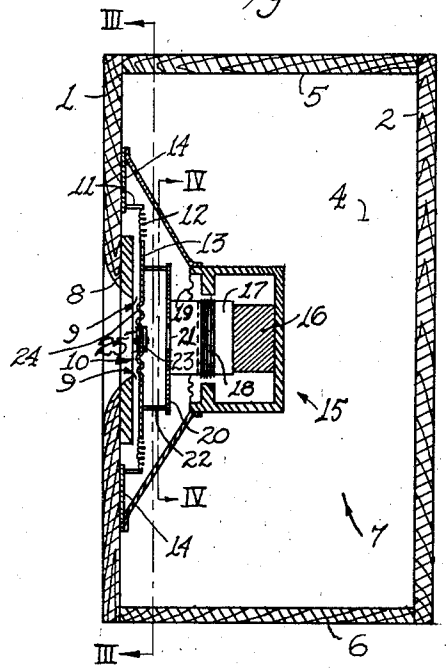
Jan. 21, 1958 E. A. TAVARES 2,820,526

SOUND PRODUCING SYSTEM

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Fig. 2.



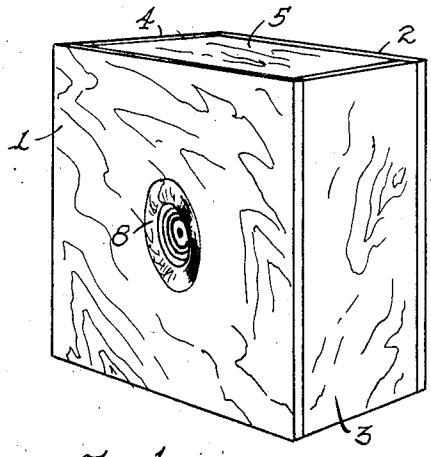


Fig. 1.

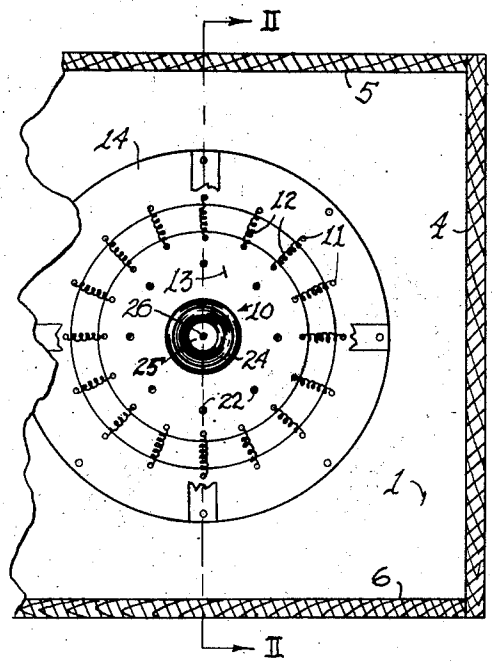


Fig. 3.

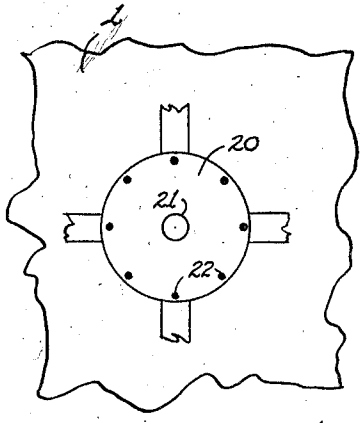


Fig. 4.

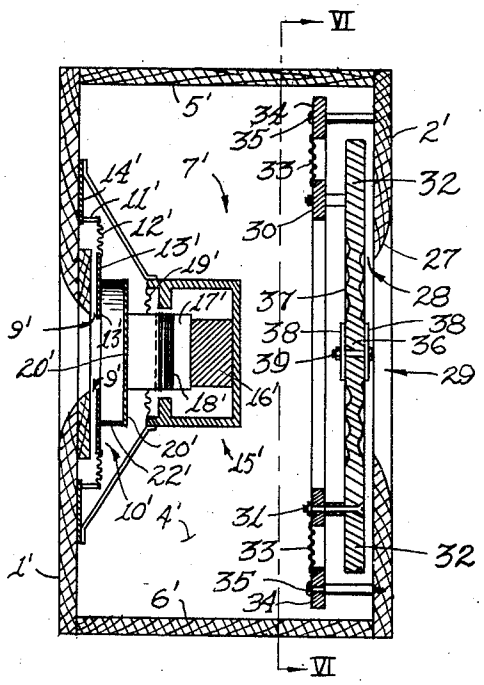
INVENTOR.
ERNEST A. TAVARES
BY R. W. Hodgson
AGENT

Jan. 21, 1958 E. A. TAVARES 2,820,526

SOUND PRODUCING SYSTEM

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Fig. 5.



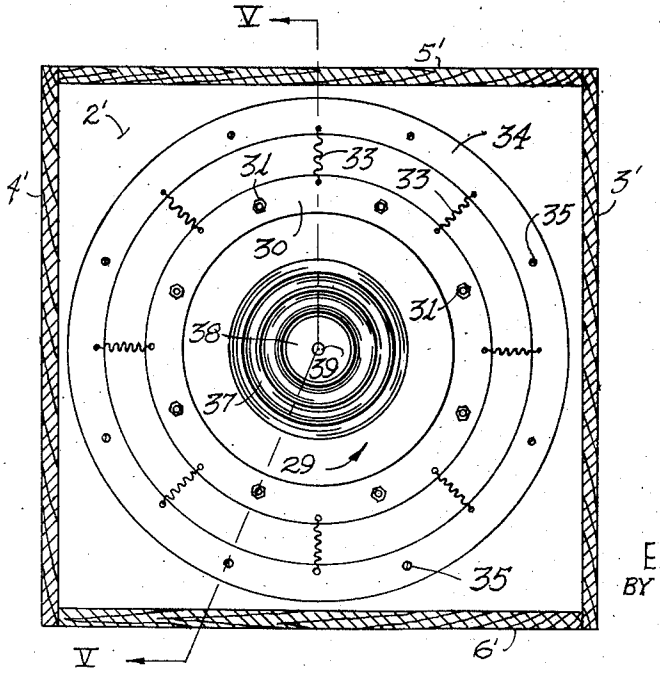


Fig. 6.

INVENTOR.
ERNEST A. TAVARES
BY R. W. Hodgson
AGENT

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2,820,526

SOUND PRODUCING SYSTEM

Ernest A. Tavares, North Hollywood, Calif.

Application July 10, 1952, Serial No. 298,107
14 Claims. (Cl. 181—31)

Generally speaking, the present invention relates to the sound producing (and/or reproducing) art. More specifically, it relates to a system for producing sound in accordance with the vibrations of an oscillatory driving motor means associated therewith. Its major applications are as a sound reproducing system wherein the oscillatory motor means may comprise an electro-magnetic motor means of the general type customarily associated with loudspeakers, and energized with a variable electric input signal corresponding to the acoustic output to be reproduced. However, the system is not limited to this application or construction. It will, however, be primarily described herein as a sound reproducing system of the type just mentioned because this is one of its principal uses. In this specific arrangement it relates, in particular, to a novel, small sound reproducing system adapted to greatly extend the low frequency range of useful acoustic energy radiated therefrom and available in an adjacent listening region.

It should be noted that this patent application is a continuation-in-part of my co-pending patent application entitled Novel, Small, Extended Low Frequency Response Loudspeaker Enclosure, Serial No. 163,994, filed, May 24, 1950, subsequently granted July 19, 1955, as U. S. Patent No. 2,713,396, and my co-pending patent application entitled An Improved Small Extended-Low-Frequency-Response Loudspeaker Enclosure, Serial No. 280,903, filed April 7, 1952, subsequently granted August 7, 1956, as U. S. Patent No. 2,757,751 (which explicitly and/or implicitly disclose the inventive concepts, more specifically described, illustrated and claimed herein).

Generally speaking, the present invention comprises a sound producing and/or reproducing system including a chamber (usually a closed chamber) having emission port means connecting the interior and the exterior of said chamber and having diaphragm means effectively, resiliently mounted in closely spaced position across the emission port means to effectively provide flow restricting, variable emission slit means. Said diaphragm means being effectively connected to and adapted to be vibratively driven by oscillatory motor means whereby to modulate air flow through the slit means.

In one preferred general form of the present invention the chamber means may comprise pressure tank means adapted to contain air under pressure greater than that of ambient air on the other side of the emission port means whereby to cause air to flow outwardly through the slit means for modulation thereby.

In one preferred general form of the present invention, the diaphragm means (and associated variable slit means) may comprise air pump means adapted to effectively pump air intermittently into the interior of the chamber and may also comprise modulating means adapted to modulate air intermittently flowing out of the chamber, in a manner corresponding to the vibration of the oscillatory motor means.

In another preferred general form of the present invention, auxiliary pressurizing means for pressurizing the interior of the chamber may be provided. In one form, this may comprise auxiliary port means connecting the interior and the exterior of the chamber and an auxiliary diaphragm means resiliently mounted in closely spaced position across the auxiliary port means so as to define resiliently variable auxiliary slit means; said auxiliary diaphragm means having a substantially greater surface area than the area of the auxiliary port means immediately adjacent thereto whereby vibratory movement of the auxiliary diaphragm means toward and away from the auxiliary port means in response to vibration of the first diaphragm means, will tend to intermittently pump air into the chamber and increase the mean air pressure therein, thus altering the effective compliance of the air within the chamber and altering the variable slit means in a manner increasing the effective air mass moved.

From the above general description of the basic and several preferred forms of the present invention, it will be apparent to those skilled in the art that virtually all of the hereinabove mentioned prior art disadvantages are virtually entirely eliminated and overcome in and through the use of the system of the present invention.

For example, in the basic form of the present invention wherein only one diaphragm is utilized, there is absolutely no problem of the prior art type involving cancellation of front and back radiation as a result of phase difference. Even in the other general forms of the present invention wherein one (or more) auxiliary diaphragm means is employed, there is little or no low frequency cancellation of front and back radiation as a result of phase difference, as occurs in prior art systems. In one form, this may be true because the auxiliary diaphragm (or diaphragms) may radiate very little sound. In other forms, this may be true because the coupling, comprising the compliance of the air mass in the chamber and the compliant auxiliary diaphragm means, and the alteration in the mass of the effectively moved air, are such as to cause back radiation and front radiation to reinforce each other, instead of cancelling out, to produce a very strong low frequency acoustic output. And this in spite of the fact that the volume of air enclosed in the chamber may be very small and would ordinarily have a compliance such as to be incapable of producing the above mentioned results—the difference being produced by the compliantly mounted diaphragm means (and the variable slit means associated therewith), which greatly modify the effective compliance of the small volume of air enclosed within the chamber and the effective mass of the moved air.

In the basic form of the present invention, wherein a single vibratively driven diaphragm is employed in closely spaced position across (usually inside of) emission port means so as to define resiliently variable slit means, the diaphragm comprises an air pump means adapted to intermittently pump air into the chamber, thus increasing the pressure therein and altering the compliance of the air therein and altering the loading on the vibrating diaphragm and effectively altering the mass of air moved thereby in a manner such as to achieve high efficiency, low frequency generation of acoustic output.

The arrangement is such as to tend to eliminate harmonics, overtones and resonance of the chamber and vibrating elements.

The system of the present invention can be very small and yet have low frequency output characteristics as good as or better than a bass reflex cabinet, which is a great deal larger. This is because the most critical factor in connection with a bass reflex cabinet is the volume of air

enclosed therein, which determines the coupling compliance; whereas, in the present invention this factor is virtually entirely eliminated thus eliminating the necessity for large cabinet volume in a sound reproducing system.

Furthermore, the system of the present invention minimizes distortion and spurious harmonic generation in the low frequency range, and is capable of producing virtually pure fundamental tones as low as thirty cycles per second, or even lower in certain cases. This cannot be dublicated by the customary prior art systems in cabinets of anything like a comparable size.

Also, the present invention can use an oscillatory motor of any desired type. If desired, it can comprise an electromagnetic motor of very much greater efficiency and effective power output than standard loudspeaker motors. This is possible because of other features of the system, whereas it is not possible in customary loudspeaker motors employed to actuate the usual light, conical loudspeaker diaphragm.

Also, it should be noted that the usual limiting factors in connection with sound reproducing systems are largely inoperative in conection with at least certain forms of the present invention because sound is produced by modulating air flowing outwardly through the variable slit emission means, which is entirely different from the method employed in standard loudspeaker and/or loudspeaker enclosure systems. Furthermore, the slit source of sound provides a very effective means for disseminating the sound into a listening region defined by a large solid angle, in a manner vastly superior to the best that can be attained in prior art systems.

It should also be noted that the system of the present invention is not limited to use as a sound reproducer but can be employed as a primary generator of sound, which will produce acoustic output corresponding to the vibrations of the oscillatory motor means.

With the above points in mind, it is an object of the present invention to provide a novel sound producing (and/or sound reproducing) system which can be made very small and which is capable of effectively radiating into a listening region substantial acoustic energy (usually, though not necessarily, in the low frequency range) in a manner as good as or better than very much larger prior art sound reproducing systems.

Another object of the present invention is to provide a novel sound producing (and/or sound reproducing) system adapted to produce sound by modulating air flowing through controllably variable slit emission means whereby to produce useful acoustic output power in a very efficient manner.

Other and allied objects will be apparent to those skilled in the art after a careful perusal, examination and study of the accompanying illustrations, the present specification, and the appended claims.

To facilitate understanding, reference will be made to the hereinbelow described drawings, in which:

Fig. 1 is a small perspective view of one illustrative embodiment of the present invention.

Fig. 2 is a somewhat larger vertical sectional view taken in the direction of the arrows II—II in Fig. 3.

Fig. 3 is a vertical sectional view taken in the direction of the arrows III—III in Fig. 2.

Fig. 4 is a vertical sectional view taken in the direction of the arrows IV—IV in Fig. 2.

Fig. 5 is a vertical sectional view, similar in aspect to Fig. 2, but illustrates a modified form of the invention.

Fig. 6 is a vertical sectional view taken in the direction of the arrows VI—VI in Fig. 5.

Generally speaking, the present invention includes a chamber having emission port means connecting the interior and exterior of said chamber. Also, generaly speaking, diaphragm means is effectively resiliently mounted in closely spaced position across the emission port means to effectively provide flow restricting, controllably variable emission slit means, and is effectively connected

to oscillatory motor means in driven relationship with respect thereto whereby to be vibrated thereby.

In the specific example illustrated in Figs. 1, 2, 3, and 4, the chamber is defined by a plurality of walls, including a front wall **1**, a back wall **2**, two side walls, **3** and **4**, and a top and bottom wall, **5** and **6**, all joined together in spaced relationship to form a small chamber, indicated generally at **7**.

The front wall **1** of the chamber **7** is provided with emission port means (in the specific example illustrated, centrally located and of circular, outwardly-flared shape) indicated at **8**.

In the specific example illustrated, the flow restricting means comprises variable emission slit means, indicated generally at **9** defined by the positioning of a diaphragm **10**, which is illustrated as being circular and resiliently mounted by a plurality of circumferentially spaced fastening means **11**, fastened at their outer ends to a plurality of circumferentially spaced spring means **12**, which are fastened to the periphery of the annulus **13** of the diaphragm **10** at points spaced around the periphery thereof. The other ends of the fastening posts **11** are fixedly mounted with respect to the annular rim portion **14** of a housing carrying the oscillatory motor means, indicated generally at **15**. It should be noted that the fastening posts **11** and the rim portion **14** of the housing **15** are fastened to the inside of the front wall **1** in a concentric position with respect to the emission port means **8**. Any other desired type of fastening means may be employed to resiliently mount the diaphragm means **10** with respect to the front wall **1** of the chamber **7**. It should also be noted that the diaphragm **10** is mounted by the resilient means **12** so that the annular outer portion **13** of the diaphragm **10** is positioned in virtually parallel, closely spaced relationship with respect to the inside of the front wall **1** immediately around the emission port **8** therethrough, in a manner such that the annular portion **13** of the diaphragm **10** lies closely adjacent to a corresponding annular portion of the front wall **1** of the box and defines the resiliently variable emission slit means **9**.

In the specific example illustrated, the oscillatory motor means **15** includes a permanent magnet central portion **16** and a movable, hollow, tubular voice-coil-carrying member **17** positioned thereon for lateral sliding movement with respect thereto. The voice-coil-carrying member **17** carries a voice coil **18** thereon and is mounted by a resilient spider **19**, in the customary manner. The left end of the voice-coil-carrying tube **17** is provided with a circular, disc member **20** (which may or may not be centrally apertured as indicated at **21**) which carries at circumferential spaced points around the periphery thereof spacers **22** effectively connecting the disc **20** to the annular portion **13** of the diaphragm **10**, whereby vibratory movement of the voice-coil-carrying member **17** will effectively vibrate said annular portion **13** of the diaphragm **10** toward and away from the corresponding portion of the inside of the front wall **1**.

The arrangement is such that lateral vibratory oscillation of the diaphragm **10**, tends to move the annular portion **13** of the diaphragm **10** toward and away from the adjacent annular portion of the front wall **1** in a manner such as to tend to alter the variable slit emission means **9** (and to thus alter the effective air mass moved), and to intermittently pump air into the chamber **7** through the slit means **9** between the front surface of the annular ring **13** and the inside surface of the adjacent annular portion of the front wall **1**, and such that vibratory, oscillatory movement of the annular ring **13** toward the extreme left, as viewed in Fig. 2, tends to almost (or in some cases completely) momentarily seal the port **8** and minimize (or partially prevent) the escape of air from within the chamber **7** to ambient atmosphere. This tends to produce a pressure increase within the chamber **7**, which will intermittently leak backwardly through the variable slit emission means **9** and be modulated by vibra-

tory movement of the diaphragm ring **13** so as to produce sound in an extremely efficient manner, generally akin to that employed in a vibrating reed type of sound producer, or the like and to effectively radiate the same into a large solid angle by reason of the slit source of sound.

It should also be noted that the pressure increase in the chamber **7** tends to effectively alter the variable slit emission means **9**, thus effectively altering the mass of moved air in a manner tending to lower the resonant frequency of the chamber.

It should also be noted that the air pressure increase (and/or density and/or compliance change) and/or the compliance of the resilient diaphragm and/or the spring coupling thereof to the front wall of the chamber **7** are such as to alter the effective compliance against which the diaphragm **10** works. This, plus the effective alteration of the air mass moved, effectively lower the resonant frequency of the system and greatly increase the useful acoustic output in a selected low frequency range.

In the specific example illustrated in Figs. 1, 2, 3, and 4, the diaphragm **10** is also provided with a central disc-shaped portion **23**, effectively connected to the outer annular ring 13 by annular corrugations **24**, which are intended to compliantly couple the outer annular ring **13** to the central disc portion **23**. The central disc portion **23** may be provided with suitable weight means **25**, which may be fastened by any desired type of fastening means, such as indicated at **26**, to the disc **23**, and which may be removable for replacement by a greater or lesser weight for modification and adjustment of the low frequency response characteristic of the system. The central disc portion **23** and the outer annular ring **13** are connected by the flexible corrugations **24** for the purpose of reducing the resonant frequency of the diaphragm **10** and the weight carried thereby, since the effective low frequency limit which can be radiated into listening regions is effectively controlled (to a certain extent in some forms of the invention) by the reasonant frequency of the diaphragm as well as the oscillatory motor means. The corrugations **24** also act to isolate, to a desired degree, the actions of the outer ring **13** and the inner disc **23**.

It should be noted that either the annular ring **13** or the adjacent annular portion of the front wall may be provided with suitable resilient means in order to prevent any spurious and extraneous noise from being produced, in the event that vibratory movement of the annular ring **13** toward the left causes it to actually make engagement with the adjacent annular portion of the front wall **1**.

The spring means **12** may be positionally adjustable so that the spacing between the annular ring **13** and the adjacent annular portion of the front wall **1** can be adjusted at will, so that, at maximum excursion of the annular ring **13** contact of the ring **13** and the wall **1** does not quite take place.

In another general form of the present invention, I contemplate arranging the spacing between the annular ring 13 and the adjacent annular portion of the front wall **1** so that outward movement of the ring **13** effectively closes the port **8** during the earlier portion of the outward stroke and tends to produce a more effective air pumping action into the chamber **7**. In this form of the invention, it is desirable that the annular ring **13** and the closely adjacent portion of the rear surface of the front wall **1** be resiliently cooperable when they abut. This may be provided by making either of the abutting portions resilient, or the equivalent.

It should be noted that the use of the terms "front" and "back" or "rear," as used in connection with the above descripiton, are not to be taken in a limiting sense. The system can be positionally reversed or otherwise repositioned.

The modified form of the present invention, shown in Figs. 5 and 6, is generally similar to the first form of the present invention in many respects except that the front diaphragm is modified somewhat so as to act entirely as a modulator of outflowing air, and except that an additional port, resiliently mounted diaphragm and variable slit means are provided to act as an auxiliary pressurizing means to increase air pressure within the chamber. In this version of the invention, similar parts will be indicated by similar reference numerals, primed however.

In this modification, the front diaphragm **10'** no longer has corrugations, such as the corrugations **24** in the first form of the present invention, or a central disc portion, such as the disc portion **23** in the first form of the present invention, or a central weight, such as the weight **25** in the first form of the present invention. The hole **21** is also eliminated, and the annular ring **13'** is driven by means of the oscillatory motor means **15'** so as to merely modulate air flowing outwardly through the variable emission slit means **9'** so as to produce sound by said modulatory action in a very efficient manner adapted to radiate into a listening region defined by a very large solid angle. As illustrated, the spacer means **22'** comprises a sealed ring instead of spaced posts.

In this modification, the back wall **2'** of the chamber **7'** is provided with auxiliary port means (in the specific example illustrated, centrally located and of circular, outwardly-flared shape) indicated at **27**. In the specific example illustrated, variable slit means, indicated generally at **28**, is defined by the positioning of an auxiliary diaphragm **29**, which is illustrated as being circular and resiliently mounted by an inner mounting ring **30** fastened by fastening means **31** to the annulus **32**; said mounting ring **30** being also fastened to spring means **33** spaced around the periphery thereof, the other ends of which are fastened to an outer mounting ring **34**, which is fastended with respect to the inside of the back wall **2'** by fastening means, such as the screw means **35**. Any other desired type of fastening means may be employed to resiliently mount the diaphragm means **29** with respect to the back wall **2'** of the chamber **7'**. It should be noted that the auxiliary diaphragm **29** is mounted by the resilient means **33** so that an outer annular portion **32** of the diaphragm **29** is positioned in virtually parallel closely spaced relationship with respect to the inside of the back wall **2'** around the port **27** therethrough in a manner such that the annular portion **32** of the diaphragm **29** lies closely adjacent to a corresponding portion of the back wall **2'** of the box.

The arrangement is such that lateral vibratory oscillation of the diaphragm **29**, which occurs as a result of back acoustic radiation from the front diaphragm annular ring **13'**, in a selected low frequency range, tends to move the annular portion **32** of the rear diaphragm **29** toward and away from the adjacent annular portion of the back wall **2'**, in a manner which tends to alter the variable air slit **28** (and to thus alter the effective air mass moved) and to pump air into the chamber **7'** through the slit means **28**, and such that vibratory oscillatory movement of the annular ring **32** toward the extreme right, as viewed in Fig. 5, tends to almost (or in some cases, completely) seal the port **27** and minimize (or prevent) the escape of air from within the enclosure **7'** to ambient atmosphere. This tends to produce a pressure increase within the chamber **7'** whenever the oscillatory motor means **15'** is vibrating in a selected low frequency range. This pressure increase effectively converts the chamber **7'** into a pressure tank and causes air to flow outwardly through the front variable slit means **9'** and to be modulated by the vibration of the front diaphragm ring portion **13'**, as it passes through said slit means.

In certain forms of the present invention, the rear diaphragm **29** may also be adapted to radiate sound, which will be in an additive relationship with respect to sound radiated from the front of the system.

It should be noted that the pressure increase in the chamber **7'** tends to effectively alter the variable slit means **28** (while at the same time altering the variable

slit means 9') thus effectively altering the mass of moved air in a manner tending to lower the resonant frequency of the chamber.

The air pressure increase (and/or density and/or compliance change) and/or the compliance of the resilient diaphragm 29 and/or the spring coupling thereof to the back wall 2' of the chamber 7', is such as to alter the effective compliance against which the front ring 13' works in rearward oscillatory movement in a selected low frequency range. This effectively lowers the resonant frequency of the system and greatly increases the useful acoustic output in a selected low frequency range.

In the specific example illustrated in Figs. 5 and 6, the diaphragm 29 is also provided with a central disc-shaped portion 36, effectively connected to the outer annular ring 32 by annular corrugations 37, which are intended to compliantly couple the outer annular ring portion 32 to the central disc portion 36.

In the specific example illustrated in Figs. 5 and 6, the central disc portion 36 is provided with suitable weight means 38, which may be fastened by any desired type of fastening means, such as indicated at 39, to the disc 36, and which may be removable for replacement by a greater or lesser weight for modification of the response characteristics of the system. The central disc portion 36 and the outer annular ring 32 are connected by the flexible corrugations 37 for the purpose of reducing the resonant frequency of the diaphragm 29 (and the weight carried thereby), since the effective low frequency limit which can be radiated into a listening region (in at least certain forms of the invention) can be effectively altered by controlling the resonant frequencies of either or both of the diaphragms (as well as certain other variables). The corrugations 37 also act to effectively isolate the central disc portion 36 and the outer annular portion 32 (to any desired degree).

In certain forms of the present invention, the central disc portion 36 of the diaphragm 29 may act as a very efficient acoustic radiator for radiating low frequency energy outwardly through the port 27 (and this in addition to the modulatory action of the outer annular portion).

It should be noted that either the annular portion 32 or the adjacent annular portion of the back wall 2' may be suitably made resilient in order to prevent any spurious and extraneous noise from being produced, in the event that vibratory movement of the annular ring 32, toward the right as viewed in Fig. 5, causes it to actually make engagement with the adjacent annular portion of the back wall 2'.

The spring means 33 may be positionally adjustable so that the spacing between the annular ring 32 and the adjacent annular portion of the back wall 2' can be adjusted at will, so that, at maximum excursion of the annular ring 32, contact of said ring and the wall 2' does not quite take place.

In another general form of the present invention, I contemplate arranging the spacing between the annular ring 32 and the adjacent annular portion of the back wall 2' so that outward movement of the ring 32 effectively closes the port 27 during the earlier portion of the outward stroke and thus produces a more effective air pumping action into the chamber 7'. This form of the invention requires the use of resilient means positioned between the annular ring 32 and the rear wall 2' or requires that said wall or said ring be of resilient construction at the contacting surface.

It should be noted that the use of the terms "front" and "back" or "rear," as used in connection with the above description are not to be taken in a limiting sense.

It should also be noted that the present invention is not limited to the arrangement shown in Figs. 1 through 4, inclusive, or the arrangement shown in Figs. 5 and 6. Any source of air under pressure may be employed. This might include a pressure vessel containing air under pressure, or any suitable pressurizing means adapted to pressurize the interior of the chamber and to allow outflow through the variable emission slit means past the vibrating diaphragm for modulation thereby.

Numerous modifications and variations of the present invention will occur to those skilled in the art after a careful study hereof. All such properly within the spirit and scope of the present invention are intended to be included and comprehended as fully as if specifically described, illustrated, and claimed herein.

For example, the shape and configuration of the chamber is not limited to the forms illustrated herein, but may assume a great variety of forms and may be of integral or non-integral construction, and may be made of any desired materials.

Either or both of the diaphragm means and/or port means and/or variable slit means need not be positioned in any particular wall or walls of the system, but can be positioned in a great variety of relationships. The structure, arrangement and composition of either or both of the diaphragm means, and/or port means and/or slit means and/or means for mounting the diaphragm means can be modified substantially from that described and illustrated herein.

The oscillatory motor means can be modified substantially, and may comprise any arrangement capable of driving a diaphragm means.

Either or both of the diaphragm means need not be positioned on a certain specified side of a wall but may be located in any selected position with respect thereto. Either or both of the diaphragm means may be compliantly coupled with respect to the chamber or may be inherently compliant, or may be relatively stiff and be provided with compliant coupling means so as to have piston-like action. Either or both of the diaphragms may have several relatively stiff portions connected by flexible portions therebetween, if desired, or they may be provided with weight means (which may be adjustable, if desired) in order to alter the effective resonant frequencies thereof. Either or both may be arranged so as to not effectively close the associated port but to merely oscillate or vibrate in spaced relationship with respect thereto. If desired, either or both of the diaphragms may be arranged to have two (or more) portions connected by relatively flexible portions in a manner such that the resonant frequency of one of said portions is different from the resonant frequency of the other of said portions, to facilitate the operation of the system. In certain cases, the compliant diaphragm means may not be positioned between the interior of the chamber and ambient atmosphere but may be effectively positioned within the chamber in a manner whereby to produce the hereinbefore mentioned advantageous features.

The embodiments of the present invention specifically described, illustrated and claimed herein are exemplary only, and are not intended to limit the scope of the present invention, which is to be interpreted in the light of the prior art and the appended claims only, with due consideration for the doctrine of equivalents.

I claim:

1. A sound producing system, comprising: a closed chamber; emission port means connecting the interior and the exterior of said chamber; oscillatory-motor-driven substantially planar diaphragm means effectively resiliently mounted in closed spaced substantially parallel position across the emission port means and effectively defining annular substantially parallel-edged flow restricting variable emission slit means communicating the interior of said chamber with said emission port means, said diaphragm means being cooperable to be directly vibrated by oscillatory motor means whereby to modulate air flow through the slit means.

2. A system of the character defined in claim 1 wherein the diaphragm means comprises pump means and has

a substantially greater substantially planar surface area than the area of the emission port means immediately adjacent and substantially parallel thereto, whereby vibratory movement of the diaphragm means toward and away from the emission port means, will tend to intermittently pump air into the chamber and increase the mean air pressure therein, thus intermittently causing air outflow through the annular variable slit emission means, and altering the effective compliance of the air within the chamber and altering the variable slit emission means in a manner increasing the effective air mass moved.

3. A sound producing system, comprising: a closed chamber; emission port means connecting the interior and the exterior of said chamber; oscillatory-motor-driven substantially planar diaphragm means effectively resiliently mounted in closely spaced substantially parallel position across the emission port means and effectively defining annular substantially parallel-edged flow restricting variable emission slit means communicating the interior of said chamber with said emission port means, said diaphragm means being cooperable to be effectively vibrated by oscillatory motor means whereby to modulate air flow through the slit means; said closed chamber comprising pressure tank means cooperable to contain air under pressure greater than that of ambient air on the other side of the emission port means whereby to cause air to flow outwardly through the slit means.

4. A system of the character defined in claim 2 including weight means carried by the diaphragm means for causing said diaphragm means to have the proper resonant frequency.

5. A system of the character defined in claim 4, wherein the diaphragm means includes a central disc-shaped portion and an outer annulus resiliently joined together.

6. A system of the character defined in claim 5, wherein the outer annulus is resiliently mounted with respect to the interior of the emission port means and wherein the central disc-shaped portion of the diaphragm means carries the weight means for adjusting the resonant frequency.

7. A system of the character defined in claim 6, wherein the diaphragm means and the variable slit emission means comprise air pump means adapted to effectively pump air intermittently into the interior of the chamber and also comprise modulating means adapted to modulate air intermittently flowing out of the chamber in a manner corresponding to the vibration of the diaphragm means.

8. A system of the character defined in claim 3 including pressurizing means for pressurizing the interior of the chamber.

9. A system of the character defined in claim 8, wherein the pressurizing means comprises an auxiliary port means connecting the interior and the exterior of the chamber and an auxiliary diaphragm pump means resiliently mounted in closely spaced position across the auxiliary port means.

10. A system of the character defined in claim 9, wherein the auxiliary diaphragm pump means is so spaced with respect to the auxiliary port means as to define resiliently variable auxiliary slit means.

11. A system of the character defined in claim 10, wherein the auxiliary diaphragm pump means has a substantially greater surface area than the area of the auxiliary port means immediately adjacent thereto whereby vibratory movement of the auxiliary diaphragm means toward and away from the auxiliary port means in response to vibration of the first diaphragm means, will tend to intermittently pump air into the chamber and increase the mean air pressure therein, thus altering the effective compliance of the air within the chamber and altering the variable slit means in a manner increasing the effective air mass moved.

12. A system of the character defined in claim 11, including weight means carried by the auxiliary diaphragm means for causing said diaphragm means to have the proper resonant frequency.

13. A system of the character defined in claim 12, wherein the auxiliary diaphragm means includes a central disc-shaped portion and an outer annulus resiliently joined together.

14. A system of the character defined in claim 13, wherein the outer annulus is resiliently mounted with respect to the interior of the auxiliary port means and wherein the central disc-shaped portion of the auxiliary diaphragm means carries the weight means for adjusting the resonant frequency.

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2,121,008	Bilhuber	June 21, 1938
2,295,483	Knowles	Sept. 8, 1942
2,713,396	Tavares	July 19, 1955