April 1, 1941. R. C. EDSON 2,236,568

RECEIVER CAP ACOUSTIC FILTER

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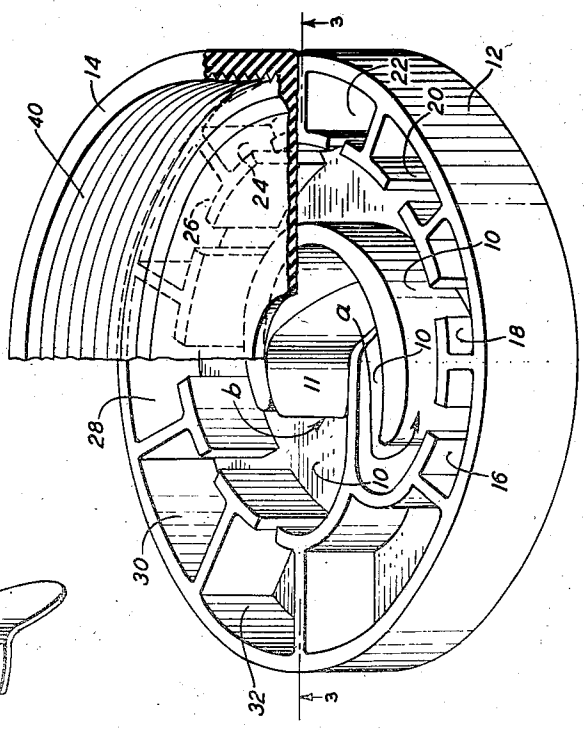


FIG. 2

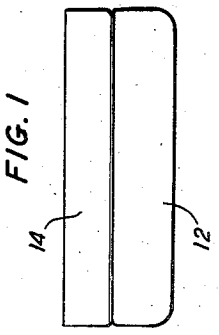


FIG. 1

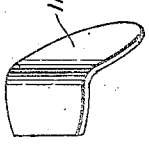


FIG. 4

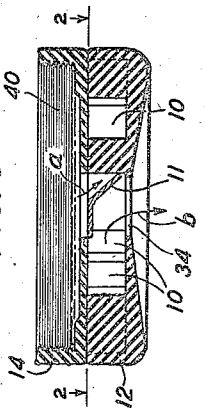


FIG. 3

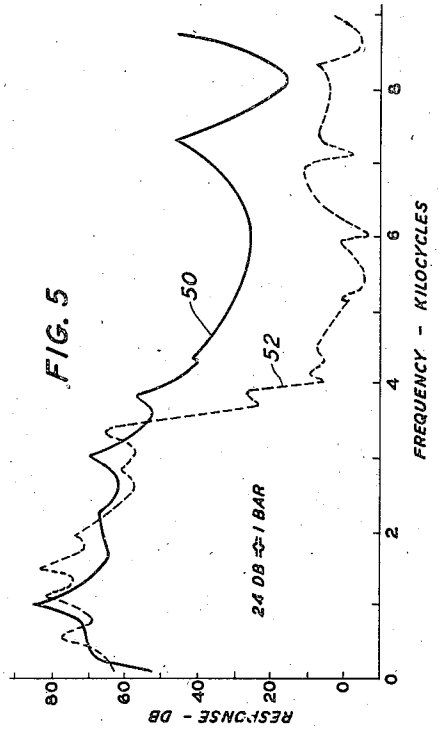


FIG. 5

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## RECEIVER CAP ACOUSTIC FILTER

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5 Claims. (Cl. 179—182)

This invention relates to an improved telephone receiver cap and more particularly to a telephone receiver cap incorporating an acoustic filter therein.

It is often found desirable to employ a single metallic circuit or pair of wires to carry both voice frequency telephone currents and carrier frequency telephone currents. This necessitates the use of frequency discriminating devices to select for each communication channel its appropriate band of frequencies and to reject frequencies properly belonging within other channels.

While such devices are commonly reactive electrical networks it is possible, as pointed out in Patent 1,692,317 issued November 20, 1928, to G. W. Stewart, to employ acoustic filters to provide in whole or in part the frequency discriminatory properties desired between the several channels of the system. Acoustic filters designed in accordance with the teachings of the prior art have, however, been employed infrequently, chiefly because the mechanical structures suggested do not lend themselves to convenient cooperative use with the commonly used telephone instruments and particularly with the receiver which is normally manually supported by the user in proximity with his ear.

It is therefore a primary object of this invention to provide a method of incorporating acoustic frequency discrimination into a telephone receiver without radically altering its external contour or its mechanical properties or otherwise changing it so as to interfere with normal and convenient use thereof.

Other objects of the invention will become apparent during the course of the following description. The nature of the invention will be more readily understood in connection with the description of the illustrative embodiment given below and the appended drawing in which:

Fig. 1 shows a side view of a receiver cap modified in accordance with this invention;

Fig. 2 shows in perspective and to approximately double scale the arrangement of sound passages and communicating cavities in a receiver cap in accordance with the invention which imparts acoustic frequency selective properties to the telephone receiver with which it is employed;

Fig. 3 shows to scale a cross-sectional side view of the receiver cap of Fig. 1;

Fig. 4 shows the guide employed in the device of the preceding figures which directs sound energy from the receiver diaphragm into the channel of the filter;

Fig. 5 illustrates the modification in the response of the receiver effected by incorporating the acoustic filter in the cap thereof.

In more detail, in Fig. 1, the receiver cap of this invention comprises an internally threaded portion 14 adapted to screw onto the body of the receiver and clamp the diaphragm in place and an adjacent portion 12 in which a channel and communicating cavities, comprising an acoustic filter to be described in detail hereunder, have been formed to convey the sound generated by the diaphragm to the ear.

In the perspective view of Fig. 2 piece 14 has been broken away to show in portion 12 the passage 10 which at one end opens upon the space adjacent to the diaphragm 40 (indicated in Fig. 3). The other end of passage 10 connects with the orifice in the right side of portion 12 intended to emit sound into the listener's ear. Guide 11 (shown by itself in Fig. 4) serves to guide sound from the diaphragm into channel 10 as indicated by arrow *a*. Sound leaves the other end of channel 10 by passing underneath guide 11 and thus to orifice 34 (shown in Fig. 3) as indicated by arrow *b*. Along the outside of the passage 10 in portion 12 are arranged cavities designated by numbers between 16 to 32, inclusive, each of which communicates through an opening of appropriate area with passage 10. The cavities and the channel are made progressively larger, cavity 16 being the smallest and cavity 32 being the largest, the channel size increasing in proportion to the size of the adjacent cavities.

The approximate dimensions of the channel, the cavities and the openings therebetween may be determined as for low-pass filters of the type shown in Fig. 2 of the above-mentioned patent to G. W. Stewart. As pointed out by W. P. Mason in U. S. Patent 1,874,326 issued August 30, 1932, a uniform structure is not entirely suitable since recurring pass-bands of frequencies above the range of frequencies desired will be encountered. The channel and the cavity volumes should therefore be changed progressively to give, in effect, a tandem combination of a plurality of low-pass acoustic wave filter sections of progressively increasing cut-off frequencies so that the recurring pass-bands of each section will be sufficiently attenuated by the combined effect of the other sections. The section of lowest cut-off should begin to attenuate just above the highest frequency of the range it is desired to pass, assuming that we are designing a low-pass structure such as is illustrated by the specific embodiment shown in Figs. 1 to 3, inclusive. Applying the same principle, if a band-pass structure is desired, a tandem

chain of sections having increasingly wide primary pass-bands centered with respect to the desired range of frequencies should be employed and for high-pass structures a tandem chain of sections having increasingly lower cut-offs, the highest cut-off frequency being below the lowest frequency of the desired range, should be employed.

It has been found that the structures designed in accordance with the procedure outlined above may in many instances be placed within a receiver shell, the external contour and dimensions of which are not substantially different from conventional receiver caps having wide commercial application at the present time.

In Fig. 3 the combined portions 12 and 14 are shown in cross-section as indicated by the lines 3—3 and 2—2 of Figs. 2 and 3, respectively, in a side view. Portion 14, as mentioned above, is threaded internally, as indicated, and serves to hold the cap on the receiver and to clamp the periphery of the diaphragm, indicated by dot-dash lines 40, in place. Part 14 also serves to close one side of all the passages and cavities of part 12 except for an opening adjacent to guide 11 which communicates with the space adjacent to the diaphragm 40. This permits sound to enter channel 10 as indicated by arrow *a*. The other end of passage 10, of course, communicates with the orifice 34 of the receiver through which sound is emitted into the surrounding atmosphere as indicated by arrow *b*.

In Fig. 4 guide 11 is shown in perspective.

From the above description of Figs. 1 to 4, inclusive, it is apparent that the combination described does not radically change the contour of the receiver nor add very appreciably to its bulk. No protruding pipes extend from its sides and in most instances the user will scarcely be aware in so far as its mechanical characteristics are concerned, that he is not using an ordinary type of receiver. Furthermore, any receiver may be converted to the improved type of this invention by simply removing the standard cap and substituting therefor a cap incorporating an acoustic filter therein.

In Fig. 5 the frequency response of a common type of telephone receiver is shown by curve 50 whereas the response of the same receiver with a particular design of acoustic filter of this invention incorporated in the cap is shown by curve 52. As a reference point 24 decibels on the response scale of Fig. 5 is equivalent to a sound pressure of one bar (sometimes stated as one dyne per square centimeter). By suitably altering the design of the acoustic filter in accordance with the principles above described the combination of receiver and filter may be given any one of a large number of widely differing frequency-response characteristics. Obviously, too, the response of a given combination may be conveniently changed by substituting a different acoustic filter therein.

Numerous applications of the principles of the invention will occur to those skilled in the art. The scope of the invention is defined in the following claims.

What is claimed is:

1. A telephone receiver cap for conveying sound from the diaphragm of the receiver to the ear of a user of said receiver, said cap including within it a channel for said sound and a plurality of cuboid cavities, each of said cavities having a single opening only, said opening in each instance communicating only with said channel, the dimensions of said channel, cavities and openings being proportioned to impart desired band-pass frequency selective properties with respect to sound waves passing through said cap whereby all sounds having frequencies lying within a particular range are freely passed through said cap and all sounds of other frequencies are suppressed by said cap.

2. In a telephone receiver cap, an acoustic filter, said filter comprising a tapered channel for conveying sound from the diaphragm of the receiver to the ear of the user and a plurality of cavities of progressively increasing size, each of said cavities having a single opening only, all of said openings communicating only with said channel, the cavities being arranged adjacent to said channel with the smallest cavity opening near the smaller end of said channel, the progressively larger cavities opening at points progressively nearer the other end of said channel and said cavities, channel and openings therebetween being proportioned to impart to said receiver cap the property of freely transmitting sound waves of frequencies within one frequency range and suppressing sound waves of frequencies within a second frequency range.

3. A telephone receiver cap, the external contour and dimensions of which substantially conform to conventional design, said cap incorporating within it a tapered channel for conveying sound from the receiver diaphragm to the ear of a user, and a plurality of cavities of progressively increasing size, each of said cavities having a single opening only, said cavities lying completely within said cap and communicating with said channel, said channel, cavities and the openings therebetween being proportioned and arranged to constitute an acoustic filter which will freely pass sounds of frequencies within one frequency range and suppress frequencies not in said range.

4. A telephone receiver cap as per claim 3, said cap being mechanically interchangeable with caps of conventional design in complete telephone receiver assemblies.

5. In a telephone receiver cap, a spiral channel, one end of which communicates with the diaphragm chamber of the receiver and the other end of which communicates with the surface of the receiver which in normal use is placed against the ear of the user, a plurality of cavities arranged within said cap along the outer wall of said channel, each of said cavities having only a single opening, said opening in the case of each of said cavities communicating with said channel only, said channel, said cavities, and the openings between said channel and said cavities being proportioned to constitute a wave filter for sound energy, freely transmitting sound energy of all frequencies within a particular range of frequencies and suppressing frequencies outside of said range.

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