

Jan. 20, 1959

D. J. LESLIE

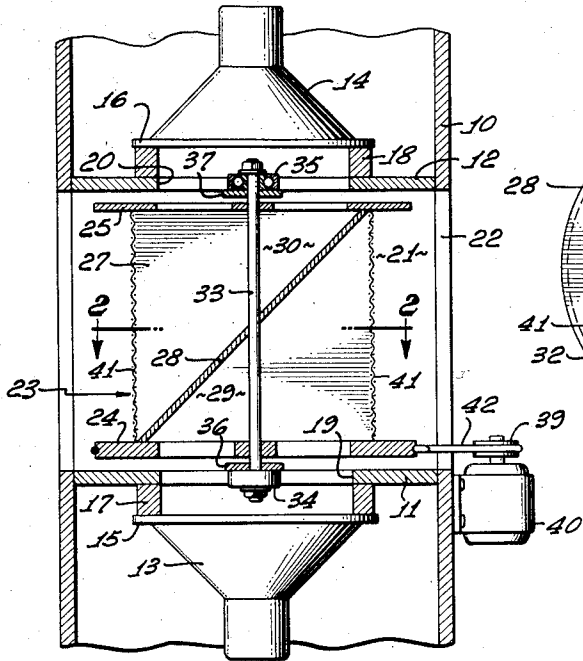
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ROTATABLE TREMULANT SOUND PRODUCER

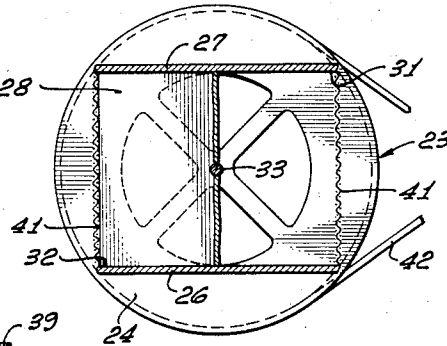
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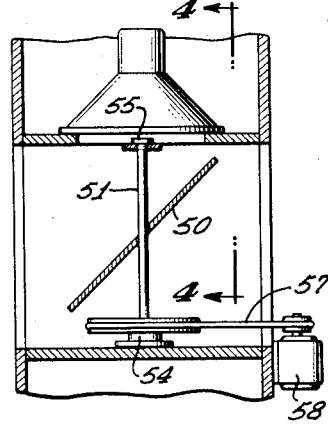
**FIG. 1.**



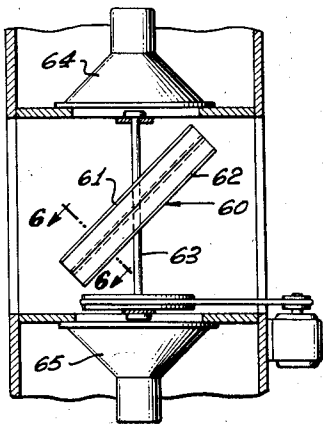
**FIG. 2.**



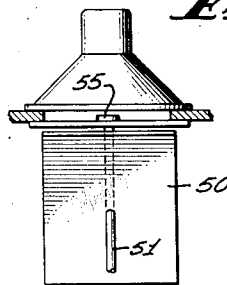
**FIG. 3.**



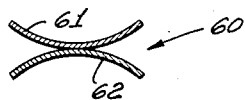
**FIG. 5.**



**FIG. 4.**



**FIG. 6.**



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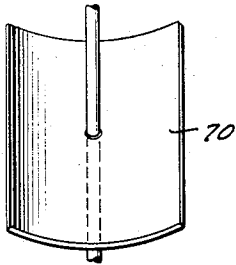
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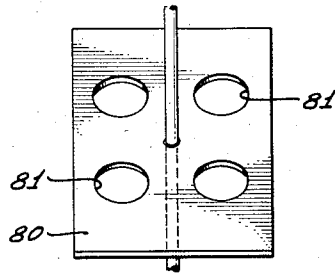
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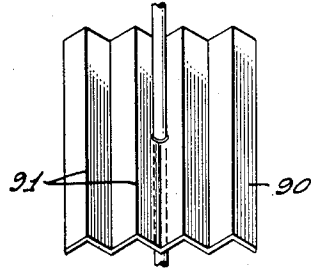
*FIG. 7.*



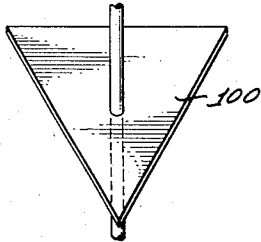
*FIG. 8.*



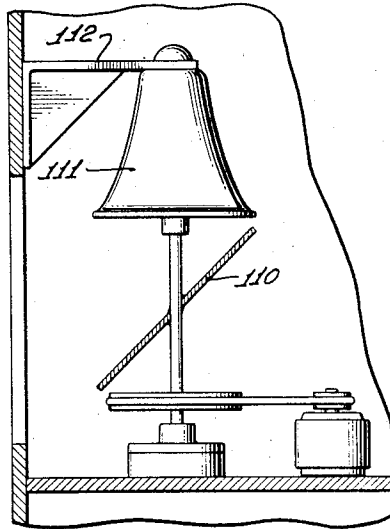
*FIG. 9.*



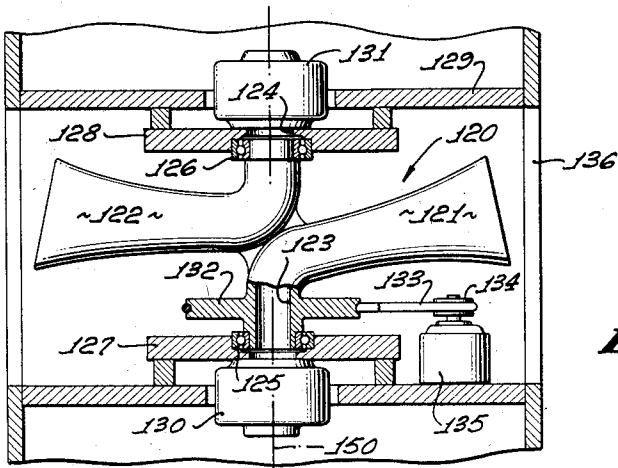
*FIG. 10.*



*FIG. 11.*



*FIG. 12.*



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## ROTATABLE TREMULANT SOUND PRODUCER

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Application January 3, 1956, Serial No. 556,893

8 Claims. (Cl. 181—27)

This invention relates to electrical musical instruments, and particularly to apparatus for adding tremolo or vibrato to the sound produced by the loud speaker.

It is often desirable, from the standpoint of interpretation or expression, that a melody note, for example, have substantial tremolo while the complementary chords or notes have little or no tremolo. If tremolo is added electrically, appropriate selective circuits and controls could be provided, but at the expense of materially complicating an already complex instrument. The object of this invention is to provide a simple mechanical tremolo device that has controllable frequency selective characteristics.

For this purpose, use is made of a rotating reflector plate or the like, the shape and size of which may be varied to achieve appropriate frequency response.

In some installations a plurality of loud speakers are necessary or desirable in order to produce special results. For example, in my United States Letters Patent No. 2,596,258, issued May 13, 1952, and entitled, Electric Organ Speaker System, there is described a system in which alternate half tones are grouped in separate channels in order to avoid certain undesirable "beat effects." Another object of this invention is to provide simple rotary apparatus cooperable with two speakers for creating tremolo effects. Use is made of opposite sides of the reflector plate cooperable with facing speakers located on a common axis. A material saving of space and equipment is accordingly achieved in multiple sound channel apparatus.

This invention possesses many other advantages, and has other objects which may be made more clearly apparent from a consideration of several embodiments of the invention. For this purpose, there are shown a few forms in the drawings accompanying and forming part of the present specification. These forms will now be described in detail, illustrating the general principles of the invention; but it is to be understood that this detailed description is not to be taken in a limiting sense, since the scope of the invention is best defined by the appended claims.

Referring to the drawings:

Figure 1 is a fragmentary sectional view of a dual speaker system incorporating the present invention;

Fig. 2 is a sectional view, taken along a plane indicated by line 2—2 of Fig. 1;

Fig. 3 is a sectional view similar to Fig. 1, showing another form of the present invention;

Fig. 4 is a sectional view, taken along a plane indicated by line 4—4 of Fig. 3;

Fig. 5 is a sectional view similar to Figs. 1 and 3, and showing a further modified form of the present invention;

Fig. 6 is a fragmentary sectional view, taken along a plane indicated by line 6—6 of Fig. 5;

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Figs. 7, 8, 9 and 10 illustrate, respectively, further modified plate structures for use in the forms illustrated in Figs. 3 to 5;

Fig. 11 is a fragmentary sectional view of a cabinet structure showing apparatus similar to that of Fig. 3, but cooperating with a horn structure; and

Fig. 12 is a fragmentary sectional view, showing a further modified form of the present invention, in which the apparatus is intended to cooperate with sources of high frequency sounds.

In Fig. 1 a cabinet structure 10 has spaced partitions 11 and 12 respectively supporting speaker structures 13 and 14. Flanges 15 and 16 of the respective speakers are secured in place upon annular supports 17 and 18 respectively registering with circular ports or openings 19 and 20 of the partitions 11 and 12. The speakers 13 and 14 face each other and are located on a common axis. The mouths of the respective speakers open into a common space 21 between the partitions 11 and 12. The sound is permitted to pass outwardly of the cabinet 10 through openings 22 in the walls of the cabinet.

A rotary plate 28 in the space 21 is inclined at an angle of about 45° to the common axis of the speakers, and is rotated about that common axis. Opposite sides of the plate 28 reflect the sound waves of the respective speakers, the angular position of the reflected waves changing in accordance with the rotation of the plate. Tremolo is accordingly superimposed on the sound.

A rotary drum 23 in the present instance guides substantially all of the sound waves to the plate 28 so that tremolo is added substantially uniformly over the entire frequency range. The drum 23 includes parallel spaced lower and upper discs 24 and 25 joined together by two parallel spaced walls 26 and 27 (Fig. 2). The plate 28 extends diagonally between the discs 24 and 25, with the side edges of the plate engaging the walls 26 and 27. Separate triangular spaces 29 and 30 on the lower and upper sides of the drum 23 are formed.

The triangular spaces 29 and 30 register with the openings of the speakers 13 and 14. For this purpose, the central portions of the discs are of web-shape configuration.

The walls 26 and 27 of the drum 23 define with the upper and lower discs openings 31 and 32 from which the sound of the respective speakers 13 and 14 is emitted. Screens 41 cover these openings.

The drum 23 is supported for rotary movement by the aid of a shaft 33 extending through the discs 24 and 25 as well as through the diagonal reflector plate 28. Bearings 34 and 35, secured centrally of narrow bars 36 and 37 extending across the partition openings 19 and 20, support the ends of the shaft 33. For rotating the shaft, a small motor 40 is provided.

For coupling the drum and motor, an endless belt 42 engages a peripheral groove of the disc 24 and a pulley 39 mounted on a shaft of the motor 40.

The parts are so constructed and arranged that the drum structure 23 rotates at about five to seven cycles per second in order to achieve the characteristic vibrato or tremolo effect.

It is generally assumed that a plurality of sound channels intended to produce tremolo cannot be angularly spaced about a common axis and rotated, since this produces a multiple vibrato or fast fluttering sound. However, as set forth in my copending application, Serial No. 520,000, filed July 5, 1955, and entitled, Multiple Channel Speaker System, a plurality of sound channels can be angularly located about a common axis and rotated without in the least detracting from the characteristic tremolo effect, provided similar sounds are not produced

in both channels. Accordingly, the speakers 13 and 14 cooperate with distinct or segregated signal sources. A system in which two electrical channels are used is described in my United States Letters Patent No. 2,596,258, above identified.

In the form shown in Fig. 3, a rotary plate 50 is provided as before. But in this instance no sound channel is provided to direct all of the sound waves thereto. As in the previous form, the shaft 51 is supported by bearing structures 54 and 55. A pulley wheel 56, secured to the shaft 51, serves as a means whereby the shaft 51 and plate 50 are rotated. A pulley belt 57, driven by a motor 58, is provided.

By the aid of the rotary reflector plate shown in Fig. 3, it is possible to control to some measure those frequencies to which tremolo is added. Sound waves, the quarter wave lengths of which are greater than either dimension of the plate, will be relatively unaffected by the plate, and little tremolo will be added to such sound waves. But sound waves of higher frequencies will be affected by the plate 50, and substantial tremolo will be added. Desirable characteristic music can be created by controlling the form and size of the plate 50. Also, the sound absorbent characteristics of the plate may control the amount of sound reflected in a well known manner.

In the form shown in Fig. 5, a rotary reflector 60 comprises similar plates 61 and 62, each of segmental cylindrical or other arcuate configuration. The plates 61 and 62 are secured to each other so that the concavities of the respective plates face in opposite directions away from each other. The reflector 60 is secured to a shaft 63 as in the previous forms, with the plates 62 and 61 directed respectively toward the speakers 64 and 65, but at an angle of about 45°. The curved configuration of the plates 61 and 62 provides desirable directional characteristics to the sound reflected by the plates, especially to sound of longer wave lengths, thereby more clearly defining the tremolo effect.

Figs. 7, 8, 9 and 10 illustrate different forms of plates. For example, in the form shown in Fig. 7, a single reflector plate 70 is shown that is of a configuration similar to the plate 61 or 62.

In Fig. 8 the flat rectangular plate 80 has a series of small ports 81 that permit certain frequencies to be relatively unaffected. Some of the higher frequency waves pass through the ports 81, but a substantial area, especially at the periphery of the plate, is effective to reflect the higher frequency waves. Since the effective areas for these frequencies are at a distance from the axis, appropriate magnitudes of sound velocity changes are imparted.

In the form shown in Fig. 9, the plate 90 is of fluted configuration. The plate provides definite edges 91 so that the radiation pattern for high frequencies is well defined.

In Fig. 10 a triangular plate 100 is illustrated that is relatively more effective for high frequency sounds than low frequency.

Any desired configuration, determined empirically, can be provided in order to achieve appropriate acoustical characteristics to the reflected sound waves.

In Fig. 11 a plain rectangular plate 110 cooperates with an exponential or other type horn 111 suspended from a bracket 112. It operates in a manner similar to the plate shown in Fig. 3.

In Fig. 12 a double horn structure 120 is provided that includes two exponential sound channel elements 121 and 122. Oppositely and outwardly extending inlet openings 123 and 124 for the respective elements are located on a common axis 150. The channel elements 121 and 122 curve oppositely and have outer ends extending generally radially in opposite directions from the axis 150.

The double horn structure 120 is mounted for rotation about the axis 150 so that orbital motion is imparted to the outer openings for achieving the tremolo effect. The

inlet openings continuously register with high frequency speakers 130 and 131 located on the axis 150.

For rotatably supporting the structure 120, bearings 125 and 126 are provided. The bearings are seated in recesses of spaced plates 127 and 128 of the cabinet 129, and receive reduced ends of the channel elements at the inlet ends thereof. The speakers 130 and 131 are supported on the remote sides of the plates 127 and 128.

For rotating the structure, a small motor 135 is provided. Integrally formed on the horn structure 120 is a pulley wheel 132 cooperating with a pulley belt 133 that is engaged by a pulley 134 mounted on the shaft of the motor 135. The horn elements 121 and 122 have their openings located substantially in a common orbit, and the horn structure 120 is substantially symmetrical about the axis 150 of the device. Accordingly, the horn is dynamically balanced. The sound emitted by the horn elements 121 and 122 passes outwardly through openings 136 in the cabinet 129.

It is understood, of course, that the speakers 130 and 131 cooperate with separate sources of sound so that appropriate tremolo effect is achieved.

The inventor claims:

1. In apparatus for producing tremolo: a pair of means for translating electrical impulses into sound, and having sound openings; means supporting said translating means so that said openings are spaced from and directed toward each other on a common axis; and a device between the openings and rotatable about said axis for adding tremolo to the sound emitted from said openings.

2. In apparatus for producing tremolo: a pair of means for translating electrical impulses into sound, and having sound openings; means supporting said translating means so that said openings are spaced from and directed toward each other on a common axis; a plate rotatable about said axis, and inclined at an angle less than 90° to said axis, opposite sides of said plate being cooperable with said translating means for adding tremolo to the sound emitted from said openings; and means supplying separate signals to said translating means respectively.

3. In apparatus for producing tremolo: a member mounted for rotation about an axis; a sound reflector plate having free peripheral edges and mounted on the member at an angle to the axis so that the axis is transverse to the plate; means for rotating the member about said axis at tremolo frequencies; and sound channel means spaced from said peripheral edges, and having an axis substantially coinciding with the axis of said member for directing sound waves along the axis for reflection of sound waves of at least some frequencies by said reflector.

4. In apparatus for producing tremolo: a pair of means for translating electrical impulses into sound, and having sound openings; means supporting said translating means so that said openings are spaced from and directed toward each other on a common axis; a reflector rotatable about said axis, and including a pair of plates, each being concave and facing outwardly and oppositely, and cooperable respectively with the translating means.

5. In apparatus for producing tremolo: a member rotatable about an axis; a reflector plate carried by the member and inclined to said axis at an angle less than 90°; said reflector plate having a fluted configuration for defining a series of edges extending transversely of the direction of movement of the plate; and means for directing sound waves along the axis on opposite sides of the plate for reflection by said reflector plate.

6. In apparatus for producing tremolo: a pair of speakers; means supporting the speakers in opposed spaced relationship; and a member between the speakers and rotatable about an axis transverse to both speakers, said member having means forming separate sound channels cooperable with the speakers respectively.

7. In apparatus for producing tremolo: a pair of speakers; means supporting the speakers in opposed spaced relationship; and a member between the speakers and ro-

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tatable about an axis transverse to both speakers, said member comprising a pair of spaced ported discs, a reflector plate extending diagonally between the discs, and a pair of side walls cooperating with the side edges of the reflector plate and the discs to define channels cooperable with the respective speakers.

8. In apparatus for producing tremolo: a pair of speakers; means supporting the speakers in opposed spaced relationship; and a member between the speakers and rotatable about an axis transverse to both speakers, said member comprising a pair of horn elements having

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inlet openings facing outwardly in opposite directions at said axis and registering with the speakers, said horn elements having outlet openings located on opposite sides of the axis and located substantially in a common orbit.

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