Nov. 23, 1954 W. E. KOCK 2,694,954

ELECTRICAL MUSICAL INSTRUMENT

Filed Oct. 10, 1950

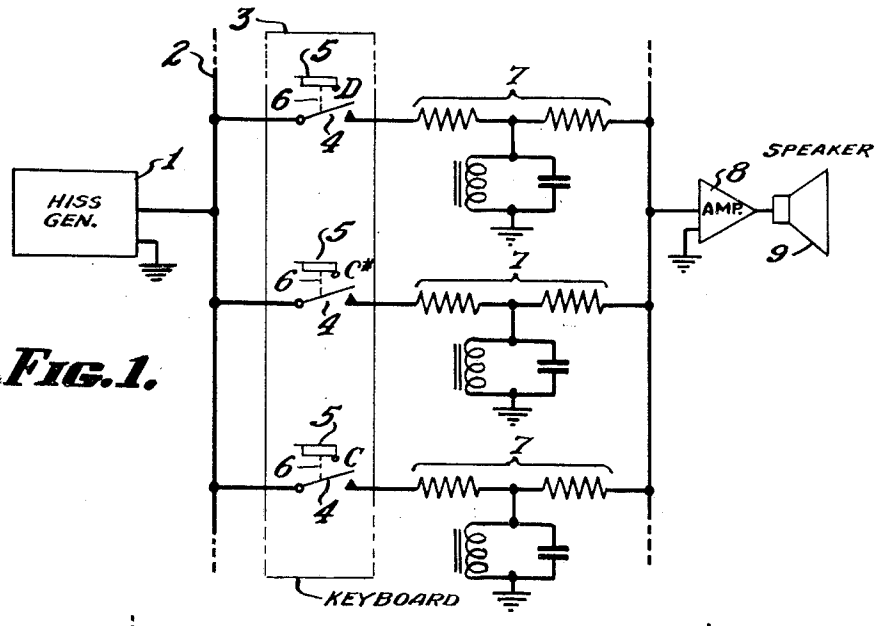


FIG. 1.

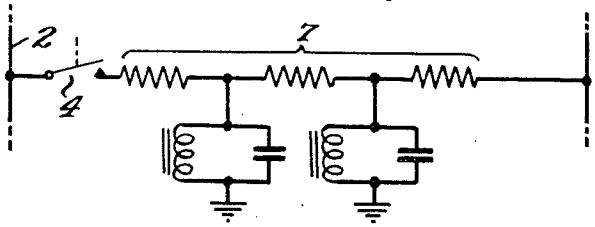


FIG. 2.

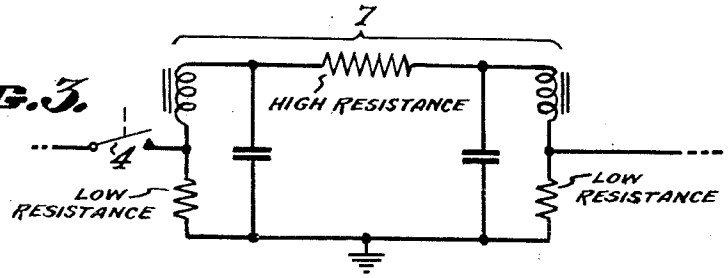


FIG. 3.

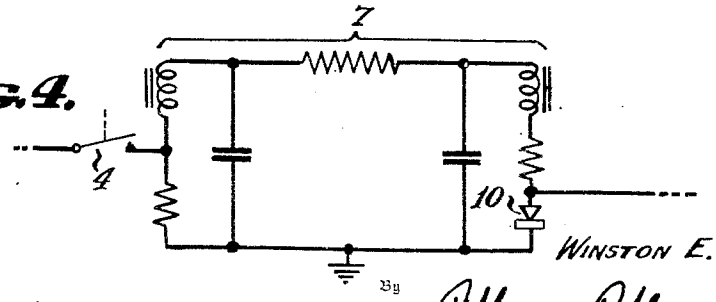


FIG. 4.

Inventor,
WINSTON E. KOCK,
By
Allen & Allen
Attorneys.

United States Patent Office 2,694,954 Patented Nov. 23, 1954

2,694,954

ELECTRICAL MUSICAL INSTRUMENT

Winston E. Kock, Basking Ridge, N. J.

Application October 10, 1950, Serial No. 189,388

1 Claim. (Cl. 84—1.11)

This invention relates to electrical musical instruments and more particularly to such an instrument wherein all tones are derived from a single source.

In most electrical organs of the prior art the tones are generated by a plurality of generators interlocked mechanically or electrically to insure that the instrument remains in tune. A notable exception is the type of instrument employing wind blown reeds with an electrostatic pick-up associated with each reed but even in the latter case a plurality of tone sources or generators must be provided with a complicated pneumatic and mechanical means for actuating them. An outstanding defect of all known electrical organs is the lack of an adequate choral effect in its tone. This effect simulates the tone characteristic of many voices with their random amplitude, frequency and phase variations.

It is the object of this invention to provide a greatly simplified electric organ system wherein all tones are derived from a single, exceedingly simple source rich in an inherent choral effect.

The foregoing object is achieved by this invention which provides a combination comprising a keyboard, a broad-band electric generator of the random noise type, a plurality of band-pass filters one for each note of the keyboard, an audio frequency speaker system and a switch means for each filter for connecting the filter in series with the source and the speaker system upon operating a key on the keyboard.

The invention may be better understood by referring to the accompanying drawings in which:

Figure 1 discloses a preferred embodiment of this invention.

Figures 2 and 3 disclose modifications of the filtering means which may be used with the system of Figure 1, and

Figure 4 discloses a filter circuit combined with means for generating harmonics of the transmitted narrow tone band to provide an increased choral effect.

Referring now to Figure 1, where the invention is disclosed in a preferred embodiment, the reference numeral **1** refers generically to a broad-band electric generator of the random noise type often referred to as a "hiss" generator. Such generators are well known in the art and examples thereof are shown in United States Patent 1,914,414, granted June 20, 1933, to F. E. Fairchild; in United States Patent 1,968,164, granted July 31, 1934, to H. Nyquist; and in an article by E. Peterson published in the "Bell Laboratories Record" for November 1939, page 81.

The output of the "hiss" generator **1** is connected by way of conductor **2** to a plurality of switches **4** in keyboard **3**. A switch **4** is provided for each of the keys **5** on the keyboard **3** and these switches are adapted to be closed through force provided by a mechanical linkage **6** from its corresponding key **5**. It is to be understood, of course, that there are as many such keys **5** provided as are normally found on an organ keyboard, and in Figure 1 only three of the keys corresponding to notes C, C sharp and D are shown.

Corresponding with each of the keys **4** is a band-pass filter **7** of conventional configuration. The parameters of each of these filters are so adjusted as to pass only a narrow band of frequencies about the frequency corresponding to the pitch of the key to which it is connected. For example, when the key **5** is pressed corresponding with note C in Figure 1, the band-pass filter **7** connected thereto may pass most readily frequencies from "hiss" generator **1** corresponding to 261.6 cycles per second. Other random frequencies very close to this frequency will also be transmitted but to a slightly lesser degree. The resulting tone so derived has been found to be musically pleasing to the ear and to be rich in choral effect. This is apparently due to the random nature of the frequencies of the generator and the narrow band thereof which is permitted to pass through filter **7**. Chords built up from tones thus produced are also very pleasing to the ear.

The output circuit of each of the filters **7** is connected to the input circuit of an amplifier **8** and is converted to acoustic energy by a speaker **9**. It will be evident that if the keyboard **3** is located between the filters **7** and the amplifier **8**, instead of as shown in Figure 1, an equally operative system will result.

From the foregoing description of Figure 1 it will be evident that the components of the organ system are of an extremely simple nature and that the simplicity is primarily due to the fact that a composite source containing all audible frequencies is utilized instead of the usual arrangement of separate generators for all frequencies, or at least a plurality of generators each providing a certain group of frequencies harmonically related in some way to the others. Other organ features such as the swell control and timbre controls have not been shown for the sake of simplicity. Such circuit arrangements are conventional in the electric organ art and it will be obvious that their principles may be applied to this invention to complete the organ details necessary for a complete practical organ. Because of their conventional nature, further descriptive matter relating to these features is believed unnecessary.

The simple filtering arrangement **7** shown in Figure 1 to be successful requires inductors of very high Q. Such inductors are quite expensive and, as an alternative, the filter of Figure 2 employing two tuned circuits instead of one may be substituted. Where two such tuned circuits are used as shown in Figure 2, the Q of the inductors need not be so high and the over-all cost is considerably less. Of course, it is evident that if still greater selectivity is required for any particular frequency channel, it may be obtained by adding an additional third section with another tuned circuit.

The filter arrangements shown in Figures 1 and 2 are primarily adapted for high impedance circuits. If it is desired in order to minimize hum and the undesirable pick-up that the filters have low terminating impedances, the arrangement shown in Figure 3 may be substituted. The operation of such a circuit is quite conventional and requires no detailed explanation.

Figure 4 discloses a modification of Figure 3 capable of providing a still more pronounced choral effect. This is provided by including in the resistance of the output circuit of the filter **7** an asymmetric, non-linear conductive element, **10**. This element is preferably of the type commonly referred to in the art as a varistor. For a general discussion of this type of circuit element, reference may be made to the "Bell Laboratories Record" for July 1940, page 322. The manner in which the increased choral effect is produced by this device may be better understood when it is remembered that the tone transmitted by filter **7** is actually a narrow band of frequencies close to the frequency to which the filter sections are tuned and that within this narrow band these frequencies appear in a purely random manner. When the harmonics of this narrow band of random frequencies are generated by the varistor and transmitted to the speaker system, they cover more of the harmonic spectrum of each tone and thus the effect more closely approximates that of a choir of voices.

It will be understood that modifications may be made in my invention without departing from its spirit. Having thus described my invention, those features which I desire to protect by Letters Patent comprise:

An electric organ system for producing tones rich in choral effect comprising in combination a keyboard having a key for each note of the musical scale, a broad-band, continuously operating electric generator of the random noise type, a plurality of band-pass filters, one corresponding to each note of the keyboard, tuned to the frequency of that note, and a switch means respon-

sive to each key for selectively connecting its filter to the source upon pressing the key, and an asymmetric, non-linear conductive element included in at least one of said filters, whereby the noise band transmitted by said filter is caused to contain harmonics to increase the choral effect.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
2,142,038	Bier	Dec. 27, 1938
2,220,098	Guanella	Nov. 5, 1940
2,342,338	Hanert	Feb. 22, 1944
2,403,664	Langer	July 9, 1946
2,432,152	Hanert et al.	Dec. 9, 1947
2,565,497	Harling	Aug. 28, 1951