25 illustrated in Fig. 2. The current applied to the lamps 24 and 25 will therefore be amplitude modulated by the signals applied to the input jack 14, and the light intensity will vary at a frequency depending upon the tone of the instrument being tuned, with both the fundamental frequency and harmonics being reproduced by the lamps.

The power supply 32 provides potential for operation of the electron tubes, the motor and the neon bulbs of the instrument from a standard 110 volt supply which may be applied to the plug 70. The rectified output is applied to a filter 71 with certain potentials being derived across condenser 72 and other potentials being further filtered by condenser 73. The heavy current drawn by the tubes 57 and 58 driving the motor 60 is derived from the first filter condenser 72 and changes in current resulting from changes in frequency are therefore found to have less effect on the voltage applied from condenser 73 to the neon lamps 24 and 25. Accordingly, the brilliance of the indication remains substantially constant for all frequencies.

Considering now the operation of the tuning system, it will be noted that the stroboscopic disc illustrated in Fig. 3 has a two-frequency pattern at the lowest frequency portion, so that the disc must revolve at a frequency one-half that of the tone being observed. The motor 60 which has been used in one structural embodiment of the invention is of the type which rotates at 1200 revolutions per minute when 60 cycle per second current is applied thereto. In the instant case the frequency applied varies and the motor therefor provides one revolution for each three cycles of the energizing

current. Since it is desired to have one rotation for each two cycles of the fundamental frequency of the tone being tested, the frequency of the current supplied to the motor from the oscillator in the instrument must have a three-to-two relation to the frequency of the tone being observed. It is obvious that by using motors and/or discs of different construction, this relationship will change.

In view of the above, the oscillator must be designed so that the lowest frequency is three-halves that of the lowest frequency to be tested. The oscillator frequency may be changed by the control 12 to provide disc frequencies for the twelve tones within a first octave. To test tones of a higher octave, the control 12 is set at the note involved, and the disc is observed at a different portion corresponding to the octave involved. When the instrument is tuned so that the frequency is that desired for the particular note, the portion of the disc for the proper octave will appear to remain stationary. This makes it very easy for an inexperienced person to tune an instrument.

As previously stated, the variation in light from the neon lamps 24 and 25 will follow both the fundamental frequency and harmonics of the tone being tested. Accordingly, the instrument can be used to observe the harmonic characteristics of a tone being tested which results in an additional important use for the instrument.

In order to calibrate the instrument, arrangements are made for applying the 60-cycle power supply frequency to the neon tubes 24 and 25. The oscillator is simultaneously tuned to produce a frequency of 90 cycles for the calibrate operation. This is accomplished by moving switch 11 to the down position in which contact 41 makes connection from the point 75 on the inductor 36 to the grid of triode 35. The contact 42 connects the auxiliary condenser 43 in the circuit to further establish the desired oscillator frequency. Contact 44 connects the auxiliary power supply winding 76 to the grid of the tube 67. This causes the neon tubes to flash at a 60-cycle rate, and the control 17 can be operated to change the inductance of variable inductor 37 until the pattern comes to rest. The inductor 37 may have a core with an adjustable air gap to thereby permit variations in the inductance. As previously stated, variation of inductor 37 does not change the frequency relation provided by the taps on inductor 36.

Referring now to Fig. 1, the arrow 77 behind the calibration control knob 17 may be movable with respect to the knob but held in frictional engagement therewith. This permits the arrow to be moved to the zero position when the calibrating action is completed. If it is then desired to tune an instrument either sharp or flat, the control 17 can be turned until the arrow indicates the desired number of cents (one cent is equal to one-hundredth semitone) of difference in the tone from the standard frequency, to thereby off-tune the inductor 37. Use of the stroboscopic instrument when so adjusted will cause the instrument being tuned to be tuned either sharp or flat with respect to the standard frequency. The control 17 may also be used to bring the tuning instrument in tune with an instrument being tested. In such a case, the arrow 77 will indicate the difference of the tone of the instrument being tested from the standard value for the tone.

Although the oscillator has been described for use in a tuning instrument, and it has been found to be highly satisfactory for such use, it has also been found to be extremely advantageous in other applications. For example, the oscillator has been used in a circuit for providing pedal tones as required in electric organs. By using the oscillator in accordance with the invention, a single oscillator can provide the 12 tones within an octave with great accuracy and without additional gating means. That is by changing the tap connection to the inductor, which may be accomplished by the use of pedals or keys, the tone produced will change, with the transi-

tion being smooth and free of undesired transient oscillations. It will be apparent that the oscillator may be used to provide a greater or lesser number of tones than 12 as may be desired.

In Fig. 5 there is illustrated a second embodiment of the oscillator portion of the invention which is somewhat different than that illustrated in Fig. 4. The oscillator includes the parallel connected inductors 80 and 81 which are generally equivalent to the inductors 36 and 37 of Fig. 4. The inductors are tuned by condenser 82 which is selectively connected to taps on inductors 80 through switch 83. The tuned circuit is connected through condenser 84 to the grid of tube 85 with a tap 86 on the coil 80 being connected to the cathode of the tube. Plate potential is supplied from a B+ source through resistor 87 and a grid bias is provided by resistors 88, 89 and 90. The circuit thus far described is the same as in Fig. 4. In the circuit of Fig. 5, however, the bottom terminals of the inductors 80 and 81 are not connected directly to a reference potential (ground), but are connected through a resistor 91. The resistor 91 has developed thereacross a wave which has a pulse wave form and may therefore be used to produce tones similar to those produced by reeds. The waves developed across inductor 80 are, however, of substantially sinusoidal form as produced by a flute. These waves may be derived from some point on the inductor 80 such as the point connected to the cathode of the tube 85, and may be applied through the filter including resistor 93 and condenser 94 to terminal 96. Accordingly by selectively connecting to terminals 95 and 96 waves of different types may be provided to produce various tones as are necessary in an electric organ or similar instrument.

The oscillator circuits as shown in Figs. 4 and 5 have been highly advantageous in that the taps providing the various tones within an octave can be accurately positioned and the range provided thereby is not substantially changed as the tuning is adjusted. That is, the variable inductor connected in parallel with the tapped inductor can change the tuning of the circuit to provide a particular standard tone, and then by switching to the various taps the other tones are tuned along with the standard tone so that all of the tones produced by the oscillator are properly coordinated. The spacing between the tones remains accurate over the range of frequencies necessary to tune the oscillator to a standard frequency. Further smooth transition is provided between tones so that gating means is not required to remove objectionable transients.

It is therefore seen that an improved instrument for use in tuning musical instruments has been provided. By the use of a single oscillator, which accurately provides the twelve different semitones within an octave, the over-all system is greatly simplified and can be provided as a small compact unit. Only very simple controls are required for operating the tuning instrument, and the unit includes calibrating facilities so that the accuracy of the instrument can be continually maintained. The stroboscope indicator indicates very small variations in frequency and requires no skill on the part of the operator so that accurate tuning can be obtained by persons with no musical skill.

As previously stated, the oscillator used in the tuning instrument can also be used in other applications such as for providing a tone source for a musical instrument. As one example, it has been proposed to use such an oscillator to provide the pedal tones for an electric organ. In such application the switching of the taps on the inductor can be accomplished by pedal switches and the oscillator will move from one tone to another as the pedal switches are operated in a smooth fashion to thereby make the use of gating means unnecessary. This thereby provides a simple and inexpensive tone source which has highly desirable features.

I claim:

1. An oscillator for producing frequencies having a

fixed relation to a plurality of musical tones which differ from each other by steps of a semitone, said oscillator including in combination, an electron discharge valve having cathode, anode and control grid electrodes, first inductor means having a plurality of taps thereon, second variable inductor means connected in parallel with at least a portion of said first inductor means, means connecting one terminal of said first inductor means to a reference potential, switch means connected to a number of said taps on said first inductor means remote from said one terminal for selectively connecting a conductor thereto, first condenser means connecting said conductor to said one terminal to form a tuned circuit with said inductor means, second condenser means connecting said conductor to said grid of said valve, means connecting said cathode of said valve to a tap on said first inductor means intermediate said one terminal and said taps connected to said switch means, and means applying a positive potential to said anode of said valve, whereby oscillations are produced in said valve having frequencies varying in steps in accordance with the position of said switch means, with the frequencies being continuously variable through a narrow range by said variable second inductor means for fine tuning of said oscillator.

2. An oscillator for producing frequencies having a fixed relation to a plurality of musical tones, said oscillator including in combination, a resonant circuit including a first inductor having a plurality of taps thereon, a second continuously variable inductor connected in parallel with at least a portion of said first inductor, means connecting one terminal of said first inductor to a reference potential, switch means connected to a number of said taps on said first inductor remote from said one terminal for selectively connecting a conductor thereto, condenser means connecting said conductor to said one terminal to form a tuned circuit with said inductors, an electron discharge device having a plurality of electrodes, means connecting one electrode of said device to said conductor and connecting another electrode of said device to a tap on said first inductor, and means for applying operating potential to said device, whereby oscillations are produced in said device the frequency of which may be varied in steps in accordance with the position of said switch means, with the frequencies being continuously variable through a narrow range by said variable second inductor for fine tuning of said oscillator.

3. An oscillator for producing frequencies having a fixed relation to a plurality of musical tones which differ from each other by steps of a semitone, said oscillator including in combination, a resonant circuit including a first inductor having a plurality of taps thereon, a second variable inductor connected in parallel with said first inductor, means connecting one common terminal of said first and second inductors to a reference potential, switch means connected to a number of said taps on said first inductor remote from said common terminal for selectively connecting a conductor thereto, first capacitor means connecting said conductor to said common terminal to form a tuned circuit with said inductors, a plurality of additional capacitor means having one terminal of each connected to said common terminal, said switch means including a portion for selectively connecting the other terminals of said additional capacitor means to said conductor as said taps on said first inductor are selectively connected so that said additional capacitor means are selectively connected in parallel with said first capacitor means for producing particular frequencies, an electron discharge device having a plurality of electrodes, means connecting one electrode of said device to said conductor and connecting another electrode of said device to a tap on said first inductor intermediate said common terminal and said taps connected to said switch means, and means for applying operating potential to said device, whereby oscillations are produced in said device the frequency of which may be in varied steps in accordance

with the position of said switch means, with the frequencies being continuously variable through a narrow range by said variable second inductor for fine tuning of said oscillator.

4. An oscillator for producing frequencies having a fixed relation to a plurality of musical tones which differ from each other by steps of a semitone, said oscillator including in combination, a resonant circuit including a first inductor having a plurality of taps thereon, a second continuously variable inductor connected in parallel with said first inductor, said first and second inductors each having one terminal thereof connected to a reference potential, switch means connected to a number of said taps on said first inductor remote from said reference potential for selectively connecting a conductor thereto, and first condenser means connecting said conductor to said reference potential to form a tuned circuit with said inductors, an electron discharge device having a plurality of electrodes, means connecting one electrode of said device to said conductor and connecting another electrode of said device to a tap on said first inductor intermediate said reference potential and said taps connected to said switch means, means for applying operating potential to said device, whereby oscillations are produced in said valve having frequencies varying in steps in accordance with the position of said switch means, with the frequencies being continuously variable through a narrow range by said variable second inductor for fine tuning of said oscillator, and resistor means connected between said reference potential and said tap on said first inductor connected to said other electrode from which the output from said oscillator is derived.

5. An oscillator for operation at a plurality of frequencies having a fixed relation to tones of musical instruments including in combination, an electron discharge valve having cathode, anode and control grid electrodes, a first inductor having a plurality of taps thereon, a second variable inductor connected in parallel with said first inductor, said first and second inductors each having one terminal thereof connected to a reference potential, switch means connected to a number of said taps on said first inductor for selectively connecting a conductor thereto, first condenser means connecting said conductor to said reference potential to form a tuned circuit with said inductors, second condenser means connecting said conductor to said grid of said valve, said cathode of said valve being connected to a tap on said first inductor intermediate said one terminal thereof and said taps connected to said switch means, means for applying a positive potential to said anode of said valve, and potentiometer means connected between said cathode of said valve and said reference potential for providing the oscillator output, whereby oscillations are produced in said valve having frequencies varying in steps corresponding to the spacing of musical tones in accordance with the position of said switch means, with the frequencies being continuously variable through a narrow range by said variable second inductor for fine tuning of said oscillator.

6. An oscillator for operation at a plurality of frequencies having a fixed relation to tones of musical instruments including in combination, an electron discharge valve having cathode, anode and control grid electrodes, a first inductor having a plurality of taps thereon, a second variable inductor connected in parallel with said first inductor, said first and second inductors each having one terminal thereof connected to a reference potential, switch means connected to a number of said taps on said first inductor for selectively connecting a conductor thereto, first condenser means connecting said conductor to said reference potential to form a tuned circuit with said inductors, second condenser means and first resistor means connected in series in the order named between said conductor and said grid of said valve, second resistor means connecting said cathode of said valve to the junction between said second condenser means and said first resistor

means, said cathode of said valve being connected to a tap on said first inductor means intermediate said one terminal thereof and said taps connected to said switch means, and means applying a positive potential to said anode of said valve, whereby oscillations are produced in said valve having frequencies varying in steps corresponding to the spacing of musical tones in accordance with the position of said switch means, with the frequencies being continuously variable through a narrow range by said variable second inductor for fine tuning of said oscillator.

7. An oscillator for operation at a plurality of frequencies to a plurality of musical tones including in combination, an electron discharge valve having cathode, anode and control grid electrodes, first inductor means having a plurality of taps thereon, second variable inductor means connected in parallel with at least a portion of said first inductor means, resistor means connecting one terminal of said first inductor means to a reference potential, switch means connected to a number of said taps on said first inductor means remote from said one terminal for selectively connecting a conductor thereto, first condenser means connecting said conductor to said one terminal to form a tuned circuit with said inductor means, second condenser means connecting said conductor to said grid of said valve, said cathode of said valve being connected to a tap on said first inductor means, and means applying a positive potential to said anode of said valve, whereby oscillations are produced in said valve having frequencies varying in steps in accordance with the position of said switch means, with waves of pulse waveform being developed across said resistor means and waves of substantially sinusoidal waveform being developed across said first inductor means, the frequency of said waves being continuously variable through a narrow range by variation of said second inductor means.

8. An oscillator for operation at a plurality of frequencies corresponding to a plurality of musical tones which differ from each other by steps of a semitone including in combination, an electron discharge valve having cathode, anode and control grid electrodes, a first inductor having a plurality of taps thereon, a second variable inductor connected in parallel with said first inductor, first resistor means connecting one common terminal of said first and second inductors to a reference potential, switch means connected to a number of said taps on said first inductor remote from said common terminal for selectively connecting a conductor thereto, first condenser means connecting said conductor to said common terminal

to form a tuned circuit with said inductors, second condenser means connecting said conductor to said grid of said valve, resistor means connecting said grid to a reference potential for applying a bias thereto, said cathode of said valve being connected to a tap on said first inductor intermediate said common terminal and said taps connected to said switch means, and means applying a positive potential to said anode of said valve, whereby oscillations are produced in said valve having frequencies varying in steps in accordance with the position of said switch means, and waves of pulse waveforms are developed across said first resistor means, and means connected to said cathode of said valve for producing waves of substantially sinusoidal wave form, the frequency of said waves being continuously variable through a narrow range by variation of said second inductor.

9. An oscillator for producing predetermined frequencies having a fixed relation to the frequencies of a plurality of musical tones, said oscillator including in combination, a resonant circuit including a first inductor having a first terminal and a plurality of taps spaced from said first terminal, a second continuously variable inductor connected in parallel with at least a portion of said first inductor, switch means having portions connected to a number of said taps on said first inductor and operable to a number of positions for selectively connecting a conductor to said taps, means including a capacitor connected between said conductor and said first terminal to resonate with said inductors, an electron device having a plurality of electrodes, means for applying operating potential to said device, means connecting said resonant circuit to first and second electrodes of said device to form an oscillator circuit, whereby the frequency of oscillations produced in said device may be varied in steps in accordance with the position of said switch means to produce the predetermined frequencies, and the frequency may be continuously varied through a narrow range by said variable second inductor for fine tuning of the oscillator.

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