

April 22, 1952

E. A. KINDEL

2,593,892

EARPIECE

Filed April 5, 1950

3 Sheets-Sheet 1

FIG. 1.

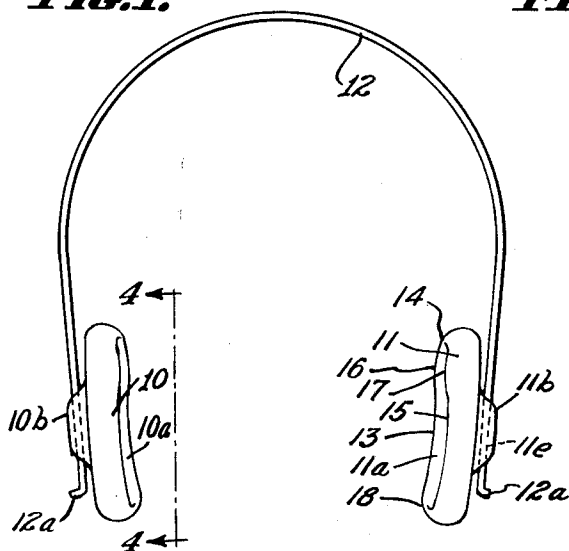


FIG. 2.

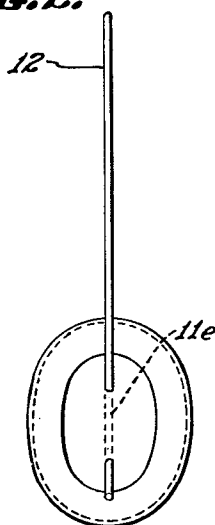


FIG. 3.

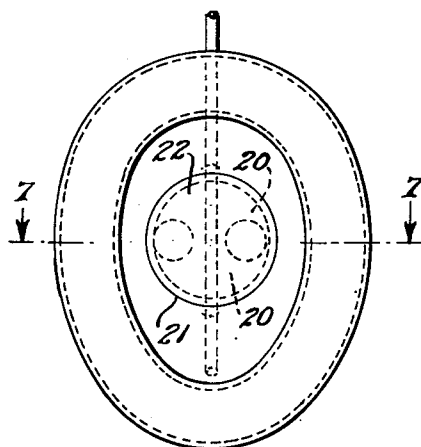
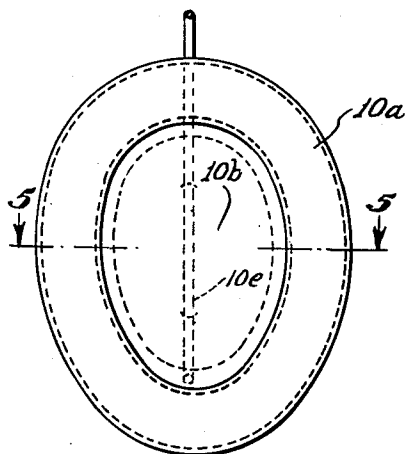
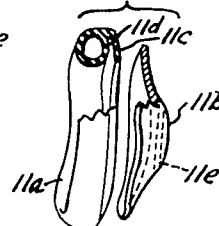


FIG. 5.

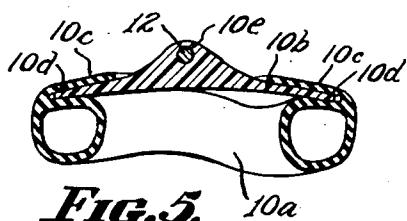


FIG. 6.

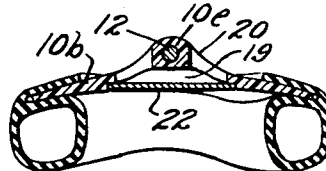


FIG. 7.

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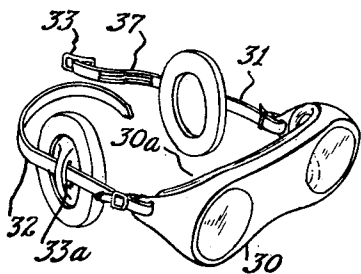


FIG. 8.

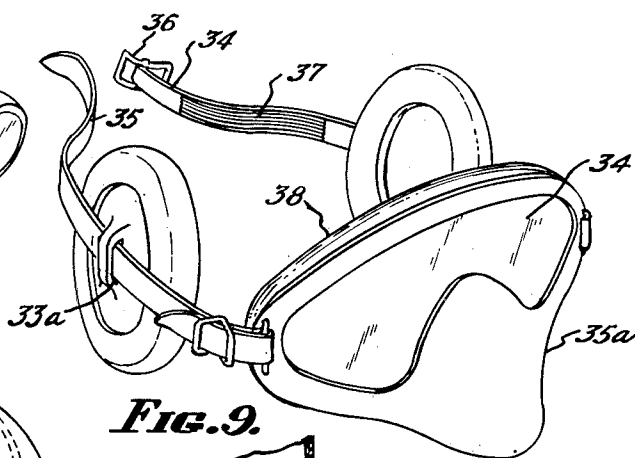


FIG. 9.

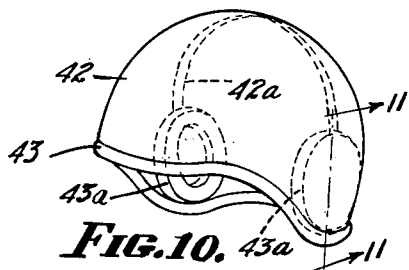


FIG. 10.

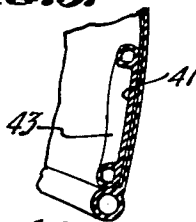


FIG. 11.

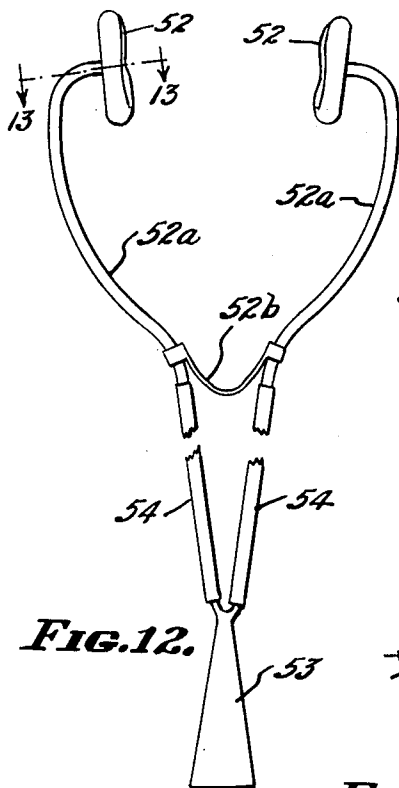


FIG. 12.

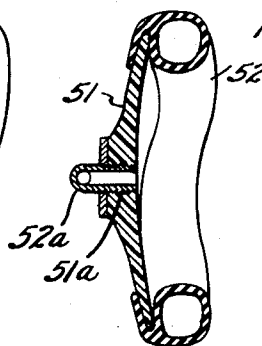


FIG. 13.

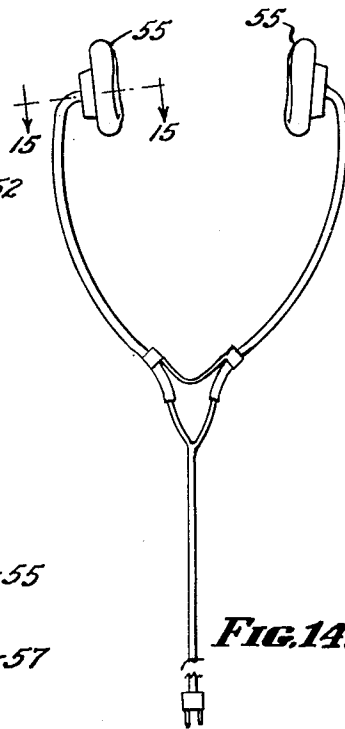


FIG. 14.

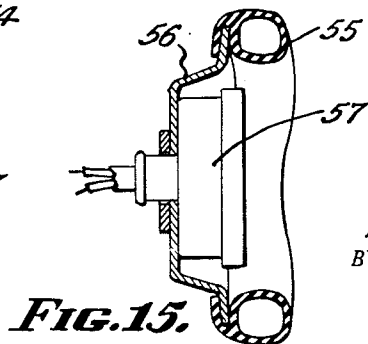


FIG. 15.

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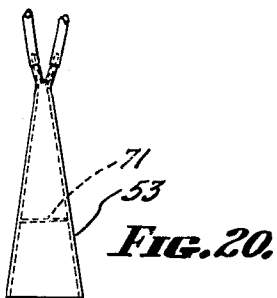
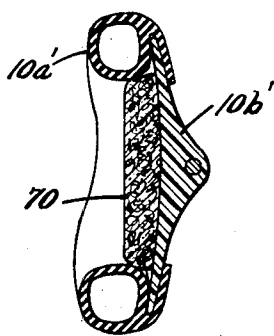
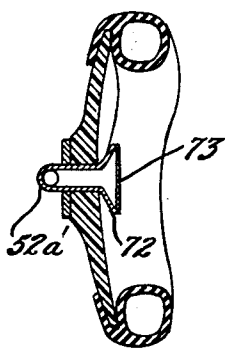
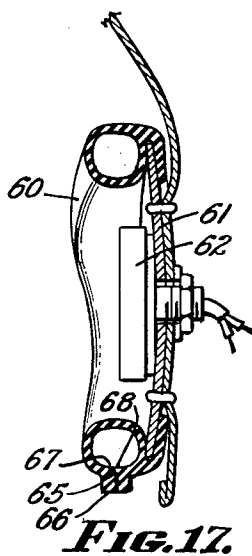
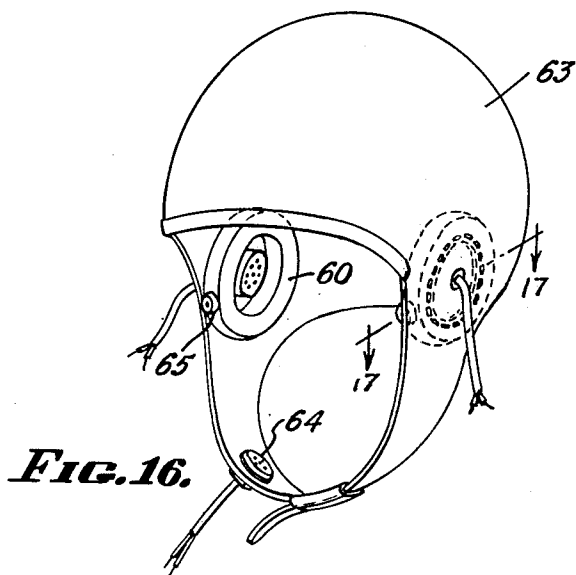
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3 Sheets-Sheet 3



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EARPIECE

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Application April 5, 1950, Serial No. 154,135

7 Claims. (Cl. 2—174)

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This invention relates to an ear piece arranged to seat against the bones of the skull around the human outer ear. As will more fully appear hereinafter, the invention has numerous fields of application, many of which will be described in detail hereinafter. But the fundamental principles of the invention are present in all modifications.

Swimming is an extremely popular pastime, and it is a very healthful pastime in most cases. There are, however, numerous situations where a person should not expose the ear to influx of water. Such situations may be permanent in the case of people who have been subjected to a radical mastoidectomy or who have a perforated ear drum, or the condition may be temporary on account of some minor infection within the ear where access of water would be contraindicated.

There have been available in the past numerous devices designed to prevent access of water to the ear. Such devices, for the most part, have comprised plugs or caps of one form or another, designed to fit in the aural canal or over the ear; but such devices have been objectionable for the reason that they are uncomfortable to the user, and for the further reason that they are not fully effective in preventing access of water. In addition, unless an extremely careful fit is obtained, such ear plugs are liable to dislodgement during violent exercise in the water and they, therefore, do not accomplish their purpose satisfactorily.

It may also be noted that those who have had a radical mastoidectomy can usually not wear ear plugs because they will not stay in position and physicians have generally advised such people, either not to indulge in swimming at all, or, if they do, to be extremely careful not to permit water to enter the ear.

In one aspect, therefore, it is an object of my invention to provide a device which can be worn by anyone whether or not such person has had a radical mastoidectomy or a perforated ear drum, which will effectively prevent influx of water to the ear. It is another object of the invention to provide such a device which can be worn not only without discomfort, but with complete comfort over long periods of time. It is yet another object of the invention to provide a device as outlined above which will securely remain in position and will not be subject to accidental dislodgement.

In certain areas of the country, particularly in Florida where the water is very clear and

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many interesting under-water organisms may be seen, there has ground up the sport of deep diving and under-water exploration. For this sport, the swimmers usually wear goggles which permit them to keep their eyes open without discomfort, and such goggles may be provided with a nose piece or have a nose piece integral therewith to prevent accidental influx of water to the nose. In connection with this sport, it is another object of the invention to provide in combination with goggles, with or without a nose piece, all constructed on the same principles as the ear piece, a pair of ear pieces as above outlined, which may be in the form of accessory attachments, or which may be made integral therewith. A swimmer equipped with a device according to this aspect of the invention may dive to great depths without discomfort other than that occasioned by the necessity of holding his breath. There will be no sensation of pressure on the ear drums even at great depths.

It is yet another object of the invention to provide in combination with a bathing cap, a pair of ear pieces as above outlined for use by women who, besides wishing to prevent access of water to the ears, desire to prevent access of water to the hair. The cap itself may embody the same principle as the ear pieces.

An ear piece, as outlined above, has another and different field of utility wherein there is no need to prevent access of water. This field includes such items as radio earphones, earphones for secretarial machines and ear pieces for stethoscopes. Ear pieces useful in such fields may be specifically different from those in connection with the prevention of water influx, but they are nevertheless governed by the same principles of construction. It is therefore, another object of the invention to provide an ear piece which can be worn with comfort for long periods of time by a radio or telephone operator, a stenographer, a doctor, or by one who desires simply to exclude sound.

These and numerous other objects of the invention, which will be described in more detail hereinafter, or which will become apparent to one skilled in the art upon reading these specifications, I accomplish by that certain construction and arrangement of parts of which I shall now describe several exemplary embodiments.

Reference is made to the drawings forming a part hereof and in which

Figure 1 is a front elevational view of a device suitable for use by swimmers.

Figure 2 is a side elevational view of the same.

Figure 3 is an exploded view of one of the ear pieces with parts broken away to show the construction.

Figure 4 is an elevational view of one of the ear pieces on an enlarged scale.

Figure 5 is a cross-sectional view of the same taken on the line 5—5 of Figure 4.

Figure 6 is a view similar to Figure 4 of a modified ear piece.

Figure 7 is a cross-sectional view of the same taken on the line 7—7 of Figure 6.

Figure 8 is a perspective view of a device comprising a pair of ear pieces according to the invention combined with a pair of goggles.

Figure 9 is a perspective view similar to Figure 8, showing a pair of ear pieces combined with a pair of goggles having a nose piece.

Figure 10 is a perspective view of a bathing cap, incorporating a pair of ear pieces according to the invention.

Figure 11 is a fragmentary cross-sectional view on the line 11—11 of Figure 10.

Figure 12 is an elevational view of a stethoscope, incorporating ear pieces according to the invention.

Figure 13 is a cross-sectional view taken on the line 13—13 of Figure 12.

Figure 14 is an elevational view of a head set for a stenographer's transcribing machine.

Figure 15 is a cross-sectional view of the same on an enlarged scale taken on the line 15—15 of Figure 14.

Figure 16 is a perspective view of an aviator's helmet, incorporating a pair of ear pieces according to the invention, and a throat microphone.

Figure 17 is a cross-sectional view on an enlarged scale taken on the line 17—17 of Figure 16.

Figure 18 is a horizontal cross-sectional view through an ear piece for sound-exclusion purposes.

Figure 19 is a view similar to Figure 13 showing a slight modification.

Figure 20 is an elevational view of a stethoscope bell incorporating a slight modification.

Figure 21 is a central cross-sectional view through a modified ear piece.

The principle of the invention is based upon the discovery that, while individuals may differ greatly in size, weight and bone structure, the conformation of the skull around the outer ear is substantially the same. It has been found that ear pieces of the prior art were uncomfortable to wear because they exerted undue pressure at one place or another against the skull. The principle of the present invention, therefore, resides in providing an ear piece which is peculiarly shaped so as to fit the conformation of the human skull in the region immediately surrounding the outer ear. If the ear piece is of such conformation, then the pressure holding it against the skull is evenly distributed around the periphery of the ear piece and any sensation of undue pressure is eliminated.

Since the conformation in the region of the ear may be altered by surgery, as in the case of a radical mastoidectomy where considerable portions of the skull are cut away, I prefer where it is necessary to prevent the ingress of water, to provide the ear piece of a soft, resilient material and, preferably, under pneumatic pressure, so that when the ear piece is pressed against the skull around the outer ear, the increase in pressure in certain regions, based upon the fact that there would normally be no contact in the region where bone has been removed, will cause

an expansion in the cut-away region so that again the ear piece will conform to the shape of the skull and prevent access of water.

Referring now more particularly to the drawings, I have illustrated in Figure 1 a device useful for swimmers to prevent access of water to the ears, which comprises two ear pieces indicated generally as 10 and 11, connected together by a clamping member 12, which may be of spring steel or the like. The ear pieces 10 and 11 will, of course, be mirror images of each other and will definitely have to be labeled "right" and "left." In Figure 1, the position of the device is as though it were on the head of a person looking at the reader. Thus, the device 10 is designed for the right ear, and the device 11 for the left ear. As can be seen more clearly in Figure 3, each ear piece comprises two members which have been designated by the same numeral as the ear piece with the postscripts *a* and *b*. Thus the member 11*a* is made of rubber or rubber-like material and is yielding, while the member 11*b* is a plate of some rigid and light material such as a lightweight metal or plastic. Generally speaking, the member 11*a* comprises an inner tube-like portion having a flange 11*c*. Between the annular flange 11*c* and the main portion of the device 11*a* there is thus provided an annular groove 11*d*. In assembly, the periphery of the plate 11*b* fits into the annular groove 11*d* and the clamping member or connecting piece 12 is suitably connected to the plate 11*b*. As illustrated in the drawings, the connection may simply amount to a hole 11*e* through which the end of the member 12 may pass. In order to prevent the ear pieces from becoming separated from the connecting or clamping member 12, the ends of the member 12 may be bent over as at 12*a*, or any other suitable structure may be provided for this purpose. The device may be adjusted to the individual head by a sliding movement of the member 12 with respect to the plates 10*b* and 11*b*.

The ear pieces, as above outlined, are shaped to conform to the human skull in the region immediately surrounding the outer ear. Thus, it will be observed, that at the point indicated at 13 there is a slight depression to accommodate the bony prominence immediately behind the ear. At the point 14 there is a depression to accommodate the prominence immediately above the ear. At 15 there is a depression to accommodate the prominence just in front of the ear, substantially at the end of the upper jaw. In between the depressions 13, 14 and 15 there are provided the prominences 16, 17 and 18 to engage the depressions in the skull contour between the prominences above referred to.

The rubber or rubber-like portions 10*a* and 11*a* of the ear pieces are preferably molded to the configuration above described. This may be done by providing a metallic piece having the desired contour and dipping it in a rubber latex so as to provide a coating of rubber about the contoured metallic piece. When the metallic piece is removed from the rubber, the rubber piece will, to some extent, retain the configuration which was molded into it but it will not retain the configuration completely. In other words, the prominences will be less prominent and the depressions will be less deep. The contours will be in general somewhat smoothed out. In order to maintain the desired contour, I provide the plates 10*b* and 11*b* with the same desired contour so that when the plates 10*b* and 11*b* are incor-

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porated respectively into the rubber pieces 10a and 11a they will force the rubber pieces to retain the necessary contour. If the portions 10a and 11a are molded to the correct configuration, they will normally retain their shape indefinitely. Nevertheless it is desirable that the plates 10b and 11b be shaped as above described, not only to assure a retention of the correct configuration by the portions 10a and 11a, but also to insure the application of uniform pressure over the entire area of contact with the skull. In order that both ear pieces may be fully illustrated, it will be noted that Figures 2 and 3 show details of the left ear piece 11, while Figures 4 and 5 show details of the right ear piece 10. These ear pieces should be understood to be identical except for being mirror images of each other.

Since these ear pieces fit over the outer ear so perfectly, I have found that sounds are transmitted through them with difficulty, particularly if the plates 10b and 11b are of metallic material. Sounds are transmitted somewhat better if these plates are of a plastic material such as one of the phenol-aldehydes, urea aldehydes, melamines, vinyl, acrylic or polystyrene plastics. Therefore, if it is desired that sound be transmitted through the ear pieces, the plates 10b and 11b must be modified by the provision of some membrane to transmit sound waves to the inner ear. Such a modification is shown in Figures 6 and 7, where the plate 10b has been cut away as at 19 to provide a circular opening in the plate 10b bridged by an arch portion 20, which arch portion 20 is in turn provided with the hole 10c to accommodate the clamping member 12. The hole in the plate is preferably circular, as indicated at 21 in Figure 6, and is covered with a rubber or rubber-like membrane 22. Sound waves impinging upon the outside of the membrane 22 will set it in vibratory motion, which in turn will set into vibration the air inside the membrane 22 and will thus transmit sounds to the ear drum.

In passing on to a description of the other figures, it will be understood that the ear pieces themselves will be as described heretofore unless specifically stated otherwise.

In Figure 8 I have shown a pair of ear pieces combined with a pair of goggles, indicated generally at 30, which goggles are designed to fit tightly around the eye sockets of the wearer so that he may keep his eyes open in swimming under water without discomfort. The goggles may be of rubber or rubber-like material or one of the plastics, and will preferably be shaped to fit the skull contour over their entire periphery. They will also preferably be provided with a rubber or rubber-like tube 30a around their periphery, functioning in the same manner as the portions 10a and 11a of the ear pieces. Such goggles are generally held in place by straps 31, 32, provided with conventional fastening means 33. The plate portion of each ear piece may be secured to the strap 31 or 32 in any desired manner as for example by passing the strap through a slot 33a in the plate.

In Figure 9 I have shown the combination of a pair of ear pieces, as above outlined, with a face piece comprising a pair of goggles 34a and a nose-covering member 35a. The face piece comprising the members 34a and 35a is designed to fit snugly on the face of a wearer to exclude water from the eyes and nose. Such devices are well known and again are usually provided with straps as at 34 and 35, and fastening means 36. In both the embodiments of Figures 8 and 9 one

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or both the straps may be provided with an elastic insert, as at 37, so as to provide an element of resilience. The face piece of the type shown in Figure 9 will preferably be provided with a peripheral tube (similar to the member 30a) as indicated at 38. By virtue of the passage of the straps 31, 32, 34, 35 through the slots 33a, the ear pieces may be adjusted to any desired point along the straps.

In Figures 10 and 11, I have shown the combination of ear pieces according to the present invention with a bathing cap for use by women who desire not only to keep water out of their ears, but to keep their hair dry. These ear pieces, while they may be provided with the plate members described above, need not have the plate members but may simply have a rubber diaphragm 41 in place of the metallic or plastic plate. The ear pieces may be cemented or even vulcanized in place on the interior of the cap 42 and the cap itself will preferably have a pneumatic sealing arrangement around its periphery as indicated at 43. The material of the cap may simply be rolled to form a sealed tube, and the sealed tube will then bear against the skull of the wearer and will prevent entrance of water. Any water which might enter around the member 43 to wet the hair of the user would, nevertheless, not enter the ear because of the supplemental protection of the ear pieces according to the invention. The ear pieces are indicated generally at 43a in these figures. It may be desirable to provide a spring steel connecting member as shown in broken lines at 42a, in which case of course the plates may not be omitted. If the member 42a is used, a chin strap will generally be unnecessary. Preferably also the tube 43 will be contour molded as above described for the ear pieces and face pieces, so as to conform closely to the configuration of the skull.

The various embodiments thus far described have been provided for the principal purpose of preventing access of water to the ear. The embodiments to be described hereinafter do not necessarily have the function of preventing access of water, but have the function of supporting a listening device of one sort or another for the ear with a maximum of comfort to the wearer.

Thus, in Figures 12 and 13 I have illustrated the adaptation of my invention to a stethoscope. The particular stethoscope shown may be of the simple tube type. Thus the curved pieces of rigid metallic or plastic tubing 52a which are resiliently urged toward each other by the spring 52b, may be threaded into the respective plates 51 as indicated at 51a. Each tube 52a is connected to the bell 53 by a flexible tube 54. The portion 52 of the ear piece may be in all respects the same as the members 10a and 11a respectively.

In Figures 14 and 15, I have shown an adaptation of my invention to earphones such as are used by radio and telephone operators. Here again the rubber portions 55 of each ear piece may be the same as described above, but the plates 56 will be modified to provide space for an acoustical device indicated generally at 57.

The ear pieces may be held in place by means of an arrangement such as was described above in connection with Figure 12, or if desired, a single ear piece may be used with a conventional over the head clamp.

In Figures 16 and 17, I have shown an adaptation of my invention to an aviator's helmet wherein radio headphones are required. Here again the rubber portions of the ear pieces indicated

at 60 may be the same as heretofore described. The plate member 61 is provided with means for supporting the acoustical member 62 and the plate 61 may be stitched or riveted or stapled, or otherwise suitably secured to the fabric or material of the helmet 63. In the particular embodiment of Figure 16, the incorporation of a throat microphone 64 is shown.

In Figures 16 and 17 I have illustrated yet another minor modification where a valve member 65 may be provided for the ear piece, which valve member may have a perforation 66 terminating at an angle as at 67. This type of valve may be employed with a needle, wherein the needle is inserted through the hole 66, lifting up the flap 68 and upon withdrawal of the needle the flap 68 returns to the position shown in Figure 17 and is maintained in a leak-proof condition by the pressure within the member 60. The valve may also be of the type wherein the needle hole is sealed by a piece of crude rubber, as is well known in the art. It will be understood that any of the devices heretofore described may be provided with such a valve if thought to be desirable or necessary.

In Figure 18 I have shown an arrangement wherein the ear piece is the same as that described in connection with Figures 1 to 5, but wherein a layer of sound absorbent material is inserted as indicated at 70. Such a device will most effectively exclude sound, and may be comfortably worn by those exposed to nerve shattering noises as in boiler factories and the like.

Figures 19 and 20 illustrate a modification in connection with stethoscope of Figures 12 and 13, wherein the bell 53' is provided with a membrane diaphragm 71, and wherein the ends of the tubes 52a' are flared as at 72 and carry a membrane 73. It will be clear that an air space is provided within the tubes 52a' and 54 and the bell 53', which is closed at its ends by the diaphragms 71 and 73. A more sensitive stethoscope may be provided in this way at a lower cost than the electronic stethoscope.

While all of the ear pieces in all the modifications described thus far have been of rubber or rubber-like material, and all of them have been described as being hollow and containing a volume of air, this construction is not necessary in all uses to which the device may be put. As pointed out hereinbefore, such a structure is desirable where the object is to prevent access of water to the ear. Where, however, the desire is simply to support comfortably adjacent the ear an acoustical device or the like and there is no necessity to prevent access of water, the ear piece may be made of some light material such as one of the plastics mentioned above or the like, and may be hollow for lightness as indicated in Figure 19, or, it may, if desired, be solid if weight considerations are not important. By virtue of the conformation of the ear pieces described above and clearly visible in Figure 19, the ear pieces will fit comfortably with no sensation of pressure even though they are not of a resilient or yieldable material. Since they are so contoured as to fit the area of the skull uniformly around the periphery of the ear, the pressure of any clamping device will be uniformly distributed and will not cause sensations of pressure at any particular point. Thus, in any embodiment where my invention is employed for the purpose only of holding an acoustical device or the like in position adjacent the ear, the ear

piece may be made solid and it may be made of an unyielding material. In any event, the material will preferably be light in weight. Such embodiments include, as described above, stethoscopes, radio head phones and stenographic transcribing machine head phones and the like.

While in all the embodiments wherein a clamping member has been employed, the clamping member has been shown as passing over the top of the head of the wearer, it will be understood that this is not a definite requirement. The connecting or clamping member 12, may, if desired, pass under the chin of the wearer or around the back of the head of the wearer. All that is necessary is that the ear pieces be pressed against the skull, and it will be clear that this can be accomplished regardless of the position of the member 12.

While numerous modifications of the basic concept have been shown, it will be understood that these have been shown by way of illustration only and that many other embodiments will suggest themselves to those skilled in the art. Likewise, I do not intend to limit myself to specific details of structure or methods of manufacture otherwise than as specifically set forth in the claims which follow.

Having now fully described my invention, what I claim as new and desire to secure by Letters Patent is:

1. An ear piece comprising an annular hollow member of smoothly rounded surface adapted to seat against the human skull around the outer ear, said annular member independent of external forces being deformed from a mean general plane and having a protuberance in the region adapted to contact the skull in front of the helix of the ear and a protuberance in the region adapted to contact the skull below the lobe of the ear and depressions intermediate said protuberances whereby said ear piece in place has substantially uniform contact with the skull, and a rigid plate secured to said annular member on the side which is away from the skull in use to form a pocket adapted to cover the outer ear, said plate being deformed peripherally from a mean general plane to the same configuration as said annular member, and being domed, whereby to help said annular member to retain its contour permanently.

2. A device according to claim 1, wherein said annular member is tubular in cross-section, and is constituted of a yieldable material.

3. A device according to claim 1, wherein said annular member is provided with an annular flap on the side which is away from the skull in use, and wherein said plate is engaged between said annular member and said flap.

4. A device according to claim 1, wherein said plate has a perforation and said perforation is closed by a diaphragm capable of vibratory motion for the transmission of sound.

5. A device according to claim 1 wherein said plate is imperforate and has on its inner side a layer of sound absorbent material for the exclusion of noise.

6. A device according to claim 1 in which said plate carries on its inside an acoustic device.

7. An ear piece according to claim 1, said ear piece being made of a light but rigid material.

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