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ACOUSTICAL ENCLOSURE TO SIMULATE ORGAN TONES

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Fig. 1

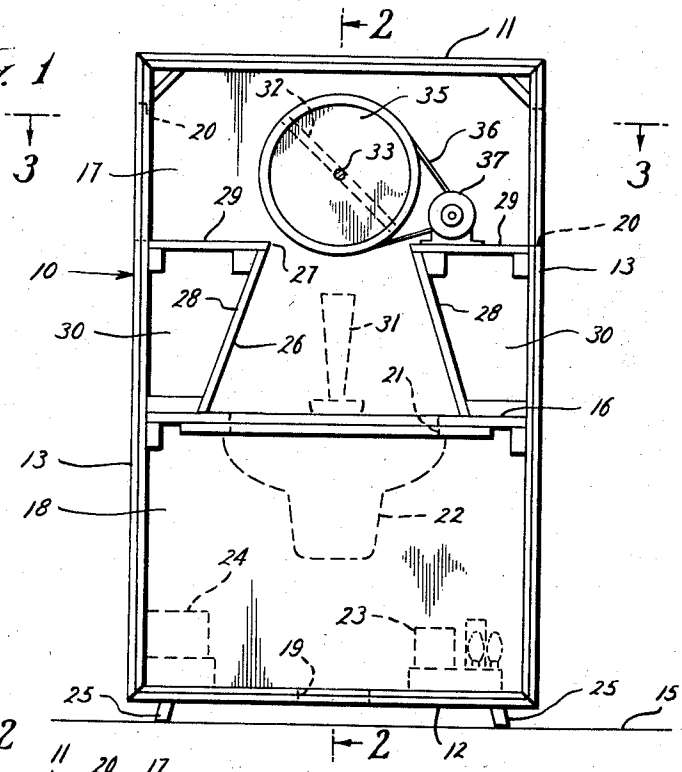


Fig. 2

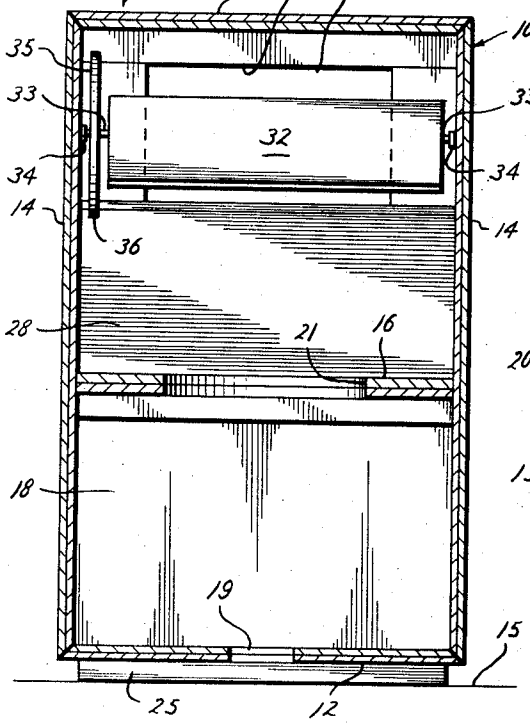
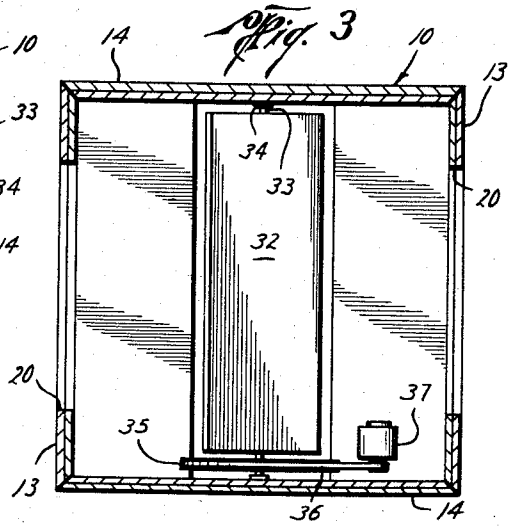


Fig. 3



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ACOUSTICAL ENCLOSURE TO SIMULATE ORGAN TONES

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9 Claims. (Cl. 181—31)

This invention relates broadly to sound reproduction apparatus and, more particularly, to a speaker enclosure as a part of such apparatus which enables the reproduction of improved acoustical values.

Various enclosures have been devised for improving the tone quality of sound waves emanating from the speaker, and particularly the quality of bass notes or low frequency sound waves. Inasmuch as such notes do not travel in free air, an early development in this field was the infinite type baffle in which the back of the speaker cone was sealed off within an enclosure so as to enable the cone vibrations to drive pressurized air and thereby provide greater tone sensitivity.

However, the infinite type baffle provided little flexibility for sound waves of differing frequencies, and a later development introduced the bass reflex in which the back of the speaker was loaded by means of a valved or choked enclosure.

Of the commercially available speaker enclosures of which I am aware, the best alleged performance is the reproduction of sound waves down to 30 cycles. However, it is admitted that this is accomplished only with a 10 decibel loss. Furthermore, this particular enclosure is dependent for its operation upon building acoustics—i. e., it embodies a triangular construction for use in the corner of a room.

An object of the present invention is to provide a speaker enclosure capable of producing improved tone values independently of building acoustics.

Another object is to provide a speaker enclosure which enables the reproduction of bass tones not possible with prior enclosures and, more particularly the full bass range of a pipe organ without power loss.

A further object is to provide a speaker enclosure constructed in a novel manner to provide a considerably longer path of sound waves between opposite sides of the speaker cone than has been possible with prior enclosures of comparable size.

Still another object is to provide a speaker enclosure in which a stereophonic effect may be simulated with the use of a single speaker.

It has heretofore been proposed to simulate the reverberation effect of organ music by what is known as a tremulant which comprised a rotatable blade positioned within the speaker cone or a channel or duct within a speaker enclosure. The result has been a baffling of the sound waves and a consequent variation of intensity.

An object of this invention is to provide a speaker enclosure in which a truer pipe organ effect may be obtained and, more particularly, in which such sound may be simulated without baffling.

Other objects, advantages and features of this invention will be apparent to one skilled in the art upon a consideration of the written specification, the attached claims and the annexed drawings.

In the drawings, wherein like reference characters are used throughout to designate like parts:

Fig. 1 is a vertical sectional view of an illustrative

embodiment of the acoustical enclosure of the present invention mounted or standing in a preferred position with respect to the floor or other support;

Fig. 2 is another vertical sectional view of the enclosure but taken substantially along broken line 2—2 of Fig. 1; and

Fig. 3 is a horizontal sectional view of the upper chamber of the enclosure taken substantially along broken line 3—3 of Fig. 1.

According to one of its novel aspects, the speaker enclosure of the present invention cludes a chamber on the front side of the speaker cone which lengthens the travel of sound waves between the front and back of the cone, and thus improves the tone quality, as previously mentioned. In addition, this upper chamber is provided with outlet openings through opposite sides thereof such that the sound emanating from the speaker may be spread rather than being directed to the audience, thus producing a stereophonic effect with only a single speaker. Still further, the upper chamber of the speaker enclosure, while not actually choking the sound waves emanating from the speaker, does provide a certain loading effect upon the front of the speaker cone which further improves the speaker sensitivity.

According to another of its novel concepts, this speaker enclosure is provided with a passageway above the portion thereof for receiving the speaker cone which is constructed to elongate the pattern of sound waves emanating from the speaker cone and thereby reproduce the full bass range of a pipe organ as previously mentioned. More particularly, the enclosure is provided with means for receiving the speaker cone suspended within a lower chamber in which the back of the cone may be loaded, and the afore-mentioned passageway is disposed in surrounding relation to the speaker cone receiving means at its lower end from which it is convergent toward its upper end so as to flatten out or elongate the pattern of sound waves.

Preferably, the afore-mentioned novel aspects of the present invention are combined into an enclosure comprising a cabinet partitioned off into upper and lower chambers and being closed except for an outlet from the upper chamber and an inlet to the lower chamber. The outlet from the upper chamber comprises the afore-mentioned openings through opposite side walls of the enclosure, and the afore-mentioned passageway opens into the upper chamber with its lower end surrounding an opening through the partition which provides the afore-mentioned speaker cone receiving means. Further, the inlet to the lower chamber comprises a choke of a size so as to permit substantially no free air on the back side of the speaker cone and, as shown, is substantially axially aligned with the speaker cone receiving opening.

In accordance with a still further novel aspect of this invention, and particularly for use in the reproduction of organ music, a blade similar to the tremulant rotors previously mentioned may be mounted in the upper chamber of the enclosure for rotation above the speaker cone receiving means and about an axis which extends longitudinally of side walls for the enclosure through which outlet openings are provided. Thus, the blade is operative to divert sound waves emanating from the speaker from one opening to the other. However, with the blade rotatably mounted above the opening provided for receiving the speaker cone, there is no muffling of the sound waves. In the preferred embodiment of the invention, the above-described rotatable blade construction is combined with the sound wave pattern elongating passageway.

Referring now to a detailed description of the drawings, the speaker enclosure shown therein is designated in its entirety by the numeral 10 and comprises a cabinet having top and bottom walls 11 and 12, respectively, as well as

opposite side walls **13** and **14**. In this respect, the terms "top," "bottom" and "side," as well as corresponding terms, such as "upper" and "lower," are merely relative and do not necessarily define the position of the enclosure with respect to its support, such as the floor **15**. That is, although the upright position of the enclosure shown in Figs. 1 and 2, in which bottom wall **12** is adjacent the floor **15**, is preferred, the enclosure may be disposed in other positions, as will be described hereinafter.

The walls of the enclosure may be made of any suitable acoustical material, such as the laminated plywood which is indicated in the cross-sectional views of the drawings. The walls are joined to one another in a secure manner so as to prevent excessive vibration within the enclosure and, further, to provide an air-tight interior for the cabinet.

The cabinet is divided by a partition **16** extending substantially transversely between the side walls thereof into an upper chamber **17** and a lower chamber **18**. An inlet to the lower chamber comprises a choke **19** through the bottom wall **12** and an outlet from the upper chamber comprises openings **20** through opposite side walls **13** of the cabinet. The cabinet is closed except for the inlet and outlet **19** and **20**.

An opening **21** is provided through the partition **16** for receiving a speaker, which is shown in Fig. 1 by the phantom lines as at **22**, suspended within the lower chamber **18**. More particularly, the opening **21** through the partition is provided for supporting and surrounding the upper flared end of the speaker cone such that the back side of the cone may be enclosed by the lower chamber **18** and the front side of the speaker cone enclosed by the upper chamber **17**.

As previously mentioned, the inlet **19** to lower chamber **18** is a choke which enables loading of the back side of the speaker cone by permitting substantially no free air within the lower chamber **18**. As also mentioned previously, this construction is known in the art as the bass reflex and it is in this sense that the term "choke" is used. Thus, with the cross-sectional area of the choke so designed relative to the speaker and volume of the lower chamber **18** as to enable the back side of the speaker cone to drive pressurized rather than free air, the speaker is provided with greater sensitivity. Since this construction which loads the back side of the speaker cone is known in accordance with earlier developments in the art, it need not be elaborated upon. However, by way of example, I have employed with a 15-inch, 50 watt "University" speaker suspended within a lower chamber of about five cubic feet, a choke having a cross-sectional area of 40 square inches.

Also shown in phantom in Fig. 1 within lower chamber **18** is an amplifier **23** and suitable electrical controls **24**. Although it is conventional practice to place such equipment within the enclosure back of the speaker cone, such an arrangement is not an essential part of the present invention. Obviously, the disclosure of the present invention has not been complicated by a showing of electrical connections between the amplifier and the electromagnetic generator of the speaker.

The bottom wall **12** of the cabinet is provided with runners or legs **25** which elevate the bottom wall above the floor **15** or other support, thus permitting access to choke **19**. According to one novel aspect of this invention, the runners are disposed longitudinally of the side walls **13** through which outlet openings **20** are provided and are further imperforate for a length substantially coextensive with such side walls, as shown in Fig. 2, such that sound waves emanating from the speaker **22** are caused to travel a distance considerably further than the shortest distance between the outlet and inlet. As a result of the above-described arrangement of the upper chamber **17**, as well as the runners **25** in connection with outlet openings **20**, the enclosure **10** provides a greater length of travel for sound waves between the front and back sides of the speaker cone than prior enclosures of comparable size.

Although the runners thus define a preferred position of the cabinet relative to the support **15**, it should be understood, especially in connection with the "top," "bottom" and "side" wall designations, that the enclosure or cabinet may be laid with either of its side walls **14** or top wall **11** upon the support **15**. With the outlet openings **20** disposed as shown, it is preferred that the cabinet not be laid upon either of its side walls **13**; and, still further, that it not be disposed with either side wall **13** facing the audience, the reason for which will be more apparent hereinafter. However, if, for example, the outlet from upper chamber **17** consisted of one or more openings through top wall **11**, there would be still further flexibility as to the position in which the speaker enclosure may be mounted. Although the foregoing is merely exemplary, it is obvious that the enclosure of the present invention is not restricted by building or room acoustics.

The area of outlet **20** from the upper chamber **17** is of such size as not to choke the sound waves emanating from the front of the speaker, but at the same time has a loading effect upon the front of the cone and thereby further increases its sensitivity. Also, with the outlet comprising openings **20** through opposite side walls **13**, there is a spreading of the sound waves emanating from the speaker **22**. Thus, with both outlets **20** exposed, and preferably facing transversely to the audience, there results a stereophonic effect which has heretofore been possible only with the use of two or more particularly located speakers. As will be understood hereinafter, this arrangement of outlet openings further enables the use of the improved tremulant type rotor blade of this invention.

The upper and lower chambers of the cabinet are connected by a passageway **26** which surrounds opening **21** at its lower end and is gradually convergent toward its upper end for elongating the pattern of sound waves emanating from the speaker **22**. It will be understood that the sound waves at the flared end of the speaker cone which enter the passageway **26** correspond to the cross section of the speaker in that they have a substantially circular pattern. The bass tones or the pattern of low frequency sound waves at the periphery of the cone are flattened out or elongated by means of the converging passageway **26** such that it has been found possible to reproduce with the enclosure of this invention the full bass range of a pipe organ.

Thus, it can be seen from the drawings, that the width of opening **27** through the upper end of passageway **26** is less than the width of opening **21** in a corresponding direction of the flared end of the speaker cone. The desired result, as indicated above, is to flatten out rather than choke the sound. In other words, the circular pattern of the sound waves is transformed into an oval pattern.

In this respect, it is the width of the opening **27** through the upper end of passageway **26** which is critical inasmuch as, on the one hand, too large a width will permit free air and, on the other hand, too narrow a width will tend to muffle the sound such that many of the intermediate sound waves will not be audible. The length of the opening **27**—i. e., in this instance the distance between side walls **14**—is critical in that it should be at least long enough to accommodate the elongation of the sound waves in accordance with the narrowing of the width of the passageway or, in other words, its convergency. The critical width of the upper end of passageway **26** depends on a number of variables which will enable one skilled in the art to dimension the passageway to his own needs upon an experimental basis.

That is, there are several factors which will determine just how much the sound waves can be flattened out and still be audible. Such variables are the variation in voice

coil diameters of the speaker, the variation in speaker cone flexibility, and the variation in wattage output of the speaker. With the speaker, lower chamber, and choke previously mentioned, I have successfully reproduced the full bass range of a pipe organ with a passageway having a width at its lower end corresponding approximately to the speaker diameter and at its upper end of approximately 10 inches, and a length of approximately 20 inches.

To my knowledge, this phenomenon of sound wave pattern elongation has not heretofore been put to practical use in the construction of speaker enclosures. As noted above, its application in the present invention is to reproduce bass tones or low frequency sound waves. In this sense, the bass tones are those generally having frequencies less than 250 cycles.

Referring now to the construction of passageway **26**, it can be seen from the drawings that it is defined by two spaced apart and laterally extending inner walls **28**. These walls extend between side walls **14** so as to define an elongated opening through the passageway extending in substantially the same direction as the side walls **13** through which outlet openings **20** are provided. Substantially horizontally disposed inner walls **29** are connected between side walls **13** beneath outlet openings **20** and the upper end of inner walls **28** so as to partition off spaces **30** in the upper chamber at each side of the passageway **26**. These spaces may be left empty or may be filled with any suitable insulating material.

It will be understood that the above-described construction of passageway **26** is preferred principally because of its simplicity and minimum parts, although equivalent structures may be used. As can be seen from Fig. 1, the lower ends of inner walls **28** are disposed on opposite sides of the cone receiving opening **21** and are convergent upwardly therefrom to the open upper end **27** through the passageway.

For illustrative purposes, there is shown in phantom in Fig. 1 a second speaker **31** within the passageway **26** above the speaker **22**. This speaker **31** may be of the type used for high frequency sound waves, particularly those above 2,000 cycles, and is thus positioned substantially coaxially of opening **21** and speaker **22** inasmuch as these high frequency sound waves follow substantially straight paths.

The blade for simulating organ music is indicated in its entirety by the numeral **32** in each of Figs. 1, 2 and 3, and would be incorporated into only those enclosures used for this purpose. As can be seen from the drawings, this blade is mounted in the upper chamber for rotation above the opening from which the speaker **22** is suspended and about an axis extending substantially longitudinally of the side walls **13** through which outlet openings **20** are provided. In this manner, assuming a rotation of the blade in a single directional sense, sound waves emanating from the front of the speaker **22** will be directed or diverted from one opening **20** and then to the other and, intermediate such diversions, the sound waves, rather than being muffled as in prior art structures, are spread between passage to each of said outlet openings.

It is thus important that the blade be mounted about an axis above the opening or, in the preferred form of the invention shown in the drawings, also above the outlet **27** through the open upper end of passageway **26**. In this manner, with the blade **32** disposed in one angular position as shown in Fig. 1, the sound waves from passageway **26** are diverted into the outlet opening **20** in the left side wall **13** of the cabinet as it is shown in Fig. 1. However, as the blade is further rotated such that it reaches a substantially horizontal position, there will be no muffling or choking of the sound waves, but to the contrary, they will be permitted to pass outwardly through either of the outlet openings **20**. Also, as shown in Fig. 1, the lower end of the blade **32** is so mounted as to be spaced a short distance from one edge or side of opening **27** as it diverts sound waves to the outlet opening nearest the opposite side.

It is further important that the blade extend lengthwise substantially coextensively with the length of the opening **27** through the upper end of the passageway **26** and that it be of a width greater than that of the upper end of such passageway. In this manner, the axis of rotation of the blade may be disposed a distance less than one-half of its width above the upper end of the passageway so that, in reaching a position such as is shown in Fig. 1, substantially all of the sound waves emanating from speaker **22** and passing outwardly through passageway **26** are diverted in a single direction and through a single outlet opening. Obviously, none of the aforementioned advantages and functions of the blade **32** are possible with the previously described tremulant rotors of the prior art.

As mentioned above, it is preferred that the blade **32** be employed in connection with the sound wave pattern elongating passage **26** although, as will be understood, the blade may be used solely in connection with the speaker opening **21** in which case the relation of the blade to such speaker opening would preferably correspond to the above-described relation of the blade to the opening **27** through the upper end of passageway **26**. Also, of course, it is the disposal of outlet openings **20** through opposite side walls **13** which makes possible the improved functioning of the blade **32** in simulating organ music.

Referring more specifically to the drawings, it can be seen that the blade itself is provided with stub shafts **33** supported in bearings **34** at opposite ends at the side walls **14**. The blade is rotated by means of a pulley **35** on one of the stub shafts and carrying a belt **36** which is driven by any suitable motor **37**. As shown in the drawings, one of the substantially horizontally disposed inner walls **29** provides a support for the motor **37**.

In a preferred construction of the enclosure, the top wall **11** is disposed at a level relatively close to the upper end of the blade **32** when it is vertically disposed such that leakage across the top of the blade in such vertical position will be kept to a minimum. The speed at which the blade will be rotated is determined, of course, by the simulated effect it is desired to obtain.

From the foregoing it will be seen that this invention is one well adapted to attain all of the ends and objects hereinabove set forth, together with other advantages which are obvious and which are inherent to the apparatus.

It will be understood that certain features and subcombinations are of utility and may be employed without reference to other features and subcombinations. This is contemplated by and is within the scope of the claims.

As many possible embodiments may be made of the invention without departing from the scope thereof, it is to be understood that all matter herein set forth or shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense.

The invention having been described, what is claimed is:

1. An acoustical enclosure for a speaker, comprising a cabinet having an imperforate top, a bottom and side walls and a partition extending between the side walls to divide the cabinet into upper and lower chambers, said cabinet being closed except for an outlet from the upper chamber and an inlet to the lower chamber which comprises a choke through the bottom wall, the partition being provided with an opening for receiving a speaker cone suspended within the lower chamber above the choke, the outlet from the upper chamber comprising outlet openings through opposite side walls of the cabinet of a size to produce a loading effect upon the front of the speaker cone, the bottom wall of the cabinet provided with runners extending longitudinally of the side walls

through which the outlet openings are provided and at opposite sides of the choke, said runners being imperforate for lengthening the travel of sound waves between each of the outlet openings and choke.

2. An acoustical enclosure for a speaker, comprising a cabinet having upper and lower chambers and being closed except for an outlet from the upper chamber and an inlet to the lower chamber which comprises a choke through the bottom wall thereof, a passageway connecting the upper and lower chambers, and means at the lower end of the passageway having a substantially circular opening therethrough for receiving a speaker cone suspended within the lower chamber, said passageway surrounding the substantially circular opening through the speaker cone receiving means at its lower end and being gradually convergent upwardly to an elongate portion at its upper end connecting with the upper chamber, the area of said elongate portion being substantially that of the substantially circular opening through the speaker cone receiving means for transforming the sound waves emanating from the cone from a circular to an oval pattern.

3. Sound reproduction apparatus, comprising a cabinet having top, bottom and side walls, a partition extending between the side walls to divide the cabinet into upper and lower chambers, said cabinet being closed except for an outlet from the upper chamber and an inlet to the lower chamber which comprises a choke through the bottom wall, a speaker cone received through an opening in the partition for suspension within the lower chamber, and a passageway in the upper chamber having a substantially circular portion at its lower end in surrounding relation to the partition opening and communicating through its upper end with the outlet, said passageway being gradually convergent from said substantially circular portion at its lower to a substantially elongate portion at its upper end, the area of said elongate portion being substantially that of the outlet from the speaker cone for transforming the sound waves emanating from the cone from a circular to an oval pattern.

4. Sound reproduction apparatus of the character defined in claim 3, wherein the outlet from the upper chamber comprises an opening through a side wall thereof, the top wall being imperforate, and the upper portion of the passageway being elongated in a direction of the side wall through which the outlet opening is provided.

5. Sound reproduction apparatus of the character defined in claim 4, wherein the outlet from the upper chamber also includes an opening through a side wall opposite and parallel to the side wall through which the first-mentioned outlet opening is provided.

6. An acoustical enclosure for a speaker, comprising a cabinet having top, bottom and side walls and a partition extending between the side walls to divide the cabinet into upper and lower chambers, said cabinet being closed except for an outlet from the upper chamber comprising openings through opposite side walls thereof, the top wall being imperforate, and an inlet to the lower chamber comprising a choke through the bottom wall thereof, the partition provided with an opening for receiving a speaker cone suspended within the lower chamber, and a blade mounted in the upper chamber for rotation above said opening about an axis extending in the direction of the side walls through which the outlet openings are provided.

7. An acoustical enclosure for a speaker, comprising a cabinet having upper and lower chambers closed except for an outlet from the upper chamber comprising openings through opposite side walls thereof, the top wall being imperforate, and an inlet to the lower chamber comprising a choke through the bottom wall thereof, a passageway connecting the upper and lower chambers, means at the lower end of the passageway for receiving a speaker cone suspended within the lower chamber, and a blade mounted in the upper chamber above the upper end of the passageway for rotation about an axis extending in the direction of the side walls through which the outlet openings are provided.

8. An acoustical enclosure of the character defined in claim 7, wherein the blade extends lengthwise substantially from side wall to side wall of the cabinet and is of a width greater than that of the upper end of the passageway, and the axis of rotation of the blade is disposed a distance less than one half of its width above said upper end of the passageway.

9. An acoustical enclosure of the character defined in claim 7, wherein the passageway is gradually convergent from a substantially circular portion at its lower end surrounding said speaker cone receiving means to an elongate portion at its upper end for transforming the sound waves emanating from the speaker cone from a circular to an ovel pattern.

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