June 4, 1940. J. G. ROBERTS 2,203,105

EARPIECE MANUFACTURE

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Fig. 1.a

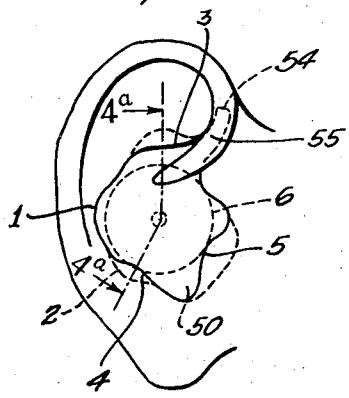


Fig. 1.b

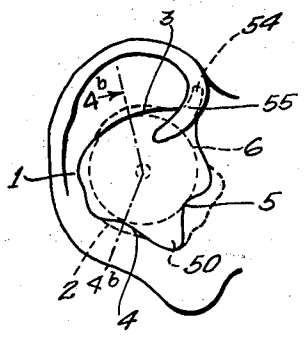


Fig. 1.c

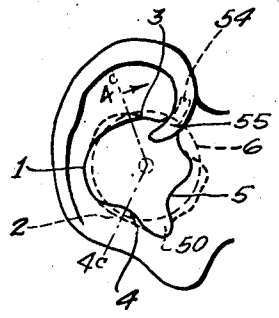


Fig. 4.a

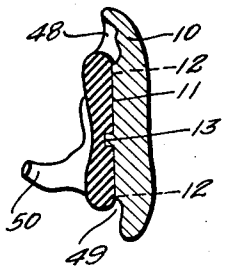


Fig. 4.b

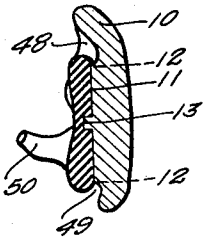


Fig. 4.c

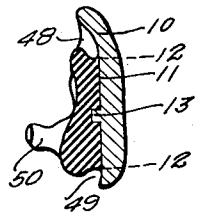


Fig. 2.

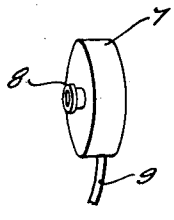


Fig. 3.

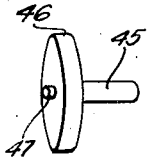


Fig. 5.

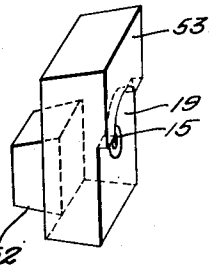
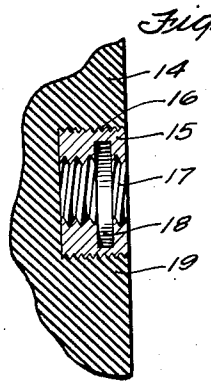


Fig. 6.



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Fig. 7.

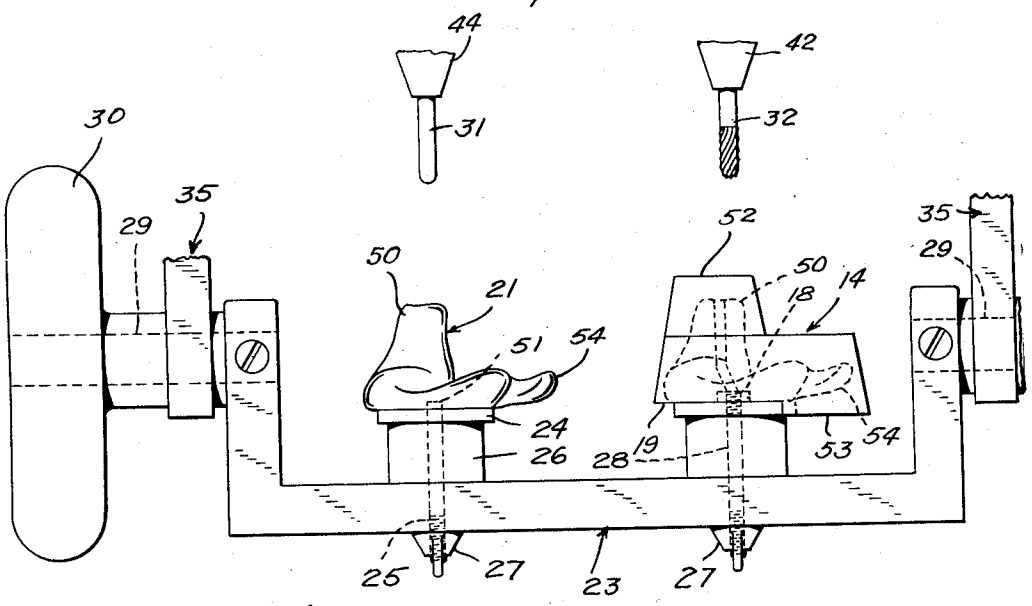


Fig. 8.

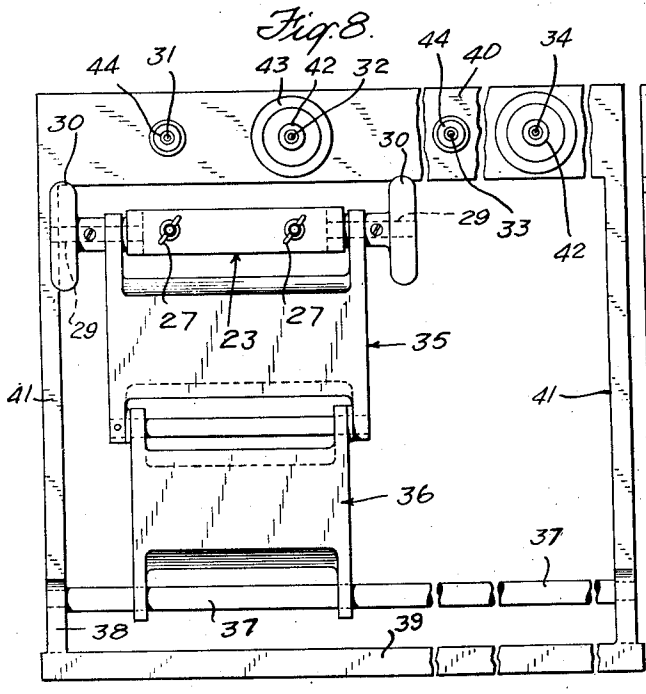
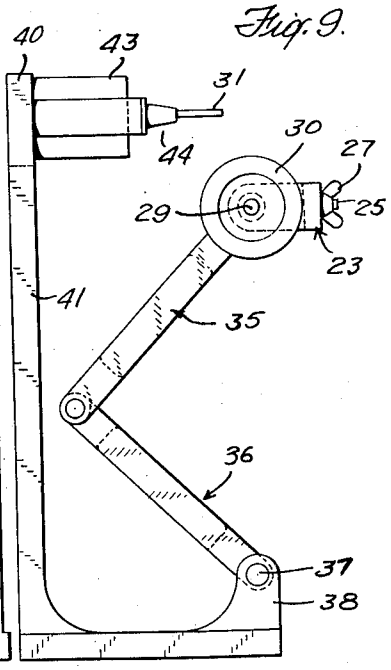


Fig. 9.



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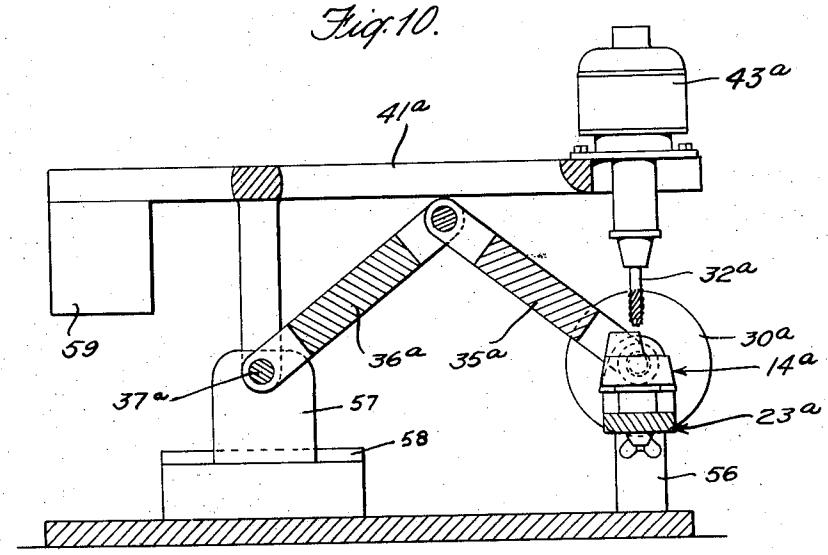
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Fig. 10.



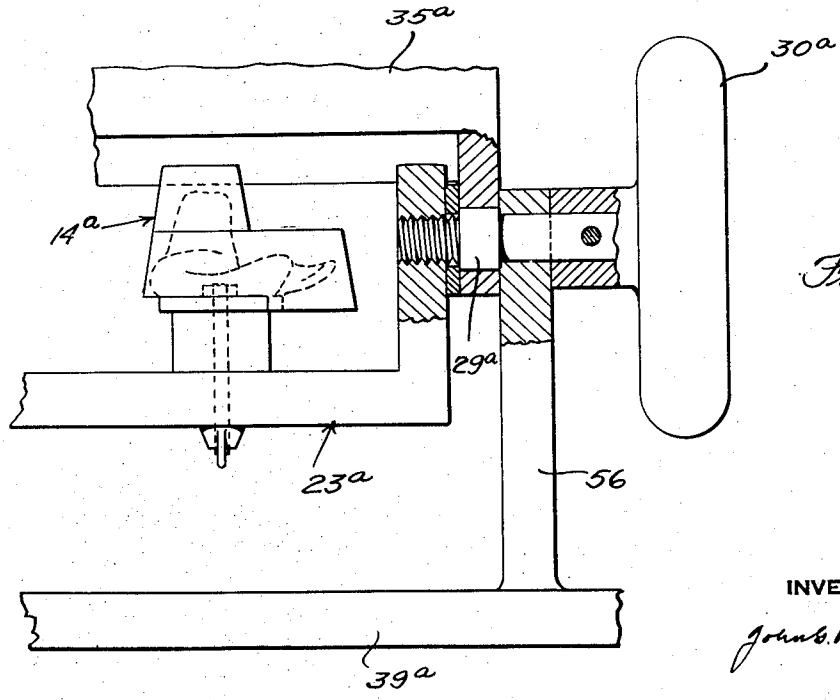


Fig. 11.

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UNITED STATES PATENT OFFICE

2,203,105

EARPIECE MANUFACTURE

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Application March 3, 1938, Serial No. 193,610

2 Claims. (Cl. 179—182)

This invention relates to the manufacture of individually fitted earpieces, such as are worn by the hard of hearing and sometimes by others, for the support of telephone receivers and the like.

Heretofore, devices of this kind have been produced by processes similar to those practiced in the dental industry. As a preliminary step, a plaster impression of an ear to be fitted has been taken by a doctor or other qualified person. The impression is then usually shipped to the earpiece maker, who fashions a duplicate in hard rubber. The desired conformity is attained by first using the impression to make a mold, or positive likeness of the ear, and then vulcanizing the rubber in the mold, after which the earpiece is finished by polishing. The impression and the mold are destroyed in this process, the former being picked out in pieces from the mold, and the mold being broken apart from the vulcanized earpiece. In this known process an intermediate step is taken to locate the proper surface of contact for the support of the receiver and the best point thereon for an attachment device. The importance of this intermediate step lies in the desirability, for the sake of unobtrusive wearing appearance and good sound conduction, of making as thin an earpiece as is practical, that is to say one on which the receiver is held close to the ear, and of placing it so that the point of attachment is not far removed from the auditory canal, while permitting no discomforting contact of the receiver with the ear tissues. The practice, in these respects, has been to insert warm wax in the mold and to mark the supporting surface thereon by means of a dummy receiver. This enables the workman to construct with accuracy the outer as well as the inner part of a two part molding flask so that the proper supporting surface and attachment point will be impressed on the vulcanized rubber earpiece.

The objects of the present invention are to simplify the procedure in, to shorten the time required for, and to reduce the cost of, making ear conforming earpieces. In practicing it, the making of a mold, or positive of the ear, and the vulcanizing of the earpiece material therein may be omitted. By virtue of it individually fitted earpieces can be made of various materials, some of which have hitherto been unadaptable for such use because of process limitations. Instead of depending, as hithertofore, on a mold for locating the proper contact surface and point of attachment, these objectives are now attainable, either when the impression is being taken or in a preliminary step thereafter. Another advantage gained is that the original impression is not destroyed. It can, therefore, be filed away and used again for making additional earpieces when called for.

According to the present invention the supporting surface and point of attachment are marked or identified by means of a dummy receiver that is placed in the ear before the plaster hardens; or, alternatively, the excess plaster at the outer portions of the impression is removed and a suitable surface and point marking device is affixed thereto. Either way, the impression is made usable as an overall model for the purpose of shaping an ear conforming and receiver supporting earpiece. Selection is then made of a block of earpiece material having a surface adapted for contact with a receiver and a member suitable for the temporary mounting of the block in a carving machine imbedded in such surface. Preferably the model and a block of earpiece material are mounted side by side on a jig of a duplicating machine, which has one or more sets of carving implements each of which has a power driven cutting tool and a tracer of the same shape as the tool, likewise mounted side by side the same distance apart as, and in parallel alignment with, the model and block. The arrangement and machine construction are such that, as the tracer comes into contact with the surfaces of the model, the cutting tool shapes the block, first roughly and then finally into the conforming earpiece. The imbedded member is then reshaped so that it may serve as the center attachment device for the receiver.

The invention is more fully set forth in the following statement, which makes reference to the accompanying drawings, wherein:

Figs. 1*a*, 1*b* and 1*c* are outline representations, respectively, of typical large, medium and small ears.

Fig. 2 is a view of a telephone receiver and Fig. 3 of a dummy thereof.

Figs. 4*a*, 4*b* and 4*c* are rectified sectional views of original impressions, taken along indicating lines 4—4 of Figs. 1*a*, 1*b* and 1*c*, respectively.

Fig. 5 is an isometric view of an uncut block of earpiece material.

Fig. 6 is an enlarged sectional view of a fragment of a block showing an insert for the earpiece imbedded therein.

Fig. 7 illustrates a jig for a duplicating machine and the manner of mounting thereon an ear impression model, and a block of uncut earpiece material.

Figs. 8 and 9 are front and end elevations, re-

spectively, of an arrangement of the working parts of a duplicating machine to aid in an understanding of its principle of operation.

Fig. 10 is an end elevation showing an alternative arrangement for a duplicating machine, and

Fig. 11 is a fragmentary sectional view in front elevation of such alternative duplicating machine.

Referring to Figs. 1*a*, 1*b* and 1*c*, the solid contour lines 1, respectively, represent the boundaries at the entrances to the inner cavities of the three typical ears, while the lines 2 in small dots likewise represent the contours of lateral extensions of these cavities which usually occur just inside the entrance boundaries 1 at the positions thereon of the antihelix 3, the antitragus 4 and the tragus 5. It is these ear cavities with their lateral extensions to which earpieces are fitted and into which they are retained. The broken circular lines 6 indicate the most advantageous positions for the receivers with respect to the boundaries of such ear cavities.

The receiver illustrated in Fig. 2 comprises a casing 7 of cylindrical shape enclosing the usual electromagnet and diaphragm for translating electric waves into sound waves. It is provided with a snap fastener button 8 by which it is removably held in position against the outer or supporting surface of its earpiece and with a depending cord 9 for electrical connection with the hearing-aid equipment. With such a receiver in position at the ear the sound waves are directed into an air passage which extends through the button and a hole in the earpiece to the auditory canal. The position of such a hole with respect to the general outline of an earpiece is indicated by dotted lines within the block 14 of earpiece material in Fig. 7.

In the earpiece impression views, Figs. 4*a*, 4*b* and 4*c*, the cross hatched portions 10 represent those excess parts of original impressions conforming to the outer areas of large, medium and small ears, respectively, that are discarded in the step of preparing the impressions for use as models.

For such impression models the surfaces 11 which lie between the dotted lines 12—12 represent the desired supporting surface areas for the earpiece; the indentations 13 therein determine the points of attachment.

Blocks of material 14 (see Figs. 5 and 6), ample in size for large earpieces and, therefore, for the smaller ones as well, are fashioned to the shapes and sizes of various models in a duplicating machine (see Figs. 7, 8 and 9). As furnished the machine operator, each such block has imbedded in it flush with its broad surface 19 a metal insert member 15, knurled on its cylindrical surface 16, having a threaded hole 17 with a lateral cut 18. When the earpiece is removed after the carving operation, the threads are removed by a drill leaving a smooth hole for entry of the button receiver 8. A split ring (not shown) is inserted in the slot 18 to grip the button and hold the receiver snugly against the surface 19.

In Fig. 7 are shown an impression model 21 and uncut earpiece block 14 mounted side by side on a jig 23 in position for the carving operation. The model is cemented or otherwise secured to the head 24 of a bolt 25, which passes through a hole in a spacing block 26 and is held in place by a wing nut 27. The block 14 is likewise secured in place by means of a screw threaded extension 28 above the head of a similar bolt. At the outer ends of bearing shafts 29 of the jig are knobs 30 by which the machine operator can move the model and block to a wide range of space and angular positions. Always, however, the line of direction between them is parallel to the line between a tracer 31 and a rough cutting tool 32, and to the line between a tracer 33 and a fine cutting tool 34. See also Figs. 8 and 9. This consistent positional relationship is provided for by virtue of a slidable support, comprising two H shaped members 35, 36 pivoted together and to the jig 23 and a track 37. The track is supported at each end in short upright arms 38 of a base 39 of the machine frame. An upper part 40 supported by upright arms 41 serves as a mounting rack for the tracers and cutting tools, the latter being held in clutches 42 and rotated by electric motors 43. The tracers are also held in like clutches 44 but are stationary. The distance between centers of each pair of tools 31 32, and 33 34, is the same as that between the mounting centers of the model and block.

The alternative duplicating machine shown in Figs. 10 and 11 is so arranged that the jig 23*a* is stationary during the carving operation but adjustable rotatably to present different angular positions to the tracers and cutting tools. By loosening the knob 30*a*, the jig can be thus angularly moved and the knob again tightened into the new position. In this case the shank 29*a* of the knob becomes the shaft on which the arm 35*a* is angularly movable. The support for this shank is the upright 56 of the base 39*a*. The support for the track 37*a* consists of two blocks 57, one at each end of the track, slidable forwardly and rearwardly on a track 58. A pair of horizontal arms 41*a* support the tracers and cutting tools, the one shown in Fig. 10 being a rough cutting tool 32*a* driven by a motor 43a. On the rearward extension of arm 41*a* is a counterweight 59. In using this alternative duplicating machine, the tracer is handled by the operator and brought down in various positions upon the surface of the model.

To carve the block, the operator, having placed the tracers and cutting tools, which as to each pair conform in size and shape, into the clutches and having started the motors, grasps the knobs 30 and first rough-trims the block with the cutter 32 while tracing the model with the tracer 31 and then, moving the jig to the right, finishes the carving with the fine tool 34, while tracing with the tracer 33. Obviously, machines working on the same principle may be equipped with three or more pairs of tracing and carving tools for rough, medium and fine cuts, respectively, if so desired.

The uncut block 14 may be of any material suitable for reduction in size and contour by carving tools, as, for example, hard rubber, hard wood, polymerized methyl methacrylate (called "Lucite"), other thermo plastics and numerous compounds.

In practicing the invention with the aid of a dummy receiver (Fig. 3) the attendant in charge of taking the impression of an ear, handles the dummy by means of the stem 45 and, before the plaster has set, places the cylindrical part 46, which is of the same diameter as the receiver, in the position best suited to that ear. In a large ear, as indicated in Figs. 1*a* and 4*a*, the best position is found when the dummy is not only within the cavity but also away from contact with the antihelix 3 and rests close to or lightly against the tips of the tragus 5 and antitragus 4. In cases of medium size ears, as indicated

in Figs. 1*b* and 4*b*, the dummy can just comfortably enter the cavity, lightly touching the tips of the tragus and antitragus and also contacting or nearly contacting the antihelix. In the cases of small ears, however, as indicated in Figs. 1*c* and 4*c*, the cavity is too narrow to permit such entry without forcing the dummy and consequent discomfort to the one who is to wear the earpiece and its supported earpiece. The dummy, in this case therefore, should overlap the entrance to the cavity and just touch, or almost touch, the outer surfaces of one or more of these inwardly extending parts of the ear. In every case the dummy will leave its mark on the impression so as to determine at once the correct receiver supporting surface for the earpiece. The boss **47** will also mark the center point thereon for the attachment device.

An alternative procedure, in cases where a dummy receiver is not used, is to remove the excess plaster **10** (see Figs. 4*a*, 4*b* and 4*c*) by first cutting it down close to the surface **11**, as it appears in Fig. 4*c*, and then finish the cutting, for small ears, just before reaching the inwardly extending depression **48**, formed by the antihelix, and **49**, formed by the antitragus, and the depression (not shown) formed by the tragus which lies behind the base of auditory canal extension **50**. The possibilities of further cutting down impressions of large and medium ears, as indicated in Figs. 4*a* and 4*b*, will be recognized after the first cutting, to the level shown in Fig. 4*c*. In thus cutting down the excess plaster, just as in using the dummy, it is desirable to shape the model, whenever it is practical to do so, for a thin earpiece and to mark the center point **13** for the attachment device as near as practical to the base of the auditory canal extension **50**.

When thus shaped to size and contour for ear fitting and receiver supporting purposes the model may be dipped in glue or other suitable surface hardening material. It may also be enlarged all over by one or more coatings of the same material to offset the diminution effect of finally polishing the earpiece. And it may be otherwise treated over certain areas for better retentive results. It is then affixed to the head **24** of a bolt **25** for mounting in the jig **23** of a carving machine (see Fig. 7), the shank **51** on the bolt head fitting into the marked depression **13** of the model. Likewise a block **14** of earpiece material is secured, in the manner previously stated, to a similar bolt. With the model and block in place on the jig, the latter is carved to conform to the model. The block may be of any suitable shape, but for economy of material and cutting time it is preferably pre-formed as shown in Figs. 5 and 7, having an extension **52** on one side to provide for the earpiece extension **50** and an enlargement **53** upon the upper portion of the surface **19** to provide for an extension **54** of the earpiece sometimes desired for engagement behind the crus of helix **55**. The block **14** is pre-formed for cutting earpieces for right ears. For left ears the extension **52** would be shifted to the left of the position there shown.

Upon completion of the carving operation the model and earpiece are removed from the jig, the former being marked for identification and filed away, and the latter being trimmed of any superfluous material at the outer edges of its receiver supporting surface or elsewhere and then polished over its ear fitting areas. The screw threads in the hole **17** of the attachment device are cut away, an air conduction hole is drilled from a point inside this attachment device to the lip of the part **50**, the earpiece is cleaned, a split ring inserted in the circular slot **18** and the thus finished device is shipped to the customer.

I claim:

1. In the manufacture of earpieces adapted for surface contact with and center attachment to receivers, the process which includes taking an impression of an ear cavity, shaping the open portion of said impression in accordance with such surface and center attachment requirements, mounting a block of earpiece material preshaped as to such surface and center attachment requirements in a carving machine, and cutting said block to conform with the said impression over the remaining surfaces thereof.

2. In the manufacture of earpieces adapted for surface contact with and center attachment to receivers, the process which includes taking an impression of an ear cavity, shaping the open portion of said impression in accordance with such surface and center attachment requirements, imbedding within a corresponding surface of a block of earpiece material a member suitable for the temporary mounting of said block in a carving machine, cutting said block to conform with said impression over the remaining surfaces thereof, and reshaping said imbedded member for service as the receiver attachment device.

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