Improvement in the faceplates (10) of intracanal hearing aids, which faceplate (10) constitutes the main support for all the electronic components and for a battery-holder (28) that has a particularly convenient disposition and an original shape; the unit comprising a small cover (28A) that houses the battery, and can rotate about a hinge (27) lying in the upper face of the external plate, between a lowered ON closing and operating position, a partial raised, OFF position, and a completely raised open position for extracting the battery, wherein these functions are performed by cooperating electrical contacts (33, 34) which both engage the battery opposite poles for supplying the power to the hearing aid operative circuit and hold the battery holder (28) in the different positions thereof.
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IMPROVEMENT IN THE FACEPLATES OF INTRACANAL HEARING AIDS

The present invention relates to an external closure plate for intracanal hearing aids, completely original and of new arrangement and design.

The intracanal hearing-aids have met a great success in the world for the considerable advantages in respect to the previous hearing aids of the type lying in the concha; the main advantages consisting in a nearly total invisibility joined at high acoustical efficiency.

The technology of these hearing-aids is in particular directed to obtain the following objectives:

- to have smaller dimension, in order to give the possibility of its insertion in small diameter auditory meatus, assuring at the same time a very good acoustical quality.

- To have easy and quick maintenance operation joined at the necessary possible repairing operations.

- To have less protrusion from auditory canal for cosmetic and then psychologic reasons.

The present invention had the purpose to provide a faceplate for intracanal hearing aids, constituting a considerable improvement in the construction technology, in respect to miniaturization, mounting operation, simplification, maintenance and repairing.

Moreover, in a first embodiment, such a closure faceplate consists of two separate parts, joinable with a quick connection. In particular, an external flat inert element, provided with a central opening, is destined to be joined at the hearing aid shell with well-known means; an insertable-removable module, connected in such opening with a snap
action is instead intended to house and support all the electric connections between the various elements inserted in the hearing aid shell.

This module is firmly joined, with well-known means, into the central opening of the closure element.

The two parts disconnection is at the same time very easy and fast; the said means operating in order to liberate the module from the face plate; that is realized with the opposite operation of connection already described.

Since, as said, the module houses all the electrical, electromechanical and electronic components, it can be easily removed for maintenance or repairing; moreover the module can be substituted with a working spare one, directly by the user or by a technical people, avoiding in this case that the user hasn't the hearing aid availability for a long time.

Other advantage of this solution is a great simplification of hearing aid assembling, that realized in this way a highly personalized component; in fact the shell with the closure element must be modeled on the patient auditory canal shape and dimension, becoming a standard component constituted by the module and by all the hearing aid working parts.

One of the fundamental peculiarities of the invention is the miniaturization obtained with the battery insertion in a "flat" position; the space for battery is derived under the small liftable external cover.

The battery position in the small cover is studied in such a way that the opening destined for its insertion and remo-
val, has very small dimension in respect to the opening of
the hearing aid faceplates at present available; as a conse-
quence the cover dimensions are greatly reduced.
The battery, moreover, is coupled to the small cover when
opened; in this case is avoided the battery falling down.
According to the invention, the microphone is placed in ver-
tical position back to the opening of battery seat, while
the potentiometer is placed over the battery.
As it will be better shown in the following the potentiome-
ter is positioned in the fixed part of the faceplate and
not in the liftable small cover, as it occurs at the present
in some hearing aids available on the market; this arrange-
ment avoids any flexible electrical connection between the po-
tentiometer and the remaining fixed parts of hearing aid.
This flexible connection is certainly a week point, causing
inconveniences and failures; for this reason its elimination
gives a better reliability.
This peculiar disposition of the invention allows a greater
free space in the faceplate in respect to the present avail-
able hearing aid; this space is used to insert the micropho-
ne, realizing the desired volume reduction.
Another favourable faceplate characteristic, according to
the invention, consists in the fact that the ON/OFF switch
is constructed with co-operating parts of the small cover and
the space that the cover closes, in such a way that is pos-
sible to use a potentiometer without ON/OFF switch; it means
that smaller and cheaper potentiometers can be used.
The hearing aid characteristics will be now related more in
detail in one preferred embodiment, referring to the annexed drawings, wherein:

- Fig. 1 is the perspective view as a whole of one intracanal hearing aid, provided with a faceplate according to the invention, shown in a greater size;
- Fig. 2 is an enlarged section with omitted parts, of the preferred embodiment, in which the face plate module element system and the respective insertion therein are shown.
- Fig. 3 is the two parts exploded section, in which the small cover of battery holder is shown in the working ON position with full lines, and with dotted lines in the OFF position.
- Figg. 4 and 5 are perspective views showing in detail the locking of the module in the faceplate.
- Fig. 6 is an enlarged top view of the faceplate with module.
- Fig. 7 is a section on the 7-7 line of fig. 6 in another embodiment.
- Fig. 8 is a similar section with the small cover partially raised (full lines) and completely raised (dotted lines).
- Fig. 9 is a similar section of another embodiment.
- Fig. 10 is a section on the 9-9 line of fig. 6
- Fig. 11 is a detailed view in perspective, showing the thin plate contacts inserted in the various faceplates.

Referring in particular to fig. 1 it is clear that an intracanal hearing aid according to this invention, fundamentally includes:
- an empty shell GS of a modelling material, taking place in the patient auditory canal and realized, with well known techniques, starting from patient ear mould and varying in shape and dimensions for different patients;

- an upper closure plate (faceplate 10) that is realized with thermoplastic resins and is fixed at the shell with well known techniques.

This invention relates in particular to these very improved type of face plates.

In one embodiment the faceplate (10) is formed with an external part, fixed at the shell GS (not shown), and with a module (20) destined to be easily mounted or removed from the part (11), see figg. 2 and 3.

The module houses the electronic, electrical and mechanical parts of the hearing aid.

In order to receive this module, the plate (11) has in its center an opening (12) that generally has the same shape of the module (20) edge, see fig. 3.

On the left side (13) the opening (12) has a length (14) of round stiffening, while on the opposite side (15) it has two teeth (16) spaced by a length (18), see figg. 4 and 5.

The module (20) includes an external part (21) and a bottom (40), see fig. 3.

The part (21) has a back wall (21 A), two side walls (21 B) and a front wall (21 C), partially closed by a length of the upper wall (21 D).

On the back wall (21 A) a length of a groove with round bottom (22) is formed, having same shape and dimensions as the
length of stiffening 14 existing on the side 13 of opening 12.
The central part of the front wall 21C, provided with a notch 23, forms an elastic tooth suitable to be fixed under the teeth 16 formed on the side 15 of opening 12, in such a way to block the module 20 in the opening 12 of the plate 11.
In order to realize this fastening is necessary to carry out the following operations, very well shown in fig. 2:
- to fit in the round stiffening 14 into the groove 22, and, rotating the whole module in the direction of arrow F, to fasten the notch 23 under the teeth 16 with an resilient snap action.
The upper wall 21D presents a former opening 24 and a second opening 25, intended, respectively, to house the open part PA of the microphone MF and the potentiometer PT. In particular the opening 25 is partially lying on a central bracket (26), that protrudes towards the front wall 21C.
In the bracket 26 is formed a cross hole employed to receive the pin or pivot 27 of the moving battery holder (28). In effect most part of the internal cavity (19) of the module 20 is taken up by the battery BT, which, however, is not directly received in the cavity aforesaid, but is always lying in its seat 28; this seat is constituted with an upper wall 28A, having two spacing appendices 28B which enclose the bracket 26, and with a back wall 29 and a short lower wall 30.
The three walls define a room 31, open in the front (see fig. 2) and partially open in the back; in this room houses the battery BT that, for this reason, is always contained in the room 31 in which is elastically retained with a light pressure.

In addition to the first embodiment now just described, wherein the module 20 and the plate 11) constitute two separate parts, suitable to be assembled together through a snap action, this invention provides also other embodiments, that are different mainly because the module 20 and plate 11 are integrally formed.

Since, the other characteristics of the invention are identical or very similar in all the embodiments, these characteristics will be related to referring indifferently to the drawings of whichever embodiment of the invention.

As pointed out, in the present invention the battery holder 28 accomplishes many functions.

As first function, the battery holder contains and retains (see figg. 2 and 3) the battery BT by means of the wall 28A and the edge 28D, that embraces part of the battery; while the wall 30, opposite to the wall 28A and capable of being resiliently deformed, lightly tightens the battery BT. The insertion or removal of the battery BT are obtained rotating the battery holder as shown with dotted lines in fig. 2, while its removal, for replacement, is obtained by opening the battery holder and by doing a light traction, as consequence of the elastic deformation of the wall 30.

As it will be better shown in the following, the second func-
tion fulfilled by the battery holder 28 is a switching function, because it cuts off the supply of current to the electronic circuit.

At last, as shown in figg. 7 and 8, the upper part 28A of the battery holder 28 is externally hollowed out in 32, in order to provide therefor an opening angle higher than 90°. It is possible to note that with the structure of the internal part of module 20 and battery holder 28, and, owing to the possibility for the battery holder to be hinged on the pin 27, the following features are obtained:

- a reduction of the opening width necessary for battery insertion and removal; the battery in fact partially slides below the bracket 26 and then below the potentiometer PT (housed over the battery holder) describing a circle arc.

- A reduction of space occupied in the module for microphone MT, potentiometer PT and battery BT.

The function of ON/OFF switch for supply current breaking, is performed slightly raising the battery holder in respect of its completely lowered position.

This function, according to the invention, is obtained placing into the cavity of the module 20, in which the housing 28 of the battery is received, a former contact with upper thin plate 33 and a second contact with lower thin plate 34, see fig. no. 11.

These contacts are shaped in such a way that, when the battery is in its seat, the upper contact 33 engages the
positive pole, while the lower contact 34 engages the negative pole.

The upper contact 33 includes for this purpose:
- an upper thin plate 35 flared on the right side
- two square bended arms 36 connected to a small crossbar 37 supporting the upper plate.
- a small connection arm 38

The lower contact 34 includes:
- a small rectangular frame having its short sides 39 raised.
- a short central arm 41 upside-down V shaped, greatly opened, having a vertex 42 and an appendix 43 in the opposite side.
- a small connection arm 44.

The two contact arrangement, is designed in such a way that, when the battery BT is inserted in its seat and the battery holder 28 is in the close position, the thin plate 34 engages the positive pole and the appendix 43 engages the negative pole of the battery.

Moreover the external face of lower wall 32 of the battery holder 28 is shaped with a former and a second groove 45, 46), having a complementary form in respect to the form of the small arm 41 of the contact 34.

The section of figure 10 shows the mutual position of module 20 into the room 19, the position of the battery BT and the contacts 33, 34, as well as the position of connections 38, 44 and hearing aid printed circuit board CS.
As shown in figs. 7 and 8, when the battery holder 28 is completely closed, the former groove 45 is engaged with the small arm 41, and the appendix 43 is engaged with the lower face or battery BT negative pole PN.

When the battery holder is partially raised, the small arm 41 is engaged in the groove 46 and it is stopped in such position, in this case the supply current to hearing aid electronic circuits is interrupted, because the battery negative pole PN is spaced from the appendix 43.

This position is the normal hearing aid OFF position or not working position; for this reason, as said, it is possible to use a potentiometer PM without a switch.

As shown in the top view of fig. 6, in addition to the different elements arrangement, is also shown how the structure, according to this invention, allows to have the minimum possible space for a lot of components.

For example, on the hearing aid printed circuit board, situated under the cavity 19, is possible the insertion of adjusting trimmers (indicated with R₁ R₂ in the drawings), which are easily accessible from the top, when the battery holder 28 is in the open position.

The arrangement of one of the trimmers is also shown in figg. 7 and 8.

It can be noted easily that the embodiment of figs. 7 and 8 differs from the others described in figs. 2 and 3 in that the module 20 and the plate 11 are integrally formed and the mobile bottom 40 is here unnecessary.

This bottom, on the contrary, assumes an essential importan-
ce in the embodiment illustrated in fig. 9; in this embodiment the bottom has a greater depth than in the embodiment shown in figs. 2 and 3 since it receives and includes all the operative elements of the hearing aid, housing also the acoustical transducer TA in the inner part thereof, i.e. the part lying below the circuit MS.

Both these embodiments have the bottom fixed to the upper part through a joint, by means of a connection including a stiffening strip 50 formed by a lower part of the walls 21A and 21C, and a similar groove turned outwardly and formed near the upper edge of the bottom 40, (see drawings).

Finally, it is useful to note that, in all the embodiments, the front part of the battery holder wall 28A is provided with a finger-flap 52, in order to make it easier to raise the battery holder 15 for carrying out the opening thereof.

Furthermore, it is important to note that the small battery holder cover 28, in the completely open position, constitutes an element that protrudes from the faceplate and provides a very good finger-grip, making it easier the insertion and removal operations of the hearing aid from the user's auditory canal.

As a consequence of the foregoing explanation it will be obvious that the hearing aid faceplate according to this invention has new and original technical features which allow to reduce to a minimum the space required for containing all the mechanic, electrical, electromechanical and electronic parts of an intracanal hearing aid.
CLAIMS

1) In an intracanal hearing aid intended to be inserted into the auditory canal of the ear, comprising essentially an empty shell of a modelling material in a steady form, obtained from an internal auditory canal ear mould, varying in shape and dimension for different patients, and an upper closure plate, realized with thermoplastic resins and fixed to said shell with well known techniques; an external improved face plate comprising a peripheral part fixed at said empty shell and a module containing all the electronic, electrical and mechanical functional parts of the hearing aid; said module comprising an external part constituted by a back wall, two side walls, a front wall partially closed by a length of the upper wall, in such a way to leave a wide opening substantially horse-shoe shaped, provided with a bracket protruding towards the front wall over said opening; a battery holder seat suitable to contain and retain the hearing aid battery, hinged on said bracket to rotate between a completely closed position, in which the upper wall of the battery holder completely closes said opening and the battery is in its working position and a completely open position in which the battery can be removed from the battery holder.

2) Improved hearing aid external faceplate of claim 1 wherein said length of the upper wall presents a first opening and said bracket presents a second opening; said first opening being intended to house the upper part of the hearing aid microphone, said second opening being intended to house the potentiometer of the hearing aid.
3) Improved hearing aid external faceplate of claim 2 wherein said battery holder is hinged on said bracket in such a position that, in its rotating movement between the two extreme positions, the battery describes a circle arc about said said bracket.

4) Improved hearing aid external faceplate of claim 2 wherein said battery holder includes an upper wall having two spaced appendices enclosing said bracket, a back wall and a short lower wall; the three walls defining a room open in the front and partially open in the back, that houses the battery which battery, therefore, is always contained in said room wherein it is elastically retained with a light pressure.

5) Improved hearing aid external faceplate of claim 4, wherein the hinge pivot transversely crosses said bracket element and said appendices.

6) Improved hearing aid external faceplate of claim 2 wherein said potentiometer, fixedly housed in said second opening, is connected to the hearing aid electronic circuit by means of a rigid fixed connection.

7) Improved hearing aid external faceplate of claim 2, wherein into the cavity situated below the opening, closed by said battery holder seat, a first more external electrical contact, having an upper elastic bracket and a second more internal contact, placed in the bottom of said cavity and having a central elastic appendix slightly raised in the top, are received.

8) Improved hearing aid external faceplate of claim 7, wherein said first and second contacts are able to engage the
upper face, or battery positive pole, and with the lower face, or battery negative pole, respectively when said battery holder is in its closed position, in which it is completely received in said cavity.

9) Improved hearing aid external faceplate of claim 8, wherein on said battery holder seat and on the bottom of said cavity, matching means are formed capable to block said seat in a first not working, partially open position and in a second completely open position for extracting the battery therefrom.

10) Improved hearing aid external faceplate of claim 9, wherein said matching means comprise a first and second notches angularly spaced, formed on said housing, and an elastic appendix, formed on said inner electric contact and apted to engage said one or second notch.

11) Improved hearing aid external faceplate of claim 1, wherein said peripheral part of said plate and said module, comprise two separate and distinct elements, said said peripheral part having an opening of shape and dimensions similar to the shape and dimension of said module contour.

12) Improved hearing aid external faceplate of claim 11, wherein, on said module and said opening, matching means are formed, which make possible to join the two elements and, oppositely, and to separate the same, so that the hearing aid personalized inert part, i.e. the shell and the peripheral part can easily receive a spare module, in case of failures.
13) Improved hearing aid external faceplate of claim 9, wherein said module has a detachable bottom, wherein the electronic and electromechanical components of the hearing aid are received.
# INTERNATIONAL SEARCH REPORT

**PCT/IT 86/00028**

## I. CLASSIFICATION OF SUBJECT MATTER

According to international Patent Classification (IPC) or to both National Classification and IPC

| IPC | H 04 R 25/02 |

## II. FIELDS SEARCHED

**Classification System | Classification Symbols**

| IPC | H 04 R |

**Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched**

## III. DOCUMENTS CONSIDERED TO BE RELEVANT

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<td>Hearing Instruments, volume 35, no. 1, January 1984, Duluth, (US) B. Voroba: &quot;A tool for optimization of hearing aid fittings&quot;, pages 12-14,16, see the whole document</td>
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## IV. CERTIFICATION

**Date of the Actual Completion of the International Search**

10th June 1986

**Date of Mailing of this International Search Report**

04 AUG 1986

**International Searching Authority**

EUROPEAN PATENT OFFICE

**Signature of Authorized Office**

M. VAN MOL
ANNEX TO THE INTERNATIONAL SEARCH REPORT ON
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INTERNATIONAL APPLICATION NO. PCT/IT 86/00028 (SA 12840)
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This Annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 29/07/86.

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For more details about this annex: