

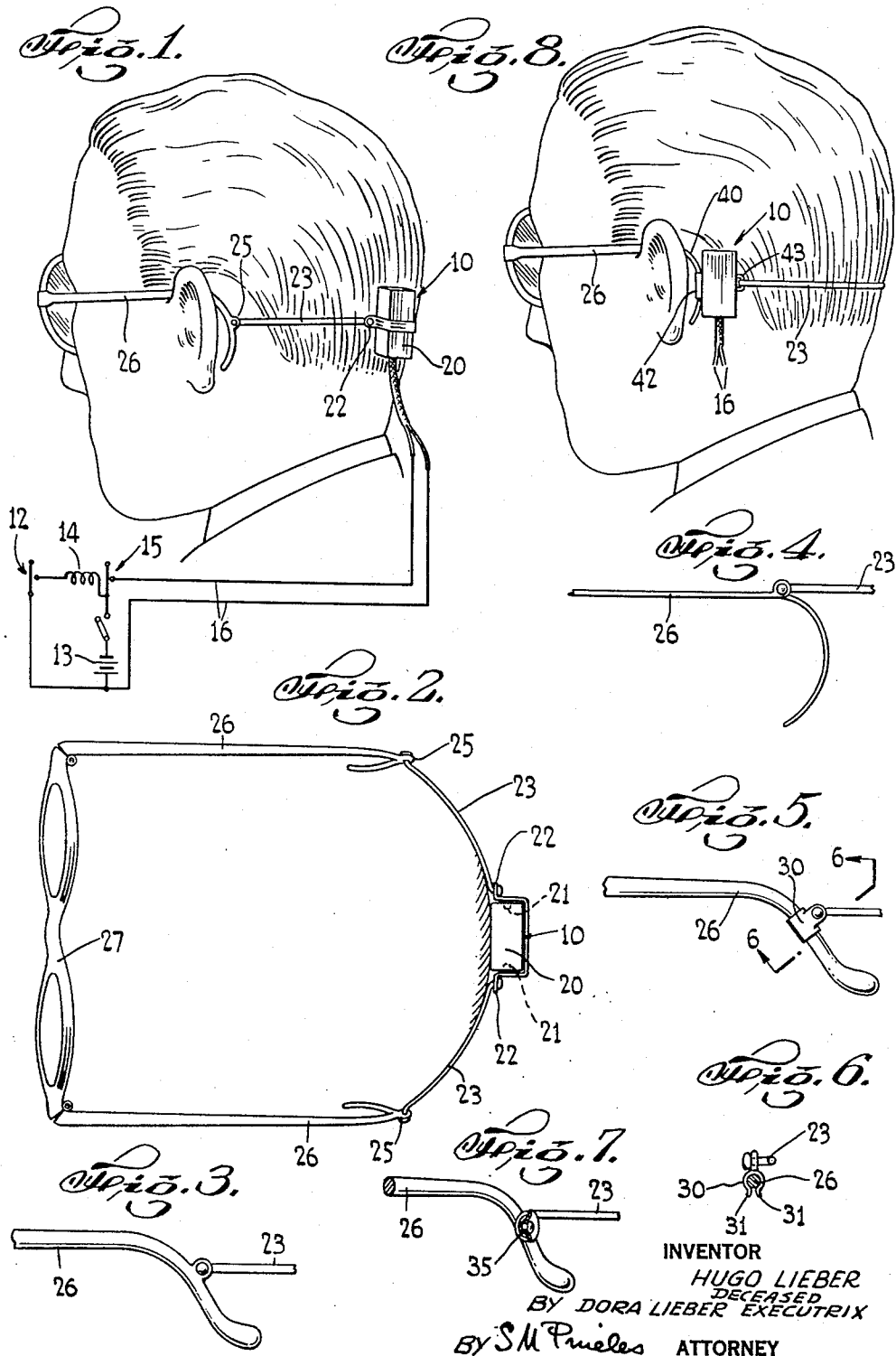
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WEARABLE BONE-CONDUCTION HEARING AID

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WEARABLE BONE-CONDUCTION HEARING AID

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This application is a division of the copending application, Serial No. 681,002, filed July 18, 1933 by Hugo Lieber, deceased now Patent No. 2,151,706, issued March 28, 1939.

This invention relates to wearable bone conduction hearing aids and it has among its objects a bone conduction hearing aid utilizing a support encircling the head of the user and having a strip of flexible self-aligning material held stretched along the bony lower rear portion of the head for pressing the vibration imparting contact surface of a bone conduction receiver against the bones of the head and inducing hearing by bone conduction under elimination of the discomfort caused by stiff arcuate head bands clamped around the head for pressing with one of its ends the vibration transmitting contact surface of the receiver against the bones of the head.

The foregoing and other objects of the invention will be best understood from the following description of exemplifications thereof, reference being had to the accompanying drawing, wherein

Fig. 1 is a perspective view showing a bone conduction receiver worn on the head of a person in accordance with the invention, and a diagram of the operating circuit of the receiver;

Fig. 2 is a top view of the bone conduction receiver of Fig. 1 and its supporting arrangement; and

Figs. 3 to 8 are views of different modifications of the supporting arrangement.

In the exemplifications of the invention shown in the drawing, a wearable bone conduction receiver 10 is arranged to be supported inconspicuously and comfortably on the head of the user so as to press its vibration transmitting contact surface portion against a bony part of the head for transmitting therethrough hearing inducing vibrations of the inner ear required to enable a deafened person having an impaired middle ear to hear and thus compensate for his impairment.

As explained, for instance, in Greibach Patent Re. 21,030, such bone conduction receiver consists of a tiny vibratory structure, which is energized by electric speech frequency oscillations and comprises a driving vibratory mass portion, which is resiliently carried by a driven vibratory portion having a contact surface, which is held pressed against the bones of the head, so as to subject the driving vibratory portion, under the action of the oscillations, to sufficient acceleration relatively to the bones for exerting on the contact surface portion and therethrough on the bones against which it is pressed inertia reaction forces required for transmitting hearing inducing vibrations through the bones of the head to the inner ear of the user and induce hearing by

bone conduction. In a conventional hearing aid such receiver may be supplied with operating currents from a supply circuit formed of a transmitter 12 connected in series with a supply battery 13 to the actuating coil 14 of an amplifier microphone 15 which is connected in series with the battery 13 to the leads 16 which supply actuating current to the vibratory mechanism of the bone conduction receiver 10, all the elements of the supply circuit being constructed so as to be suitable for inconspicuous wear by the user.

Prior to the invention, the generally used bone conduction receivers had been supported on the head by a stiff arcuate head band strip of spring metal, such as steel, which was clamped over a part of the head so as to press with one end, attached to the receiver, its vibration transmitting contact surface against a bone with a force required to induce with a small receiver unit satisfactory hearing by bone conduction. In order to enable the attached end of the head band to press the contact surface of the receiver against the bone with the required force, the head-band strip had to be made relatively stiff, and its other unattached end had to exert on the underlying portion of the head a relatively large concentrated force equal and opposite to the force with which the attached end of the head band had to press the contact surface against the bone.

As a result, the relatively small surface portion of the head underlying the unattached end of such arcuate head band is subjected to relatively large concentrated force, causing discomfort, and, at times, even pain to the user. Since deafened persons are very sensitive, the discomfort caused by such generally used stiff arcuate head band has long been recognized as very undesirable. In some cases, the discomfort caused by the use of such prior art head band was the chief reason why a deafened person requiring a bone conduction receiver in order to overcome his handicap preferred to forego the use of such receiver and continue to suffer bad hearing.

In accordance with the invention, the foregoing difficulties are eliminated by pressing the contact surface portion of a bone conduction receiver against a hearing inducing bone of the head by a support encircling the head having a part extending over the front of the head and along the junction of each ear to the adjacent head portion and holding a strip-like connector of soft, self-aligning, flexible, vibration-dampening material extending along and resting on the occipital bone below the occipital protuberance of the head sufficiently stretched so as to press the vibration transmitting contact surface of the receiver against the bone with a pressing force sufficient for transmitting thereto the vibratory forces required to induce hearing by bone con-

duction while distributing on the front and rear portions of the head the forces required to produce said pressing forces at the contact surface of the receiver and maintaining said support in a stable equilibrium position.

In the form of the invention shown in Figs. 1 and 2, the supporting arrangement comprises a U-shaped frame member 20 having two inwardly projecting pins 21 on which the bone receiver 10 is pivotally mounted and two eyelets 22 to which are attached, as by tying, the ends of two strip portions 23 of a soft self-aligning fabric-like material which is held stretched over the rear portion of the head below its greater occipital protuberance by means of a suitable support extending over the front of the head. In the form of the invention shown in the drawing, the ends of the supporting strips 23 are held stretched by tying them to eyelets 25 provided on the rear ends of the bows or side pieces 26 of an eye spectacle frame structure 27 worn in front of the eyes of the user.

Any type of eye-spectacle structure may be used for such support, for instance, a shell type frame spectacle in which the eyelet may be formed on the bows in the way shown in Fig. 3 or a wire frame spectacle in which the eyelet may be formed on the bows in the way shown in Fig. 4. In Figs. 5 and 6 is shown a strip support in the form of a detachable eyelet 30 having clamping arms 31 which keep the eyelet firmly clamped around the bow member 26 of the spectacle frame.

The length of the supporting strip 23 and its frontal stretching means are so arranged and proportioned that when the supporting strip 23 is held against the bones, it will exert on the contact surface of the bone receiver 10 sufficient forces for maintaining its vibration transmitting contact surface in contact with the bones for securing efficient transmission of the hearing inducing vibrations from the contact wall of the receiver casing 10 to the bone structure.

The provision of eyelets for tying the ends of the supporting strip 23, permits easy adjustment of the length of the supporting strip 23. In the form shown in Fig. 7, the bow of the spectacle frame is provided with a small clamping pin 35 having a flat head portion arranged so as to permit winding one or more turns of the supporting strip 23 on the clamping pin 35 for adjusting the length of the supporting strip.

In Fig. 8 is shown a supporting arrangement in which one side of the bone receiver 10 is directly supported by the rearward end of the spectacle bow 26 through its engagement of the bow with the channel member 42 provided on one side of the receiver casing, the other side of the receiver casing being provided with an eyelet 43 to which the end of the supporting strip 23 is tied.

The supporting strip 23 may be made of any suitable soft flexible self-aligning material, for instance, rubber covered with a woven fabric or any other type of fabric-like material having a soft texture that assumes the shape of the head when held against the head, and does not cause discomfort.

The exemplifications of the invention described above will suggest to those skilled in the art many other ways for holding the vibration transmitting contact surface of a bone conduction receiver pressed in vibration transmitting coupling engagement with the hearing inducing bones of the user by means of a strip of soft self-aligning material held stretched along the rear side of the

bony skull below the greater occipital protuberance of the head by frontal supporting means extending on the side of the head lying opposite the stretched strip. It is accordingly desired that the appended claims be given a construction commensurate with the scope of the invention.

What is claimed is:

1. In a wearable bone-conduction hearing-aid device designed and arranged for inconspicuous wear on the head of the user, a small light bone conduction receiver having a vibration transmitting contact surface arranged to be held pressed and coupled to a hearing-inducing bone of the user, supporting means encircling the head of the user for supporting said receiver thereon and pressing its vibration transmitting contact surface against said bone, said supporting means comprising a spectacle structure engaging the front of the head, and a strip-like connector of soft, self-aligning, flexible, material connected to the side portions of said spectacle structure and extending along the occipital bone below the greater occipital protuberance on the rear of the head, said spectacle structure and said connector being so designed and interconnected with said receiver as to maintain said connector in stretched condition required to press said contact surface against said bone with a pressing force sufficient for transmitting thereto the vibratory forces required to induce hearing by bone conduction while maintaining said front member and said connector in a stable equilibrium position on the head and distributing over the front and rear portions of the head a substantial portion of the forces required in order to balance said pressing forces.

2. In a wearable bone-conduction hearing-aid device designed and arranged for inconspicuous wear on the head of the user, a small light bone conduction receiver having a vibration transmitting contact surface arranged to be held pressed and coupled to a hearing-inducing bone of the user, supporting means encircling the head of the user for supporting said receiver thereon and pressing its vibration transmitting contact surface against said bone, said supporting means comprising a spectacle structure engaging the front of the head having junction portions overlying the opposite sides of the head so as to engage the junction of each ear to the adjacent head portion, and a strip-like connector of soft, self-aligning, flexible, vibration-dampening material joined to said junction portions and extending along the occipital bone below the greater occipital protuberance of the head, said spectacle structure and said connector being so proportioned and designed as to maintain said connector in stretched condition required to press said contact surface against said bone with a pressing force sufficient for transmitting thereto the vibratory forces required to induce hearing by bone conduction while maintaining said spectacle structure and said connector in a stable equilibrium position on the head and distributing over the front and rear portions of the head a substantial portion of the forces required in order to balance said pressing forces, said connector being of a material which substantially prevents the transmission of vibratory forces from said bone conduction receiver to other portions of said support.

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