

[54] TREMOLO GENERATING DEVICE WITH MULTI-DIRECTIONALLY ROTATING SPEAKER

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[30] Foreign Application Priority Data

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June 8, 1972	Japan	47-67830

[52] U.S. Cl. **181/143**

[51] Int. Cl. **H04r 1/20; H04r 1/28**

[58] Field of Search **181/27 A, 31 B; 84/1.25, 84/1.24; 179/1 J**

[56] References Cited

UNITED STATES PATENTS

3,084,585 4/1963 Wayne, Jr. 84/1.24

Primary Examiner—Stephen J. Tomsky
Attorney, Agent, or Firm—Cushman, Darby & Cushman

[57] ABSTRACT

A sound effect generating device for use in an electronic musical instrument comprises a first rotary shaft, a second rotary shaft extended in a direction, for example, perpendicular to the first rotary shaft so as to rotate about itself and about the first rotary shaft, and a sound radiating member fixed to the second rotary shaft so as to radially generate a sound in a given direction, for example, perpendicular to the axis of the second rotary shaft, whereby the sound radiating member rotates simultaneously about the first and second rotary shafts, radiating sound in multiple directions, which can be heard as tremolo or similar sound effect which is very pleasing to the ear.

9 Claims, 19 Drawing Figures

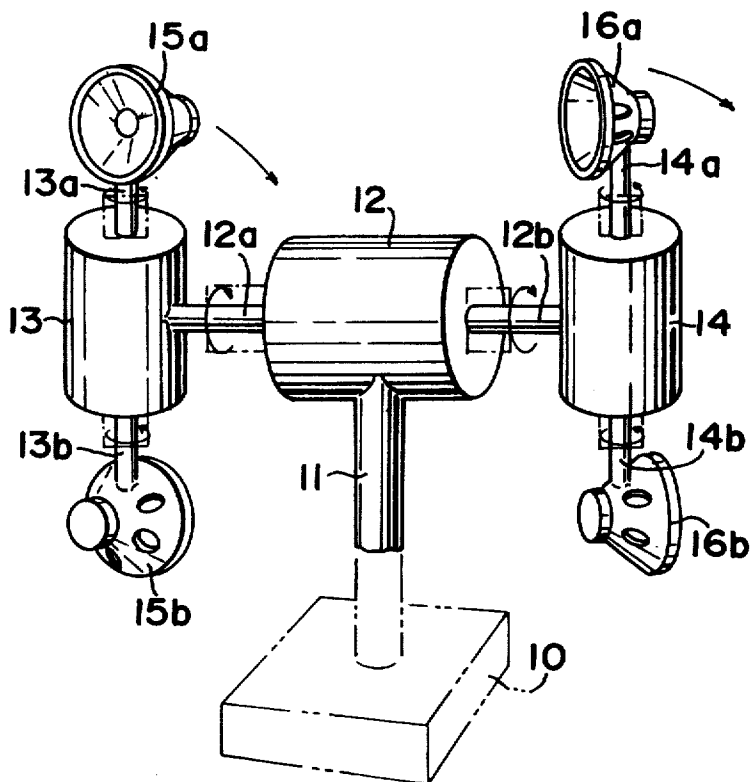


FIG. 1

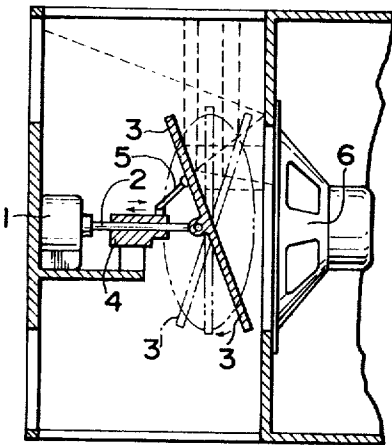


FIG. 2

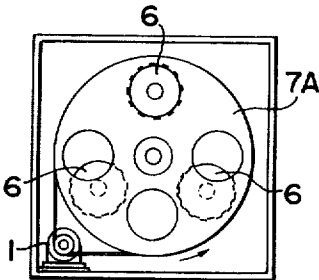


FIG. 3

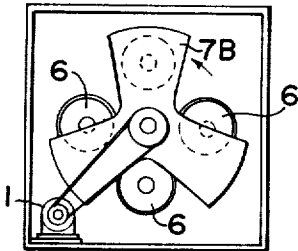


FIG. 4

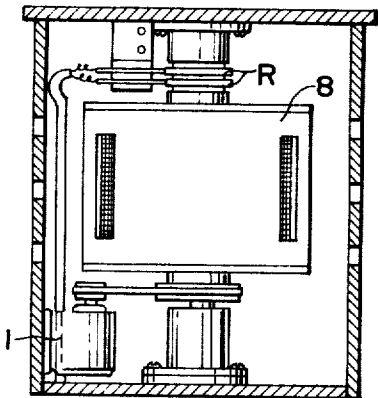


FIG. 6

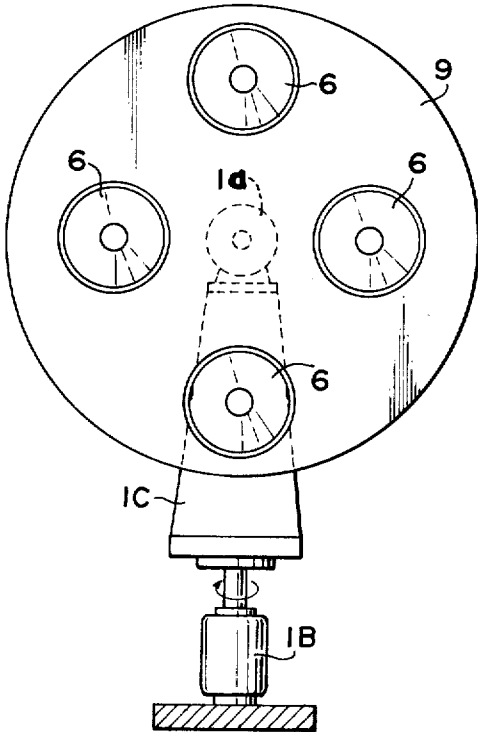


FIG. 5

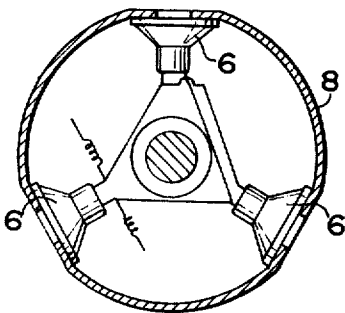


FIG. 7

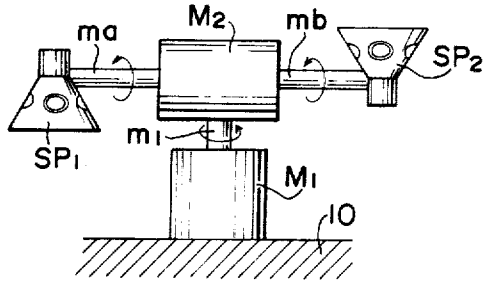


FIG. 8

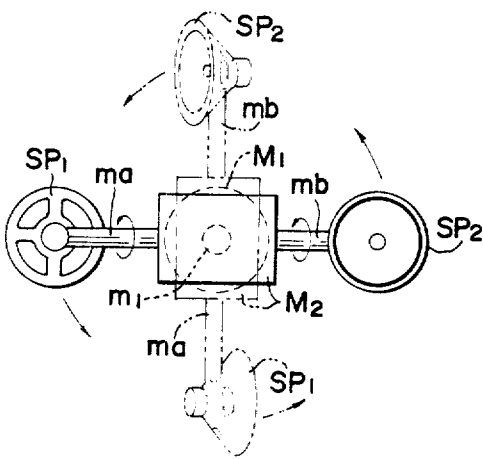


FIG. 9

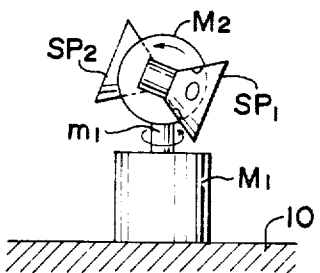


FIG. 10

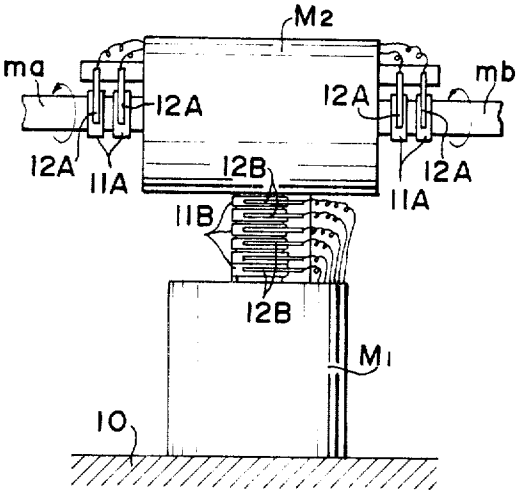


FIG. 11

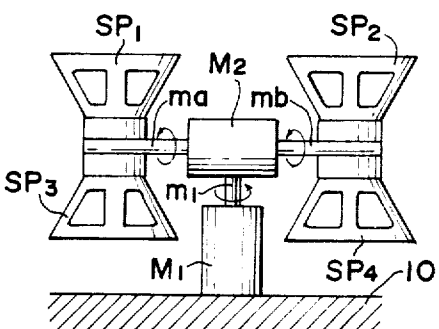


FIG. 12

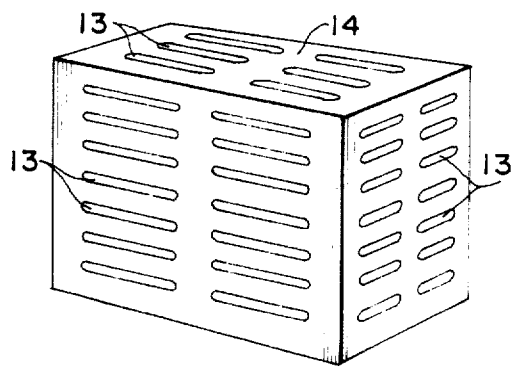


FIG. 13

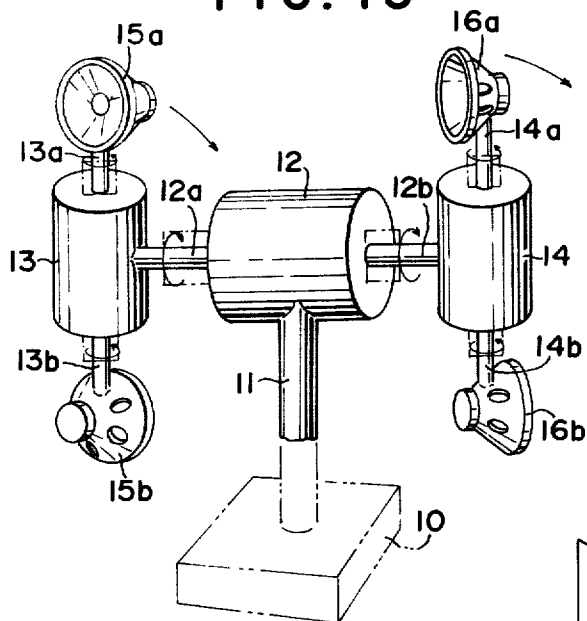


FIG. 15

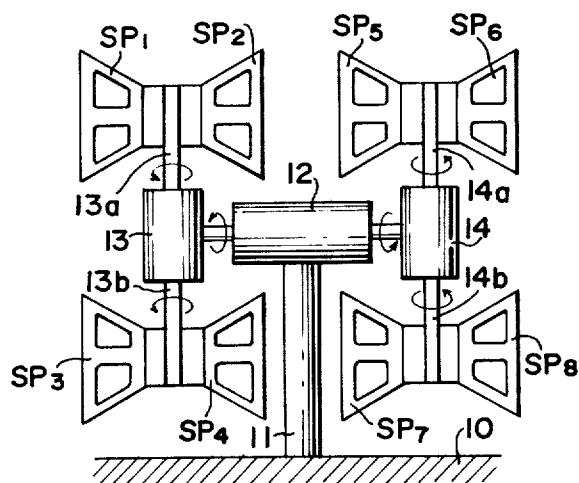


FIG. 14

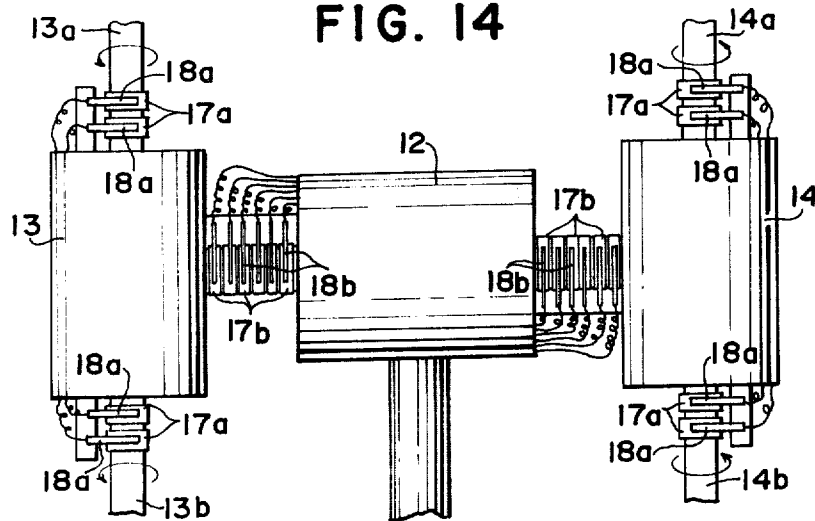


FIG. 16

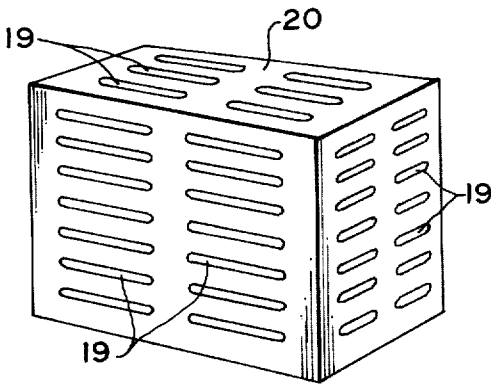


FIG. 17

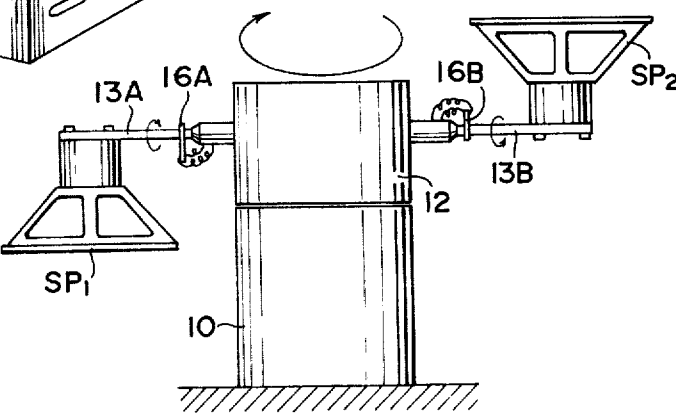


FIG. 18

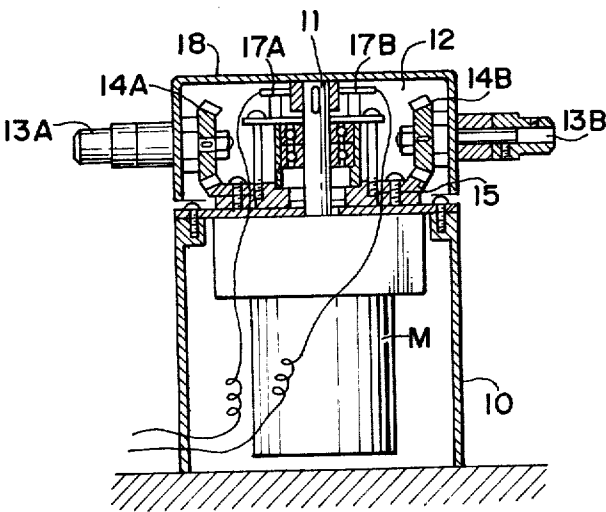
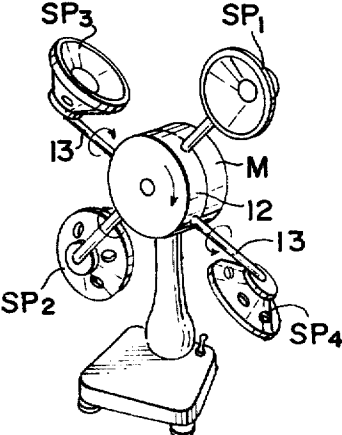


FIG. 19



TREMOLO GENERATING DEVICE WITH MULTI-DIRECTIONALLY ROTATING SPEAKER

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a sound effect generating device to obtain acoustically tasty audio vibrato or tremolo effect by linkagedly operating a sound radiating member in multiple directions.

2. Description of the Prior Arts

There are some references as prior art as disclosed in Japanese Utility Model Publication No. 22436/65 and U.S. Pat. No. 3,204,722 which are provided with a rotary plate in front of a speaker thereby producing a tremolo effect, respectively.

The former one is as shown in FIG. 1 wherein a sound generating reflection plate 3 is pivotally received at its center to a rotary shaft 2 at its one end so as to rotatably move within a optional plane, and a sleeve 4 slidably mounted on the shaft 2 and connected to a side portion of the sound reflection plate 3 with a connector 5, and a speaker 6 is provided opposite to the plate 3, whereby a tremolo effect is produced by tiltably rotating the sound reflection plate 3.

The latter disclosed in said U.S. patent is provided with a rotating disk 7A having spaced apertures or rotary member 7B having fan-like extensions in front of a plurality of speakers 6 as shown in FIGS. 2 and 3. The rotary disk (or member) 7A (or 7B) is rotated at a required speed via a belt by a motor 1 thereby giving a tremolo effect to a sound produced from the speakers 6.

In such devices, however, the speaker or speakers are mounted stationary, and, as a result, the sound produced is given only a flat tonal variation, with a resultant defect that no musically satisfactory tremolo effect can be obtained.

Further to the devices, there are found other sound effect generating devices that produce vibrato or tremolo effects by rotating the speakers themselves in a horizontal plane, as is disclosed in U.S. Pat. Nos. 3,100,024 and 3,084,585.

As is shown in FIGS. 4 and 5, the device disclosed in U.S. Pat. No. 3,100,024 is arranged such that a cylindrical speaker structure 8 including a plurality of speakers 6 as shown in FIG. 5 is rotated via a belt and rotary shaft by a motor 1 and said speakers are supplied low frequency currents through slip-rings R. This system provides that the speakers are rotated in a same plane thereby producing some vibrato effect but such vibrato lacks a variation of the sound. No musically satisfied sound was obtained.

The device disclosed in U.S. Pat. No. 3,084,585 is shown in FIG. 6 and is provided with speakers 6 mounted in a circular supporting disk 9 rotated about an axis 1a of a motor 1. The supporting disk 9 is mounted about another axis perpendicular to the axis 1a, thereby producing vibrato or tremolo effects due to Doppler effect. However such sound does not yet give a desirable musical sound of tremolo effect since such sound cannot be enhanced in a vertical direction because the speakers rotate only in a horizontal plane, radiating the sound in the same plane.

As described foregoing, conventional devices give no desirable musical audio-sound effect for the listeners and players.

SUMMARY OF THE INVENTION

The object of the present invention is to provide a sound effect generating device for electronic musical instrument, which produces a tremolo or similar effect of sufficient variation through the rotation of a sound radiating member or members in different directions.

According to an aspect of this invention, a second rotary shaft is extended in a direction of the given angle to a first rotary shaft so that the second rotary shaft rotates about the first rotary shaft, and a sound radiating member having a sound radiating face is directed at a given angle, i.e. at a right angle to the second rotary shaft, whereby the sound radiating member is rotated simultaneously about the first and second rotary shafts.

According to another aspect of this invention, a plurality of the second shafts are spatially located with respect to the first rotary shaft at a given angle, i.e. at a right angle to the first rotary shaft, and a sound radiating member having a sound radiating face is directed at a given angle, i.e. at a right angle to each second shaft, is provided in the vicinity of the free end of each second shaft, whereby said sound radiating members are rotated simultaneously about the first and second rotary shafts.

According to a further aspect of this invention, at least one second rotary shaft is mounted extending from a side of a rotary support which is rotatable with a first rotary shaft, and a stationary engagement member is fixed around the first rotary shaft, and another engagement member rotating with the second rotary shaft is fixed to the second rotary shaft, so that both of the engagement members are in mesh with each other to communicate the rotation of the rotary support, driven by a motor to the second rotary shaft and a sound radiating member having a sound radiating face directed at a given angle, i.e. at a right angle to the second rotary shaft, whereby the sound radiating member is rotated simultaneously about the first and second rotary shaft.

BRIEF EXPLANATION OF THE DRAWING

FIGS. 1-6 are constitutional figures, each showing an embodiment of a conventional device for producing a tremolo or similar effect;

FIGS. 7-9 are simplified figures showing respective embodiment of this invention;

FIG. 10 is a partially enlarged vertical view showing an electrical system for the embodiment of FIGS. 7-9;

FIG. 11 is a view showing a modification of this invention;

FIG. 12 is a perspective view showing one embodiment of a suitable cabinet for this device of this invention;

FIG. 13 is a view showing another embodiment of this invention;

FIG. 14 is a partial enlarged vertical constitutional view showing an electrical system in FIG. 13;

FIG. 15 is a view showing a further modification of this invention;

FIG. 16 is a perspective view showing one embodiment of suitable cabinet for this invention;

FIG. 17 is a side elevational view showing still another embodiment of this invention;

FIG. 18 is an enlarged cross section showing a major portion of a gear box; and

FIG. 19 is a perspective view showing still another modification of this invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Now, the preferred embodiments will be described with reference to the accompanying drawing.

In FIG. 7, on a base 10 is rigidly fixed a motor M_1 , from which a first rotary shaft is upwardly extended so as to be rotated by the motor M_1 . The first rotary shaft m_1 is provided, at its upper end, with a double shaft motor M_2 having second rotary shafts ma , mb extending approximately at right angles to the first rotary shaft m_1 . Thus, the second rotary shafts ma , mb can be rotated by the double shaft motor M_2 , while at the same time that double shaft motor M_2 having the second rotary shafts is rotated about the first rotary shaft m_1 by the motor M_1 . The second rotary shafts ma , mb may not necessarily be extended at right angles to the first rotary shaft m_1 , but may be extended at any other angles thereto. The second rotary shafts ma , mb should, of course, not be extended in the same direction as the lengthwise direction of the first rotary shaft m_1 . The second rotary shafts ma , mb , for instance, may make different angles to the first rotary shaft m_1 , one ma from the other mb . Speakers SP_1 , SP_2 are rigidly fixed to the ends of the second rotary shaft ma , mb , respectively so as to radially produce a sound wave at a right angle to the shaft ma or mb , for example, with a balanced center of gravity.

The rotary shafts m_1 , ma , and mb are respectively rotated in each direction of arrow as shown in FIGS. 7 and 8. Their rotation speeds are set for example at 0.5–20 rps. For convenience, speakers SP_1 , SP_2 are shown so as to radiate a sound wave in a direction of right angles to the shafts ma , mb , but the arrangement is not limited to the above and it is permitted to fix said speakers to radiate most of sound waves in a direction making any optional angles to the shafts ma , mb . However, if the speakers SP_1 , SP_2 are so fixed to the shafts ma , mb as to radiate the sound waves in a direction which is the same as the lengthwise direction of each shaft ma or mb , such arrangement takes little or no effect. The speakers SP_1 and SP_2 may also be arranged to radiate sound waves in different directions, one speaker SP_1 from the other SP_2 .

An electric current is supplied to the speakers SP_1 , SP_2 and the motors M_1 and M_2 via slip-rings 11A, 11B and brushes 12A, 12B as shown in FIG. 10.

According to the sound effect producing device of this invention, the speakers SP_1 , SP_2 rotate about the second rotary shafts ma and mb while simultaneously rotating about the first rotary shaft m_1 , radiating sound waves in multiple directions, whereby a vibrato or tremolo effect can be heard by listeners at a stationary position. The vibrato or tremolo effect sound thus heard becomes remarkably wider spread and more natural than that obtained by the conventional devices.

When the first rotary shaft m_1 (motor M_1), and the second rotary shafts ma , mb (motor M_2) rotate at a speed ratio (S_1/S_2) represented by any integral number, where S_1 is a rotational speed of either of the shaft m_1 and shaft ma or mb , and S_2 is a rotational speed of the other, and $S_1 > S_2$, the movement of each speaker SP_1 , SP_2 describes always the same locus without making any random movement. As a result, radiation of the sound waves becomes relatively monotonous. There-

fore, it is preferred to set the speed ratio (S_1/S_2) to the value represented by a non-integral number to obtain more variation of the sound radiation.

Another embodiment is shown in FIG. 11 wherein a pair of sound radiating members or speakers SP_1 and SP_3 are fixed to the second rotary shaft ma with the rear sides of the speakers face to face, and another pair of sound radiating members or speakers SP_2 and SP_4 are fixed to the rotary shaft mb with the rear sides of the speakers face to face. Each speaker SP_1 , SP_2 , SP_3 or SP_4 is directed so as to radiate most of the sound waves in a direction making a given angle to the shaft ma or mb , for example, at right angles to the shaft ma or mb , as shown. If, however, the speaker SP_1 , SP_2 , SP_3 or SP_4 is so directed as to radiate most of the sound waves in a direction that is the same as the lengthwise direction of the shaft ma or mb , little or no effect can be attained. According to this embodiment, a more profound and enhanced vibrato or tremolo effect is produced, and the weight balance of the speakers and the shafts ma and mb become improved.

In practice, the rotational speakers shown in FIGS. 7 and 11 may be installed within a cabinet 14 having sound discharge slits 13 as shown in FIG. 12, whereby the aesthetic view is enhanced.

Further embodiments of this invention are described below referring to FIGS. 13–16.

In FIG. 13, on a base 10 is rigidly fixed via support 11 a double shaft motor 12, from which first rotary shafts 12a and 12b are extended on opposite sides of the motor 12 so as to be rotated thereby. Double shaft motors 13 and 14 are fixed to the ends of the first rotary shafts 12a and 12b, respectively, so as to be rotated therewith. Each double shaft motor 13 or 14 has second rotary shafts 13a and 13b (or 14a and 14b) extended from the motor 13 or 14 at the opposite ends thereof and rotatable therewith. Sound radiating members or speakers 15a, 15b, 16a, and 16b are provided, respectively, to the shafts 13a, 13b, 14a and 14b, so that most of the sound waves are emitted in a direction, for example, making right angles to the shaft 13a, 13b, 14a, or 14b.

The rotary shafts 12a, 12b, 13a, 13b and 14a, 14b are respectively rotated in directions as indicated by the arrows in FIG. 13. Thus, the speakers 15a, 15b, 16a, and 16b are rotated about the shafts 13a and 13b or 14a and 14b, respectively, while at the same time rotating about the shaft 12a or 12b. Their rotation speeds are set for example at 0.5–20 rps.

For convenience, speakers are shown so as to radially emit sound waves in a direction making right angles to the second shafts but an arrangement is not limited to the above and it is permitted to fix said speakers to radiate sound waves in a direction making optional angles to said second shaft. The speakers 15a, 15b, 16a and 16b may also be arranged to radiate sound waves at different angles to the shafts 13a, 13b from to the shafts 14a, 14b.

An electric current is supplied to the speakers 15a, 15b, 16a and 16b and to the motors 13 and 14 via slip-rings 17a, 17b and brushes 18a, 18b as shown in FIG. 14.

Still another embodiment is shown in FIG. 15 wherein a pair of sound radiating members or speakers SP_1 and SP_2 (SP_3 and SP_4 , SP_5 and SP_6 , or SP_7 and SP_8) is fixed to each of the second rotary shafts 13a, 13b, 14a, and 14b with the back side of the pair of speakers

face to face. The speakers SP_1 to SP_n are so arranged as to radiate most of the sound waves in a direction perpendicular to the shafts 13a, 13b, 14a, and 14b, respectively.

FIG. 16 shows a cabinet 20 having sound discharge slits 19 on their walls in which the rotational speakers can be housed aesthetically.

Other embodiments according to this invention are described referring to FIGS. 17-19.

Referring first to FIGS. 17-18, a base frame 10 is provided wherein a motor M is rigidly installed, and a first rotary shaft 11 is extended upward from the motor M so as to be rotated thereby. A first bevel gear 15 is fixed on to the base frame 10 around the shaft 11. A case 18 is fixed to the shaft 11 and is rotatable therewith. The shaft 11 and the bevel gear 15 are enclosed within the case 18, from the opposite sides of which are extended horizontally second rotary shafts 13A and 13B. The ends of the second rotary shafts 13A and 13B are provided with second bevel gears 14A and 14B engageable with the first stationary bevel gear 15. Thus, the rotational movement of the first rotary shaft 11 is transmitted to the second rotary shafts 13A and 13B through the bevel gears 14A, 14B and 15. The second bevel gears 14A and 14B are also enclosed within the case 18 defining a gear box 12 therein.

Speakers SP_1 , SP_2 are provided to the other ends of the second rotary shafts 13A, 13B. Electric current for feeding signals to the speakers SP_1 and SP_2 is supplied, as shown in FIG. 17, through slip rings 16A and 16B and further through slip rings 17A and 17B provided around the shaft 11, as shown in FIG. 18.

According to this embodiment, the first and second rotary shafts 11, 13A and 13B are rotated by only one motor M.

It is of course possible to replace the bevel gears 14A, 14B and 15 with rubber pulleys of trapezoidal cross section. In such a case, a pulley box 12 is defined by the case 18. In place of the engagement members 14A, 14B, and 15, any members may be employed as long as such engagement members effectively transmit the rotation of the motor to the rotary shafts 13A, 13B.

In the above construction, when the motor rotates, the rotary shaft 11 rotates and the case, namely, rotary support 18 also rotates.

The rotation of the motor is further communicated to the rotary shafts 13A, 13B through the engagement of the stationary gear 15 and the movable gears 14A and 14B. In other words, the second shafts 13A, 13B rotate themselves while simultaneously rotating about the shaft 11. Therefore, the speakers SP_1 , SP_2 radiate sound waves in multiple directions whereby vibrato or tremolo effect sound is audible by the listeners at a given stationary position.

A further embodiment is shown in FIG. 19, wherein four speakers SP_1 to SP_4 are provided, respectively, to the four shafts 13 which are extended from the case 12. Within the case 12 are housed engagement members (not shown), which are driven by the motor M.

As described above, according to this invention, the second rotary shafts having the sound radiating members are provided to the first rotary shaft at a given angle thereto and the first and second shafts are rotated simultaneously so that the sound radiating members radiate sound waves in almost all directions, whereby a

vibrato or tremolo effect is effectively obtained.

As apparent, the device according to this invention is most suitable for electronic musical instruments.

What I claim is:

1. A sound effect producing device comprising:

at least one first rotary shaft,
means for rotating said first rotary shaft about its longitudinal axis,

an even number of second rotary shafts positioned symmetrically with respect to said first rotary shaft, said second rotary shafts extending at approximately right angles to the longitudinal axis of said first rotary shaft,

means secured to said first rotary shaft for rotating said second rotary shafts about their longitudinal axes, and

at least one sound radiating member mounted on each of said second rotary shafts and being rotatable therewith, said sound radiating members radiating sound waves in a direction making an approximate right angle to said second rotary shafts.

2. Device according to claim 1, wherein said at least one first rotary shaft is a plurality of first rotary shafts positioned symmetrically with respect to one another, each of said first rotary shafts being protrudably provided with said plurality of second rotary shafts, each of said second rotary shafts being provided with said at least one sound radiating member.

3. Device according to claim 1, said means for rotating said at least one first rotary shaft is a motor.

4. Device according to claim 3, said means for rotating said second rotary shafts is a motor.

5. Device according to claim 1, wherein said second rotary shafts are mounted to the first rotary shaft via said means for rotating the second rotary shaft.

6. Device according to claim 1, wherein said first and second rotary shafts are arranged to rotate with their rate of rotation ratio represented by a non-integral number.

7. A sound effect producing device comprising at least one first rotary shaft, means for rotating said first rotary shaft about its longitudinal axis, at least one second rotary shaft rotatable about the longitudinal axis of said first rotary shaft, said second rotary shaft being extended at a given angle with respect to said first rotary shaft, means secured to said first rotary shaft for rotating said second rotary shaft about its longitudinal axis, and at least one sound radiating member mounted on said second rotary shaft and being rotatable therewith, said sound radiating member radiating sound waves in a direction making an approximate right angle to said second rotary shaft.

8. Device according to claim 7, wherein said at least one sound radiating member is a plurality of sound radiating members fixed to said at least one second rotary shaft, said plurality of sound radiating members being arranged to radiate sound waves in different directions.

9. Device according to claim 7 wherein said means for rotating said second rotary shaft includes a first bevel gear mounted stationary around the first rotary shaft, and a second bevel gear fixed to the second rotary shaft, said gears being in mesh with each other, whereby the rotation energy of the first rotary shaft is communicated to the second rotary shaft.

* * * * *