Jan. 8, 1963 R. Y. CHAPMAN 3,072,212

ACOUSTIC RESONANT CABINET

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Fig. 1.

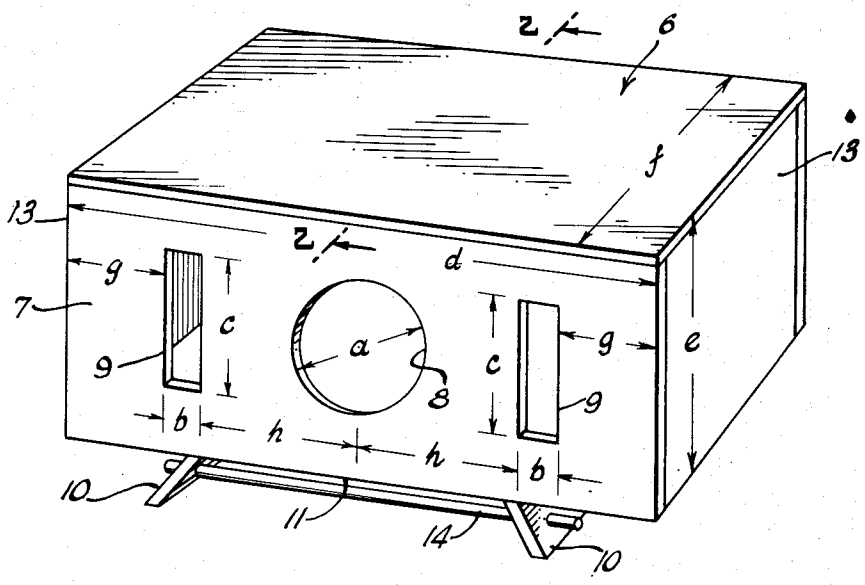
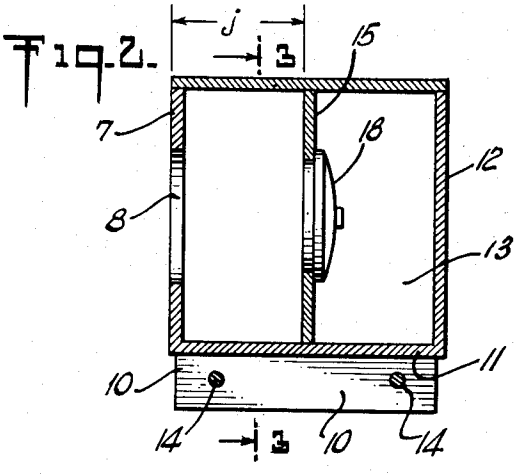


Fig. 2.



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FIG. 3

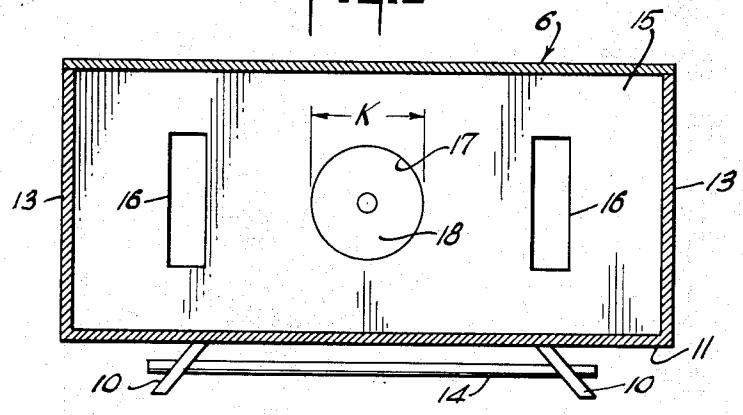
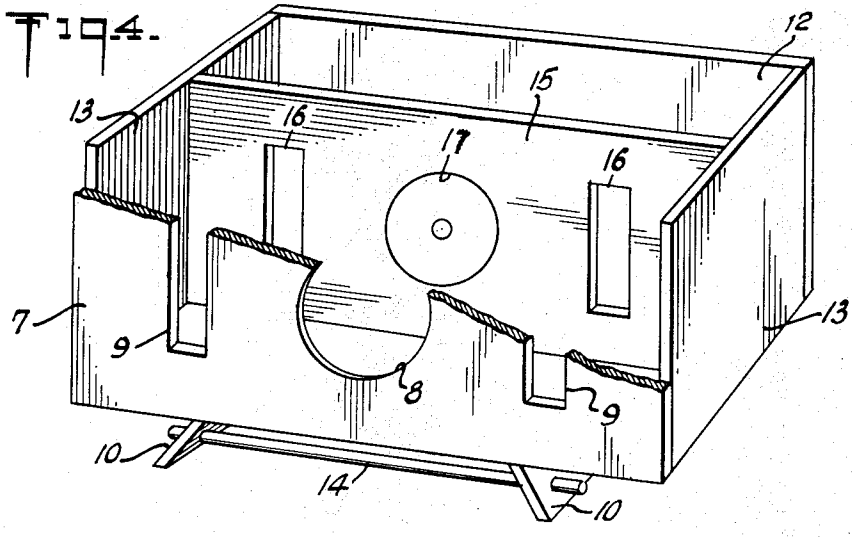


FIG. 4



CHART

TYPICAL DIMENSIONS FOR 60c RESONANT CABINET USING A 12" LOUDSPEAKER + 1/2" PLYWOOD

DIMENSION	INCHES
a	13 1/2
b	3 3/4
c	13 1/2
d	48
e	24
f	24
g	6 3/4
h	6 3/4
j	13 1/2
K	11

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ACOUSTIC RESONANT CABINET

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The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

This invention relates to sound reproducing apparatus and more particularly to acoustical enclosures or cabinets for loudspeakers whereby increased fidelity may be obtained.

With increased use and wide application of sonar and the production of high fidelity recording means, it is now possible to evaluate and analyze sound signals detected by sonar equipment. In addition, it is necessary to reproduce for listening purposes these signals and to present them to personnel both for evaluation, analysis and training identification. The limitation for true reproduction in the past has been chiefly due to the detection systems. However, with more recent developments in the art, the present primary limitation exists in the reproduction transducer which in the majority of situations is a loudspeaker system. As is inherent in sonar system, a portion of the frequency spectrum, particularly in the 50–60 cycle band, contains undesired and detrimental components which should or must be eliminated or lat least reduced in magnitude.

Various methods have been suggested and techniques employed in order to reduce this unwanted 60 cycle hum or noise. These have been chiefly directed toward modification of the detecting system and the amplifier stages, that is, in relation to the electronic circuitry. The success encountered by these techniques has been limited and in some cases has even resulted in the amplification of undesired frequencies and components. Further, the required modification or filtering where necessary, was limited to the particular equipment employed and substitution of separate units among systems was impossible since in each case the inherent characteristics of the system must be considered.

An object of this invention is to provide an acoustic cabinet for the attenuation of selected undesired frequencies.

Another object is to provide a simple, practical, efficient and inexpensive resonant chamber for the faithful reproduction of sound.

A still further object is to provide a loudspeaker enclosure for the faithful reproduction of underwater recordings.

Still another object is to provide an acoustic chamber which will attenuate 60 cycle signals.

A further object of this invention is to provide a resonant acoustic chamber which will minimize the transmission of acoustic energy from the chamber to a support member or floor.

Other objects and advantages will be apparent from the following description of an embodiment of the invention, and the novel features thereof will be particularly pointed out hereinafter in connection with the appended claims.

In the accompanying drawings:

FIG. 1 is a front perspective view of an embodiment made in accordance with this invention;

FIG. 2 is a cross-section view of the embodiment of FIG. 1 taken approximately along line 2—2 of FIG. 1;

FIG. 3 is a cross-sectional view taken approximately along line 3—3 of FIG. 2; and

FIG. 4 is a perspective view of the embodiment of the invention with the top thereof removed and a portion of the front broken away to reveal the inner construction.

In the embodiment of the invention illustrated in FIG. 1, a closed hollow cabinet **6**, in the general form of a parallelepiped, has a front wall **7** having a number of openings therethrough from face to face. The central circular opening **8** or aperture is disposed centrally of the marginal edges of the front wall, that is, the intersection of diagonals drawn from the corners of the front wall **7** would determine the physical center of circular aperture **8**. Disposed on opposite lateral sides of aperture **8** and midway from the side edges of the front wall are a pair of vertically elongated apertures **9** approximately rectangular in shape. The vertical height of each of the elongated apertures **9** is approximately equal to the diameter of the circular aperture **8** and aligned laterally therewith. The cabinet is supported by a pair of longitudinally extending legs **10** which are rigidly affixed to the bottom wall **11**. The upper edge of the leg affixed to the wall **11** and the opposite edge are chamfered at approximately 45 degrees so that the legs which extend from the front wall **11** toward the back wall **12** parallel to the side walls **13** diverge outwardly from one another while remaining in an approximate parallel relationship. In order to prevent separation of the legs beyond their selected spaced relation, dowels **14** or any other structural members connected between, and to, both legs are provided. The dowels have been shown in FIGS. 2 and 3 and are illustrative of a typical structural member. The dowels can be made to pass through or enter into mating holes in the legs and firmly secured therein.

A partition **15** is provided wtihin the cabinet and divides the interior of the cabinet into two approximately equal chambers. The partition extends to and its edges tightly abut the inner surface walls of the cabinet. The relative position of the partition is shown in FIGS. 2 and 4, while its physical configuration is illustrated in FIG. 3. The partition is provided with three apertures similar in shape to those of the front wall **7** and aligned with them. The elongated apertures **16** are of the same dimensions as those of the front wall while the circular aperture **17** is somewhat smaller than aperture **8**. A cone or similar type loudspeaker **18** is mounted and supported on the rear surface of the partition with its mouth aligned with the aperture **17** and entirely closing the aperture. The support means are usually provided with the loudspeaker and generally consist of a mounting ring, bolts and screws. The mouth of the loudspeaker is directed toward the front wall while the apex of the loudspeaker cone is directed toward the back wall **12** of the cabinet. The speaker cone is in registration with the center of aperture **17**, and the mouth opening of the loudspeaker is somewhat larger than the aperture **17** but smaller than the front circular aperture **18**. The cabinet has now been described in sufficient detail for anyone skilled in the art to construct it knowing the required dimensions.

In operation the vibrations emanating from the cone or similar element of the loudspeaker create sound waves which travel both forward (toward front wall **7**) and rearward of the speaker. Those waves travelling in a forward direction pass through both circular apertures and out of the cabinet. The front circular aperture **8** is somewhat larger than the partition aperture **17** since the waves generated by the speaker tend to diverge after passing through the partition aperture. This is particularly true at the higher frequencies. The rear waves travel into the rear chamber or resonator cavity where the air contained therein acts as a compliant member in response to the changes of air pressure generated therein by the loudspeaker. The elongated apertures **16** of the partition act as pressure release members or emis-

sion ports through which a portion of the rear waves passes into the front chamber. The front apertures 9 act in a somewhat similar manner and tend further to coact with the rear ports in affecting the transmission of the low frequency waves. The overall effectiveness of the cabinet depends on its internal dimensions and it is designed to attenuate the 60 cycle band while permitting a faithful response to most other frequencies although the attenuation range may be extended or changed by corresponding dimensional alterations. In one respect the design contemplates the use of a bass reflex type of resonant response with the addition of narrow band cancellation due in part to the phase reversal between the forward and rearward waves over the selected narrow low frequency band and the use of a double system of attenuating acoustical traps, namely, the rear and forward chambers with their apertures or ports.

In order to clearly set forth a typical cabinet as described, the construction of a 60 cycle antiresonant cabinet will be discussed. The term antiresonant implies merely that there occurs over the frequency range, a portion which is attenuated while the remainder is unaffected by any loss and tends to create a linear response. It is generally good and established practice to construct any sound reproducing cabinet of a rigid, dense material which will not tend to transmit sound waves through it and yet be sturdy enough to withstand pressure changes generated within the cabinet. The component parts of the cabinet should be rigidly and firmly joined and fabricated with a high degree of accuracy and precision. Plywood of at least ½ inch thickness has been found satisfactory in most respects although the greater the thickness of the plywood up to a limit, the better the cabinet and less vibration. A chart showing the dimensions used in the construction of a cabinet for 60 cycle attenuation is shown. Plywood of ½ inch thickness was used and has been found satisfactory but it is a simple matter to maintain the internal dimensions of the cabinet if a thicker wood or material is used. It should also be noted that the dimensions illustrated have taken into account that plywood is generally available in 4 x 8 feet sheets and the normal waste associated with this type of construction has been minimized. The interior of the cabinet especially the rear wall and rear chamber should be lined with any well-known acoustic absorber material. This, however, is not absolutely necessary since tests conducted on cabinets constructed in accordance with the above, have performed satisfactorily without the use of acoustic absorbers.

In describing the embodiment of this invention reference has been made to front, rear and side, which in itself was helpful in considering the figures or illustrations, but this however should not be considered as a limitation since the cabinet operates equally well irrespective of its orientation. As for example, the cabinet may be placed on its side with the elongated apertures disposed in a horizontal direction and the legs extending from the lower side. With this positioning the response of the system is as good as that obtained with the orientation of the original description. In addition, the loudspeaker employed should be of good quality and have an acceptable response throughout the spectrum of interest. The desired low frequency characteristics of the loudspeaker affect the overall performance of the system so that the better the speaker in this range, the better the fidelity of the combination. A 12 inch speaker of good quality was used with excellent results since both economy and performance must be considered. A 15 inch or 8 inch speaker will produce frequency responses somewhat different but by proper compensation, they may be used without difficulty especially in view of the fact that a 15 inch coaxial speaker is superior to either an 8 or 12 inch in the low frequency spectrum. The following are typical dimensions (see FIG. 1) for a 60 cycle resonant cabinet using a 12 inch loudspeaker and constructed of ½ inch plywood made in accordance with the principles of this invention.

Dimension:	Inches
a	13½
b	3¾
c	13½
d	48
e	24
f	24
g	6¾
h	6¾
j	13½
k	11

It will be understood that various other changes in the steps, details and materials which have been herein disclosed in order to explain the nature of this invention may be made by those skilled in the art within the principle and scope of the invention as expressed in the appended claims.

I claim:

1. An acoustic resonant cabinet for use with a loud electro-acoustic speaker, which comprises an enclosure of parallelepiped shape having a back wall, a front wall and a partition wall within said enclosure, parallel to said front wall and intermediate of the space between said front and back walls and spaced well from both to provide front and rear acoustic chambers at both sides of said partition wall, said front and partition walls each having approximately midway between its opposite margins an approximately circular aperture, and horizontally at each side of such circular aperture and spaced well from it and from the side margins of such walls, a vertically elongated aperture of approximately the height of the circular aperture, said loud speaker mounted and supported on the rear face of said partition and in alignment with the circular aperture in that partition, with its discharge face towards said circular aperture, the diameter of each circular aperture being approximately equal to the sound emitting face of the loud-speaker.

2. The cabinet according to claim 1, wherein said partion wall is disposed slightly to the rear of the mid distance between said front and rear walls.

3. The cabinet according to claim 1, wherein said circular aperture in said front wall is slightly larger than the circular aperture in said partition wall.

4. The cabinet according to claim 1, wherein the loud speaker is one of the cone type and the spacing between the partition wall to the rear wall is that which will attenuate the sounds of a selected frequency range.

5. The cabinet according to claim 1, wherein said enclosure front wall is approximately twice as long as is its vertical height and the side walls are approximately square.

6. The cabinet according to claim 1, wherein said circular aperture in said partition is slightly less than the loudspeaker cone and the aperture in said front wall is slightly larger than said loudspeaker cone.

7. The cabinet according to claim 1, wherein said vertically elongated apertures are rectangular and have widths approximately ¼ of their vertical dimension.

8. The cabinet according to claim 1, further including leg means affixed to said enclosure for supporting said cabinet.

9. The cabinet according to claim 8, wherein said support means are legs extending from the lower base wall of said cabinet in a direction outwardly of the center of said cabinet.

10. The cabinet according to claim 9, wherein said legs are approximately rectangular, extend in a direction parallel to the side walls of said cabinet and are spaced apart and disposed on opposite sides of the center of said cabinet.

11. An acoustic cabinet for attenuation of frequencies near 60 cycles for use with a loud-speaker which com-

prises an enclosed enclosure of parallelepiped shape having front and back walls, a partition wall parallel to said back and front walls within said enclosure dividing said enclosure into two approximately equal chambers, said partition having approximately centrally thereof a circular aperture and a loud-speaker mounted for support thereon aligned with said aperture for radiation therethrough in a direction toward said front wall with the mouth of said loud-speaker in registration with said circular aperture and closing off said aperture, said circular aperture being slightly smaller than the mouth of said speaker, a pair of vertically extending apertures disposed on opposite sides of and midway between said circular aperture and the vertical edges of said partition, said apertures being of a vertical height slightly larger than the diameter of said mouth and of a width approximately ¼ of said vertical height, said front wall having vertical and circular apertures aligned with said vertical and circular apertures in said partition, said vertical apertures in said front wall being of the same dimensions as said vertical apertures in said partition and said circular aperture in said front wall being slightly larger than said mouth, the vertical height and depth of said cabinet being approximately twice the diameter of said mouth and the length of said cabinet being approximately twice its height.

12. The cabinet according to claim 11, further including a pair of supporting elongated legs disposed on opposite sides of the center of said cabinet each in a direction substantially parallel to and for the entire depth of said cabinet, abutting the lower outer wall of said cabinet and extending in a diverging direction from one another, means attached to said legs for limiting their movement toward or away from one another.

13. The cabinet according to claim 12, further including sound absorbing material lining the inner surfaces of said cabinet.

14. An acoustic device comprising an enclosure of generally parallelepiped form, having a front wall, a back wall, and a partition wall all upright and generally parallel to one another, with the partition wall disposed intermediate between the front and back walls to provide front and rear chambers, said partition wall having an aperture therethrough approximately centrally thereof behind which is said rear chamber, a loud-speaker supported by and mounted on said partition in said rear chamber and in a position to discharge sounds through said aperture toward said front chamber, said partition wall also having smaller apertures disposed horizontally at each said first-mentioned aperture, said front wall having about centrally thereof an aperture of approximately the same size and shape as, and aligned with said central aperture in said partition wall, and also horizontally at side thereof smaller apertures between the central aperture and the upright side edges of the said front wall.

15. The device according to claim 14, wherein said central aperture is approximately the same size as the mouth of said loud-speaker.

16. The device according to claim 15, wherein said smaller apertures are rectangular and vertically elongated.

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