Nov. 18, 1952 D. J. LESLIE 2,618,352

ROTATABLE TREMULANT SOUND PRODUCER

Filed June 13, 1949

Fig. 1.

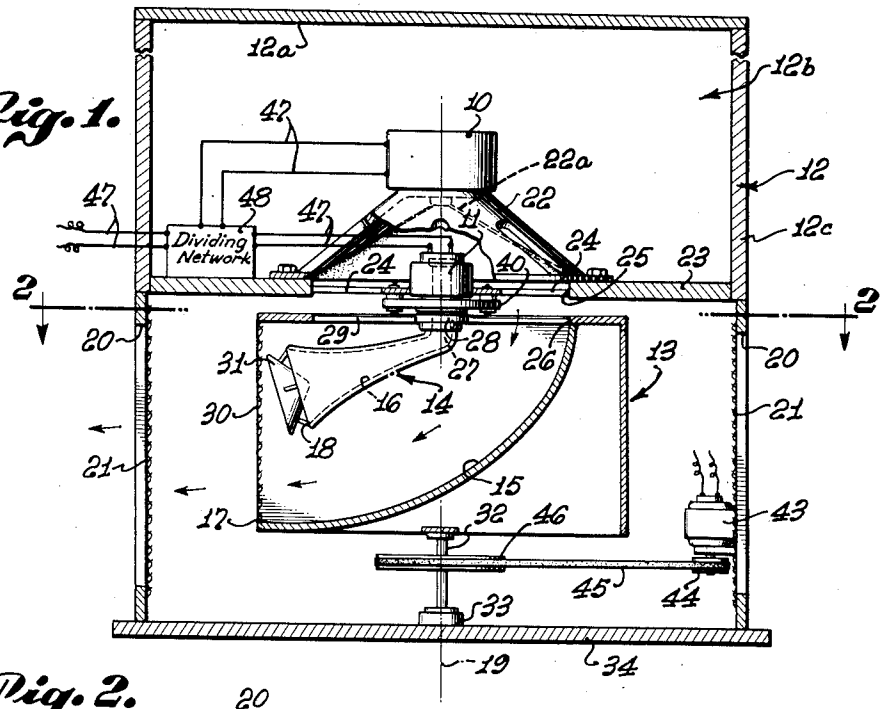


Fig. 2.

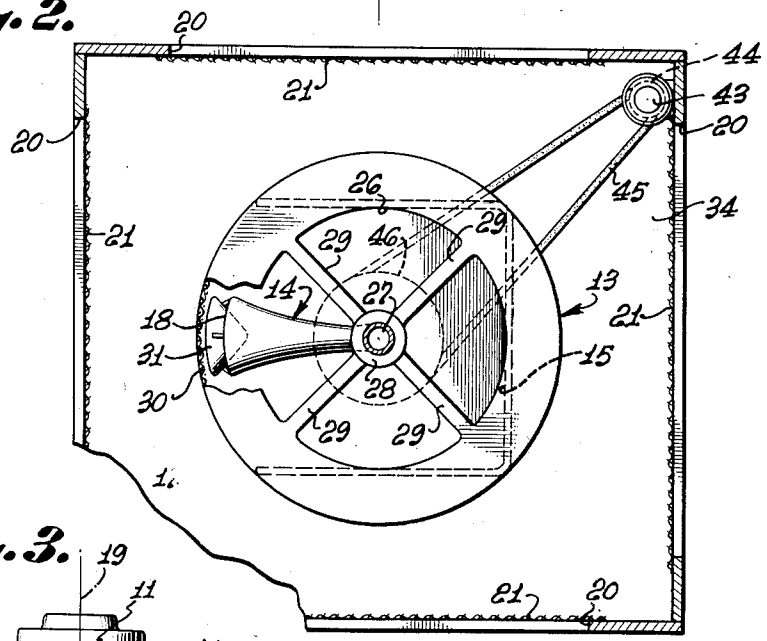
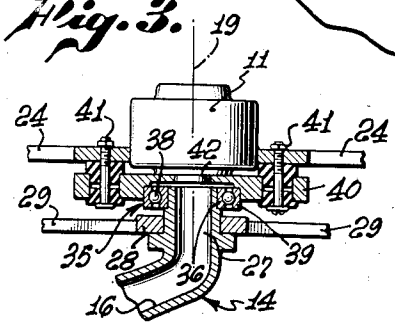


Fig. 3.



INVENTOR.
DONALD J. LESLIE,
BY
John Flam
ATTORNEY.

Patented Nov. 18, 1952

2,618,352

UNITED STATES PATENT OFFICE

2,618,352

ROTATABLE TREMULANT SOUND PRODUCER

Donald J. Leslie, Wilmar, Calif.

Application June 13, 1949, Serial No. 98,815

3 Claims. (Cl. 181—27)

1

The present invention relates to the production of musical tones, and is more particularly directed to apparatus or devices for imposing pitch tremolo or vibrato on musical tones.

This application is a continuation-in-part of an application filed in the name of Donald J. Leslie, Serial No. 603,850, filed July 9, 1945, for "Acoustic Apparatus," now Patent No. 2,489,653, which application is a continuation-in-part of an abandoned application filed in the name of Donald J. Leslie, Serial No. 369,413, filed December 10, 1940, for "Acoustic Device."

The foregoing applications disclose the production of musical tones by electrical means, including a low frequency sound translating device and a high frequency sound translating device. A sound transmitting channel is associated with each device and vibrato effects are obtained by causing the mouths of these channels to rotate. During such rotation, the mouths move alternately toward and away from the listener or sound source at a frequency corresponding to the vibrato. In this manner, the pitch of the sounds heard by the listener is alternately increased and decreased.

As set forth in the foregoing applications, proper vibrato effects are obtainable by moving each sound channel through which the sound passes cyclically between five and eight cycles per second, or at a speed of rotation of between about 300 and 480 revolutions per minute.

An object of the present invention is to provide an apparatus for imposing vibrato on sound, embodying rotatable and separate high frequency and low frequency sound translating devices and associated sound channels that are compactly arranged and occupy much less space than was heretofore necessary.

Another object of this invention is to provide an apparatus for imposing pitch tremolo or vibrato on sound, embodying separate rotating or movable low frequency and relatively high frequency sound channels, in which the sound is transmitted simultaneously through the channels in the same direction.

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

2

Referring to the drawings:

Figure 1 is a vertical section through a portion of an apparatus embodying the invention;

Fig. 2 is a cross-section taken along the line 2—2 on Fig. 1; and

Fig. 3 is an enlarged vertical section through part of the high frequency speaker and horn portion of the apparatus.

As disclosed in the drawings, a base or low frequency speaker or sound generator 10, and a treble or high frequency speaker or sound generator 11 are housed within a cabinet 12. A directional horn 13 is associated with the low frequency speaker 10, and another directional horn 14 is operatively associated with the high frequency speaker 11. These horns form sound channels 15, 16 having mouth or sound emitting openings 17, 18 spaced from their common axis of rotation 19. The sound may pass from the horns 13, 14 outwardly of the cabinet through a number of openings 20 that may be covered by louvers, grilles, or with a light fabric material 21.

In the form of invention disclosed in the drawings, the speakers 10, 11 and horns 13, 14 are coaxially arranged. The low frequency speaker 10 is disposed upon a low frequency cone 22, including the diaphragm 22*a*, that is suitably fastened to a platform or shelf 23 extending across the cabinet 12 above the cabinet openings 20. The high frequency speaker 11, which is coaxial of the low frequency speaker, is suitably supported in a transverse bar 24 extending across a central opening 25 in the platform or shelf 23, through which the sound from the low frequency speaker and cone may pass.

The cabinet 12 is of such design as to prevent radiation from the back of the speaker cone 22*a* into the room. Thus, the cabinet can have a top or transverse partition 12*a* forming a complete enclosure 12*b* with the cabinet side walls 12*c*, or it may be of the bass reflex design, with relief ports which radiate at low frequencies only. The purpose of the enclosure is to restrict radiated sounds to the front surface of the cone only, as this is the portion of the speaker radiation that is directed through the rotary horn 13.

The sound from the low frequency cone 22*a* passes through the opening 25 and through the throat 26 of the rotatable low frequency horn 13, which has its mouth or sound emitting opening 17 spaced from the axis of rotation 19 of the horn. This horn defines the elbow-like sound channel 15 extending between its throat 26 and

mouth 17, to enable its direction of sound outwardly through the cabinet openings 20.

The sound from the high frequency speaker 11 passes into the throat or hub portion 27 of the rotatable high frequency horn 14. The high frequency horn is suitably secured in a hub member 28 fixed to and supported coaxially of the low frequency horn 13 by a plurality of radial spokes 29 extending across the low frequency horn throat 26 to its outer portion. Thus, the high frequency horn 14 is fixed to, and coaxially of, the low frequency horn 13, with its mouth 18 facing in the same direction as the mouth 17 of the low frequency horn 13. This latter mouth may be suitably covered by cloth 30 to reduce the effects of windage during rotation of the horn 13. If desired, a conical deflector 31 may be secured at the mouth portion 18 of the high frequency horn 14; so as to broaden the radiation pattern of the high frequency sounds emanating from the sound channel 16.

As was noted above, the desired pitch tremolo or vibrato can be obtained by rotating the horns 13, 14 at from about 300 to 480 revolutions per minute. To enable such rotation to occur, the lower portion of the low frequency horn 13, which is in the form of a drum shaped rotor, is fixed to a shaft 32 rotatably supported in a suitable bearing 33 mounted on the base 34 of the cabinet. The upper end of the rotor 13 and the high frequency horn 14 are rotatably supported by causing the throat 27 of the high frequency horn to rotate within a ball bearing 35. The inner race 36 of the bearing is secured on the throat 27, the bearing load being transmitted through suitable balls 38 to an outer race 39 mounted in a plate 40 that is suitably attached to the supporting bar 24, as by means of bolts 41. The sound emanating from the high frequency speaker 11 can pass through a central aperture 42 in the plate 40 into the throat 27 of the inner horn 14.

The bearings 33, 35 are coaxial and also coaxial with the speakers 10, 11 and throats 26, 27 of the horns 13, 14. Accordingly, rotation of the low frequency horn 13 about the axis 19 will also effect rotation of the high frequency horn 14 about the axis. Such rotation may be provided by a suitable electric motor 43 attached to the cabinet 12 and having a drive pulley 44 for moving a belt 45 disposed over a driven pulley 46 mounted on the horn shaft 32. The motor speed and diameters of the pulleys are so chosen as to rotate both horns 13, 14 at the desired speed to impose pitch tremolo on the musical tones emanating from the speakers 10, 11.

The apparatus is intended for use in connection with an electronic device, such as an electric organ (not shown). The final amplifier stages of such a device may be connected with the speakers 10, 11 by suitable cables 47, in a conventional manner, through a suitable dividing network 48, which will limit the frequencies supplied to the respective speakers. Such dividing network 48 and the connections 47 between the amplifier and high and low frequency speakers are well understood by those skilled in the art, and need not be detailed in this specification.

The horns 13, 14 are rotated simultaneously by the electric motor 43 at the appropriate tremolo or vibrato speed, the sound from the low frequency speaker 10 and cone 22 passing through the low frequency sound channel 15 and outwardly through its opening 17. Similarly, the sound is passing from the high frequency speaker 11, and through the mouth 18 of its sound channel 16, which faces in the same direction as the mouth 17 of the other channel 15. By disposing one horn 14 within the other 13, a compact arrangement is provided, necessitating only a single operating mechanism, such as the motor 43, for effecting simultaneous rotation of the horns at the appropriate speed. At the same time, the high and low frequency notes are transmitted simultaneously in the same direction at any instant of time, the high frequency notes being appropriately superposed upon the low frequency notes, as well as the vibrato effects from both notes.

Although the invention has been particularly described with respect to sound channels for directing sound from high and low frequency speakers, it is quite apparent that a similar arrangement may be used for transmitting sound from a source into high and low frequency microphones that would be located at the same positions as the speakers are located in the drawings. By rotating the horns at the appropriate speed of from about 300 to 480 revolutions per minute, or from about five to eight cycles per second, the vibrato or tremolo effect will be imposed upon the several tones entering the sound channels 15, 16.

The inventor claims:

1. In apparatus for adding tremolo to musical sounds: a pair of speakers having openings and adapted respectively to translate high and low frequency sound waves; the opening of one speaker surrounding the other opening; a mounting for said speakers, the openings of the speakers being substantially coaxial; a pair of means defining sound channels each having a throat cooperating respectively with said speaker openings, said throats being located one within the other, each sound channel having an opening for emitting sound; means mounting both said sound channel defining means for rotation about a common axis coaxial with the openings of said speakers; and power means coupled to said sound channel defining means to cause orbital motion of said sound channel openings.

2. In apparatus for adding tremolo to musical sounds: a pair of speakers adapted respectively to translate high and low frequency sound waves; each of said speakers having openings, the opening of one of the speakers being larger than the opening of the other speaker; a mounting for said speakers, the openings of the speakers being substantially coaxial; means defining a first sound channel having a throat communicable with the opening of said one speaker, said first sound channel having an opening for emitting sound; means defining a second sound channel having a throat communicable with the opening of said other speaker, said second sound channel having an opening for emitting sound; means mounting said second sound channel defining means within said first sound channel defining means; means mounting both said sound channel defining means for rotation about an axis of rotation substantially coaxial with the openings of said speakers, and to register said throats of said sound channels with the openings of said speakers respectively; and power means coupled to said sound channels for rotating said sound channels to cause orbital motion of said sound channel openings.

3. In apparatus for adding tremulant effect to

musical sounds: a high and a low frequency speaker having openings adapted respectively to translate high and low frequency sound waves; a support for said speakers mounting said high frequency speaker substantially within said low frequency speaker, the openings of the speakers being substantially coaxial and similarly directed; means forming a low frequency sound channel having a throat cooperable with the opening of said low frequency speaker; means mounting said low frequency sound channel forming means for angular movement about an axis substantially coaxial with the opening of said speakers, and mounting said channel to register said throat with said low frequency speaker; said low frequency sound channel having an opening spaced from said axis; means forming a high frequency sound channel having a throat cooperable with said high frequency speaker; means mounting said high frequency sound channel forming means within said low frequency sound channel forming means to register said throat of said high frequency channel forming means

with said high frequency speaker; said high frequency sound channel forming means having an opening spaced from said axis; and power means coupled to said channel forming means for rotating said channels to impart an orbital motion to said sound channel openings.

DONALD J. LESLIE.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
647,147	Myers	Apr. 10, 1900
2,018,463	Muchow	Oct. 22, 1935
2,214,591	Massa	Sept. 10, 1940
2,287,105	Kennenberg	June 23, 1942

FOREIGN PATENTS

Number	Country	Date
884,487	France	Aug. 18, 1943