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MID-RANGE SPEAKER AND ENCLOSURE COMBINATION

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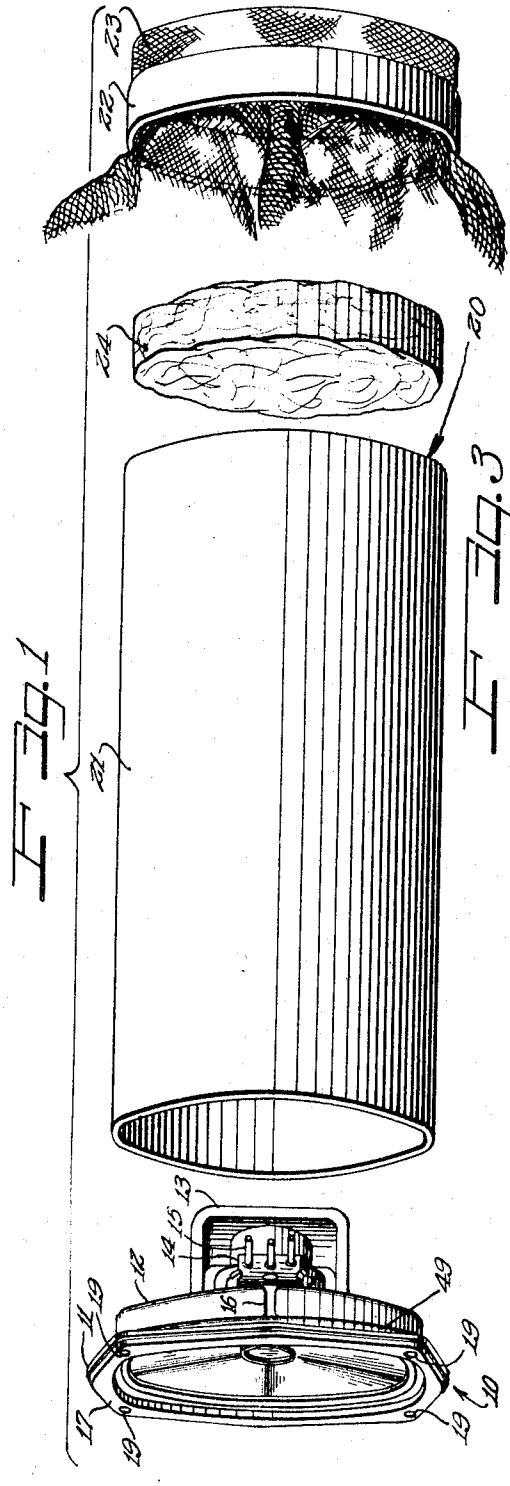


FIG. 1

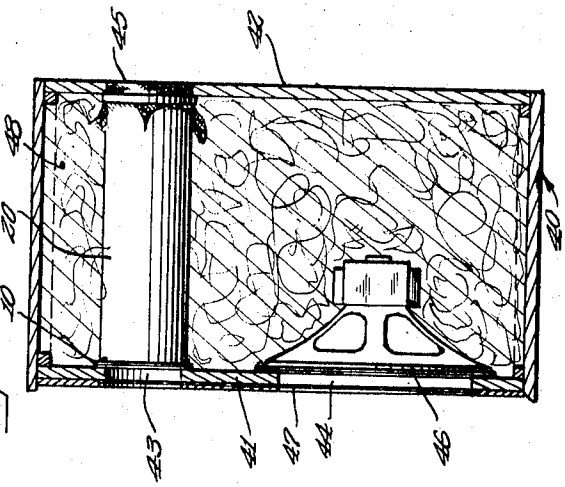


FIG. 3

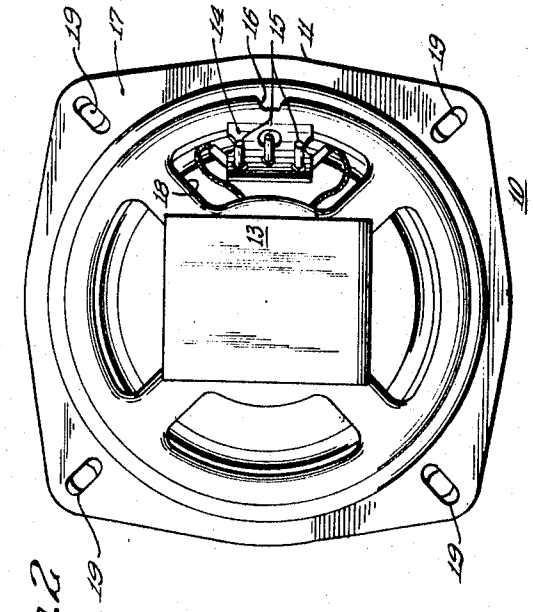


FIG. 2

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MID-RANGE SPEAKER AND ENCLOSURE COMBINATION

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ABSTRACT OF THE DISCLOSURE

A mid-range loudspeaker having a rigid framework which contains a drum portion such that a cylindrical enclosure may be frictionally attached to the speaker by forcing it over the drum portion. The cylindrical enclosure, being fabricated from material impervious to acoustic energy, provides substantial tuning such that the loudpeaker-enclosure combination operates relatively efficiently over a relatively broad range of frequencies, without interference with other speakers operating nearby.

This invention pertains to loudspeakers in general and, in particular, to economical means for acoustically enclosing soft cone mid-range loudspeakers. More particularly, this invention pertains to mid-range loudspeakers having frameworks such that cylindrical enclosures may be frictionally secured to the speakers thereby effecting substantially improved performance and acoustic isolation.

It is well-known that a single speaker cannot provide the high fidelity reproduction so much in demand today. As a result, multi-speaker systems have been developed. Common multi-speaker systems employ large woofer speakers which reproduce relatively low frequency sounds, small tweeter speakers which reproduce relatively high frequency sounds and mid-range horns which reproduce the frequencies between these extremes.

For reasons of economy and space, it is desirable to replace the mid-range compression driver horn with a conventional soft cone mid-range loudspeaker. In addition, the horn requires a relatively large baffle area which necessitates a large amount of grille-cloth. Modern furniture styles are generally inharmonious with large areas of grille-cloth so any reduction in baffle area would be more consistent with fashionable cabinet design. However, unlike the mid-range horn, which is inherently isolated from acoustic energy, the conventional soft cone mid-range loudspeaker must be provided with an external enclosure to prevent interaction with nearby loudspeakers. One method of achieving acoustic isolation is to totally enclose the loudspeaker by extending its framework completely around the rear of the speaker. Though this provides excellent isolation, the confined air inside the enclosure acts as an acoustic stiffener which raises the natural resonant frequency of the loudspeaker, restricting the extent of its low frequency operating range and generally requiring a high resonance woofer or a larger mid-range cone area. The low frequency response of the speaker may be maintained by providing an enclosure extending well beyond the rear of the speaker. Thus, it is possible to properly load the speaker for extended low frequency operation while maintaining relatively high efficiency. However, such enclosures are costly and, in addition, it is difficult to secure the enclosure to the speaker in such a way as to maintain an air-tight seal therebetween. Thus, it is relatively expensive to provide an enclosure for a mid-range loudspeaker which allows good mid-range frequency performance while maintaining acoustic isolation.

The invention provides an economical enclosure, easily

affixed to the frame of the loudspeaker, which is fabricated from material impervious to acoustic energy and which promotes relatively high efficiency and good mid-range performance.

Accordingly, the primary object of this invention is to provide economical means for securing an enclosure to the framework of a loudspeaker such that an air-tight seal is maintained.

Another object of this invention is to provide an enclosure fabricated from material impervious to acoustic energy which can be easily tuned to promote relatively high efficiency and good performance from the speaker.

A further object of this invention is to provide a mid-range speaker with a rearwardly extending drum portion adapted for mating engagement with a tubular enclosure of sound impervious material.

A feature of this invention resides in the provision of a groove in the drum portion of the speaker frame which allows ready passage of electrical wires for connection to the speaker.

Other objects and features of the invention will be apparent upon examination of the following description when read in conjunction with the accompanying drawing.

FIG. 1 is an exploded perspective view of the mid-range loudspeaker and the acoustic enclosure of the invention.

FIG. 2 is a rear view of the mid-range loudspeaker.

FIG. 3 is a cutaway view of the chamber showing the acoustic enclosure secured to the mid-range speaker in a multi-speaker environment.

Referring now to FIG. 1, a soft cone mid-range loudspeaker **10** has a rigid framework **11**, a speaker cone **18**, a permanent magnet and a magnet structure **13**. Frame **11** is formed to include a mounting flange **17** and a cup shaped drum portion **12** extending rearwardly therefrom. A raised rim **49** is formed at the junction of flange **17** and drum portion **12**. Mounting flange **17** includes a set of four mounting holes **19** through which means for securing the loudspeaker to a baffle board **41** may be driven. Rim **49**, and drum portion **12**, are fabricated by forming metal sheets into a die in accordance with well-known industrial techniques. Drum portion **12** is tapered slightly as it extends axially rearward from rim **49** and terminates in a "spoked" support structure, as best seen in FIG. 2. A groove **16** is formed in the outer surface of drum portion **12**. A terminal board **14** is secured to drum portion **12**, near groove **16**, and a pair of terminals **15** is attached thereto. The terminals are electrically connected to the voice coil of the loudspeaker (not shown). Signal currents flowing through the voice coil react, in a well-known manner, with the magnetic field of the speaker thus causing the voice coil to push against speaker cone **18**, creating vibrations resulting in sound reproduction.

An acoustic enclosure **20** having a cylindrical cardboard tube **21**, a cardboard retaining ring **22**, a loosely woven fabric **23** and a plug of acoustically resistive material **24**, is used to both tune speaker **10** and to isolate it from nearby acoustic energy. Plug **24** reduces unwanted reflections within tube **21**. In assembly, plug **24** is placed inside tube **21** near one end, fabric **23** is placed over that end of tube **21** and retaining ring **22** is slipped over the fabric, holding it taut. Connecting wires are attached to terminals **15** of the speaker. The wires are laid in groove **16** of the drum portion, with approximate "slack" being maintained at the terminal board. Tube **21** has an inside diameter intermediate the maximum and minimum diameters of tapered drum portion **12** so that a mating engagement between the enclosure and speaker may be effected. The open end of tube **21** is placed over the rear (small diameter) of drum portion **12** and forced against the increasing diameter of the drum portion until it is sub-

stantially flush against rim **49**, thereby forming an air-tight seal for the rear of the speaker.

Care should be taken to insure the integrity of the wires during this procedure, i.e., they should be maintained in groove **16** and not be sandwiched between the outside of drum portion **12** and inside of tube **21**.

The length of tube **21** is chosen such that it is approximately equal to one-fourth the wave length of the natural resonant frequency of loudspeaker **10**, thereby providing a substantially tuned enclosure. Plug **24** is chosen such that resistance to the acoustic energy passing through enclosure **20** is provided which tends to dampen any resonant peaks. Thus, the loudspeaker is rendered more efficient and free from resonance effects over a broader frequency range.

Referring now to FIG. 2, frame **11** has a set of four spokes **26** providing support for magnet structure **13**. Frame **11** is designed such that the open area behind speaker cone **18** is maximized, allowing free air movement behind the speaker and precluding the raising of the resonant frequency of loudspeaker **10**.

Referring now to FIG. 3, an air-tight chamber **40**, having a baffle board **41** and a back wall **42**, contains a large woofer speaker **46** and the mid-range loudspeaker in combination with the acoustic enclosure of FIG. 1. Baffle board **41** has a pair of apertures **43** and **44**, and back wall **42** has an aperture **45**. Woofer speaker **46** is secured to baffle **41** in alignment with aperture **44**. Apertures **43** and **45** are aligned such that the frontal portion of loudspeaker **10** is flush with aperture **43**, and the rear portion of acoustic enclosure **20** is inserted into aperture **45** forming an airtight seal therewith. Sound absorbent material **48**, lining the inside of chamber **40**, provides dampening for woofer speaker **46**. Fabric **23** allows air to pass through aperture **45** so that free air movement behind loudspeaker **10** may be maintained while also providing a portective closure for the back of enclosure **20**. Cylindrical tube **21**, being fabricated from material impervious to acoustic energy, and being tightly sealed to drum portion **12**, prevents sound emanating from woofer speaker **46** from interferring with the operation of mid-range loudspeaker **10**. Thus, acoustic enclosure **20** allows the mid-range speaker to render relatively high performance notwithstanding the proximity of other speakers, without impairing the efficiency of chamber **40** in functioning as an acoustic enclosure for woofer speaker **46**.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. In combination: a cylindrical enclosure; a loudspeaker having a rigid frame; said frame having a drum portion at the rear of said loudspeaker; said enclosure having an inside diameter approximately equal to the outside diameter of said drum portion; said enclosure being frictionally secured to said loudspeaker by forcing it over said drum portion, thereby forming a substantially air-tight seal.

2. The combination as set forth in claim **1**, wherein said cylindrical enclosure is fabricated of cardboard; and wherein means for making connections to said loudspeaker from outside said enclosure are provided.

3. The combination as set forth in claim **2**, wherein said last mentioned means comprise a groove in said drum portion adapted for passage therethrough of electrical wires for allowing said enclosure and said drum portion to be matingly engaged without endangering the integrity of said wires.

4. The combination as set forth in claim **3** further including closure means for closing one end of said enclosure such that said closure means allow passage of acoustical energy.

5. The combination as set forth in claim **4**, wherein said cylindrical enclosure has a length equal to one-fourth the wavelength of the natural resonant frequency of the loudspeaker; and wherein said closure means includes a plug of resistive material, whereby the resonant peak of said loudspeaker is reduced and nearby frequencies are reinforced.

6. In combination: a cylindrical cardboard enclosure open at both ends; a mid-range loudspeaker comprising a rigid frame, a permanent magnet and a speaker cone, including a voice coil, operatively secured to said frame; said frame having a flange portion and a drum portion at the rear of said loudspeaker; said drum portion being gradually tapered as it extends from said flange portion; said enclosure having an inside diameter equal to the outside diameter of said drum portion at one point along its tapered length; closure means comprising a cardboard retainer ring, a length of fabric and a plug of highly resistive material, closure being effected by inserting said plug in said enclosure flush with one end thereof, placing the fabric across said one end and slipping the retainer ring thereover, thus holding the fabric taut; means making connections to said loudspeaker from outside said enclosure; said enclosure being frictionally secured to said loudspeaker by forcing it over said drum portion, thereby forming an air-tight seal.

7. The combination as set forth in claim **6** wherein said last mentioned means comprise a groove in said drum portion adapted for passage therethrough of electrical wires for allowing said enclosure and said drum portion to be matingly engaged without endangering the integrity of said wires.

8. The combination as set forth in claim **7** wherein said cylindrical cardboard enclosure has a length equal to one-fourth the wavelength of the natural resonant frequency of the loudspeaker for tuning thereof; said plug significantly dampening the resonant peaks of said loudspeaker.

9. The combination as set forth in claim **8** wherein said drum portion includes an open framework support for said permanent magnet, the openings in said support extending substantially from said permanent magnet to the periphery of said drum portion such that the open space behind said cone is maximized.

10. In combination: a chamber comprising a rear wall and a baffle having first and second apertures for allowing acoustical energy to pass outside said chamber; a low frequency loudspeaker mounted to said baffle in alignment with said first aperture; a mid-range loudspeaker having a mounting flange, a drum portion, and a cylindrical cardboard enclosure impervious to acoustical energy; said enclosure having an inside diameter approximately equal to the outside diameter of said drum portion whereby said enclosure is frictionally secured to said mid-range loudspeaker; said rear wall having a third aperture in alignment with said second aperture allowing said enclosure to protrude from said chamber; means for attaching said mid-range loudspeaker to said baffle by said mounting flange in alignment with said second aperture; said chamber providing back loading for said low frequency loudspeaker whereby interaction between low frequencies and mid-range frequencies is precluded.

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