

[54] **WIRING SYSTEM BETWEEN SOUND SOURCE CIRCUITS AND KEYS CIRCUITS IN AN ELECTRONIC MUSICAL INSTRUMENT**

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[58] Field of Search.....84/1.01, 1.11, 1.19, 1.24, 84/1.22; 317/101. C E

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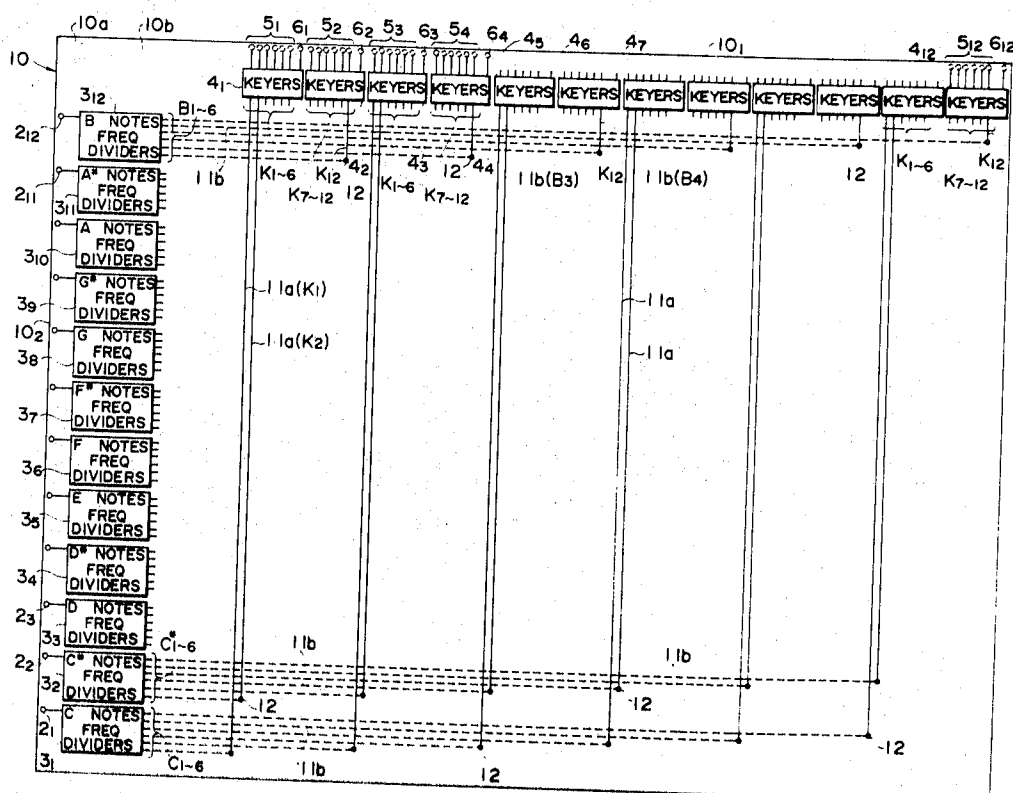
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[57] **ABSTRACT**

The wiring system of this invention is for connecting a number of integrated sound source circuits with the corresponding number of integrated keyer circuits in an electronic musical instrument, and is realized on a single piece of a rectangular wiring substrate. More particularly, the wiring system is characterized in that the sound source circuits are sequentially arranged along one arbitrary side of the rectangular wiring substrate while the keyer circuits are sequentially arranged along the second side of the substrate adjacent to said first side; that conductive members corresponding, in number, to the output terminals of the sound source circuits are extended on one surface of the substrate, from the output terminals toward the side facing said first side; that conductive members corresponding, in number, to the input terminals of the keyer circuits are extended, on the other surface of the substrate, from the input terminals toward the side facing said second side up to the points where the conductive members from the output terminals are terminated on the one side of the substrate; and that at those points the conductive members on both surfaces of the substrate are, respectively, connected by coupling means.

3 Claims, 7 Drawing Figures



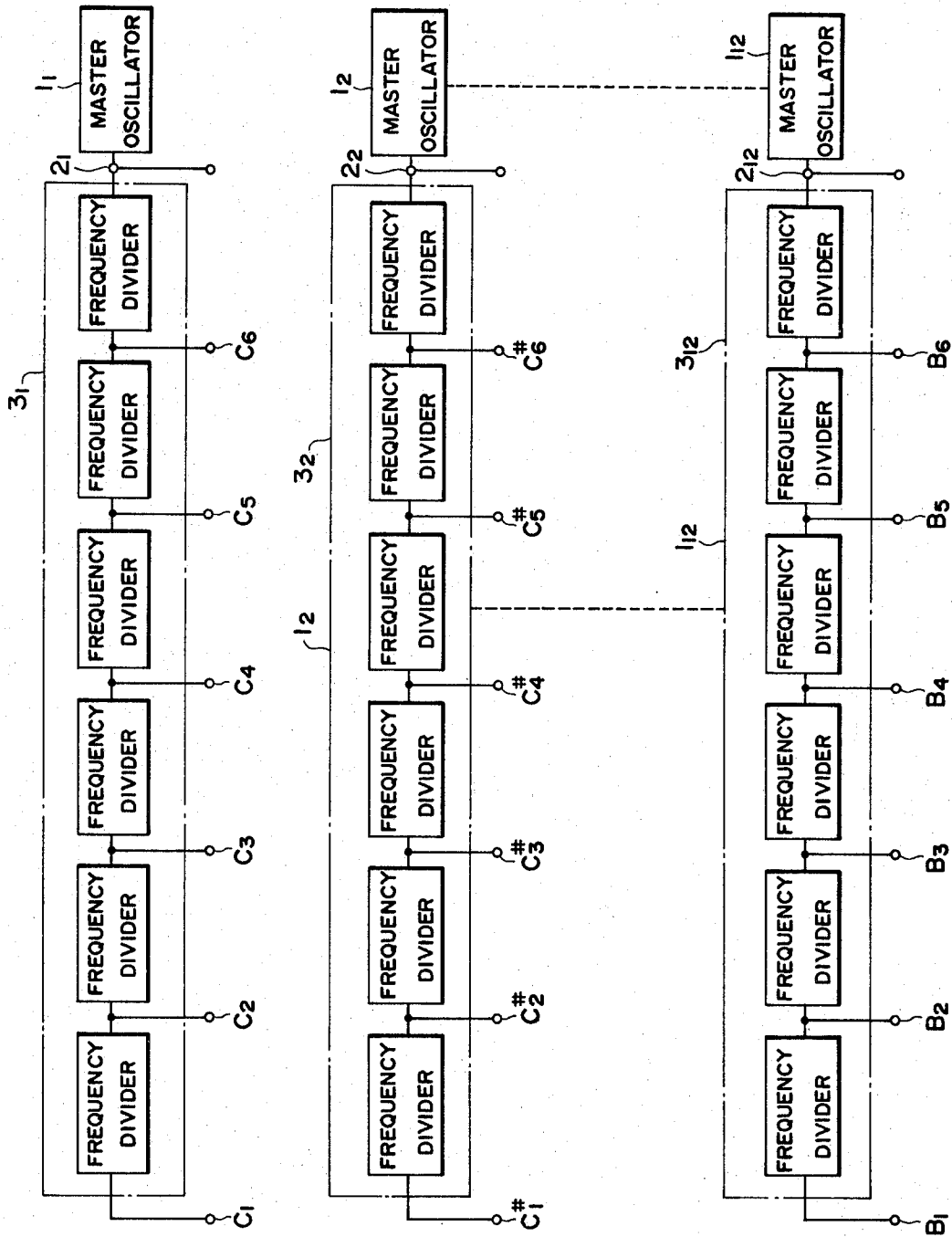
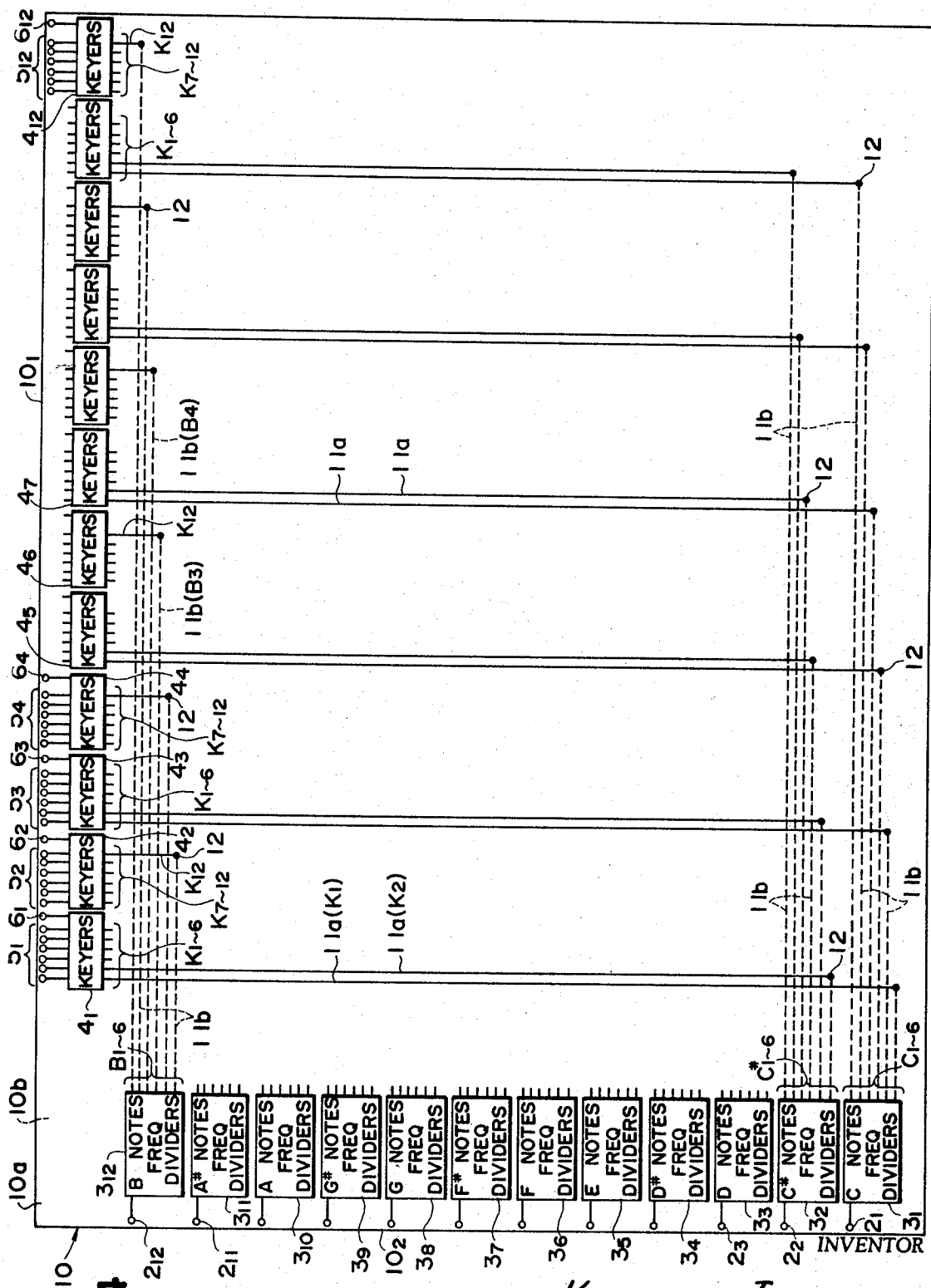


FIG. 1

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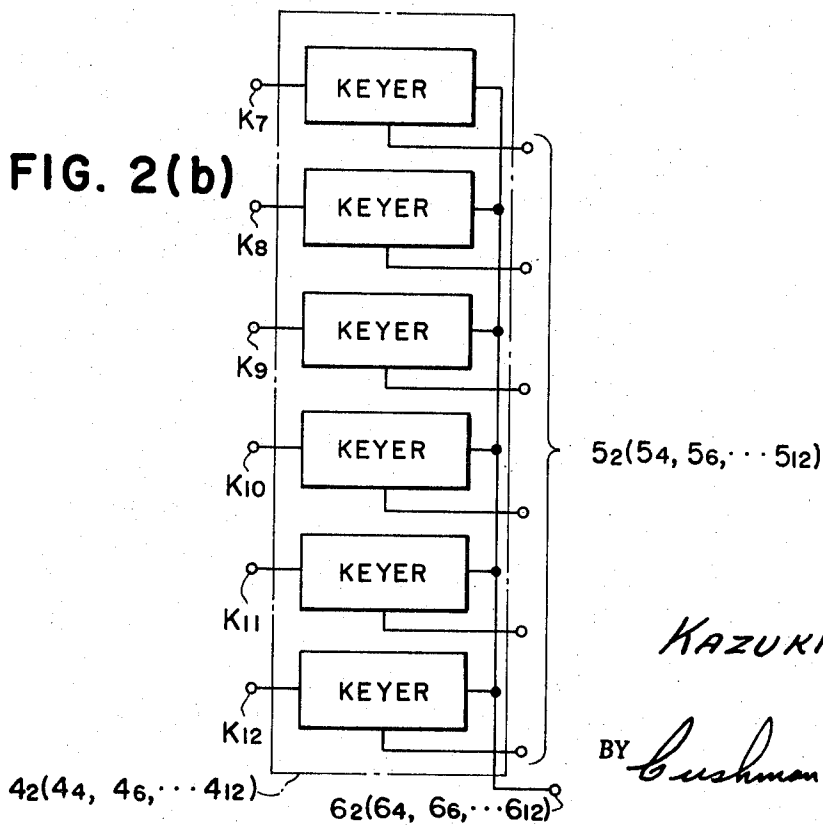
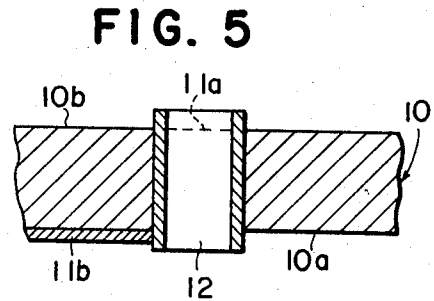
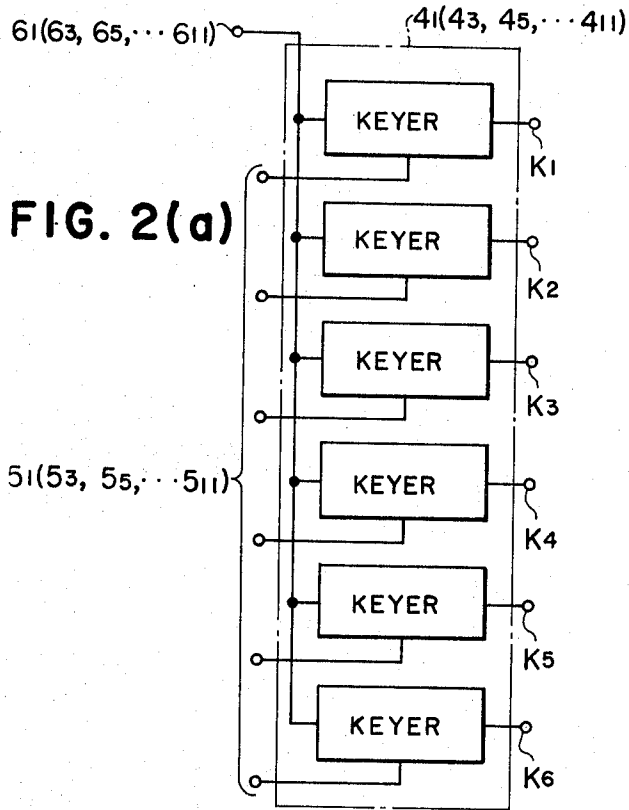
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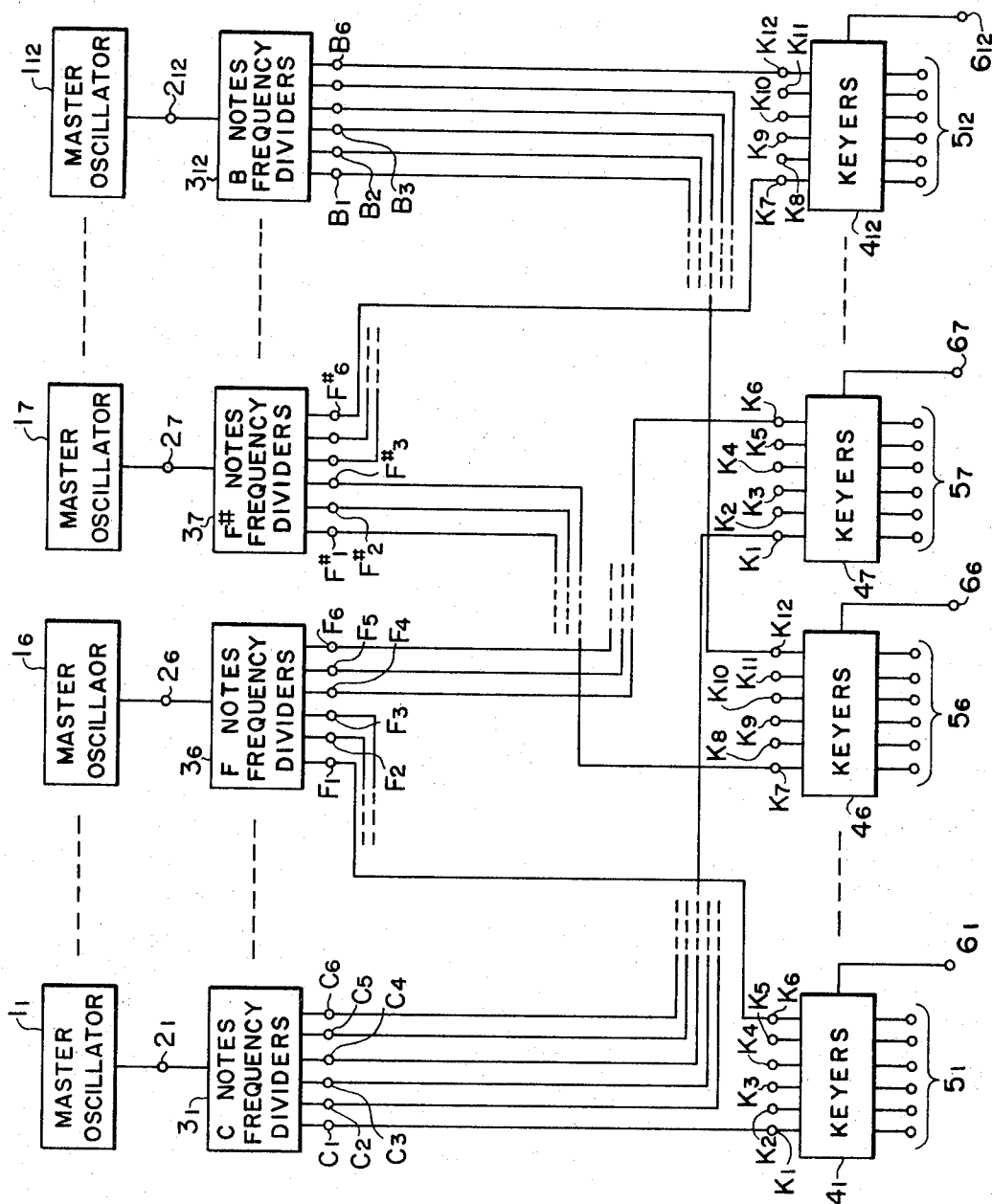
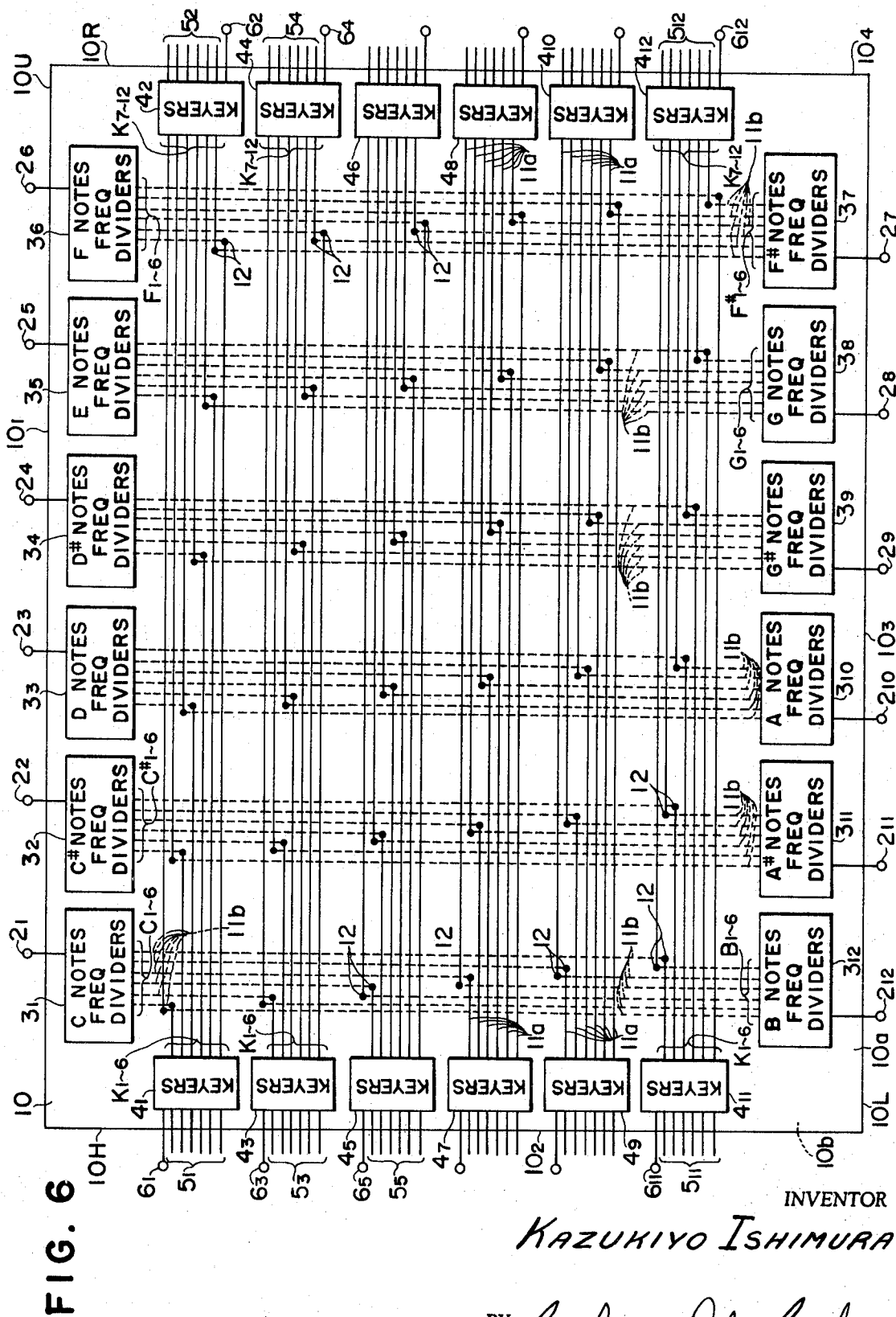


FIG. 3

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WIRING SYSTEM BETWEEN SOUND SOURCE CIRCUITS AND KEYER CIRCUITS IN AN ELECTRONIC MUSICAL INSTRUMENT

BACKGROUND OF THE INVENTION

This invention relates to wiring system for connecting a number of integrated sound source circuits with the corresponding number of keyer circuits, both used in a tone signal producing unit of an electronic musical instrument, on a piece of wiring substrate under a predetermined rule.

As is well known in the art, the tone signal producing unit of the electronic musical instrument is comprised of a number of sound source circuits including frequency dividing circuits and of the corresponding number of keyer circuits, the input and output terminals of these circuits being required to be interconnected through a huge number of lead wires or printed conductors of complex pattern under a predetermined wiring rule. Accordingly, those who design this type of electronic musical instrument should always pay attention to systematization of circuit configuration of the tone signal producing unit and rationalization of wiring scheme therefor.

In the meantime, the recent integrated circuit technique has also duly been applicable to the tone signal producing units of electronic musical instruments, making the circuit construction itself of these sound source circuits and keyer circuits smaller in size and lighter in weight. However, when constructing a tone signal producing circuit by means of these integrated circuits, a wiring work for connecting the output terminals of the sound source circuits with the input terminals of the keyer circuits in a complicated pattern under a predetermined wiring rule was still to be performed. And, inasmuch as the wires or a bundle of wires for construction of the said circuits be congested in the wiring section, difficulties were involved in simplification and automation of the wiring operation and in addition, wirings and a substrate therefor inevitably occupied a large space.

Accordingly, in the manufacture of this type of electronic musical instruments, the development of an improved wiring technique for construction of the said circuit has been a great concern for those in the art.

In the following, first the outline of construction a tone signal producing circuit will be given as to the case where the sound source circuits (frequency dividing circuits) and the keyer circuits of the tone signal producing unit to which the present wiring system is applied are formed in an integrated circuit, and then a technological problem on wiring in such circuit construction will be made clear.

FIG. 1 through 3 show the arrangement and relative relation of two types of circuits of the tone signal producing unit, that is, a number of frequency dividing circuits and the corresponding number of keyer circuits, both of which are divided into a number of integrated circuit blocks.

FIG. 1 is a system diagram of the frequency dividing circuit for producing musical notes of the electronic musical instrument;

FIG. 2 a system diagram of the keyer circuit of the same and

FIG. 3 a diagram of connection between the frequency dividing circuits and the keyer circuits.

In the system diagram shown in FIG. 1, $1_1, 1_2, \dots, 1_{12}$ are master oscillation circuits or master oscillators for generating sound sources corresponding to twelve notes of an octave or C, C[#], D, D[#], ..., A, A[#], B, the output terminals $2_1, 2_2, \dots, 2_{12}$ of each of these oscillators being connected to the input terminals of the first frequency dividers of the integrated frequency dividing circuit or divider blocks $3_1, 3_2, \dots, 3_{12}$ of the following stage, respectively. Each of the frequency divider blocks $3_1, 3_2, \dots, 3_{12}$ comprises frequency dividing circuits or dividers equivalent in number to the number of octaves of the musical instrument and the respective frequency divider blocks 3 (hereafter, if a suffix of a suffix bearing reference number is omitted it means all elements having such reference number) are provided with that number of output terminals which corresponds to the number of octaves of musical notes the musical instrument has. In the embodiment illustrated, the frequency divider blocks $3_1, 3_2, \dots, 3_{12}$ are each provided with six output terminals, which are marked with the symbols of notes allotted to the respective frequency dividers, to which symbols suffix coincident with the number of octaves are added. Accordingly, taking the output terminal C[#]₂ for example, an electrical signal corresponding to the tone at the note C[#] of the second octave will appear at the terminal marked with the symbol C[#]₂. The frequencies of the abovementioned master oscillation circuits, $1_1, 1_2, \dots, 1_{12}$ are divided successively into half by the frequency dividers $3_1, 3_2, \dots, 3_{12}$ so that, as a whole, sound source signals of 12 notes by six octaves or 72 notes can be obtained.

Further, $4_1(4_3, 4_5, \dots, 4_{11})$ and $4_2(4_4, 4_6, \dots, 4_{10}, \text{ or } 4_{12})$ indicated by FIG. 2(a) and 2(b) are a pair of IC (integrated circuit) blocks comprising a total of twelve keyer circuits, each block comprising six keyer circuits for half an octave. Each of the aforesaid groups of keyer circuits $4_1, 4_2, 4_3, 4_4, \dots$ and $4_{11}, 4_{12}$ is provided with the sound source signal input terminals $K_1, K_2, \dots, K_6, K_7, \dots, K_{12}$ each provided for each keyer circuits. Further, each keyer circuit of the keyer blocks 4_1 and $4_2(4_3 \text{ and } 4_4, \dots, 4_{11} \text{ and } 4_{12})$ is provided with control terminals 5_1 and $5_2(5_3 \text{ and } 5_4, \dots, 5_{11} \text{ and } 5_{12})$ to be connected to key contact switches(not shown). Thus the manipulation of keys permits the sound source signals to pass through the keyer circuits. Each keyer blocks $4_1, 4_2, \dots, 4_{12}$ has one output terminal $6_1, 6_2, \dots, 6_{12}$ to which the keyer circuits of the block are all connected so as to lead sound signals into next stages.

The number of output terminals C₁₋₆, C[#]₇₋₆, ..., B₁₋₆ of the aforesaid 12 frequency divider blocks 3 is 72 in all, while the number of input terminals $K_1, K_2, \dots, K_{12}$ of six sets of keyer circuits $4_1, 4_2, 4_3, 4_4, \dots, 4_{11}, 4_{12}$ is 72 in all, and the former output terminals and the latter input terminals are connected in the following manner to constitute the tone signal producing unit. That is, as shown in FIG. 3, the output terminals C₁₋₆, C[#]₇₋₆, ..., F₁₋₆ of the first six frequency divider blocks $3_1, 3_2, \dots, 3_6$ are matched with the input terminal group ($K_1, \dots, K_6$) in the keyer circuit blocks represented by the reference numerals of an odd-numbered suffix or $4_1, 4_3, \dots, 4_{11}$, while the output terminals F[#]₁₋₆, G₁₋₆, ..., B₁₋₆ of the last six frequency divider blocks $3_7, 3_8, \dots, 3_{12}$ are matched with the input terminals ($K_7, \dots, K_{12}$) of the keyer circuits represented by the reference numerals with even numbered suffix or $4_2, 4_4, \dots, 4_{12}$.

More particularly, the output terminals C_{1-6} of the frequency divider block 3_1 are each connected to the first input terminal K_1 of each of the keyer circuits with an odd numbered suffix $4_1, 4_3, \dots, 4_{11}$ and the same applying to the rest, the output terminals F_{1-6} of the frequency divider block 3_6 are each connected to the sixth input terminal K_6 of each of the keyer circuits similarly with an odd numbered suffix $4_1, 4_3, \dots, 4_{11}$, while the output terminals F_{1-6} of the frequency divider block 3_7 are each connected to the first input terminal K_7 of each of the keyer circuits with an odd numbered suffix $4_2, 4_4, \dots, 4_{12}$ and the same applying to the rest, the output terminals B_{1-6} of the frequency divider block 3_{12} are each connected to the sixth input terminals K_{12} of each of the keyer circuits similarly with an odd numbered suffix $4_2, 4_4, \dots, 4_{12}$.

In this way, by connecting the sound source circuits with the keyer circuits under the abovementioned wiring rule, it is possible to construct an electronic musical instrument equipped with six-octave keyboard, that is, 72 keys.

However, when wiring the sound circuits (frequency dividing circuits) and the keyer circuits under the predetermined wiring rule by the above wiring means, it can be easily presumed from the drawings and the above description that a bundle of wires and conductive lands of printed circuit board will cross and converge each other and the aforesaid difficulties will arise, resulting in the need to eliminate such technical problem.

SUMMARY OF THE INVENTION

Accordingly, a principal object of this invention is to solve the abovementioned technical problem and thereby to reduce size and weight of the wirings and to automate the manufacturing process, thus offering a cheap electronic musical instrument. In particular, this invention is characterized in that in paying attention to the aforesaid specificity of the conditions of connection between the integrated sound source circuits (frequency dividing circuits) and the similarly integrated keyer circuits in the electronic musical instrument, the both circuit group are put together on the front side and back side of one wiring substrate and interconnected functionally while making use of the specific wiring conditions effectively.

The wiring system of this invention is based on the conception that conductive members to be connected with the output terminals from a plurality of frequency dividing circuits corresponding to notes are formed on one side of the substrate, while, on the other side of the base plate, conductive members to be connected with the input terminals of a plurality of keyer circuits corresponding to the number of keys are provided, and further, by causing aforesaid both group of conductive members to cross on different surfaces of the substrate, the conductive members provided on the different surfaces are joined in regular manner under the predetermined wiring rule.

This wiring system can be embodied by the practical examples to be described below. The most fundamental example of embodiment is illustrated as an embodiment [I] in FIGS. 4 and 5, and its application as the embodiment [II] in FIG. 6.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a system diagram of the oscillator and frequency dividing circuits for producing sound sources of an electronic musical instrument:

FIGS. 2(a) and 2(b) are a pair of IC (integrated circuit) blocks comprising a total of twelve keyers, each block comprising six keyer circuits for half an octave.

FIG. 3 is a diagram of connection between the frequency dividing circuits and the keyer circuits;

FIG. 4 is a plan view of a first embodiment, in which a number of terminals of the sound source circuits and keyer circuits are connected on a printed circuit substrate in accordance with the present wiring system;

FIG. 5 is an enlarged section of a portion of the wirings on the wiring substrate in FIG. 4;

FIG. 6 is a plan view of a second embodiment of collective connection of a number of terminals of the sound source circuits and keyer circuits on a printed circuit substrate in accordance with the present wiring system.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

EMBODIMENT [I]

In this embodiment, the frequency dividers or divider blocks are arranged along an edge of one side of a pair of adjacent sides of a rectangular printed circuit board and the keyer circuits are arranged along the edge of the other side of said pair.

In FIG. 4, reference numeral 10 represents a rectangular printed circuit board made of such insulating material as synthetic phenol resin (sold under the trade name of Bakelite). Any two adjacent sides of its four sides, for instance, sides 10_1 and 10_2 are selected and the aforesaid keyer circuits $4_1, 4_2, \dots, 4_{12}$ are arranged in order along the edge of the former side 10_1 , while the aforesaid frequency dividers or divider blocks $3_1, 3_2, \dots, 3_{12}$ are arranged in order along the edge of the side 10_2 of the board 10. As aforesaid, each frequency divider block 3 is an aggregate of integrated frequency dividing circuits and each keyer circuit block 4 is an aggregate of integrated keyer circuits. Both groups of integrated circuit blocks are mounted on the surface of board 10 by lap terminals, pin terminals or other known means. On the front surface $10a$ of the board 10, six straight parallel conductive members $11a$ (shown in solid lines) are formed from the side 10_2 toward the side facing the side 10_1 , corresponding to the input terminals $K_1, K_2, \dots, K_{12}$ of the keyer circuits $4_1, 4_2, \dots, 4_{12}$, while on the back surface $10b$ of the board 10, six straight parallel conductive members $11b$ (shown in broken lines) are provided, from the side 10_2 toward the side facing the side 10_1 , corresponding to the output terminals $C_{1-6}, C_{7-12}, \dots, B_{1-6}$ of each frequency divider block $3_1, 3_2, \dots, 3_{12}$. Most preferably the conductive members $11a, 11b$ should be formed by a printed circuit technique, but they may be formed by any other technique, if any, that may replace the said technique. Thus, the conductive members $11a$ on the front surface $10a$ of the board 10 and the conductive members $11b$ on the back surface $10b$ are in mutual crossing relationship arranged on different surfaces of the board 10. Accordingly, as the conductive members $11a$ are

orthogonal to the conductive members 11b, they are in a condition in which they can be interconnected freely.

Such being the case, when connecting the output terminals of the frequency dividers 3 with the input terminals of the keyer circuits 4, as clearly indicated in FIG. 5 one may make beforehand a through-hole 12 in the board 10 at the point of intersection of the conductive members 11a and 11b to be interconnected, and at the time of printing, electrically connect or fix the conductive member 11a on one surface through the aforesaid through-hole 12 to the conductive member 11b on the other surface or electrically join the both conductive members 11a, 11b by following solder into the said through-hole 12.

If one connects the output terminals C_{1-6} , $C^{\#}_{1-6}$, B_{1-6} of the frequency dividers 3 of this electronic musical instrument with the input terminals K_{1-12} of the keyer circuits 4 according to the wiring scheme in FIG. 3, the connection is made as illustrated in FIG. 4. That is, the frequency dividers $3_1, 3_2, \dots, 3_6$ are connected to the keyer circuits with an odd numbered suffix, $4_1, 4_3, \dots, 4_{11}$ and for example, six output terminals C_{1-6} of the frequency divider block 3_1 are connected sequentially to the input terminals K_1 of the keyer circuit blocks with an odd numbered suffix through the conductive members 11a and 11b extended at a right angle to each other. At the points of intersection of the conductive members 11a, 11b, the through-holes 12 are made beforehand to serve as means for connecting the corresponding members 11a and 11b. On the other hand, the frequency dividers $3_7, 3_8, \dots, 3_{12}$ are connected to the keyer circuits with an even numbered suffix $4_2, 4_4, \dots, 4_{12}$ and for example, six output terminals B_{1-6} of the frequency divider block 3_{12} are connected one by one to the input terminals K_{12} of the keyer circuit block with an even numbered suffix through the conductive members 11a and 11b extended at a right angle to each other. The through-holes 12 are similarly made at the points of intersection beforehand. In the meantime, once the position of this through-hole is decided, there is no need of extending the conductive members 11a, 11b beyond that position and therefore the conductive member 11 having a length up to that position will be provided.

In FIG. 4, only the connection between the frequency divider blocks $3_1, 3_2$, and 3_{12} and the corresponding input terminals of the keyer circuit blocks is illustrated but the illustration of the conductive members 11a and 11b for connecting the other frequency divider blocks and keyer circuit blocks is omitted, as the connection of the latter circuit blocks is made in substantially the same way as in the case of the frequency divider blocks $3_1, 3_2$, and 3_{12} .

EMBODIMENT [II]

This embodiment represents the case where the frequency dividers are arranged along the edges of two opposite sides of a rectangular printed circuit board, while the keyer circuits are arranged along the edges of the other two opposite sides.

In FIG. 6, references numeral 10 is a rectangular printed circuit board made of such insulating material as synthetic phenol resin (trade name: Bakelite) and of its any two opposite sides 10_1 and 10_3 , for example, along the upper edge 10_1 and from the left to the right a

total of six frequency dividers or divider blocks $3_1, 3_2, \dots, 3_6$ ranging from the notes C to F are arranged orderly on the board 10, while on the lower side 10_3 of the board 10 and in a direction opposite to the aforesaid, the remaining frequency dividers $3_7, 3_8, \dots, 3_{12}$ ranging from the notes $F^{\#}$ to B are provided one by one from the right to the left. On the other hand, at specified positions along the opposite sides 10_1 and 10_3 of the board 10, small holes (not shown), six for each divider block, are made beforehand to pass lap terminals or pin terminals (not shown) leading from the output terminals of the aforesaid frequency dividers $3_1, 3_2, \dots, 3_{12}$ and with these through-holes as the straight points, the straight parallel conductive members 11b (shown in broken lines) are formed on the back surface $10b$ of the board, extending toward the opposite side 10_3 or 10_1 .

Further, of the other opposite side 10_2 and 10_4 of the board 10, along the left side 10_2 are provided the odd-numbered keyer circuits $4_1, 4_3, \dots, 4_{11}$ sequentially from the upper part of the board 10 downward, while on the right side 10_4 of the board 10 are provided, similar to the abovementioned, the even-numbered keyer circuits $4_2, 4_4, \dots, 4_{12}$ one by one in this order. In the meantime, one the front face $10a$ of the board 10 are formed a set of six straight conductive members 11a (shown in solid lines) corresponding to the input terminals $K_1, K_2, \dots, K_6$ and $K_7, K_8, \dots, K_{12}$ of the respective keyer circuits $4_1, 4_2, \dots, 4_{12}$. As for the connections of the aforesaid both conductive members 11a and 11b with the frequency dividers 3 and the keyer circuits 4, it is preferable to form the same at a stretch by the known printed circuit technique. In this manner, on the front and back surface of the board 10 the conductive members 11b of the frequency dividers 3 and the conductive members 11a of the keyer circuits 4 cross each other on different surfaces and therefore, conditions is brought about, in which both conductive members 11a, 11b can be interconnected.

Now, when connecting the output terminals C_{1-6} , $C^{\#}_{1-6}$, B_{1-6} of the frequency dividers 3 with the input terminals $K_1, K_2, \dots, K_{12}$ of the keyer circuits 4 on the surfaces of the aforesaid board 10 in accordance with the connection requirements for circuit construction of the aforesaid electronic musical instrument, as in the case of FIG. 5 the both conductive members 11a and 11b formed on the front and back surfaces of the board 10 are provided at proper positions and in proper length. The through-holes 12 are made beforehand in the board 10 at points where both the corresponding conductive members 11a and 11b intersect or meet each other. The conductive members 11a and 11b are not extended beyond such points of intersection that is, the conductive members 11a and 11b terminate at such intersecting points. The both conductive members 11a and 11b are connected through the holes 12 under the known coupling technique. Needless to say, if any connection method to replace the abovementioned is available, it may be employed.

Now, in accordance with the previously mentioned wiring rule, the output terminals C_{1-6} , $C^{\#}_{1-6}$, F_{1-6} of the frequency dividers $3_1, 3_2, \dots, 3_6$ of the electronic musical instrument are connected to the input terminals $K_1, K_2, \dots, K_6$ of the keyer circuits 4 with an odd-numbered suffix, while the output terminals $F^{\#}_{1-6}$, $G_{1-6}, \dots, B_{1-6}$ of the other frequency dividers $3_7, 3_8, \dots$

3_{12} are connected to the input terminals $K_7, K_8, \dots K_{12}$ of the keyer circuits with an even-numbered suffix $4_2, 4_4, \dots 4_{12}$.

Explaining this by reference to the connections shown in the figure, for instance six output terminals C_{1-6} of the frequency divider block 3_1 are connected to six input terminals $K_1, K_1, \dots K_1$ of the keyer circuit block with an odd-numbered suffix $4_1, 4_3, \dots 4_{11}$ respectively and further, for example, six output terminals $B_1, B_2, \dots B_6$ of the frequency divider block 3_{12} are connected to six input terminals $K_{12}, K_{12}, \dots K_{12}$ of the keyer circuits with an even-numbered suffix $4_2, 4_4, \dots 4_{12}$ respectively.

For this reason, at the point of intersection of the conductive members $11b$ corresponding to the output terminals $C_1, C_2, \dots C_6$ of the frequency divider block 3_1 with the conductive members $11a$ corresponding to the input terminal K_1 of the keyer circuits with an odd-numbered suffix, as already mentioned, there is provided a through-hole 12 beforehand, and the conductive members $11a$ and $11b$ on the front and the back surfaces of the board are interconnected through this through-hole 12. As is clear from FIG. 6, the conductive members $11a$ and $11b$ on the front and the back surfaces of the board 10 are formed in parallel on each surface without crossing, while the both conductive members $11a, 11b$ cross each other on different surfaces, which fully permits the formation of complicated pattern of wiring. In the meantime, once the position of the through-hole 12 is determined according to the input and output terminals to be connected, the conductive members $11a$ and $11b$ need not be extended beyond that position.

As stated above, with the wiring system of this invention, the frequency dividers 3 and the keyer circuits 4 are sequentially arranged on the adjacent sides $10_1, 10_2$ or on these first adjacent sides and the second adjacent sides 10_3 and 10_4 of the rectangular board 10 and, in correspondence to the output or input terminals thereof, the conductive members $11a$ and $11b$ crossing each other are provided on the front and back surfaces $10a$ and $11b$ of the board, whereby wiring being subjected to an extremely complicated connecting condition of an electronic musical instrument can be joined orderly and functionally through systematization on the front and back surfaces of the same board 10.

Accordingly, on the wiring board 10 to which the wiring system according to this invention is applied, the conductive members $11a$ and $11b$ on its front and back surfaces are orderly arranged maintaining a crossing relationship and further, joining of the both conductive members on the front and the back surface as well as the connections (corresponding part at lap or pin terminals) of the conductive members with integrated frequency divider block 3 and keyer circuit block 4 can be made automatically in applying the known printed circuit technique. Also it is possible to thereby reduce size and weight of a circuit construction of the tone signal producing unit of an electronic musical instrument.

Moreover, when wiring an electronic musical instrument in utilizing the wiring board under the wiring rule of this invention, instead of complicated connections of a number of wires under a predetermined wiring rule, it is possible to constitute a tone signal producing unit by

merely inserting the wired board 10 at a required position, whereby wiring work can be improved greatly. In addition, as there are no such bundles of lead wires as seen in the past, the possibility of deterioration of electrical characteristics is eliminated beforehand.

Further, the input terminals $2_1, 2_2, \dots 2_{12}$ of the frequency dividers $3_1, 3_2, \dots 3_{12}$, the control terminals $5_1, 5_2, \dots 5_{12}$ of the keyer circuits $4_1, 4_2, \dots 4_{12}$ and the common output terminals $6_1, 6_2, \dots 6_{12}$ are all arranged sequentially along the sides of the wiring board 10 respectively and therefore, wiring of these terminals with the corresponding points is greatly simplified.

As stated above, the wiring system of this invention has a great industrial advantage in that by rather positively utilizing special wiring for the circuit construction of an electronic musical instrument, it has succeeded in improvements of electrical characteristics of the wiring in the tone signal producing unit as well as in reduction of size and weight.

I claim:

1. Wiring system for connecting twelve frequency divider circuits providing a plurality of full octaves to twelve keyer circuits in an electronic musical instrument, both the frequency divider and keyer circuits having respectively, a number of output terminals and a number of input terminals corresponding in number to the number of said output terminals, comprising;

a substrate board of electrically insulating material having at least two adjacent sides extending substantially at a right angle to each other,

said frequency divider circuits being arranged along one of said at least two adjacent sides and being divided into first and second groups with each group comprising six divider circuits covering one half octave, and said keyer circuits being arranged along the other side of said at least two adjacent sides and also being divided into first and second groups each having six keyer circuits;

a plurality of first conductive members provided on one surface of said substrate board each electrically connected to a different one of said output terminals of one of said frequency divider circuits and extending from said one side along said other side in parallel to each other;

a plurality of second conductive members provided on the opposing extending surface of said substrate board, each electrically connected to one of said input terminals of one of said keyer circuits and extending from said other side along said one side in parallel to each other,

said first and second conductive members each terminating at intersecting points where the first and second conductive members to be electrically connected intersect and where each first conductive member in said first group terminates at the intersection of a second conductive member connected to a keyer circuit in said first group so that the output terminals of each divider circuit in said first group are each connected to an input terminal of a different keyer circuit of said first group and where each conductive member connected to a frequency divider circuit in said second group terminates at the intersection of a second conductive member connected to a keyer circuit in said second group so that the output terminals of each divider circuit

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in said second group are each connected to an input terminal of a different keyer circuit of said second group;
said substrate board having passages through it from one extending surface to the other at said points; 5
and
means for connecting said first and second conductive members at said points through said passages.
2. A wiring system as in claim 1 wherein said first and

second groups of keyer circuits are disposed with alternate keyer circuits along one side of said board.
3. A wiring system as in claim 1 wherein said first and second groups of keyer circuits are disposed on opposite sides of said board and said first and second groups of frequency divider circuits are likewise disposed on opposite sides of said board.

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