

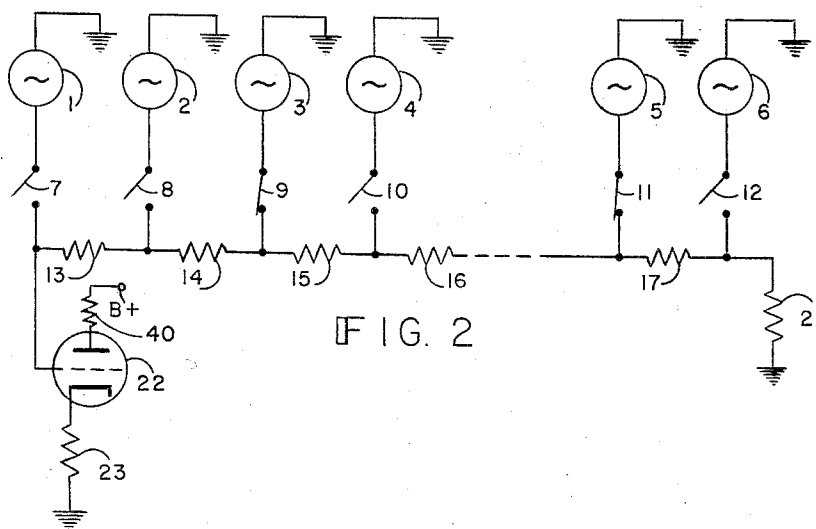
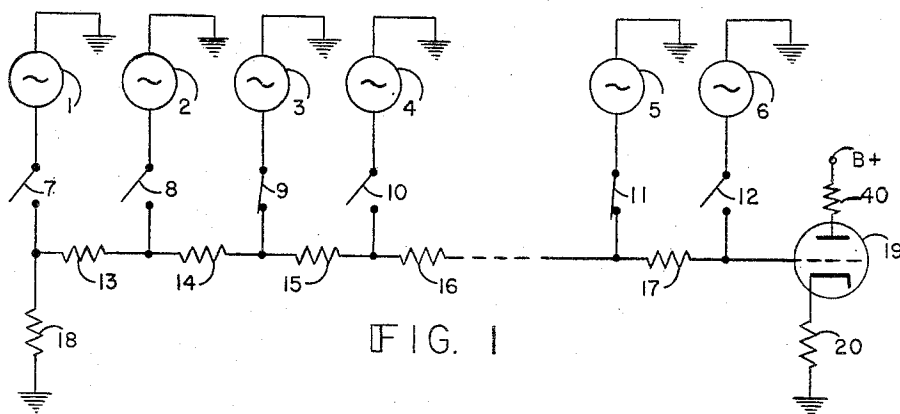
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H. E. W. BODE
PREFERENCE NETWORK

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Filed July 29, 1955

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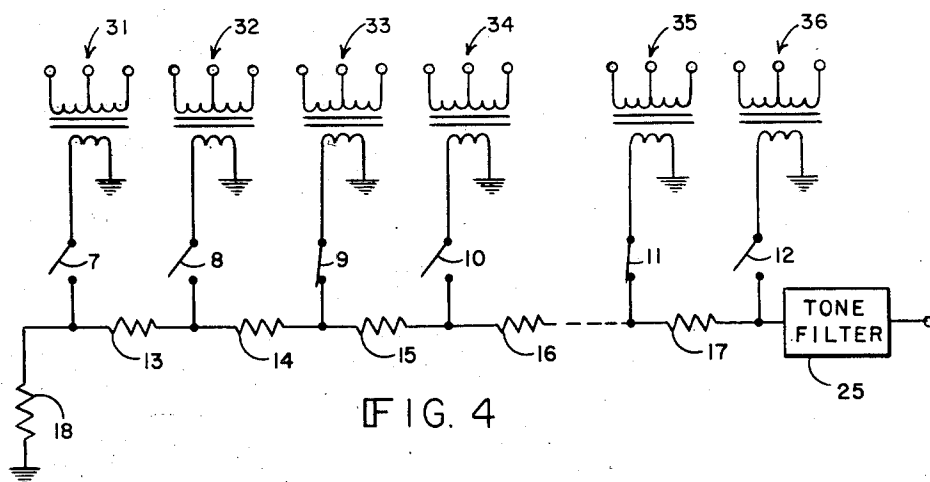
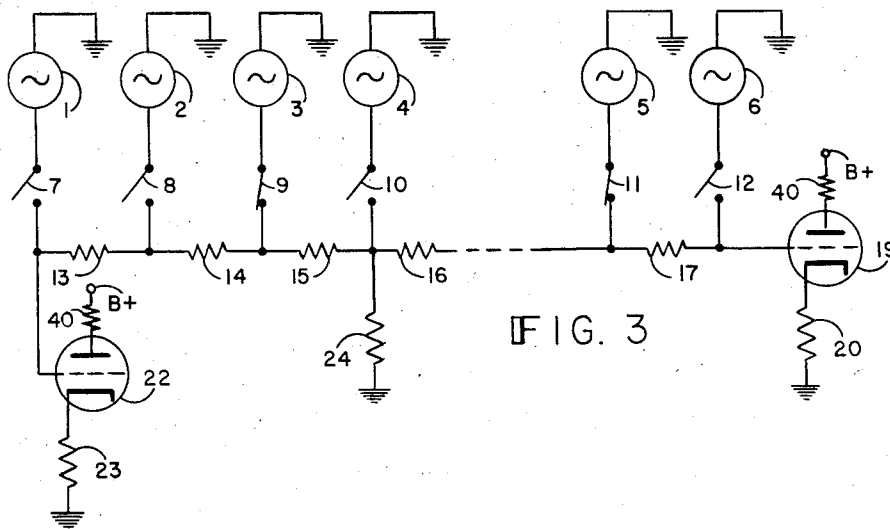
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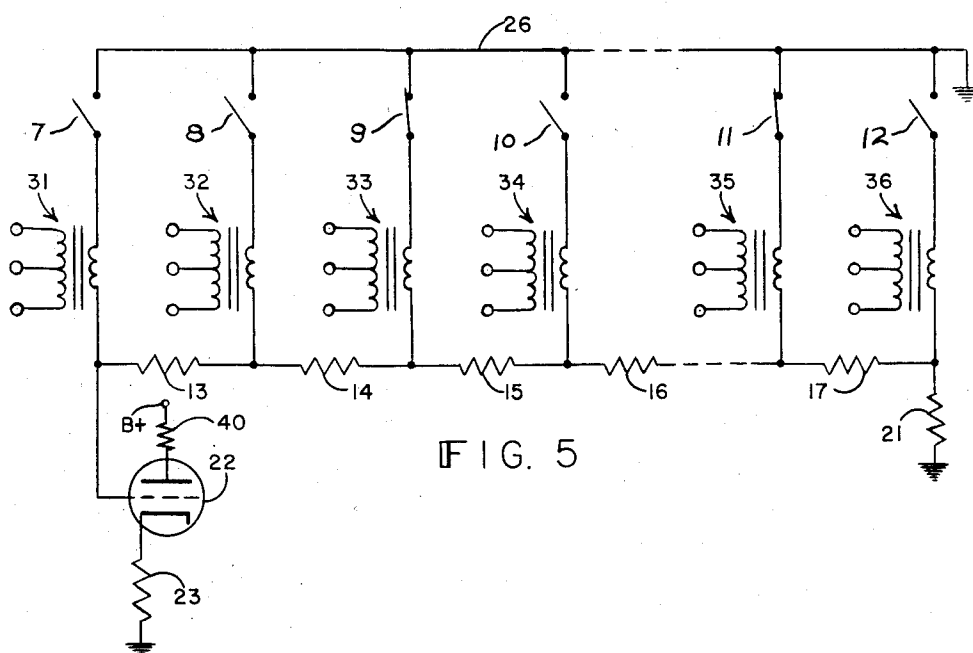
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PREFERENCE NETWORK

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This invention relates generally to electronic musical instruments, and more particularly, it relates to the type of electronic musical instruments wherein a plurality of tone generators are employed to generate electrical signals corresponding to musical tones.

In electronic musical instruments of the above-mentioned type, it is sometimes desirable to provide means whereby one or more individual voices or notes among a number of played notes may be operated upon specially so as to modify a characteristic of these notes including timbre, volume or frequency range. Although such means, or preference circuits, as they are sometimes called, have been proposed in the past, especially for electronic musical instruments utilizing a separate generator for each note of the manual range, and a single generator for the lowest octave of the pedal range, the latter being synchronized by a selected one of the generators of the lowest octave of the manuals, these have not proven completely satisfactory. The reason for this is that conventional preference circuits include make and break contact switches, one for each generator, with all of the break switches being connected in series with one another, with the result that undesirable interaction takes place between the various tone generator circuits.

It is an object of this invention, therefore, to provide a preference circuit which avoids the above-mentioned difficulty.

Briefly, according to the present invention there is provided a preference circuit, or as referred to hereinafter, a preference network, which includes a plurality of branch circuits, one for each of the tone generators, respectively. Included in the branch circuits are switch means to connect the individual tone generators in the respective branch circuits when the corresponding tones or notes are selected to be played. The branch circuits themselves are in turn connected to one another in cascade by means of impedance elements, each having a relatively high impedance as compared with the output impedances of the tone generators. As will appear, the network may be combined in various ways with some kind of tone signal response circuit, such as a frequency divider, which is adapted to modify a characteristic of at least one of the played tones or notes as compared with the others. For example, the network of the present invention may be utilized to select for modification only the highest note among a plurality of played notes or alternately only the lowest note. In addition, both the highest and lowest notes may be selected to be modified or operated upon specially according to the invention. The special treatment accorded the preferred note or notes may involve, for example, the generation of subharmonics thereof in which case the preferred notes, that is the tone signals corresponding thereto, would be utilized in part to synchronize one or more frequency divider stages. By way of further examples, the signals corresponding to the preferred notes might be applied to filter circuits, volume control circuits, switch circuits, or circuits specifically adapted to control their attack and

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decay characteristics. Insofar as the tone generators themselves are concerned, those skilled in the art will recognize that the network of the present invention may be utilized in conjunction with various electronic tone generators including tone wheel generators and electron tube oscillators of various kinds, especially Hartley oscillators.

The novel features of this invention, together with further objects and advantages thereof, will become more readily apparent when considered in connection with the accompanying drawings in which:

Fig. 1 is a schematic diagram of the preference network according to the present invention;

Fig. 2 is a schematic diagram of a modification of the network of Fig. 1 wherein the lowest of a plurality of notes rather than the highest is preferred according to the invention;

Fig. 3 is a schematic diagram of a modification of the network of Fig. 1 wherein both the highest and lowest of a plurality of notes are preferred according to the invention;

Fig. 4 is a schematic diagram similar to that of Fig. 1 except that the network is coupled to a tone filter rather than the electron discharge device of Fig. 1, and the output circuits of the various tone generators comprise tone transformers; and

Fig. 5 is a schematic diagram of a modification of the network according to the invention wherein one each of the switch contacts associated with the network are connected to a common bus.

Referring now to the drawing wherein like elements are designated by the same reference characters and more particularly to Fig. 1, it will be observed that numerals 1-6 designate a plurality of tone generators to generate electrical signals representative of the musical tones to be played, whereas the numerals 7-12 designate single-pole, single-throw switches, that is, make switches, which are adapted to be individually key actuated according to the particular tones or notes selected to be played. Since the network is adapted to operate with signal response means for modifying a characteristic of one or more of the signals provided by the tone generators and preferred by the network, numeral 19 designates, by way of example, a triode electron discharge device 19 having an anode, a cathode and a control electrode, such as might be incorporated in a frequency divider circuit. Associated with triode 19 is an anode resistor 40 connected to a source of anode potential, as represented by the terminal B+, and a cathode resistor 20 connected to a common point or ground.

With respect to the network itself, it will be observed that the individual tone generators 1-6 form individual branches of the network when connected in circuit by means of switches 7-12, one end of each branch being grounded. Coupled between the various branches of the network, so that the latter are effectively in cascade relation with one another are impedance elements, such as resistors 13-17. Those skilled in the art will recognize that the network, in essence, is of ladder configuration, each of the shunt arms of the ladder being formed with one of the tone generators 1-6 in series with one of the switches 7-12; and each of the series arms of the ladder being formed with one of the resistors 13-17. To interconnect the network with triode 19, the control electrode of the triode is connected to the stationary contact of switch 12, the right most of the switches, and a resistor 18 is provided between the stationary contact of switch 7 and ground. The latter, in combination with resistor 20, serves to properly bias the triode 19 and also to provide a sufficiently low impedance across the control circuit of the triode when no tone is being played, so that

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substantially no undesirable hum or other interference will be picked up through stray capacitive coupling.

In operation, when only one key of the instrument is depressed, thereby closing only one of the switches, such as switch 9, for example, the single tone selected to be played or more specifically the corresponding tone signal generated by generator 3, appears across the junction of resistors 14, 15 and ground. It follows, therefore, that this signal is impressed directly across the control circuit of triode 19 through resistors 15, 16 and 17 without any shunting effect being present. If now, however, a second key which actuates switch 11 is depressed, it will be observed that generator 5 provides an additional path to ground for the signal generated by generator 3, which effectively is in parallel relation with the control circuit of the triode 19. That is to say, in the case of both switches 9 and 11 being closed, resistors 15 and 16 in combination with the output impedance of generator 5 act as a voltage divider so that only a portion of the signal voltage of generator 3 appears across the control circuit of triode 19. With respect to the tone signal generated by generator 5, on the other hand, by virtue of its position in the network relative to triode 19, substantially the full signal voltage thereof is impressed across the control circuit making triode 19 far more sensitive to the latter than to the former signal. Assuming, for example, that the output impedances of the various generators are approximately 6 ohms, and the resistors 13-17 are approximately 600 ohms, the relative magnitudes of the signals from generators 3 and 5 as applied to the control circuit of triode 19 will differ by a factor of approximately 200 to 1. Hence, in the case of any pair of adjacent switches being closed simultaneously, the magnitudes of the signal voltages from the corresponding generators will differ by a factor of 100 to 1, the generator which is more nearly adjacent triode 19 providing at the control circuit of triode 19 the larger signal and being thereby preferred. The above-mentioned ratio as regards the relative values of the output impedances of the various generators as compared with the values of resistors 13-17 has proven sufficient in practice to substantially eliminate from the output of triode 19 all but the preferred one of the generator signals.

The modification of Fig. 2 is similar to the arrangement of Fig. 1, the difference being that in Fig. 2 preference is given to the bass note among a number of played notes rather than the highest or melody note. This is because the positions of triode 19 and resistor 18 (corresponding to triode 22 and resistor 21 in Fig. 2) are effectively reversed, it being apparent that the various generators in each case are arranged in the order of increasing frequency from left to right. Assuming, for example, that both switches 9 and 11 are closed, as shown, in response to their corresponding keys being depressed, it follows that resistors 15 and 16 in combination with the output impedance of generator 3 serve as a voltage divider for the signal generated by generator 5. In other words, most of the signal voltage developed by generator 5 will appear across resistors 15 and 16 and only a small fraction thereof, roughly $\frac{1}{200}$, by way of example, will be present at the input or control circuit of triode 22. The signal from generator 3, on the other hand, is impressed directly across the control circuit of triode 22 through resistors 13 and 14 so that the latter is preferred for special treatment to the exclusion of the signal from the generator 5.

Referring now to the modification of Fig. 3, two triode electron discharge devices 19 and 22 are provided, with their control circuits connected to opposite ends of the network. A single resistor 24, which serves the same purpose as resistor 18 in Fig. 1 and resistor 21 in Fig. 2, is connected between the stationary contact of one of the intermediate switches 10 and ground. As will be apparent to those skilled in the art, according to the

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modification of Fig. 3, the bass note of a number of played notes or tones as well as the highest or melody tone is preferred. In other words, only the bass tone signal of a group of signals corresponding to a number of played notes will be effective to energize the control circuit of triode 22 on the one hand, whereas only the melody or highest tone signal will be effective to energize the control circuit of triode 19. In effect, therefore, triode 22 comprises the input to the base channel and triode 19 the input to the melody channel. Since the location of resistor 24 is not critical if its value is at least as high as the total of resistors 13-17, its position as shown in Fig. 3 is merely illustrative. Accordingly, resistor 24 may optionally be connected between the junction of any two of the resistors 13-17 and ground or, for that matter, from the control electrode of one of the triodes 19 and 22 to ground.

Referring now to the modification of Fig. 4, it will be observed that each of the generators as shown in the preceding figures have been replaced by tone transformers 31-36. Also in place of a triode electron discharge device responsive to the preferred signal, there is illustrated a tone filter 25 adapted to modify the tonal quality of the preferred tone, or more specifically its corresponding signal. Tone transformers 31-36 might comprise, for example, a portion of the resonant circuits normally associated with Hartley oscillator type tone generators. Accordingly, it will be understood that neither the particular type of tone generators or the particular response means to the preferred tone signal which are utilized in conjunction with the network of the present invention are at all critical.

Whereas in Figs. 1-4 each of the contacts of the switches 7-12 are connected to a separate point in the network, there is illustrated in Fig. 5 a modification whereby one each of the contacts of switches 7-12 are connected to a common bus 26, which is in turn connected to ground. This arrangement is particularly advantageous for instruments in which various other switches are likewise connected to buses. To accomplish this result one end of the output circuits associated with the various tone generators, as represented by the secondary windings of transformers 31-36, rather than being connected to ground are individually connected to the movable arms of the corresponding switches 7-12. Although the modification of Fig. 5 is illustrated in connection with the bass note preference arrangement, it is apparent that it may also be used to select the melody note either separately as shown in Fig. 2, or in combination with the bass note as in Fig. 3. As may also occur to those skilled in the art, additional switching means may be employed in conjunction with the network of the present invention to permit one to effect a special treatment of the bass and melody notes, either singularly or in combination, at will. In this way, the overall character of a chord may be altered, while still being held in the manuals, by depressing a pedal switch, for example, and thereby altering a characteristic of one of the constituent notes of the chord.

Various other modifications within the spirit and scope of the invention will no doubt occur to those skilled in the art so that the invention should not be deemed to be limited only to those embodiments and modifications thereof having been illustrated and described in detail. Rather the invention should be deemed to be limited only by the scope of the appended claims.

What is claimed is:

1. In an electronic musical instrument having a plurality of tone generators to generate electrical signals representative of musical tones, and a tone signal response circuit to modify a characteristic of at least one of the tones corresponding to one of said signals, the combination with said tone generators and said signal response circuit of a preference network of the character described, said preference network comprising: a plurality of branch circuits, one for each of said tone generators, respectively; switch

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means to connect the individual tone generators in the respective branch circuits according to the tones selected to be played; and a plurality of impedance elements each having a relatively high impedance as compared with the output impedances of said tone generators, said branch circuits being coupled to one another in cascade through said impedance elements, respectively.

2. In an electronic musical instrument having a plurality of tone generators to generate electrical signals representative of musical tones, and a tone signal response circuit to modify a characteristic of at least one of the tones corresponding to one of said signals, the combination with said tone generators and said signal response circuit of a preference network of the character described, said preference network having a ladder configuration and including an impedance element in each of the series arms of the ladder, the impedance of the elements being relatively high as compared with the output impedances of said tone generators; and switch means to connect the individual tone generators in the individual shunt arms of the ladder when the corresponding tones are selected to be played.

3. In an electronic musical instrument having a plurality of tone generators to generate electrical signals representative of musical tones, and a tone signal response circuit to modify a characteristic of at least one of the tones corresponding to one of said signals, the combination with said tone generators and said signal response circuit of a preference network of the character described, said preference network comprising: a plurality of impedance elements connected in series with one another, each of said impedance elements having an impedance of relatively high value as compared with the values of the output impedances of said tone generators; and switch means to connect the individual tone generators between the individual junctions of said impedance elements and a common point or ground when the corresponding tones are selected to be played.

4. In an electronic musical instrument having a plurality of tone generators to generate electrical signals representative of musical tones, and a tone signal response circuit to modify a characteristic of at least one of the tones corresponding to one of said signals, the combination with said tone generators and said signal response circuit

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of a preference network of the character described, said preference network comprising: a plurality of resistors connected in series with one another, the value of said resistors being relatively high as compared with the values of the output impedances of said tone generators; and a plurality of single-pole single-throw switches, one for each of said tone generators, to connect the latter individually between the individual junctions of said resistors and a common point or ground when the corresponding tones are selected to be played.

5. In an electronic musical instrument having a plurality of tone generators to generate electrical signals representative of musical tones, and a triode electron discharge device for modifying a characteristic of at least one of the tones corresponding to one of said signals, said triode including an anode, a cathode and a control electrode, the combination with said tone generators and said triode of a preference network of the character described, said preference network comprising: a plurality of impedance elements connected in series with one another, the impedances of said elements being of relatively high value as compared with the values of the output impedances of said tone generators, and switch means to connect the individual tone generators between the individual junctions of said impedance elements and a common point or ground when the corresponding tones are selected to be played, the control electrode of said triode being coupled to one of said impedance elements and said cathode being coupled to ground.

6. The combination according to claim 5 including a first resistor connected between one of said impedance elements and ground, and a second resistor connected between said cathode and ground for biasing said triode.

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