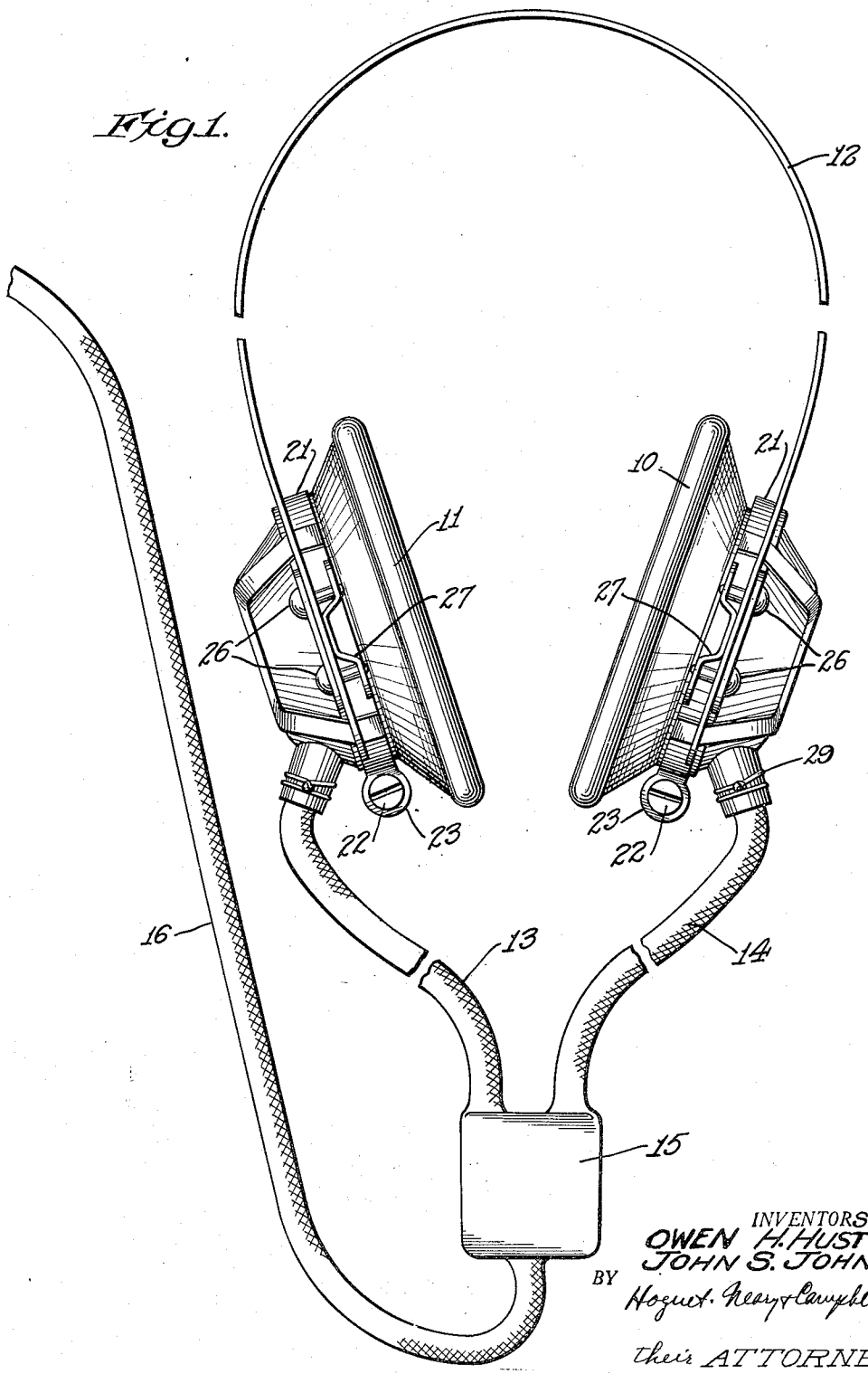
Jan. 16, 1951 O. H. HUSTON ET AL 2,538,419

WATERPROOF HEADSET

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Fig 1.



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Fig. 3.

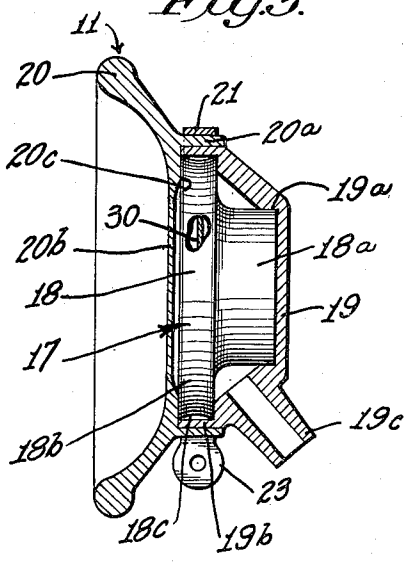


Fig. 2.

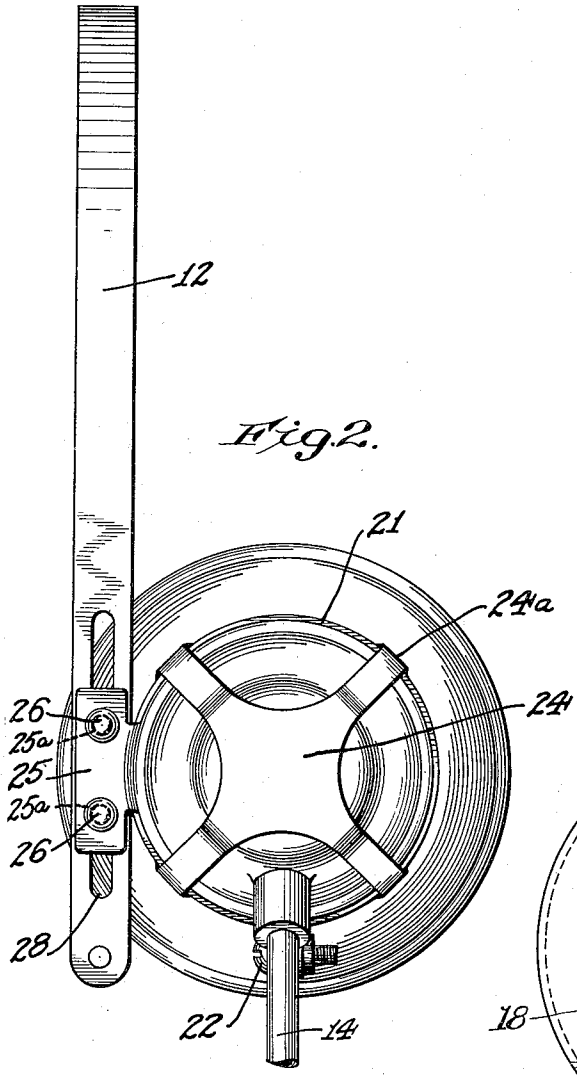
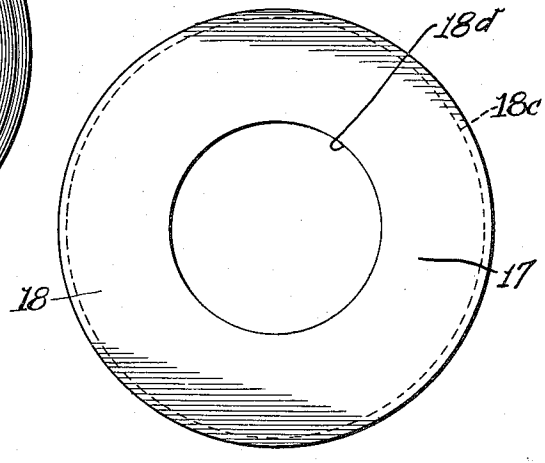


Fig. 4.



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WATERPROOF HEADSET

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4 Claims. (Cl. 179—156)

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This invention relates to headsets for use in telephony, radio, telegraph and signalling devices, and it relates particularly to waterproof headsets.

There are many conditions under which headsets are subjected to varying degrees of dampness and even to complete immersion in water. Therefore, a demand has arisen for headsets which are waterproof and are capable of operating under adverse conditions of humidity, dampness or water immersion. Attempts have been made to waterproof headphones by encasing them in rubber. However, these attempts have not been successful for the reason that the intensity of the signal is decreased by the presence of the rubber cover to such an extent as to render the earphones practically unuseable. One reason for the diminution in the signal is that rubbery materials are poor conductors of sounds and vibrations. Another reason is that when the cover is applied over the front or ear-engaging portion of the earphone, the cover has a tendency to damp the sound even when the earphone was subjected to atmospheric pressure. When the earphone is subjected to superatmospheric pressure as, for example, when the earphone is immersed in water, the rubber cover is pressed tightly against the earphone casing leaving only a very small area free and unsupported and able to vibrate with the air columns in the holes in the ear phone cap.

An object of the present invention is to provide headsets or earphones which are completely waterproof and which transmit signals satisfactorily under conditions of superatmospheric pressure such as, for example, when immersed in water.

Another object of the invention is to provide earphones or headsets that are completely waterproof and operate substantially with equal efficiency under conditions of ordinary or superatmospheric pressure.

Other objects of the invention will become apparent from the following description of typical earphones and headsets embodying the present invention.

In accordance with the present invention, earphones and headsets are provided which are characterized by the presence of a complete waterproof covering for the earphones and the connecting cords or conductors, the earphone cover being so constructed and related to the earphone that the cover acts as a diaphragm in conjunction with the usual metallic diaphragm of the

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earphone to transmit vibrations without substantial loss of efficiency.

More particularly, the earphone itself is modified to the extent of the removal of the center portion of the earphone cap to provide an enlarged opening therein, and the waterproof covering is provided with a thin diaphragm portion that is normally spaced from the earphone cap so that it is responsive to vibration of the diaphragm and acts as a secondary diaphragm for the transmission of sound to the ear. When earphones or headsets embodying the invention are subjected to increased pressure, the diaphragm portion of the waterproof cover is displaced into contact with the earphone casing or cap, but the center portion of the waterproof cover overlying the opening in the earphone cap remains in spaced relationship to the vibratable diaphragm of the earphone and follows its vibrations because of the large air column therebetween. As a result, the covered earphone operates with good efficiency under ordinary pressures and even when under a hydrostatic head as great as 10 feet of water.

For a better understanding of the present invention, reference may be had to the accompanying drawings in which:

Figure 1 is a view in front elevation of a typical headset embodying the present invention;

Figure 2 is a view in side elevation of the headset with a part of the connecting cords broken away;

Figure 3 is a view of a single earphone with the waterproof cover thereon shown in section; and

Figure 4 is a view in front elevation of the earphone shown somewhat enlarged and with the waterproof cover removed.

As illustrated in Figure 1, the headset consists of a pair of earphones 10 and 11 which are connected by means of a headband 12. The two earphone assemblies 10 and 11 are connected by means of waterproof cords 13 and 14 to a junction box 15 which is covered with waterproof sheath and is connected to a signalling device by a waterproof cord 16.

The earphones 10 and 11 are substantially identical and, therefore, only one of the earphones will be described hereinafter.

Referring now to Figure 3, a complete earphone assembly 11 may include an earphone 17 of any conventional type, for example, one including an electromagnetic element and a vibratable diaphragm 30, enclosed in a casing 18. The casing 18 may be formed of hard rubber or other

material and includes a back casing element 18a of generally cylindrical form and an enlarged cylindrical cap or earpiece 18b. Preferably, the periphery of the cap 18b is formed with a concave or curved surface 18c for a purpose to be described. Also, as shown in Figure 4, the cap 18b of the earphone 17 is provided with an enlarged central opening 18d instead of the usual group of small openings. In a typical earphone, the diameter of the central opening 18d may be about one inch. However, the opening 18d may be somewhat smaller or somewhat larger, as desired.

The earphone 17 is completely encased in a cover formed of rubbery material such as, for example, a synthetic rubber known as "neoprene" of about 35 durometer hardness. Neoprene is a polymer of chloroprene having the general formula

$$\left[-CH_2-\underset{Cl}{C}=\underset{H}{C}-CH_2\right]_n$$

Other synthetic or natural rubbers also are entirely satisfactory.

The casing or cover for the earphone 17 preferably is made up of two sections, namely, an outer cover 19 and an earphone cup or front cover 20. The outer cover 19 is of generally cup-shaped form having a recessed portion 19a for receiving the base of the earphone 18a and an external flange portion 19b overlying and engaging the concave periphery 18c of the earphone cap 18b. The outer cover 19 is also provided with a tubular sleeve 19c integral therewith through which the wires or cords of the earphones are passed.

The earphone cup 20 is of generally cup-shaped form adapted to fit over the ear and is provided with a rearwardly extending flange 20a adapted to overlap the flange 19b on the outer cover member.

The earphone cup 20 is also provided with a thin diaphragm portion 20b which is of somewhat greater diameter than the opening 18d in the earphone cap 18b. The diaphragm portion 20b is normally spaced from the earphone cap 18b by means of a circular shoulder 20c formed integrally with the earphone cup 20. The diaphragm 20b is sufficiently flexible to follow the vibrations of the diaphragm in the earphone 17.

In assembling the outer cover 19 and the earphone cup 20, the outer cover 19 is applied to the earphone 17 and the flange 20a of the cup 20 is then telescoped over the flange 19b, the flanges 19b and 20a being cemented together. A metallic band or strap 21 is placed around the flange 20a and is drawn up tightly by means of a bolt 22 (Figures 1 and 2) which passes through ears 23 on opposite ends of the strap 21, thereby compressing the flanges 19b and 20a into the concave periphery 18c of the earphone cap 18. Also, to reinforce the outer cover and provide a support for the earphone, a spider 24 formed of metal is fitted over the outer cover 19 and has its arms 24a welded or otherwise secured to the strap 21.

The strap 21 is provided with a laterally directed flange or plate 25 to which the headband 12 is secured. This flange or plate 25 is provided with a plurality of openings 25a which receive rivets or screws 26 that have their opposite ends anchored in a U-shaped spring plate 27. The end of the headband 12 is disposed between the plate 25 and the spring plate 27 and is provided with a slot 28 for receiving the rivets 26 and permitting sliding adjustment of the earphone assembly 11 along the headband 12.

The cord 14 is provided with a rubber or synthetic rubber cover and is cemented into the sleeve 19c and secured there by means of a wrapping of cord 29 or the like. Thus, the earphone 17 and all of the cords and other connecting elements are completely covered with waterproof material so that prolonged immersion of the headset in water will not short circuit, or prevent operation of, the headphone.

In operation, when the headset is applied to the ears, the vibratable diaphragms within the earphone assemblies 10 and 11 will set up vibrations in the column of air between the diaphragms and the diaphragm portions 20b. Inasmuch as each diaphragm portion 20b vibrates with the diaphragm of its associated earphone, effective sound transmission is obtained.

If the headset is immersed in water, the entire waterproof cover for each earphone 17 is subjected to increased pressure and the diaphragm portion 20b of the cover will be compresed against the earphone cap 18b. Therefore, the diaphragm portion 20b, which is somewhat larger than the opening 18d, will be supported tightly around the periphery of the opening 18d while the center of the diaphragm portion 20b is unsupported and remains in spaced relationship to the diaphragm of the earphone 17. Thus, even when subjected to substantial superatmospheric pressure, the midportion of the diaphragm portion 20b is still free to vibrate and will be vibrated by means of the air column between it and the diaphragm of the earphone 17.

Tests have shown that the earphones embodying the present invention are capable of satisfactory operation without severe loss of efficiency when subjected to hydrostatic heads as great as 10 feet. Therefore, it will be apparent that a truly waterproof headset has been provided which operates efficiently under the most adverse conditions expected to be encountered in its use.

It will be understood that the design and shape of the elements may be modified considerably and that the mechanism for securing the headphone to the headband may be varied widely. Therefore, the form of the invention described herein should be considered as illustrative and not as limiting the scope of the following claims.

We claim:

1. A waterproof headphone comprising an earphone having an earpiece provided with a centrally located opening, a vibratable diaphragm behind said earpiece, electrical means for vibrating said diaphragm and a casing member joined to said earpiece and enclosing said diaphragm and electrical means; a first resilient waterproof cover member overlying said earpiece, said cover member having a thin diaphragm portion overlying said opening and spaced from said earpiece; a second resilient, waterproof cover member overlying said casing member and telescopically engaging an edge of said first cover member in watertight relationship; and a clamping band overlying the telescopically engaged portions of said cover members and having a laterally directed flange thereon for engagement with a headband.

2. A waterproof headphone comprising an earphone having an earpiece provided with a centrally located opening, a vibratable diaphragm behind said earpiece, electrical means for vibrating said diaphragm and a casing member joined to said earpiece and enclosing said diaphragm and electrical means; a first resilient waterproof cover member overlying said earpiece, said cover

member having a thin diaphragm portion overlying said opening and spaced from said earpiece; a second resilient, waterproof cover member overlying said casing member and telescopically engaging an edge of said first cover member in watertight relationship; a tubular, resilient portion projecting from said second cover member; a waterproof phone cord connected to electrical means and extending through said tubular portion in watertight relation thereto; and a clamping band overlying the telescopically engaged portions of said cover members and having a laterally directed flange thereon for engagement with a headband.

3. A waterproof headphone comprising an earphone having an earpiece provided with a centrally located opening, a vibratable diaphragm behind said earpiece, electrical means for vibrating said diaphragm and a casing member joined to said earpiece and enclosing said diaphragm and electrical means; a first resilient waterproof cover member overlying said earpiece, said cover member having a thin diaphragm portion overlying said opening and spaced from said earpiece; a second resilient, waterproof cover member overlying said casing member and telescopically engaging an edge of said first cover member in watertight relationship; and a clamping band overlying the telescopically engaged portions of said cover members and having a laterally directed flange thereon for engagement with a headband, and a spider member having arms secured to said clamping band and extending across the outside of said second cover member.

4. A waterproof headphone comprising an earphone having an earpiece provided with a centrally located opening, a vibratable diaphragm behind said earpiece, electrical means for vibrating said diaphragm and a casing member joined to said earpiece and enclosing said diaphragm and electrical means; a first resilient waterproof cover member overlying said earpiece, said cover member having a thin diaphragm portion overlying said opening and spaced from said earpiece; a second resilient, waterproof cover member overlying said casing member and telescopically engaging an edge of said first cover member in watertight relationship; a tubular, resilient portion projecting from said second cover member; a waterproof phone cord connected to electrical means and extending through said tubular portion in watertight relation thereto; a clamping band overlying the telescopically engaged portions of said cover members and having a laterally directed flange thereon for engagement with a headband; and a spider member having arms secured to said clamping band and extending across the outside of said second cover member.

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