Nov. 11, 1969 W. G. JENSEN 3,477,405

ADJUSTABLE FREQUENCY HORN

Filed July 19, 1967 2 Sheets-Sheet 1

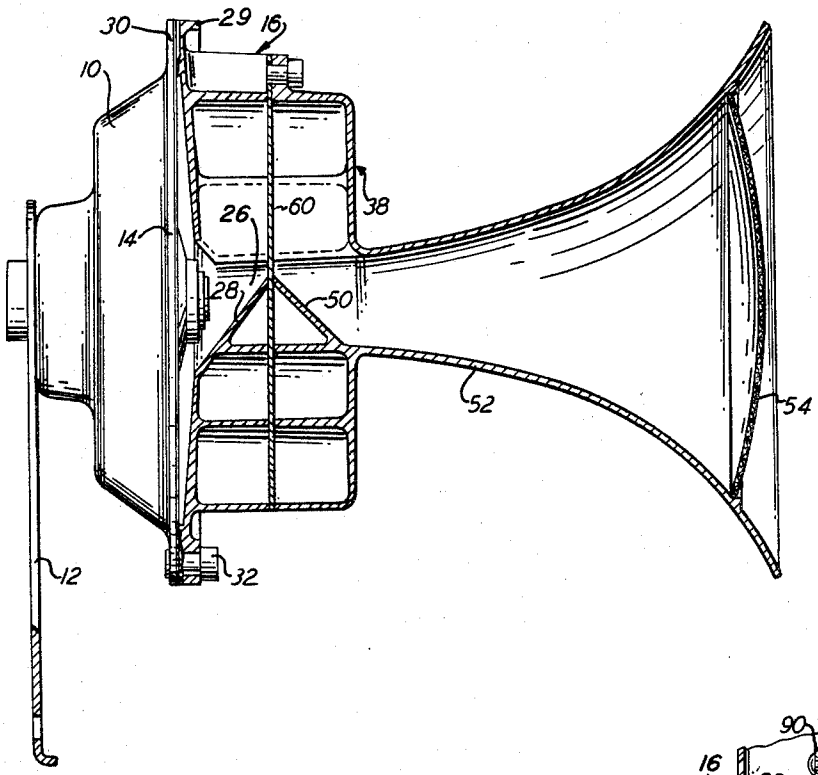


FIG. 1

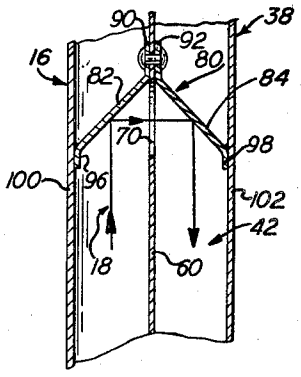


FIG. 3

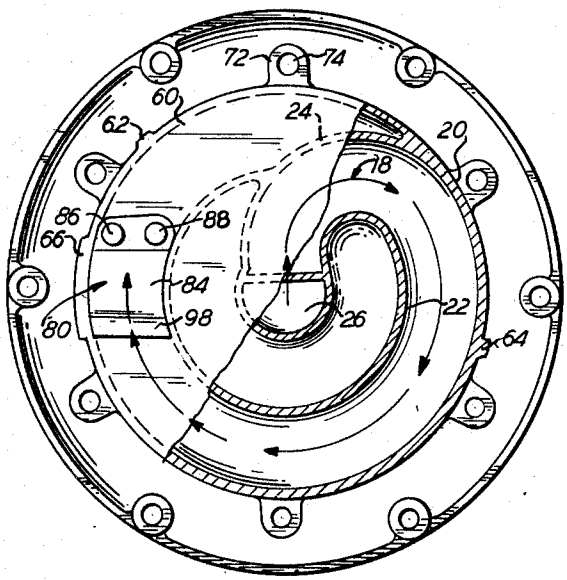


FIG. 2

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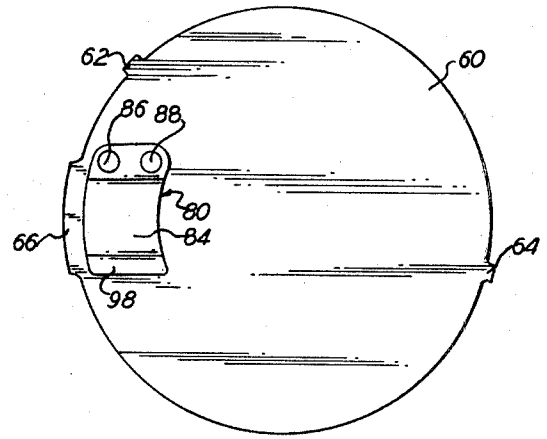


FIG. 4

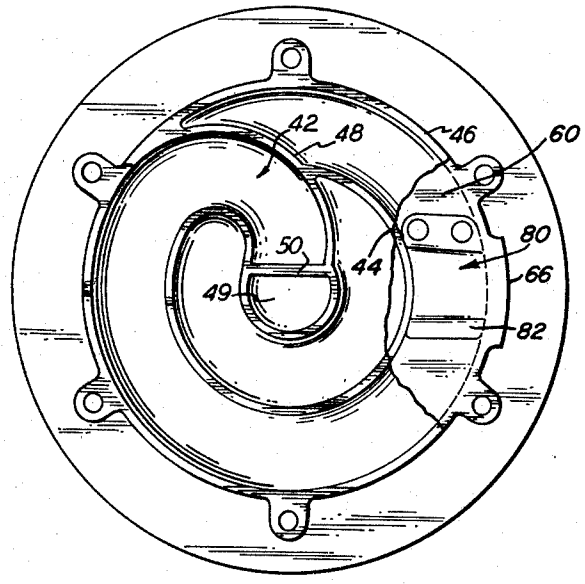


FIG. 5

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ADJUSTABLE FREQUENCY HORN

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ABSTRACT OF THE DISCLOSURE

A horn or sound projector suitable for use in an automotive vehicle in which the frequency of the sound emitted from the horn may be adjusted over wide limits. The horn has two spirally shaped air passages, separated by a sound barrier or guide therebetween having an aperture, and a deflection means within the passages. The position of the aperture and this deflection means may be suitably adjusted to adjust the lengths of the air passages thereby varying or adjusting the frequency of the sound emitted therefrom.

BACKGROUND OF THE INVENTION

This invention pertains to a horn or sound projecting means suitable for use on an automotive vehicle in which the frequency of the sound emitted may be adjusted over wide limits.

In the prior art horns known to the applicant, the frequency of the sound emitted by the horn is a function of the dimensions of the various structural components of the horn and is determined by the relative sizes of these components. For example, to produce sounds of low frequency from a horn, it is necessary to provide a large structure; particularly, with respect to the diameter of the vibratory horn diaphragm and to the length of the air passages that receive the air waves generated by the vibratory horn diaphragm. If higher frequency sounds are desired, it is necessary in prior art devices to reduce the dimensions of the structural components of the horn including the vibratory horn diaphragm that generates the sound waves emitted by the horn and the length of the air passages that receive the sound waves generated by the horn.

The present invention provides a variable frequency horn or sound projector in which the dimensions of the structural components may remain constant. Means are provided in the horn for varying the length of the air passages in the horn to correlate this length with the resonant frequency of a vibratory horn diaphragm or sound generating means. Therefore, it is possible with the present invention to provide a single sized horn structure which is capable of being adjusted to provide varying frequencies of the sound emitted by the horn or sound projector.

SUMMARY OF THE INVENTION

The present invention provides a horn or sound projector capable of use on an automotive vehicle in which the sound emitted may be varied over wide frequencies without changing the dimensions of the structural components of the horn or sound projector. This is accomplished by the use of two generally spirally shaped air passages which are complementary in shape and have their axes positioned generally parallel to one another. A separating plate positioned in a plane generally parallel to these two axes separates the two air passages. Means are provided to permit communication through the plate between the two air passages with deflection means positioned in the two air passages for deflecting sound from one of the air passages to the other. The plate may be rotated and the deflection means moved along with this rotation so that the deflection means and the aperture are positioned at various locations along the length of the two air passages to thereby vary the length of each of the passages. As a result, the frequency of the sound emitted by the horn may be adjusted over wide limits.

In the preferred form of the invention, the means for generating the air waves which will produce the sound comprises a vibratory horn diaphragm of a standard type which is coupled to one of the spirally shaped air passages. The sound waves travel through this first air passage and strike the deflecting means positioned in it. This causes the sound waves to be deflected through the aperture in the separating plate and into the second spirally formed air passage where the sound is again deflected by the deflection means so that it travels through this second spirally shaped air passage. The sound is thereafter emitted to the atmosphere through a suitable trumpet or other equivalent sound projecting means.

As stated above, the aperture in the adjustable plate means and the deflecting means may be adjustably positioned to adjust the length of the first spirally shaped air passage and the second spirally shaped air passage. These lengths should be adjusted so that the length of each of them is approximately equal to one-eighth of the wave length of the sound wave generated by the sound generating means. As previously mentioned, this sound generating means may be a vibratory horn diaphragm which is vibrated by a vibratory motor at the natural frequency of the horn diaphragm. Thus, horn diaphragms of varying natural frequencies may be employed and the position of the sound deflecting means and the aperture in the plate described above may be adjustably positioned to adjust the length of each of the spirally shaped air passages so that the length of each of them equals one-eighth of the wave length of the sound wave generated by the vibration of the horn diaphragm at its natural frequency.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is a longitudinal, sectional view partially in elevation of the horn or sound projector of the present invention.

FIGURE 2 is an end view, with a portion of the separating plate cut away, of one section of the horn or sound projector means of the present invention.

FIGURE 3 is a projected view projected from FIGURE 1 and showing the sound deflecting means of the present invention.

FIGURE 4 is a plan view of the sound separator or guide of the present invention; and

FIGURE 5 is an end elevational view with a portion of the separating plate cut away of the second section of the horn or sound projecting means of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Referring now to the drawings in which like reference numerals designate like parts throughout the several views thereof, there is shown in FIGURE 1 a longitudinal, sectional view of the present invention partially in elevation and showing a conventional vibratory horn motor **10** that is adapted to be attached to an automotive vehicle by means of a bracket **12**. The vibratory horn motor **10** actuates a diaphragm **14** of the vibratory type in a conventional manner. It can be appreciated that the horn motor **10** and the coupling of it to the diaphragm **14** are of standard construction and that as the horn motor **10** actuates the horn diaphragm **14**, it will vibrate at its natural frequency thereby producing sound waves having a frequency which is equal to the natural frequency of vibration of the horn diaphragm **14**.

The sound projector or horn of the present invention includes a first section **16** having a generally spirally shaped air passage **18** formed by spaced walls **20** and **22** preferably of cylindrical configuration and by an intermediate connecting wall **24**. As can best be seen by reference to FIGURE 1, the sound waves generated by the vibration of the horn diaphragm **14** are projected into this generally spirally shaped air passage **18** by means of a chamber **26** that has a deflecting plate or wall **28** formed at an acute angle, preferably 45°, with respect to the plane of the diaphragm **14** and to the axis of the generally spirally shaped sound passage **18**.

The first section **16** of the horn or sound projector has an annular flange **29** that is coupled to an annular flange **30** of the horn motor **10** by a plurality of rivets or suitable fastening devices **32** spaced circumferentially about the annular flange **29** on the first section **16** and the annularly extending flange **30** on the horn motor **10**. These rivets **32** not only connect the first section **16** of the horn or sound projector and the horn motor **10**, but also serve as a means for positioning and holding the horn diaphragm **14** in a proper position with respect to the horn motor **10** and the first section **16** of the horn or sound projector.

Thus, as sound waves are generated by the vibration of the horn diaphragm **14** at its natural frequency, the sound waves are projected into the chamber **26** positioned in the first section **16** and they reflect off the angularly inclined wall **28** which, as stated above, is preferably positioned at a 45° angle with respect to the horn diaphragm **14** and into the generally spirally shaped air passage **18** positioned in the first section **16** of the horn or sound projector of the present invention.

A second section **38** of the horn diaphragm has a generally spirally shaped air passage **42** that is complementary in form to the generally spirally shaped air passage **18** formed in the first section **16**. This generally spirally shaped air passage **42** is formed by means of generally cylindrical walls **44** and **46** that are joined by another or third wall **48**. Similarly, this second section has a chamber **49** including an angularly inclined deflecting wall **50** positioned at an acute angle, preferably 45°, with respect to the axis of the generally spirally shaped air passage **42**. As the sound waves travel through the generally spirally shaped air passage **42**, they are deflected against the wall **50** and are directed into a trumpet **52** so that the sound waves may be projected therefrom. This trumpet may have a screen **54** positioned over its opening to permit the passage of the air molecules outwardly through the trumpet **52**. This screen **54** not only permits the passage of the air molecules through it but it also blocks the passage of water molecules and dirt that may enter the horn from the atmosphere.

The generally spirally shaped air passage **18** formed in the first section **16** and the generally spirally shaped air passage **42** formed in the second section **38** of the horn are separated by means of a generally annular shaped flat plate **60**. This generally annular shaped flat plate **60** has a pair of radially outwardly extending tabs **62** and **64**, as well as, a radially outwardly extending tab **66** that is of relatively greater circumferential extent than the two tabs **62** and **64**. An aperture **70** in plate **60** is positioned radially inwardly from the radially extending tab **66** and is of generally rectangular configuration. This aperture, as can best be seen with reference to the dotted lines shown in FIGURE 2, extends in radial dimension across the generally spirally shaped air passage **18**, as well as, across the generally spirally shaped air passage **42** positioned in the second section **38** of the horn. It, therefore, connects or couples the air passage **18** positioned in the first section **16** of the horn or sound projector of the present invention and the air passage **42** formed in the second section **38** of the horn or sound projector of the present invention.

The generally annular flat plate **60** is positioned properly between the two sections **16** and **38** of the horn or sound projector of the present invention by means of locating washers **72** positioned around the fastening means which may be in the form of integrally formed rivets or screws **74** that connect the first section **16** and the second section **38** of the horn or sound projector of the present invention.

A deflector **80** having a first leg **82** and a second leg **84** is positioned to deflect the sound waves present in the generally spirally shaped air passage **18** into the generally spirally shaped air passage **42** formed in the second section **38**. To accomplish this, the first leg **82** of the sound deflecting means **80** is positioned at an acute angle, preferably 45°, with respect to the axis of the first generally spirally shaped air passage **18** formed in the first section **16** of the horn or sound projector of the present invention and the second leg **84** is positioned at an acute angle, preferably 45°, with respect to the axis of the generally spirally shaped passage **42** formed in the second section **38** of the horn or sound projector of the present invention. As shown in the drawings, particularly with reference to FIGURES 2, 3 and 4, the sound deflecting means **80** comprising the two legs **82** and **84** may be affixed to the generally annular flat separating plate **60** that separates the spirally formed air passages **18** and **42** positioned in the first section **16** and the second section **38**, respectively, by means of a pair of radially spaced rivets **86** and **88** that pass through and affix parallel extending tabs **90** and **92** positioned on the legs **82** and **84**, respectively, to the generally annular shaped flat plate **60**.

The legs **82** and **84** of the deflecting means **80** may have generally parallel extending extremities **96** and **98**, respectively, which are positioned in engagement with parallel extending walls **100** and **102** formed on the first horn section **16** and the second horn section **38**, respectively, to provide an extended sealing means for the air that is forced through the generally spirally shaped air passages **18** and **42**, respectively, positioned in the two sections.

It can be readily appreciated that the generally annular flat plate **60** may be rotated within given limits with respect to the first section **16** and the second section **38** of the horn or sound projector means of the present invention so that the deflecting legs **82** and **84** together with the aperture **70** positioned in the flat separating plate **60** may be located at various positions with respect to the generally spirally shaped air passages **18** and **42** positioned in the first section **16** and the second section **38**, respectively. This will shorten or lengthen the effective length of the air passage **18** and **42**, respectively; and as a result, the frequency of the sound emitted by the horn or sound projector of the present invention may be altered or varied in accordance with this position. It can readily be appreciated that the horn diaphragm **14** should be selected to have a natural frequency of vibration which will emit sound waves having a wave length equal to one-eighth of the length of the generally spirally shaped air passages **18** and **42**, respectively, positioned within the first section **16** and the second section **38** of the horn or sound projector of the present invention.

It can be readily appreciated that the deflecting means **80** need not be coupled directly to the flat annular plate **60**, but that it may be a separate V-shaped component that will pass through the aperture **80**. In this case, guide means in the form of flat shelves or protrusions may be positioned along the length of the generally spirally formed air passages **18** and **42** to receive this generally V-shaped deflection means at various locations along the length of the generally spirally shaped air passages **18** and **42**.

As a result of the structure described above, a variable frequency horn or sound projector is provided that will permit the varying of the frequency of sound emitted without a change in the dimensions of the horn structure. All that needs to be done is to position the aperture in the

annular separating plate and the sound deflecting means at a position where the desired frequency will be obtained and to provide a horn diaphragm having a matching natural frequency of vibration which will emit a sound wave having a wave length equal to four times the combined length of the generally spirally shaped air passages positioned in the first horn section and the second horn section.

The adjustable frequency horn of this invention will have many apparent modifications to those skilled in the art.

What is claimed is:

1. In a horn, means for generating sound waves, a first section having a generally spirally shaped wall means forming a first generally spirally shaped air passage coupled to said means for generating sound waves, a second section having a generally spirally shaped wall means forming a second generally spirally shaped air passage complementary to and positioned adjacent said first generally spirally shaped air passage, means coupled to said first and said second sections for separating said first and said second generally spirally shaped air passages, and adjustable means coupled to said first and said second sections and said generally spirally shaped air passages for adjusting the length of said first and said second generally spirally shaped air passages and for deflecting sound waves from said first generally spirally shaped air passages into said second generally spirally shaped air passage whereby the frequency of the sound emitted from said horn may be adjusted.

2. The combination of claim **1** in which the axes of said first and said second generally spirally shaped air passages are positioned generally parallel to one another.

3. The combination of claim **2** in which said means for separating said first and said second generally spirally shaped air passages comprises a generally flat plate positioned substantially parallel to the axes of said first and said second generally spirally shaped air passages.

4. The combination of claim **3** in which said generally flat plate has an aperture positioned therein and said means for deflecting sound waves from said first generally spirally shaped air passage into said second generally spirally shaped air passage is positioned adjacent said aperture and deflects sound waves from said first generally spirally shaped air passage into said second generally spirally shaped air passage through said aperture.

5. The combination of claim **4** in which said plate may be rotated with respect to said sections and said generally spirally shaped air passages to position said aperture at various positions in said air passages and means are provided for positioning said means for deflecting sound waves at various positions adjacent said aperture when said plate is rotated to position said aperture at said various positions with respect to said first and said second generally spirally shaped air passages.

6. The combination of claim **5** in which said means for deflecting sound between said first generally spirally shaped air passage and said second generally spirally shaped air passage compries a generally V-shaped element having a first leg positioned in said first generally spirally shaped air passage and a second leg positioned in said second generally spirally shaped air passage.

7. The combination of claim **6** in which the angle defined between said first leg and said second leg of said generally V-shaped element is approximately 90° and the juncture of said first and said second legs is positioned substantially in the plane of said generally flat plate that separates said first and said second generally spirally shaped air passages.

8. In a horn adapted for use on an automotive vehicle the combination comprising a vibratory horn diaphragm, motor means coupled to said horn diaphragm for vibrating said horn diaphragm, a first section having spirally shaped wall means forming a first generally spirally shaped air passage having an axis positioned generally parallel to said horn diaphragm, a second complementary formed section having spirally shaped wall means forming a generally spirally shaped air passage having an axis positioned generally parallel to said horn diaphragm, a flat plate positioned between said first section and said second section and between said first generally spirally shaped air passage and said second generally spirally shaped air passage, said flat plate having an aperture positioned therein, deflection means positioned adjacent said aperture for deflecting sound waves from said first generally spirally shaped air passage into said second generally spirally shaped air passage through said aperture, said deflection means comprising a generally V-shaped element positioned adjacent said aperture in said plate and having a first leg positioned in said first generally spirally shaped air passage and a second leg positioned in said second generally spirally shaped air passage with the junction of said first and said second legs positioned in the plane of said flat plate, said generally flat plate including means for rotating said generally flat plate to adjust the position of said aperture with respect to said first and said second generally spirally shaped air passages, and means for adjusting the position of said V-shaped element commensurate with the position of said aperture whereby the frequency of the sound waves emitted by said horn may be varied by varying the length of said first and said second generally spirally shaped air passages.

9. The combination of claim **8** in which the angle between said first leg and said second leg of said generally V-shaped element is approximately 90°.

10. The combination of claim **9** in which the length of the first generally spirally shaped air passage and the length of said second generally spirally shaped air passage each are adjusted by the movement of said plate and said V-shaped element to approximately one-eighth of the wave length of the sound waves produced by the vibration of said vibratory horn diaphragm at its resonant frequency.

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