

March 23, 1965

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3,174,579

ACOUSTIC APPARATUS FOR PRODUCING TREMOLO AND VIBRATO

Filed Aug. 27, 1963

2 Sheets-Sheet 1

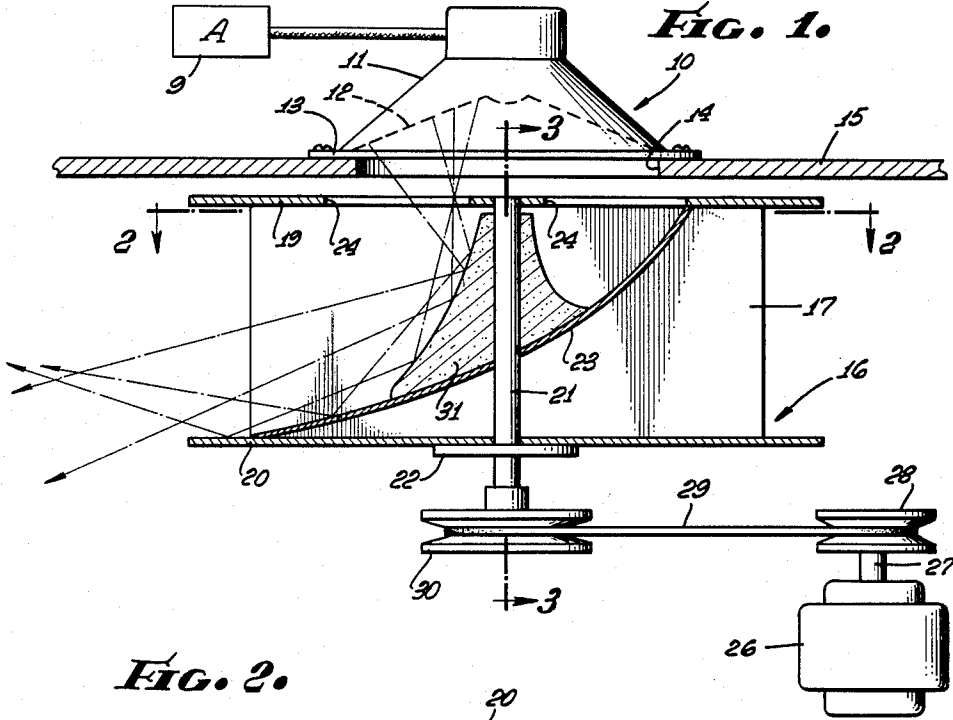


FIG. 1.

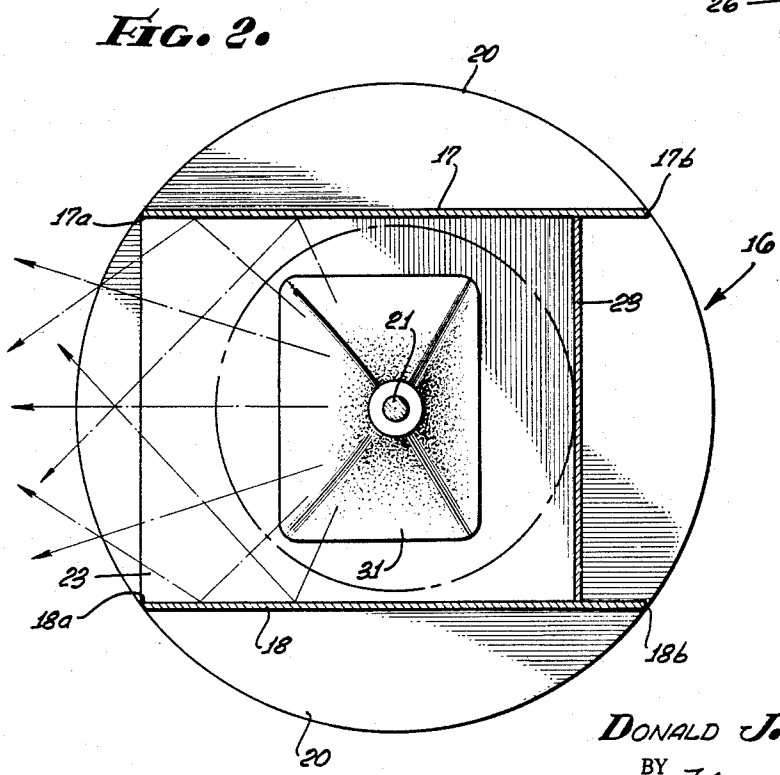


FIG. 2.

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2 Sheets-Sheet 2

FIG. 3.

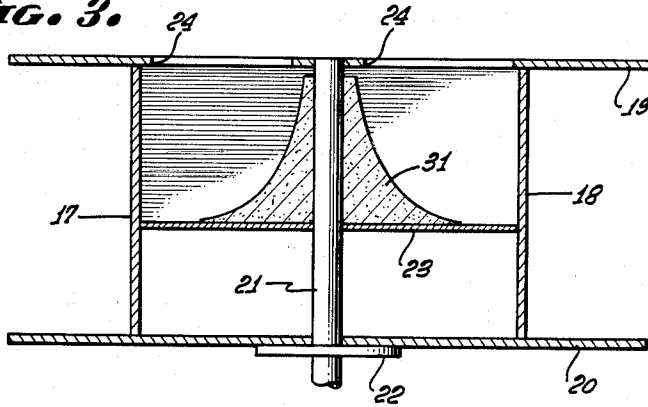


FIG. 4.

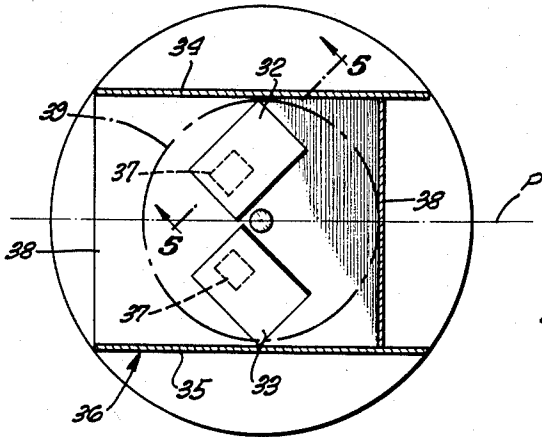


FIG. 7.

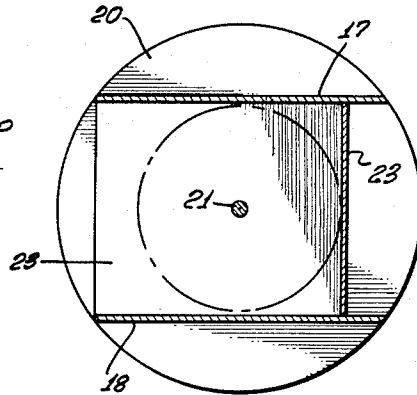


FIG. 6.

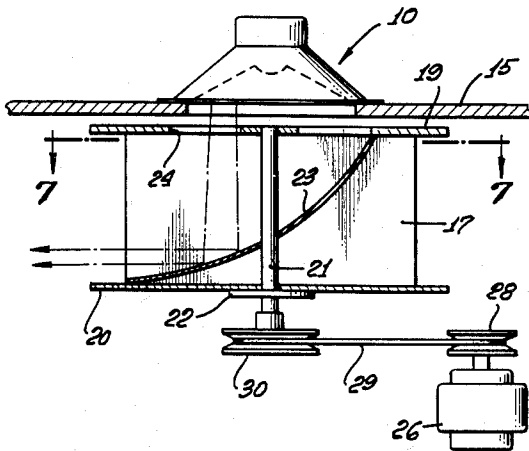
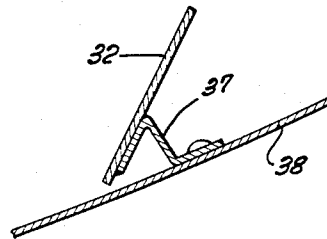


FIG. 5.



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ACOUSTIC APPARATUS FOR PRODUCING TREMOLO AND VIBRATO

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Filed Aug. 27, 1963, Ser. No. 304,778

5 Claims. (Cl. 181—27)

This invention relates to rotary apparatus for acoustic production of tremolo and vibrato of the type shown and described in my Reissue Patent No. 23,323, dated January 9, 1951, and entitled "Rotatable Tremulant Sound Producer." The apparatus shown in that patent, designed primarily for use with electronic organs, is housed in a separate cabinet of substantial size. There has been an increasing demand for incorporation of such units in cabinets of the organ itself. Space limitations have heretofore resulted in certain compromises of performance. Thus there is normally inadequate room to house both a high frequency rotary channel and a low frequency channel. A single large generally L-shaped horn has been used, the throat of the horn registering with a nonrotary triaxial or other suitable speaker structure, the horn being rotated about the axis of the speaker and throat so as to impart orbital motion to the mouth of the horn. As to high frequencies, the horn acts not as a horn, but as a reflector. As a result, the radiation pattern of high frequencies is narrow and thus the high frequency sounds are highly directional. As the horn rotates, the tremolo and vibrato effects are pulse-like in the high frequency range.

The primary object of this invention is to provide a common horn for use in acoustic tremolo and vibrato apparatus that materially broadens the sound radiation pattern of the high frequency sounds so as to produce a full, rich tremolo and vibrato effect.

Another object of this invention is to provide apparatus of this character that does not materially affect the operation of the horn as to low frequencies.

In order to accomplish the foregoing objectives, use is made of a reflecting device located in the horn and positioned along or adjacent the axis of rotation. High frequency sounds are reflected in various directions inside the horn so that a broad radiation pattern is produced.

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, and which drawings, unless as otherwise indicated, are true scale. 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 an axial sectional view of acoustic apparatus for producing vibrato and tremolo, and illustrating one form of the present invention;

FIG. 2 is a sectional view taken along the plane corresponding to line 2—2 of FIG. 1;

FIG. 3 is an axial sectional view taken along the plane corresponding to line 3—3 of FIG. 1;

FIG. 4 is a sectional view similar to FIG. 2, illustrating a modified form of the present invention;

FIG. 5 is a sectional view taken along the plane corresponding to line 5—5 of FIG. 4; and

FIGS. 6 and 7 are views similar to FIGS. 1 and 2, respectively, and illustrating known apparatus for producing vibrato and tremolo.

In FIG. 1 there is illustrated an amplifier 9 for producing electrical impulses corresponding to tones in the entire audio range. The amplifier drives a speaker 10 that is adapted to translate such signals into sound. The speaker 10 has a generally conical frame 11 in which a speaker cone 12 is mounted. The frame 11 has a peripheral flange 13 by the aid of which the speaker structure 10 is secured about a circular opening 14 formed in a supporting wall 15.

Located on that side of the wall opposite the speaker 10 is a drum 16. The drum 16 is, in this instance, a four-sided structure comprising two rectangular parallel side walls 17 and 18 (see FIG. 2) and top and bottom circular walls 19 and 20 which project beyond the side walls 17 and 18.

The drum structure 16 is supported for rotation by the aid of a shaft 21. The shaft 21 projects upwardly through the center of the bottom wall 16 to the center of the top wall 19. The drum 16 rests upon and is secured to a collar 22 carried by the shaft 21. The shaft 21 is coaxially located with respect to the speaker structure 10 and the circular opening 14 at which it is mounted.

A horn structure is formed in the drum by the aid of a curved wall 23. The wall 23 has side edges abutting and attached to the inner surfaces of the side walls 17 and 18. The curved wall 23 extends generally diagonally from the lower left hand corners 17a and 18a of the side walls 17 and 18 to an area spaced inwardly of the opposite upper right hand corners 17b and 18b. The end surfaces of the curved wall 23 respectively contact and are secured to the inner surfaces of the lower wall 20 and the upper wall 19.

Sound issuing from the speaker structure 10 enters the drum structure along the shaft axis through a series of circularly arrayed openings 24 formed in the top wall 19. The openings 24 may be of any suitable shape to provide a central hub portion for cooperation with the shaft 21. The sound entering the drum is guided by the curved wall 23 outwardly thereof through a mouth formed by the free edges of the side walls 17 and 18 and the overlying portions of the top and bottom walls 19 and 20.

The drum 16 is rotated by the aid of a motor 26. For this purpose, the motor shaft 27 has a pulley 28 connected by a belt 29 to a pulley 30 attached to the lower depending end of the drum shaft 21. The motor 26 and pulleys 28 and 30 are so designed as to impart orbital motion to the mouth of the horn at the rate of about five to eight cycles per second. Characteristic tremolo and vibrato are thus imparted to the sound.

The description of the apparatus thus far applies equally to the known apparatus shown in FIGS. 6 and 7. Like reference characters are thus applied.

As to high frequencies, the inner surface of the curved wall 23 in the apparatus of FIGS. 6 and 7 acts as a mere reflector situated at an angle of approximately 45° to the axis of the shaft 21. As indicated in the drawings, sound waves tend to be parallel. Under these circumstances, the sound radiation pattern of the high frequencies is quite restricted. In order to broaden the sound radiation pattern of the high frequencies, a deflector 31 (FIGS. 1-3) is provided.

The deflector 31 is generally conical and may be made, for example, of molded expanded polystyrene. The deflector with slight clearance surrounds the shaft 21 between the curved wall 23 and the top wall 19. The apex area of the conical deflector 31 is located adjacent the top wall 19. The deflector 31 flares outwardly where it merges with the surface of the inclined wall 23. The deflector may be attached to the inclined wall 23 by adhesive or other suitable means. The base of the deflector

3

31, in the present example, as shown in FIG. 2, is generally rectangular. Other configurations are possible.

As indicated by the dot and dash lines in FIGS. 1 and 2, the surface of the deflector 31 redirects the high frequency sounds generated at the speaker cone 12 in various directions. Some bounce off the side and top walls of the drum and others directly exit through the opening. The radiation pattern for high frequencies is thus broadened. As the drum 16 is rotated, the broad sound radiation pattern of high frequencies produces a full, rich tremolo and vibrato effect.

Since the deflector 31 is relatively small, it produces only minimal effects upon the low frequencies having long wave lengths. As to such frequencies, the curved wall 23 together with the other walls of the drum continue to act as a horn for such sounds.

In the form of the invention illustrated in FIGS. 4 and 5, a pair of deflector plates 32 and 33 are provided. These deflector plates are located symmetrically on opposite sides of an axial bisecting plane p parallel to side walls 34 and 35 of a drum structure 36. The deflector plates 32 and 33 are attached, as by brackets as at 37 (FIG. 5) to the curved wall 38 of the drum structure. The plates 32 and 33 are located within the projected area of the speaker cone, as indicated by the circle 39 in FIG. 4. The plates 32 and 33 are respectively located adjacent the walls 34 and 35. Their surfaces are so situated as to cause the sound waves to cross the plane p . Thus lines normal to the surfaces of the plates 32 and 33 are tilted toward the plane p and inclined approximately 45° to the axis of the speaker to direct the sound waves through the mouth of the horn.

In a manner similar to that provided by the deflector 31, the plates 32 and 33 broaden the sound radiation pattern for high frequencies, and a desirable full, rich tremolo and vibrato effect is achieved. Yet the plates 32 and 33 are sufficiently small so as not to interfere with the horn effect of the drum as to low frequencies.

The inventor claims:

1. In apparatus for adding tremolo or vibrato to sounds throughout an audio range: a support; a speaker mounted on the support and designed to reproduce electrical impulses corresponding to tones throughout an audio range; a rotary low frequency horn mounted for rotation about the axis of the speaker and having a throat registering with the speaker and a mouth spaced from said axis; means rotating the horn to impart orbital movement to the mouth at a rate to produce tremolo and vibrato; and deflector means mounted in the horn and having surfaces for dispersion of high frequency sound waves through the horn mouth; said deflector means being sufficiently small so as to offer negligible impedance to low frequency sound waves.

2. In apparatus for adding tremolo or vibrato to sounds throughout an audio range: a support; a speaker

4

mounted on the support and designed to reproduce electrical impulses corresponding to tones throughout an audio range; a rotary low frequency horn mounted for rotation about the axis of the speaker and having a throat registering with the speaker and a mouth spaced from said axis; means rotating the horn to impart orbital movement to the mouth at a rate to produce tremolo and vibrato; and a cone-like deflector extending along the axis, said deflector having an apex located adjacent the center of the horn throat with substantial clearance therein, said deflector flaring radially outwardly and terminating at the interior surface of the horn about said axis; said deflector having a surface for dispersion of high frequency sound waves through the horn mouth; said deflector being sufficiently small so as to offer negligible impedance to low frequency sound waves.

3. The combination as set forth in claim 2 in which a shaft located at said axis mounts the horn for rotation and in which said deflector is made of molded expanded polystyrene.

4. In apparatus for adding tremolo or vibrato to sounds throughout an audio range: a support; a speaker mounted on the support and designed to reproduce electrical impulses corresponding to tones throughout an audio range; a rotary low frequency horn mounted for rotation about the axis of the speaker and having a throat registering with the speaker and a mouth spaced from said axis; means rotating the horn to impart orbital movement to the mouth at a rate to produce tremolo and vibrato; and a number of deflector plates mounted in the horn and having surfaces oriented for dispersion of high frequency sound waves through the horn mouth; said deflector plates being sufficiently small so as to offer negligible impedance to low frequency sound waves.

5. In apparatus for adding tremolo or vibrato to sounds throughout an audio range: means for producing electrical impulses corresponding to tones throughout an audio range; a speaker mounted on the support and designed to reproduce said electrical impulses; a rotary low frequency horn mounted for rotation about the axis of the speaker and having a throat registering with the speaker and a mouth spaced from said axis; means rotating the horn to impart orbital movement to the mouth at a rate to produce tremolo and vibrato; and deflector means mounted in the horn and having surfaces for dispersion of high frequency sound waves through the horn mouth; said deflector means being sufficiently small so as to offer negligible impedance to low frequency sound waves.

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