

Feb. 21, 1950

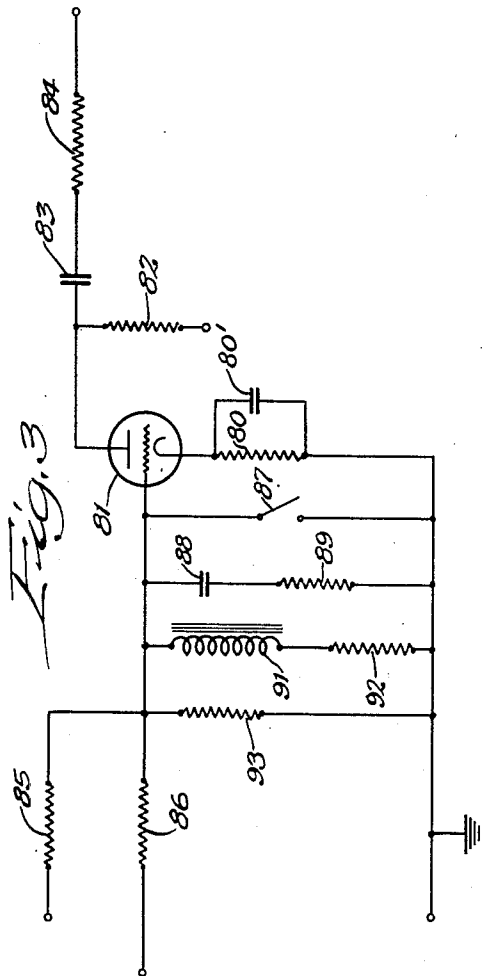
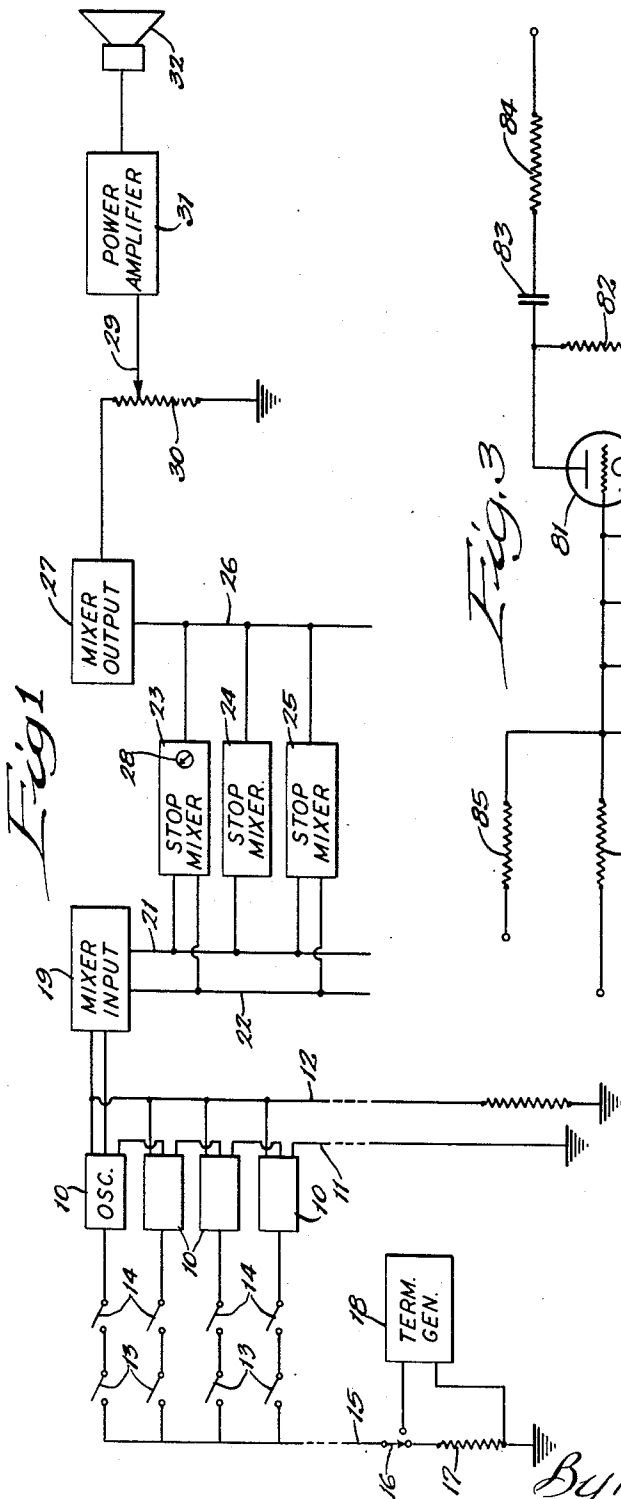
E. L. KENT

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ELECTRICAL MUSICAL INSTRUMENT

Filed April 20, 1945

2 Sheets-Sheet 1



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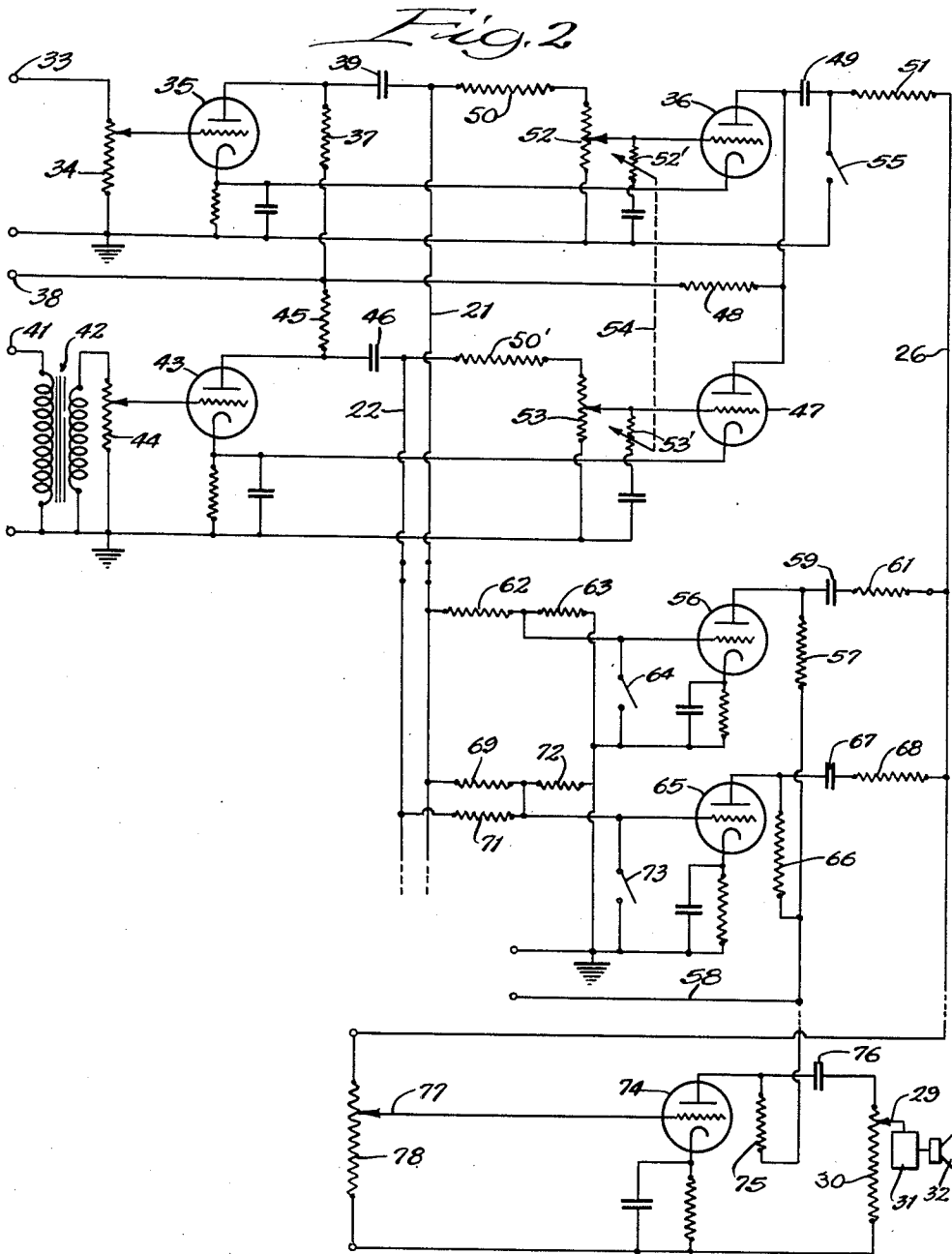
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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

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ELECTRICAL MUSICAL INSTRUMENT

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3 Claims. (Cl. 84—1.22)

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This invention relates to electrical musical instruments and more particularly to electrical instruments of the keyboard type for producing effects similar to a pipe organ.

One of the objects of the invention is to provide an instrument having substantial flexibility of control to produce organ like or instrument tones, as desired.

Another object is to provide an instrument in which a plurality of different tones may be produced simultaneously in additive fashion.

Still another object is to provide an instrument in which the tonal quality or harmonic content of the tones can be controlled, as desired, to produce different tonal effects.

A further object is to provide an instrument in which a wide variety of tonal effects can be obtained with a minimum number of parts and with a relatively simple keying arrangement.

A still further object is to provide an instrument in which the desired tonal effects are obtained by controlling the relative intensity of the fundamental and harmonic vibrations. In a preferred construction, undesirable frequencies are filtered or attenuated to the extent necessary for the production of the desired tonal qualities.

A still further object is to provide an instrument in which the desired tonal effects are produced by mixing oscillations of different harmonic contents.

The above and other objects and advantages of the invention will be more readily apparent from the following description when read in connection with the accompanying drawing in which—

Figure 1 is a block diagram of a part of an instrument embodying the invention;

Figure 2 is a circuit diagram; and

Figure 3 is a circuit diagram of one of the stop mixers.

The instrument of the present invention comprises essentially a plurality of vibration generators, one for each note, and each of which produces vibrations of two different tone qualities or harmonic contents. Keying and coupling means are provided to control the operation of the generators and the vibrations are supplied to a translating device such as a loud-speaker through selected paths in which means are included to control the relative intensities of the several frequencies present. By this means, selected tone qualities can be produced at the translating device similar to the several standard organ stops or involving unique tonal effects.

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The block diagram of Figure 1 indicates a plurality of oscillators 10 tuned to produce oscillations or vibrations corresponding to the frequencies of the several notes of a musical scale.

Any desired type of vibration generators or oscillators may be employed such, for example, as the oscillators disclosed in the patent to McKellip et al. No. 2,340,002. In oscillators of this type, vibrations approaching a pure sine wave to produce a flute tone are derived from the tank circuit while oscillations rich in harmonics to produce a string tone are derived from the cathode circuit. As shown, the several resistors across the tank circuit transformers are connected in series by a wire 11 in the manner described in the McKellip patent and the several cathode circuits are connected in parallel to a wire 12 in the manner described in the McKellip patent.

The oscillators are controlled through keying and coupling switches 13 and 14 so that operation of the respective oscillators will be initiated when the switches are closed. The keying and coupling switches may control the oscillators as described in the McKellip patent, but as shown they connect the control grids of the oscillator tubes, which may be triodes to ground through a line 15. A switch 16 is provided in line 15 to connect the keying and coupling switches directly to ground through a resistor 17 or through a low frequency tremolo generator 18. When the generator 18 is connected in the circuit, it causes a low frequency variation in the oscillator outputs to produce a tremolo or vibrato effect.

The wires 11 and 12 are connected to an input mixer 19 in which the several flute tones are combined and the several string tones are separately combined. The flute tone oscillations are transmitted from the input mixer through a line 21 and the string tone oscillations are similarly transmitted through a line 22. The input mixer may be made adjustable, as will appear more fully hereinafter, to vary the relative over-all strengths of the flute and string tones, as desired.

A plurality of stop mixers 23, 24 and 25 are connected in parallel between the lines 21 and 22 and a line 26 leading to an output mixer 27. It will be understood that while only three stop mixers are illustrated, any desired number could be provided to produce the desired variations in tonal effects. As shown, the stop mixer 23 is connected to both lines 21 and 22 and is provided with manual adjustment 28 by which the relative intensities of the flute and strong tones can be

varied to vary the harmonic content of the mixer output. By this means various tonal effects can be obtained according to the desires of the operator.

The succeeding stop mixers 24 and 25 and such other stop mixers as may be provided are preferably fixed devices which are so constructed as to produce tone qualities corresponding to the several standard organ stops. As shown, the mixer 24 is connected only to the flute output line 21 to produce a flute stop while the mixer 25 is connected to both lines 21 and 22 to produce a tone having a desired harmonic content similar to a selected one of the standard organ stops.

The output mixer 27 mixes the several tones supplied through the stop mixers and delivers them to a swell control resistor 30. An adjustable wiper 29 engages the resistor 30 and is connected through a power amplifier 31 to a translating device shown as a loud-speaker 32.

In operating the organ, the operator may selectively make effective any one or more of the several stop mixers and the tonal quality of the organ will depend upon the stop mixers selected. Since the stop mixers are all connected in parallel their effect will be additive so that operation of the organ with several of the stops effective will be substantially identical with corresponding operation of a conventional pipe organ. When using the manual stop mixer 23, various standard, as well as unique tonal effects, can be produced by adjusting the relative intensities of the flute and string type vibrations to control the harmonic content of the tone.

Figure 2 illustrates in circuit diagram, the circuit from the input mixer to the translating device. As shown, the input mixer is in two sections, the upper section being the flute tone section and the lower being the string tone section. The vibrations corresponding to the flute tone are supplied at a terminal 33 through a variable resistor 34 to the grid of a tube 35 shown as a triode. The cathode of the tube 35 is connected to ground as shown and to the cathode of a second tube 36 also illustrated as a triode. The plate of the tube 35 is connected through a load resistor 37 to a terminal 38 leading to a suitable source of plate supply voltage. A blocking condenser 39 connects the plate circuit to the line 21.

The string section includes a terminal 41 to which string type vibrations are supplied and which supplies the primary of a transformer 42. The secondary of the transformer is connected to the grid of a tube 43 through a variable resistor 44. The plate of the tube 43 is connected to the terminal 38 through a load resistor 45 and through a blocking condenser 46 to the line 22.

The manual stop mixer 23 comprises the tube 36 and a similar tube 47 whose plate circuits are interconnected and are supplied with plate voltage through a load resistor 48. Both plates are connected through a blocking condenser 49 and a resistor 51 to the line 26 leading to the output mixer.

The tube 36 is supplied from the flute mixer tube 35 through a fixed resistor 50 and a variable resistor 52 which is connected to its grid. The tube 47 is similarly supplied from the plate circuit 43 through a fixed resistor 50' and a variable resistor 53. The resistors 52 and 53 are adapted to be adjusted as desired to determine the intensities of the flute and string tones respectively. Higher frequencies in the outputs may be variably attenuated to produce a tone control by variable resistors 52' and 53' connected in series with

condensers across the grid circuits of the tubes 36 and 47 respectively. These resistors may be adjusted simultaneously through a connecting linkage 54 controlled by a manual control button, such as the button 28 of Figure 1. By means of these adjustments, the relative intensities and the harmonic contents of the outputs of tubes 36 and 47 can be varied. Since the flute tone is a substantially pure sine wave while the string tone includes a considerable number of harmonics, it will be seen that by this adjustment the harmonic content of the output supplied to the line 26 can be controlled throughout a wide range. The manual stop mixer is controlled by a stop switch 55 connecting the combined plate circuit outputs to the cathode circuits to short circuit the tubes so that when the switch is closed the manual stop mixer will not be in operation.

The stop mixer 24, as illustrated in Figure 2, comprises a tube 56 shown as a triode tube having its plate connected through a resistor 57 to a wire 58 leading to a suitable source of plate supply voltage. The plate is additionally connected through a blocking condenser 59 and resistor 61 to the output line 26 leading to the output mixer. The control grid of the tube 56 is supplied from the line 21 through a resistor 62 and is connected to the cathode of the tube through a resistor 63. When the stop mixer is in operation the tube 56 will be controlled by flute type oscillations supplied through the line 21 to supply similar oscillations to the output line 26. The operation of the mixer is controlled by a switch 64 short circuiting the grid cathode circuit of the tube so that when the switch is closed, the tube will not transmit.

The stop mixer 25 includes a tube 65 shown as a triode whose plate is connected to the wire 58 through a resistor 66 and to the output line 26 through a blocking condenser 67 and resistor 68. The control grid of the tube is supplied from both lines 21 and 22 through resistors 69 and 71 respectively which have a common connection to the grid. The grid cathode circuit is formed through a resistor 72 and operation of the tube is controlled by a switch 73 short circuiting the grid cathode circuit of the tube.

To bring any one of the stop mixers, such as 24 and 25 into operation, the respective control switches, such as 64 and 73, are opened. At this time, the tube forming a part of the mixer will transmit to supply oscillations to the output line 26. By controlling the relative values of the several circuit elements and particularly the resistors, such as 69 and 71, the relative intensities of the flute and string signals can be controlled to produce the desired harmonic content in the mixer output. Thus the mixers may be designed to produce harmonic contents respectively similar to those of the several standard organ stops or to produce such other unique effects as may be desired.

The output mixer, as shown, comprises a tube 74 illustrated as a triode whose plate is connected through a resistor 75 to the line 58 and through a blocking condenser 76 to the swell control resistor 30. The control grid of the tube 74 is connected through a wiper 77 to a resistor 78 in series in the line 26. By adjusting the wiper 77, an over-all volume adjustment can be made as, for example, to limit the volume, it being understood that the output volume is subject to further over-all variation by adjustment of the swell control wiper 29.

Figure 3 illustrates a typical circuit which can be used for the several stop mixers including a tube 81 whose plate is connected through a resistor 82 to a suitable source of plate potential and through a blocking condenser 83 and resistor 84 to the output line 26. The control grid of the tube is supplied with flute type vibrations through a resistor 85 and with string type vibrations through a similar resistor 86. A control switch 87 is provided across the grid cathode circuit of the tube to control its operation.

In order to control the harmonic content of the mixer output a filter circuit is provided across the grid cathode circuit of the tubes and, as shown, includes a condenser 88 in series with a resistor 89 and a series connected reactor 91 and resistor 92 parallel to the condenser 88 and resistor 89. A third parallel circuit includes a resistor 93 although this may be omitted in certain of the stops. The connection to the cathode is through a resistor 80 having a condenser 80' in parallel therewith.

The circuit, as shown, provides a band pass filter circuit which may be designed to pass a relatively wide band of frequencies. A filter of this type will serve to filter or attenuate certain ranges of frequencies more than others to produce the desired tone colors and the values of the several filter elements can be controlled to provide substantially any desired harmonic content in the output. Therefore, by proper selection of the values of the several circuit elements, substantially any desired tonal effect can be obtained.

Typical, although by no means limiting, values for the several circuit elements of Figure 3 for a right hand mixer for several typical stops may be as follows:

	86	85	89	93	92	91	88
Flute.....	250K	480K	0	50K	Omit	Omit	.005
Melodia.....	250K	Omit	0	50K	Omit	Omit	.05
Viole.....	892K	250K	Omit	50K	Omit	Omit	Omit
Cornopean.....	250K	480K	Omit	Omit	0	10H	Omit
Horn.....	480K	480K	0	Omit	0	10H	.01
Oboe.....	Omit	250K	Omit	Omit	Omit	10H	Omit
Diapason.....	250K	Omit	Omit	50K	Omit	Omit	Omit
Vox Humana.....	Omit	480K	0	Omit	10K	10H	.002

While several embodiments of the invention have been shown and described in detail, it will be understood that these are illustrative only and are not to be taken as a definition of the scope of the invention, reference being had for this purpose to the appended claims.

What is claimed is:

1. An electrical musical instrument comprising sources of audible frequency vibrations of different tonal qualities, a translating device, and a plurality of mixing devices connected in parallel between each of the sources and the translating

device, each of the mixing devices including an electron discharge tube having a control grid, a cathode and a plate, the sources being connected to the control grid and the translating device being connected to the plate, filter means in circuit with the control grid and the cathode, and a switch for starting and stopping operation of the tube.

2. An electrical musical instrument comprising sources of audible frequency vibrations of different tonal qualities, a translating device, and a plurality of mixing devices connected in parallel between each of the sources and the translating device, each of the mixing devices including an electron discharge tube having a control grid, a cathode and a plate, the sources being connected to the control grid and the translating device being connected to the plate, filter means in circuit with the control grid and the cathode, and a short circuit switch between the control grid and the cathode.

3. An electrical musical instrument comprising a series of oscillators for producing oscillations corresponding to different notes of a musical scale, each of the oscillators producing two oscillations of the same fundamental frequency and of different harmonic content, an input mixer having two sections for separately transmitting the several oscillations of similar harmonic content, a translating device, and a plurality of stop mixers in parallel connecting the input mixer to the translating device, each of the stop mixers including means to control the relative intensities of the fundamental and the several harmonic frequencies and control means to control its operation.

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