May 5, 1959 R. E. SWANSON 2,884,892

PNEUMATIC SOUND PRODUCING DEVICE

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Fig. 1.

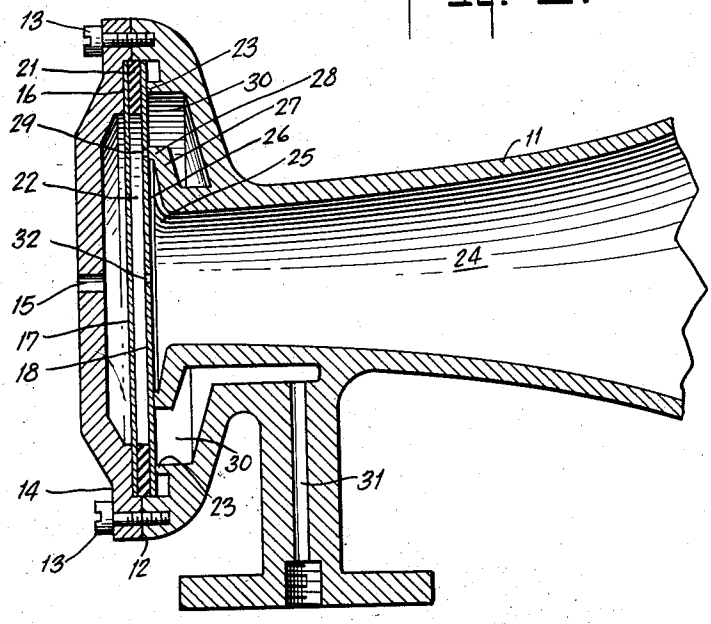


Fig. 2.

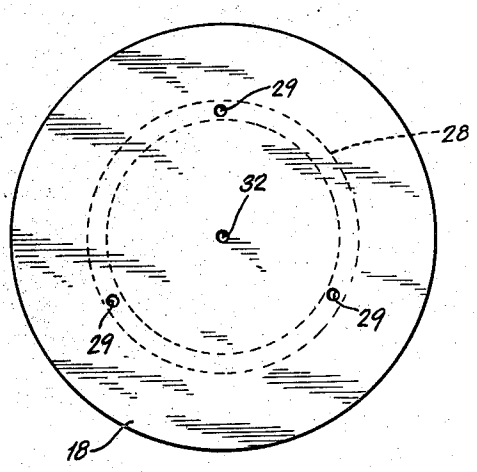
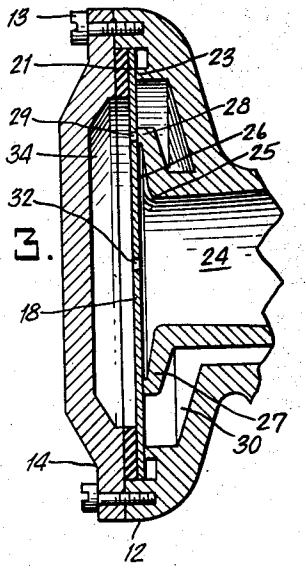


Fig. 3.



INVENTOR.
ROBERT E. SWANSON

BY

W. D. Keith,
ATTORNEY

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Fig. 4.

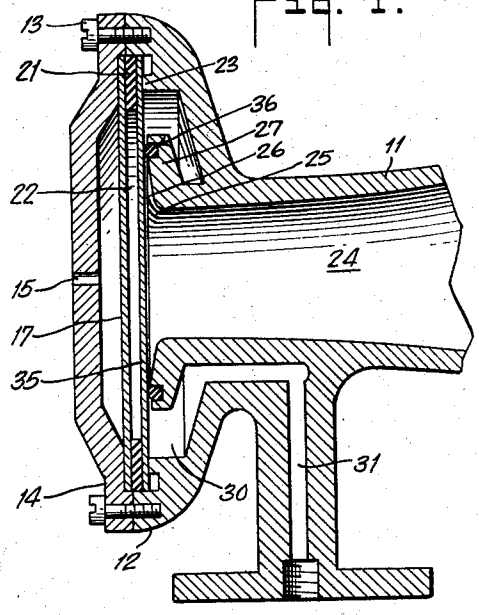


Fig. 7.

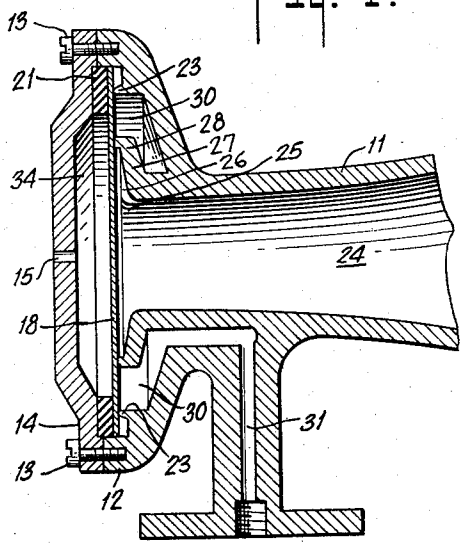


Fig. 6.

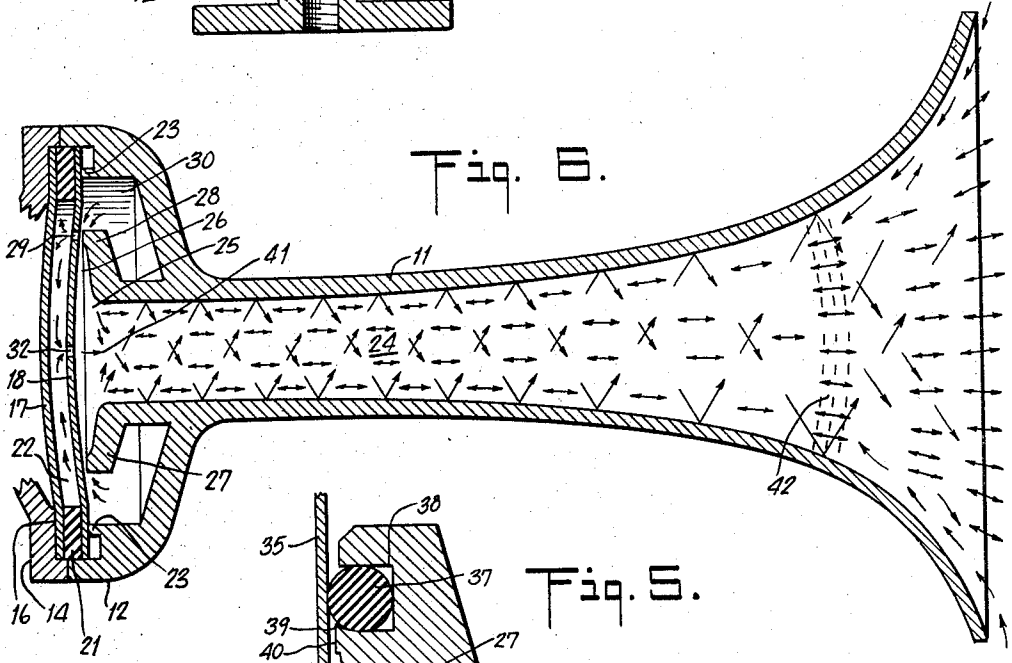
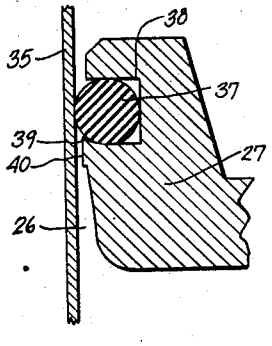


Fig. 5.



INVENTOR.
ROBERT E. SWANSON

BY

W. D. Keith,
ATTORNEY

United States Patent Office

2,884,892

Patented May 5, 1959

2,884,892

PNEUMATIC SOUND PRODUCING DEVICE

Robert E. Swanson, Vancouver, British Columbia, Canada, assignor to Nathan Manufacturing Corp., New York, N.Y., a corporation of New York

Application December 1, 1954, Serial No. 472,392

14 Claims. (Cl. 116—142)

This invention relates to sound producing devices and more particularly to improvements in a pneumatically operated horn.

As usually constructed, horns of the pneumatic type employ some type of diaphragm which is caused to vibrate, producing sound when compressed air to other gaseous fluid under pressure is caused to pass through the device. Such diaphragms are constructed in various manners well known to the art. However, a difficulty has been encountered heretofore, viz. failure due to cracking after the diaphragms have been subject to normal use over periods of time. It is well known that these failures occur where the diaphragm is clamped at its periphery and also where it pounds or touches on the central seating ring at one end of the resonating column within the horn. Furthermore, another difficulty has been that in order that a plain circular diaphragm shall vibrate on a certain frequency in harmony with the resonant frequency of the horn tube with which it is coupled, the prior art teaches that the diaphragm shall have a certain predetermined diameter in relation to the horn tube throat and to the stiffness or thickness of the diaphragm, otherwise the horn tube either fails to resonate or it will resonate on the second harmonic instead of the fundamental frequency. Prior attempts to overcome this difficulty include the use of weights or attachments to the diaphragm. Where such attachments are added the central hole necessary in the diaphragm and the added mass cause the diaphragm to crack. In order to achieve the required result without weights or attachments it was formerly necessary to have a large diameter horn throat seat with a large diameter diaphragm, when low frequencies were required, and conversely a small diameter horn throat seat and a proportionately small diameter diaphragm where higher frequencies were required. In the manufacture of multiple horns this variation seriously increased the cost and also increased the number of spare parts required by the user. In addition, a plain diaphragm even though properly proportioned, ceases to function when the operating fluid pressure is increased above certain limits and therefore the device is limited to a fairly restricted pressure range for satisfactory operation.

Consequently it is an object of this invention to provide a single or multiple pneumatic horn which is capable of tremendous power output with a wide pressure range and in which small diameter plain diaphragms can be used which have a common diameter for all frequencies.

A further object of this invention is to provide a horn with a very low initial speaking pressure but which will reinforce itself automatically as the pressure increases, thus increasing the volume.

Another object of this invention is to provide a horn which will cause the frequency to rise slightly when operating pressure is increased, rather than to have the frequency slightly lowered.

Another object of this invention is to provide a horn

where no mechanical adjustment is required to the diaphragm.

Another object of this invention is to provide a horn which will reduce the volume of compressed air or other gas required for signals of a predetermined loudness.

Another object is to produce an air horn adaptable for multiple use at a much reduced cost as most parts are common to all sizes of horns.

A further object of the invention is to provide a horn in which the diaphragm and other parts have a long life.

Briefly, this invention includes a combination to be found in a pneumatic sound producing device. Such device having a horn forming a sound resonant column, being open at one end and having an annular seating ring at the other end including an annular chamber surrounding said seating ring as well as a passage for supplying gas under pressure to said chamber. This combination comprising a pair of diaphragms, means for spacing said diaphragms apart in substantially parallel relation forming a closed chamber therebetween, and means for clamping said diaphragms near the periphery thereof so as to firmly seat one diaphragm against said seating ring to close the other end of said resonant column and said annular chamber when no gas under pressure is introduced into the annular chamber.

Other objects of the invention and features of novelty will be apparent from the following description taken in connection with the accompanying drawings in which:

Fig. 1 is a fragmentary longitudinal section showing the diaphragm head unit of a single air horn according to this invention;

Fig. 2 is an end elevation of one of the diaphragms;

Fig. 3 is a longitudinal section of the diaphragm end of a horn embodying a single diaphragm modification of my invention;

Fig. 4 is a fragmentary longitudinal section of a modified horn according to this invention;

Fig. 5 is an enlarged detail of Fig. 4 showing the metallic seating ring backing the resilient material seat ring;

Fig. 6 is a slightly reduced size longitudinal cross-section of a double diaphragm horn and bell according to this invention as embodied in Fig. 1, showing the behavior of air and sound patterns in the resonant sound column; and

Fig. 7 is a longitudinal section of the diaphragm end of a horn embodying a single unperforated diaphragm modification of my invention.

Fig. 1 of the drawings illustrates a fluid pressure operated sound producing device according to this invention. There is a horn 11 having integrally attached thereto a casing or enlarged diameter head portion 12 in which is housed the vibrating elements of the device. Attached to the casing 12 in any convenient manner as by screws 13 illustrated, there is a cover plate 14, having a vent hole 15 therein and including a recessed flat annular surface 16 to engage the periphery of a backing diaphragm 17. Another diaphragm 18 lies parallel to diaphragm 17 but is spaced therefrom by a relatively soft resilient washer or ring 21 to form a closed chamber 22 between the diaphragms 17 and 18. It will be noted that there is a clamping ring 23 located near the periphery of the diaphragm 18, that is integrally attached to the casing 12. The combined thickness of diaphragms 17, 18 and ring 21 is such that when the cover plate 14 is drawn tightly against the casing 12 the ring 21 is compressed and a slight crimp is formed near the edge of the diaphragm 18. This insures a tight seal at the edge of diaphragm 18 and provides a soft resilient support for the diaphragm 18 as well as forming a crown in the diaphragm to spread out the area where flexing takes place during vibration.

The horn 11 forms a column 24 that is open at one

end and tapers to a throat 25 at the closed end. This column acts as a sound resonating column to determine the pitch of the sound emitted by the horn when the diaphragms are vibrating. Leading into the throat 25 there is a wedge shaped (in cross-section) annular nozzle 26. This nozzle 26 is formed between the surface of diaphragm 18 and a flange 27 at the closed end of column 24 of horn 11. This flange 27 supports a seating ring 28 against which the diaphragm 18 is pressed by the bending action or crowning effect that is produced when the slight crimp is formed in the diaphragm 18 by the clamping ring 23. There are a plurality of orifices 29 located in the diaphragm 18 directly over the seating ring 28 for by-passing a predetermined quantity of the gas under pressure that is introduced into an annular chamber 30, that surrounds the seating ring 28. The gas passes through the orifices 29 as such gas unseats the diaphragm 18. There is a passage 31 for connecting the annular chamber 30 with a supply of gas under pressure when the horn is to be sounded.

As indicated in Fig. 2 the orifices 29 are small enough to be completely closed when the diaphragm 18 is seated on the seating ring 28. The number and size of these orifices may vary. However, there is a relationship between the size and number of these orifices 29 and the size of a central hole or orifice 32. It has been found that where three orifices 29 are used, an orifice diameter of one thirty-second of an inch for these orifices 29, and a diameter of the three sixty-fourths of an inch for orifice 32 is very satisfactory.

Fig. 3 illustrates another embodiment of this invention wherein the only changes over the embodiment illustrated in Fig. 1 are involved in the use of a cover plate 14 that has no vent therein. Also, the backing diaphragm is omitted so that only a single diaphragm 18 is employed. It is for this reason that there is no vent hole in cover plate 14, so that an air chamber 34 is formed behind the diaphragm 18 to apply the compression effects necessary for a superior operation in accordance with this invention. As all other elements are the same as those to be found in the embodiment illustrated in Fig. 1, the same reference numbers are applied in Fig. 3, and no further explanation is necessary.

Fig. 4 illustrates yet another embodiment of this invention that involves changes in certain of the elements over those corresponding elements illustrated in Fig. 1. One change is involved in the use of a diaphragm 35 which is mounted in the same manner as diaphragm 18 of Fig. 1 but which has no orifices therein, it being a solid flat disc-type of diaphragm. The only other change involved in this embodiment is that concerning the structure of the seating ring for diaphragm 35. Instead of employing a metal seating ring surface as was the case in the previous embodiments, there is provided a soft resilient material seating ring 36. This seating ring 36 may be mounted in any convenient manner at or near the periphery of the flange 27.

Details of the particular style of seating ring employed in this embodiment are illustrated in Fig. 5 where it may be observed that there is an O ring 37 carried by a groove 38. The dimensions of the groove 38 are such that the O ring 37 extends beyond the face of flange 27 sufficiently to make contact with the diaphragm 35 without allowing the diaphragm to touch any metallic surface of the flange 27. The groove 38 is preferably constructed with a lip 39 on the inner peripheral edge of the groove for retaining O ring 37 in place in the groove 38. It is further contemplated that there may be a metallic seating ring surface 40 located integrally on the flange 27. This metallic seating ring surface 40 will be located slightly inside of the furthest extending surface of the O ring 37 so that when the diaphragm 35 vibrates it will only make contact with the metallic seating ring 40 after a predetermined compression of the soft material O ring 37. This action allows an increase

in the amplitude of vibration of the diaphragm 35 under high air pressure while obtaining a cushioning or shock-absorbing effect in addition to an assist from the O ring 37 during the initial vibration of the diaphragm away from the seat. It is to be noted that the metallic seating ring surface 40 may be located radially outside of the O ring 37 if desired.

It will be appreciated that separating ring 21, as well as soft seating ring 36 and O ring 37, may be any relatively soft resilient material, e.g. neoprene.

Fig. 7 illustrates still another embodiment of this invention wherein the only changes over the embodiment illustrated in Fig. 3 are involved in the use of a cover plate 14 that has a vent 15 of a predetermined size, also the single diaphragm 18 is not perforated by ports 29 and 32 (with reference to Fig. 3). It is for this reason a vent hole is required in the cover 14 so that chamber 34 is in communication with the atmosphere through a restricted port 15; whereas, in Fig. 3 port 32 serves this purpose. While the operation of the device as shown in Fig. 7 is inferior to that of Fig. 1 and Fig. 3; nevertheless, it is superior to conventional horns where resilient ring 21 is not incorporated forcing a slight annular crimp near the periphery of the diaphragm by forcing metallic annular ring 23 (Fig. 3) into the diaphragm at which point 23, concentrated pressure forces the diaphragm into resilient ring 21, thus not only forming an annular crimp near the periphery of the diaphragm, but also forcing a slight concave in the diaphragm with reference to the pressure in chamber 30. This principle of the art is taught in my Patent No. 2,658,470, column 3, lines 50 to 60, and while the principle as applied in the foregoing patent embodies three concentric metal rings to force a combination of annular crimp and a concave in the diaphragm, the principle herein shown uses a combination of one concentric metal ring 23 and one resilient backing ring 21 on the opposite side of the diaphragm, the outer diameter of which resilient ring 21 is considerably greater than the outer diameter of metallic ring 23, while the inner diameter of said resilient ring 21 is considerably less than the inner diameter of metal ring 23. I have found further that the use of resilient ring 21 as shown in Fig. 7 also acts as a dampener on diaphragm 18 as the annular underhanging portion of ring 21, between points 23 and 35, due to its resilient nature, dampens high frequency harmonics in diaphragm 18, thus improving the fundamental note emitted by such a horn when constructed according to this invention. The operation of arrangement Fig. 7 is basically the same as explained with reference to Fig. 6 except that the diaphragm is not reinforced by the valving action of ports 29 and 32 in diaphragm 18; nor does it have the advantage of backing diaphragm 17. I have found, however, that where seating ring as shown in Fig. 5 is embodied in Fig. 7 operation and tone is much improved, and when backing diaphragm 17 as shown in Fig. 4 is embodied in combination with resilient seat ring as shown in Fig. 5 tone, operation and latitude is still further improved.

Fig. 6 illustrates the action of a typical horn according to the Fig. 1 embodiment of this invention, when the horn 11 is sounding under the action of compressed air or other gas that is admitted to the annular chamber 30 within the casing 12 of the horn 11. It will be noted that in operation, fluid under pressure in chamber 30 acts upon the diaphragm 18 tending to deflect it to the left as viewed in Fig. 6. Upon deflection of diaphragm 18, a circular puff of gas, i.e. compressed air, escapes over the surface of seating ring 28 to enter the nozzle 26 where it expands and increases in velocity. This circular puff of compressed air expands radially inward to cause the particles of air to collide at a central point 41 which may be termed a "node." Succeeding nodes as indicated by the arrows are then formed as the compression waves travel outward toward the open end of

horn **11**. Since the diaphragm **18** is deflected off of its seating ring **28** some of the compressed air is able to enter the orifices **29** and so compress the air located in chamber **22** between the diaphragms **17** and **18**. This compression then forces the backing diaphragm **17** to also deflect to the left, as viewed in Fig. 6, along with diaphragm **18**, until the elastic forces in the diaphragms cause them to overcome the forces of the compressed air and return rapidly to the right. The air in chamber **22** is further compressed by the action of diaphragm **17** to aid in the return of diaphragm **18**. The diaphragms **17** and **18** are separated by the air chamber **22**. Now then, as diaphragm **18** is re-seated on its seating ring **28**, a cycle of vibration is completed and the repetition of the next succeeding cycle will begin. Thus, a resonant sound frequency is set up in the column **24** within the horn **11**, that has a frequency inversely proportional to the resonant length of sound column **24**. At the end of the resonant column **24**, i.e. at about a location indicated by reference number **42**, the pulsating mass of gas slaps against the unlimited atmosphere and thus sets up sound waves that may be amplified by the size of the flare at the open end of horn **11**. Along the length of column **24** there are formed a series of stationary nodes with maximum movement antinodes therebetween.

Aiding in the stability of the action of the resonant column **24**, is the orifice **32** which relieves excess pressure built up in chamber **22** by blowing into the center or vortex of node **41**. In this manner the resonant sound pattern is not disturbed and no undesired harmonics are set up.

It has been found that the diameter of the open end of horn **11**, i.e. at the location or point **42**, should have a size relation to the throat **25** in the neighborhood of the ratio 2.52 to 1.00.

The sound pattern described above may be studied using a transparent horn and having a small amount of thick oil injected at the throat or node point **41**. The pattern becomes visible with a stroboscopic light.

It has been found that by using horns in accordance with this invention, a single size of diaphragms and casing may be employed with horns that vary in resonant length from 5 inches up to 60 inches, and no change or adjustment is necessary in the vibrating unit. Consequently, satisfactory results are obtainable over a frequency range of from 100 cycles per second up to 700 cycles per second by merely substituting various lengths of horn bells. Furthermore, it has been found that whereas a low speaking pressure in the neighborhood of 5 lbs. p.s.i. may be used, the pressure applied may be varied up to as much as 250 lbs. p.s.i. with no distortion in the note produced. At the same time, an extremely loud and musical signal is obtained, the frequency of which is slightly raised with an increase in operating pressure.

It is to be noted that a factor contributing to the stability of the horn using a seating diaphragm **18** with orifices therein, as described above, is the action involving a by-passing of a certain amount of the compressed air from the chamber **30** into the chamber **22** of Fig. 1 or into the chamber **34** of Fig. 3. This action keeps the differential of pressures on the two sides of the main diaphragm **18** from becoming excessive over a greatly increased range as pointed out above.

While there has been shown and described specific embodiments in accordance with this invention, these are merely by way of illustration, and should not be considered in any way as limiting this invention.

It is claimed:

1. In a pneumatic sound producing device having a horn forming a sound resonant column, being open at one end and having an annular seating ring at the other end, said device including an annular chamber surrounding said seating ring and a passage for supplying gas under pressure to said chamber, the combination comprising a diaphragm, a clamping ring located near the periphery of said diaphragm, means for clamping said diaphragm into firm engagement with said clamping ring to hold it seated on said seating ring, thus closing said annular chamber, said means including a resilient material ring having a radial width greater than that of said clamping ring and being located near the periphery of the diaphragm on the opposite side of the diaphragm from said clamping ring, a plurality of orifices located in said diaphragm directly over said seating ring so that said orifices are closed when the diaphragm is seated against the ring, and a solid cover attached to the device over said diaphragm and spaced therefrom on the other side from said seating ring to form an air space for acting on the diaphragm as it is flexed.

2. In a pneumatic sound producing device having a horn forming a sound resonant column, being open at one end and having an annular seating ring at the other end, said device including an annular chamber surrounding said seating ring and a passage for supplying gas under pressure to said chamber, the combination comprising a pair of diaphragms, resilient washer means near the periphery of the diaphragms for spacing said diaphragms apart to form a closed chamber therebetween, a clamping ring carried by the device and located concentrically outside said first mentioned seating ring, peripheral clamping means for holding said diaphragms with one diaphragm clamped firmly against said clamping ring and seated on said seating ring, said diaphragm engaging the seating ring including a plurality of orifices located directly over the seating ring so as to be closed when the diaphragm is seated against the ring.

3. In a pneumatic sound producing device having a horn forming a sound resonant column, being open at one end and having an annular seating ring at the other end, said device including an annular chamber surrounding said seating ring and a passage for supplying gas under pressure to said chamber, the combination comprising a pair of diaphragms, resilient washer means near the periphery of the diaphragms for spacing said diaphragms apart to form a closed chamber therebetween, a clamping ring carried by the device and located concentrically outside said first mentioned seating ring, said clamping ring having a radial surface width less than said resilient washer to form a slight annular crimp in the diaphragm resting against said clamping ring, and peripheral clamping means for holding said diaphragms with one diaphragm clamped firmly against said clamping ring and seated on said seating ring, said seating ring being relatively soft resilient material.

4. In a pneumatic sound producing device having a horn forming a sound resonant column, being open at one end and having an annular seating ring at the other end, said device including an annular chamber surrounding said seating ring and a passage for supplying gas under pressure to said chamber, the combination comprising a pair of diaphragms, resilient washer means near the periphery of the diaphragms for spacing said diaphragms apart to form a closed chamber therebetween, a clamping ring carried by the device and located concentrically outside said first mentioned seating ring, said clamping ring having a radial surface width less than said resilient washer to form a slight annular crimp in the diaphragm resting against said clamping ring, and a peripheral clamping means for holding said diaphragms with one diaphragm clamped firmly against said clamping ring and seated on said seating ring, said seating ring comprising a groove supporting an O ring thereon.

5. In a pneumatic sound producing device having a horn forming a sound resonant column, being open at one end and having an annular seating ring at the other end, said device including an annular chamber surrounding said seating ring and a passage for supplying gas under pressure to said chamber, the combination comprising a

pair of diaphragms, resilient washer means near the periphery of the diaphragms for spacing said diaphragms apart to form a closed chamber therebetween, a clamping ring carried by the device and located concentrically outside said first mentioned seating ring, said clamping ring having a radial surface width less than said resilient washer to form a slight annular crimp in the diaphragm resting against said clamping ring, and a peripheral clamping means for holding said diaphragms with one diaphragm clamped firmly against said clamping ring and seated on said seating ring, said seating ring comprising a groove supporting an O ring thereon, said seating ring comprising a relatively soft resilient material ring backed up by a metallic seating surface effective upon a given amplitude of vibration of the diaphragm.

6. In a pneumatic sound producing device having a horn forming a sound resonant column, being open at one end and having an annular seating ring at the other end, said device including an annular chamber surrounding said seating ring and a passage for supplying gas under pressure to said chamber, the combination comprising a pair of diaphragms, means for spacing said diaphragms apart in substantially parallel relation forming a closed chamber therebetween, means for clamping said diaphragms near the periphery thereof so as to firmly seat one diaphragm against said seating ring to close the other end of said resonant column and said annular chamber when no gas under pressure is introduced into the annular chamber and nozzle means for increasing the velocity of gas flow after its initial escape from said annular chamber.

7. In a pneumatic sound producing device having a horn forming a sound resonant column, being open at one end and having an annular seating ring at the other end, said device including an annular chamber surrounding said seating ring and a passage for supplying gas under pressure to said chamber, the combination comprising a pair of diaphragms, means for spacing said diaphragms apart in substantially parallel relation forming a closed chamber therebetween, means for clamping said diaphragms near the periphery thereof so as to firmly seat one diaphragm against said seating ring to close the other end of said resonant column and said annular chamber when no gas under pressure is introduced into the annular chamber, and an annular nozzle formed between said one diaphragm and the sound resonant column located radially inside said seating ring and operative to increase the velocity of gas flow following its escape past said seating ring upon flexing of said one diaphragm.

8. In a pneumatic sound producing device having a horn forming a sound resonant column, being open at one end and having an annular seating ring at the other end, said device including an annular chamber surrounding said seating ring and a passage for supplying gas under pressure to said chamber, the combination comprising a pair of diaphragms, resilient washer means near the periphery of the diaphragms for spacing said diaphragms apart to form a closed chamber therebetween, a clamping ring carried by the device and located concentrically outside said first mentioned seating ring, said clamping ring having a radial surface width less than said resilient washer to form a slight annular crimp in the diaphragm resting against said clamping ring, peripheral clamping means for holding said diaphragms with one diaphragm clamped firmly against said clamping ring and seated on said seating ring, said seating ring being relatively soft resilient material, and nozzle means for increasing the velocity of gas flow after its initial escape from said annular chamber.

9. In a pneumatic sound producing device having a horn forming a sound resonant column, being open at one end and having an annular seating ring at the other end, said device including an annular chamber surrounding said seating ring and a passage for supplying gas under pressure to said chamber, the combination comprising a pair of diaphragms, resilient washer means near the periphery of the diaphragms for spacing said diaphragms apart to form a closed chamber therebetween, a clamping ring carried by the device and located concentrically outside said first mentioned seating ring, said clamping ring having a radial surface width less than said resilient washer to form a slight annular crimp in the diaphragm resting against said clamping ring, peripheral clamping means for holding said diaphragms with one diaphragm clamped firmly against said clamping ring and seated on said seating ring, said seating ring being relatively soft resilient material, and an annular nozzle formed between said one diaphragm and the sound resonant column located radially inside said seating ring and operative to increase the velocity of gas flow following its escape past said seating ring upon flexing of said one diaphragm.

10. In a pneumatic sound producing device having a horn forming a sound resonant column, being open at one end and having an annular seating ring at the other end, said device including an annular chamber surrounding said seating ring and a passage for supplying gas under pressure to said chamber, the combination comprising a diaphragm, a clamping ring located near the periphery of said diaphragm, means for clamping said diaphragm into firm engagement with said clamping ring to hold it seated on said seating ring thus closing said annular chamber, said means including a resilient material ring having a radial width greater than that of said clamping ring and being located near the periphery of the diaphragm on the opposite side of the diaphragm from said clamping ring, a plurality of orifices located in said diaphragm directly over said seating ring so that said orifices are closed when the diaphragm is seated against the ring, a solid cover attached to the device over said diaphragm and spaced therefrom on the other side from said seating ring to form an air space for acting on the diaphragm as it is flexed, and an annular nozzle formed between said diaphragm and the sound resonant column located radially inside said seating ring and operative to increase the velocity of gas flow following its escape past said seating ring upon flexing of said diaphragm.

11. In a pneumatic sound producing device having a horn forming a sound resonant column, being open at one end and having an annular seating ring at the other end, said device including an annular chamber surrounding said seating ring and a passage for supplying gas under pressure to said chamber, the combination comprising a diaphragm, a clamping ring located near the periphery of said diaphragm, means for clamping said diaphragm into firm engagement with said clamping ring to hold it seated on said seating ring thus closing said annular chamber, said means including a resilient material ring having a radial width greater than that of said clamping ring and being located near the periphery of the diaphragm on the opposite side of the diaphragm from said clamping ring, a plurality of orifices located in said diaphragm directly over said seating ring so that said orifices are closed when the diaphragm is seated against the ring, an additional orifice centrally located in said diaphragm for maintaining a predetermined ratio of pressures on either side of the diaphragm for handling a wide range of gas pressures in said annular chamber, and a solid cover attached to the device over said diaphragm and spaced therefrom on the other side from said seating ring to form an air space for acting on the diaphragm as it is flexed.

12. In a pneumatic sound producing device having a horn forming a sound resonant column, being open at one end and having an annular seating ring at the other end, said device including an annular chamber surrounding said seating ring and a passage for supplying gas under pressure to said chamber, the combination comprising a diaphragm, a clamping ring located near the periphery of said diaphragm, means for clamping said

diaphragm into firm engagement with said clamping ring to hold it seated on said seating ring thus closing said annular chamber, said means including a resilient material ring having a radial width greater than that of said clamping ring and being located near the periphery of the diaphragm on the opposite side of the diaphragm from said clamping ring, a vented cover attached to the device over said diaphragm and spaced therefrom on the side from said seating ring to form an air space for acting on the diaphragm as it is flexed, and nozzle means for increasing the velocity of gas flow after its initial escape from said annular chamber.

13. In a pneumatic sound producing device having a horn forming a sound resonant column, being open at one end and having an annular seating ring at the other end, said device including an annular chamber surrounding said seating ring and a passage for supplying gas under pressure to said chamber, the combination comprising a diaphragm, a clamping ring located near the periphery of said diaphragm, means for clamping said diaphragm into firm engagement with said clamping ring to hold it seated on said seating ring thus closing said annular chamber, said means including a resilient material ring having a radial width greater than that of said clamping ring and being located near the periphery of the diaphragm on the opposite side of the diaphragm from said clamping ring, an orifice centrally located in said diaphragm for maintaining a predetermined ratio of pressures on either side of the diaphragm for handling a wide range of gas pressures in said annular chamber, and a solid cover attached to the device over said diaphragm and spaced therefrom on the other side from said seating ring to form an air space for acting on the diaphragm as it is flexed.

14. In a pneumatic sound producing device having a horn forming a sound resonant column, being open at one end and having an annular seating ring at the other end, said device including an annular chamber surrounding said seating ring and a passage for supplying gas under pressure to said chamber, the combination comprising a diaphragm, a clamping ring carried by the device and located concentrically outside said first mentioned seating ring means for clamping said diaphragm into firm engagement with said clamping ring to hold it seated on said seating ring, said clamping means including a resilient material ring having a radial width greater than that of said clamping ring and being located near the periphery of the diaphragm on the opposite side of the diaphragm from said clamping ring to form a slight annular crimp in the diaphragm resting against said clamping ring.

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