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WATERPROOF RADIO RECEIVER WITH HERMETICALLY SEALED HOUSING CONSTRUCTION FOR A LOUDSPEAKER

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FIG. 1.

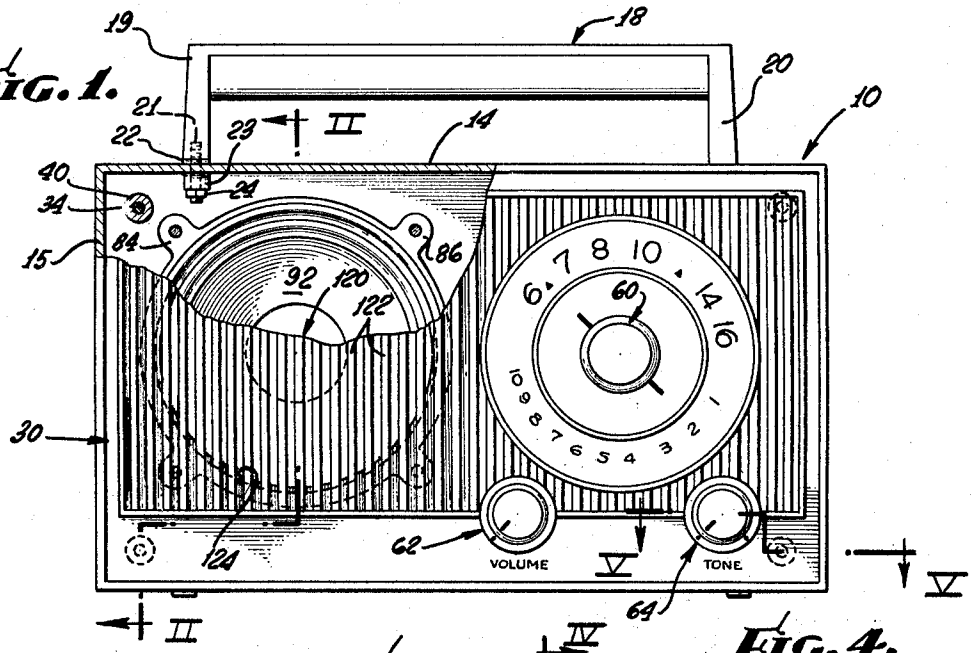


FIG. 2.

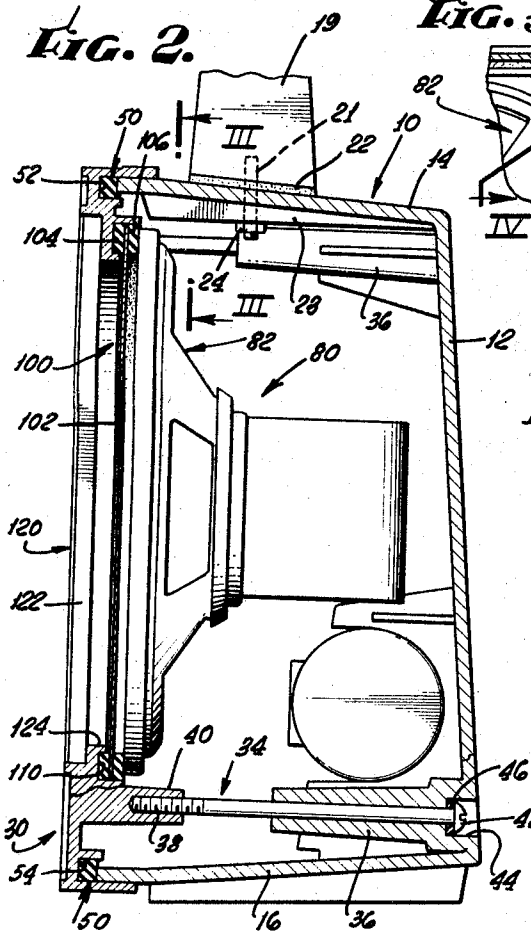


FIG. 3.

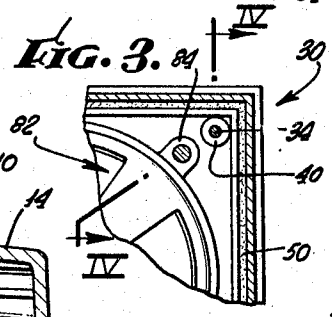


FIG. 4.

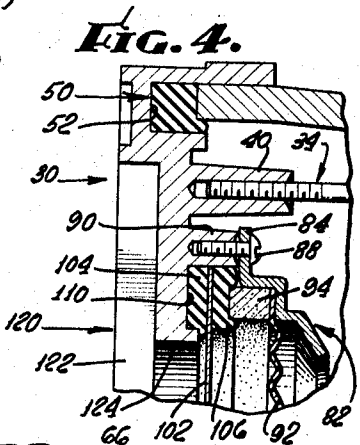
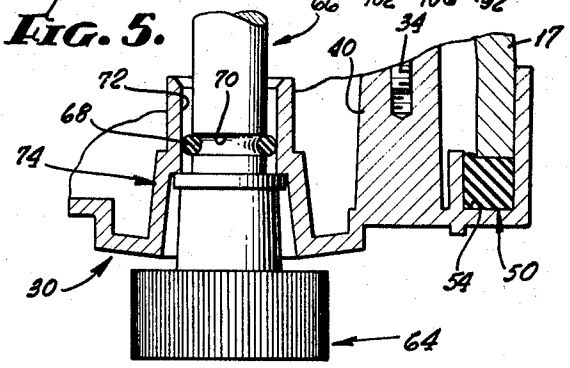


FIG. 5.



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WATERPROOF RADIO RECEIVER WITH HERMETICALLY SEALED HOUSING CONSTRUCTION FOR A LOUDSPEAKER

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ABSTRACT OF THE DISCLOSURE

Waterproof speaker construction including a housing of water impermeable material having an open front, a front cover also of water impermeable material hermetically attachable to the housing and having a speaker opening formed therein and a rearwardly facing groove surrounding the opening, a flexible impermeable membrane extending across the opening having bonded thereto a resilient ring received in the groove, and a speaker within the housing and mountable on the cover, with its acoustic output end adjacent the speaker opening, the speaker including a peripheral mounting flange overlying the portion of the membrane bonded to the resilient ring, the mounting flange being attachable to the cover outwardly of the cover groove by fastening members, whereby movement of the flange into its final mounted relation on the cover serves to abuttingly compress the ring into the groove and thereby to insure that assembly of the speaker flange to the cover does not impose tension on the membrane, and the slackness or tension of the membrane will be as predetermined by the dimensions of the ring and groove, it being desirable that the membrane be under little if any tension.

The present invention relates generally to the construction of a battery-powered radio receiver, and more particularly discloses such a construction hermetically sealing the interior of the cabinet housing the receiver; in its preferred form the internal volume of the cabinet so sealed affords sufficient buoyancy so that the entire receiver will float in water.

In accordance with the preferred form of the invention hereinafter described and illustrated in detail, there is provided a housing or cabinet made of suitable lightweight material such as a plastic and having generally rectangular open front. A facade or front cover is provided for closing the open front of the cabinet, the facade being joined to the cabinet along a waterproof line of juncture by the provision of a generally peripheral gasket therearound. Control knob shafts extend through the facade to the interior of the cabinet in order to operate the adjustable elements of the receiver, and passage of such shafts through the facade is made waterproof by suitable means such as O-rings.

It is particularly important that the speaker opening be properly waterproofed in such a way as to minimize adverse effects on the acoustic output of the speaker. In accordance with the present invention, this is accomplished by providing a thin flexible imperforate membrane of material such as sheeting of rubber or equivalent material such as neoprene, the membrane extending across the speaker opening and being hermetically sealed to the periphery of such opening. The membrane is maintained under little, if any, tension. It is found by this construction that the sound waves generated by the diaphragm of the speaker are transmitted through the membrane to the listener with virtually no deterioration in quality. When the membrane is mounted in accordance with the invention, there is in fact an effective filtering by the membrane of most of the high frequency hissing noises characteristic of battery-powered transistor radio receivers. Attenuation of the lower audio frequencies occurs to only a limited degree, with the result that the total acoustic output reaching the listener is well balanced and pleasing.

Accordingly, it is a peripheral object of this invention to provide and disclose novel improvements in the waterproofing construction of a radio receiver. Other objects and purposes are to provide, in such a construction, flexible membrane means, impervious to water, hermetically mounted across the output end of the loud speaker of the receiver; to provide, in such construction, a radio receiver sufficiently buoyant and water-impermeable to permit the receiver to float in water; and for other and allied objects and purposes as will be clear from the following description of a preferred embodiment of the invention, taken in connection with the accompanying drawing in which:

FIG. 1 is a front elevational view of a radio receiver embodying the present invention, with a portion of the front cover or facade broken away.

FIG. 2 is a vertical sectional view taken along the broken line II—II of FIG. 1.

FIG. 3 is a fragmentary view looking outwardly from within the cabinet showing the upper right portion as so viewed, taken along the arrows III—III of FIG. 2.

FIG. 4 is a sectional view taken along the arrows IV—IV of FIG. 3.

FIG. 5 is a fragmentary sectional view taken along the broken line V—V of FIG. 1.

Referring now in detail to the drawing, there is seen in FIGS. 1 and 2 a radio receiver housing or cabinet indicated generally at **10**, having a rear wall **12** and generally forwardly extending top and bottom walls **14** and **16** and side walls **15** and **17**. A suitable carrying handle is indicated generally at **18**, including a pair of downwardly extending legs **19** and **20** attached to the upper wall **14** of the cabinet by suitable hermetically tight means. Thus in the present embodiment of the invention, leg **19** is provided with a downwardly extending threaded stud **21** projecting through openings in a sealing gasket **22** and in the cabinet upper wall **14** and structural rib **23**, the stud being retained in assembled relation as shown by a nut **24** threaded on the lower end of the stud. The other handle leg **20** is, of course, similarly attached to the cabinet.

The otherwise open front of the cabinet is closed by a front cover member or facade indicated generally at **30** of approximately rectangular shape. Cabinet **10** and facade **30** are retained in hermetically tight assembled relation as seen in FIG. 2 by suitable means, preferably including an elongated threaded screw near each of the four corners of the cabinet extending forwardly from the cabinet rear wall **12** into threaded engagement with the facade. For example, as seen in the lower portion of FIG. 2, an elongated screw indicated generally at **34** extends forwardly from the rear wall **12** of the cabinet, being housed in a tubular boss **36** carried by the cabinet, and the forward end portion of the screw **34** is threadedly received at **38** in an internally threaded boss **40** carried by and preferably formed integrally with the facade. The head **42** of screw **34** is received in a recess **44** formed in the rear wall **12**, and a sealing washer **46** beneath the head **42** insures a hermetically tight connection.

Hermetic sealing between the facade and cabinet is further assured by the provision of a peripheral gasket carried by the facade and extending continuously immediately inwardly of the outer rectangular walls of the facade. Thus, with further reference to FIG. 2, a portion of the continuous sealing gasket is indicated generally at **50** housed in a rearwardly open groove **52** formed in the facade; and in the lower portion of FIG. 2, sealing gasket **50** is housed in a similar groove **54** in the facade. The front edges of the forwardly projecting walls of the

cabinet are maintained in sealing contact with the gasket **50** by the retaining screws **34**, the gasket being made of suitable resilient material such as rubber or equivalent.

Hermetic sealing means are provided in connection with the control shafts of the present radio, there being three of such shafts provided with external knobs in the present embodiment of the invention. Thus, as seen in FIG. 1, there may be a tuning knob indicated generally at **60**, an off-on and volume control knob indicated generally at **62**, and a tone control knob indicated generally at **64**. The hermetic sealing means in connection with each of these may be the same, and such means on the tone control knob and its associated shaft are seen in detail in FIG. 5. Thus, knob **64** is fixed by suitable means to the outer end of a shaft indicated generally at **66** having mounted thereon a sealing O-ring **68** received in a groove **70** formed in the shaft. The outer periphery of the O-ring **68** forms sealing contact with the inner cylindrical surface of bore **72** formed in a boss indicated generally at **74**, carried by and extending rearwardly from the facade **30**.

Hermetic sealing of the speaker opening in the facade will be understood by reference to FIG. 2 and to the fragmentary views FIGS. 3 and 4 based thereon. A conventional speaker indicated generally at **80** includes a generally annular metallic mounting flange indicated generally at **82**, provided with a number, preferably four, angularly spaced attachment ears, two of which are seen at **84** and **86**, extending generally radially outwardly from the major body portion of the flange **82**. A mounting screw **88** (see FIG. 4) extends through an opening formed in each of the ears, and is threadedly connected to a rearwardly extending internally threaded boss **90** carried by the facade, and preferably formed integrally therewith. Flange **82** also carries, immediately inwardly of its outer periphery, the outer marginal portion of the conventional cone diaphragm **92** of the speaker **80**, as well as an annular spacing member or washer **94**, the spacing member and marginal portion of the diaphragm **92** being held in assembled relation as seen in FIG. 4 by suitable means, preferably adhesive, between the several parts.

A membrane assembly indicated generally at **100** (see FIG. 2) includes a membrane proper **102** made of thin sheet rubber or equivalent material such as neoprene, the membrane having its outer annular marginal portion bonded between a pair of annular rings **104** and **106**, made of rubber or similar resilient material, resistant to deterioration or other adverse effects of exposure to water. The outer of the two rings, **104**, is received in a rearwardly open annular groove **110** formed in the facade **30**, thereby positioning the membrane **102** completely across the forwardly directed face of speaker **80**. When the parts are assembled, as seen in FIGS. 2, 3 and 4, the fibre spacing ring **94** carried by the speaker flange **82** is forced into tight engagement with annular member **106** of the membrane assembly, so that annular member **104** of the assembly is similarly under compression within groove **110**, thus providing a hermetically sealed connection around the speaker opening of the facade.

Membrane **102** is desirably maintained under little, if any, tension in its mounting as above discussed. By this arrangement, the acoustic output of the cone diaphragm **92** of speaker **80** is transmitted outwardly through the membrane without serious attenuation of sound energy. Such attenuation as does exist is primarily in the higher audible frequencies, thereby minimizing transmission of the hissing noise frequently observed in portable, battery-powered radio receivers. Very satisfactory results have been achieved through the use of a membrane **102** made of sheet neoprene having a thickness of approximately $\frac{1}{64}$" or less.

It is to be especially noted that the present construction enables the use of a conventional speaker. Some prior attempts have been made to waterproof speakers by impregnating the diaphragm in a water-resistant material such as resin, but this tends to seriously denigrate the acoustic bass properties of the diaphragm because of the stiffening resulting from the impregnation treatment.

The preferred construction of a receiver in accordance with the present invention may incorporate a cabinet and facade having overall dimensions of the order of 9 inches in width, 7 inches in height and 4 inches in depth. With circuit components now generally available, and even including the necessary batteries, a receiver of the indicated dimensions is buoyant in water. Thus the cabinet may be made of a lightweight plastic material and the facade and handle of a lightweight metal such as zinc.

Facade **30** may be provided with an ornamental grille extending across the speaker opening outwardly of the membrane to protect the latter against possible damage and rupture as by contact with items floating in a swimming pool or other water where the receiver is used. Thus a grille indicated generally at **120** and including a number of thin spaced parallel bars **122** may be carried by the facade **30** across the speaker opening **124** thereof and preferably formed integrally with the facade. The grille is spaced forwardly of the membrane **102**, well out of possible contact with the membrane.

Modifications and changes from the illustrative embodiment of the invention hereinbefore illustrated and described are within the contemplation of the invention, and are intended to be embraced within the scope of the appended claims.

I claim:

1. A hermetically sealed housing construction for a loudspeaker comprising:

a housing of water impermeable material having an open front;

a cover member hermetically closing said open front, the cover member having formed therein a speaker opening and a rearwardly directed groove surrounding the opening;

a flexible impermeable membrane extending across the opening having bonded thereto a resilient ring received in the groove;

a speaker mounted on the cover member and extending rearwardly in the housing, and having an acoustic output end adjacent the speaker opening, the speaker including flange means overlying the portion of the membrane bonded to the ring;

and attachment means for mounting the flange means to the cover outwardly of the groove and compressing the ring in the groove.

2. The invention as defined in claim **1** wherein the annular portion of the membrane immediately inwardly of the groove is spaced from the cover.

3. In a waterproof speaker construction including an open front housing, a cover for closing the front and having formed therein a speaker opening and a rearwardly directed groove surrounding the opening, a speaker in the housing having an acoustic output portion adjacent said opening and mounting flange means attachable to the cover outwardly of the groove, the provision of:

a flexible impermeable membrane having bonded thereto a resilient ring received in the groove and maintained under compression therein when the flange is mounted to the cover.

4. The invention as defined in claim **3** wherein the ring is bonded to the front surface of the membrane.

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