May 16, 1933. G. G. MULLER 1,909,375

ACOUSTIC DEVICE

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FIG. 1

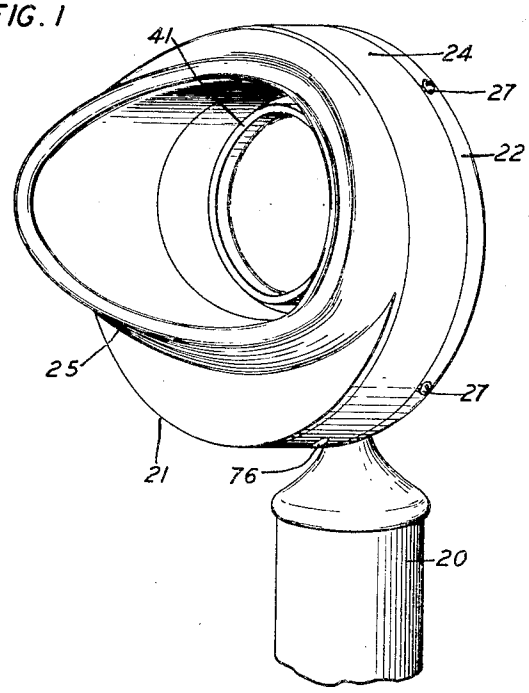
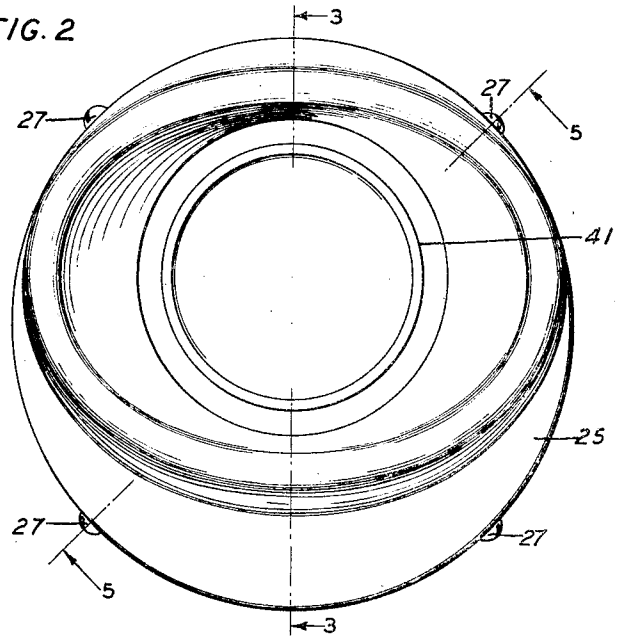


FIG. 2



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ACOUSTIC DEVICE

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FIG. 3

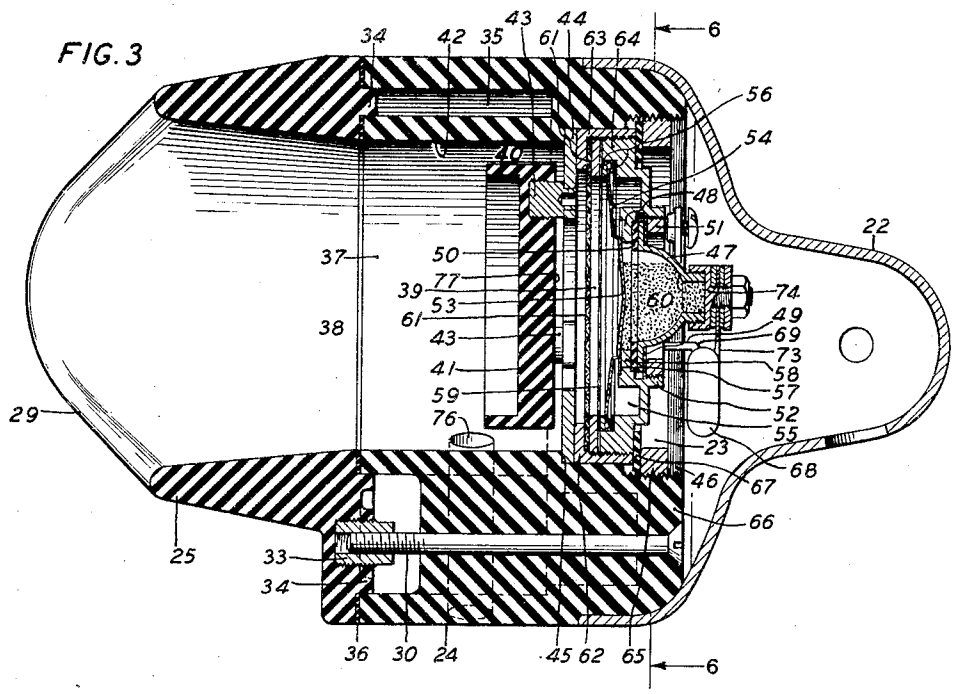


FIG. 4

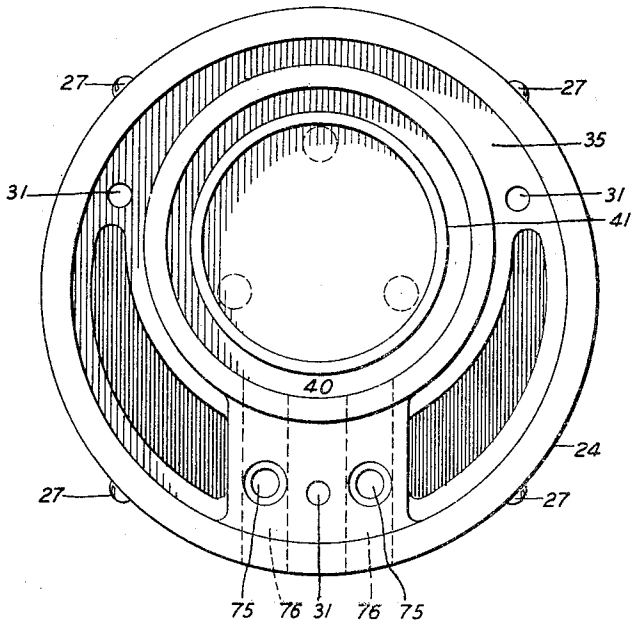
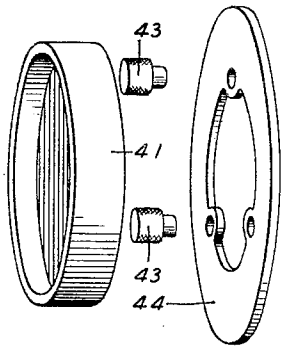


FIG. 7



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ACOUSTIC DEVICE

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FIG 5

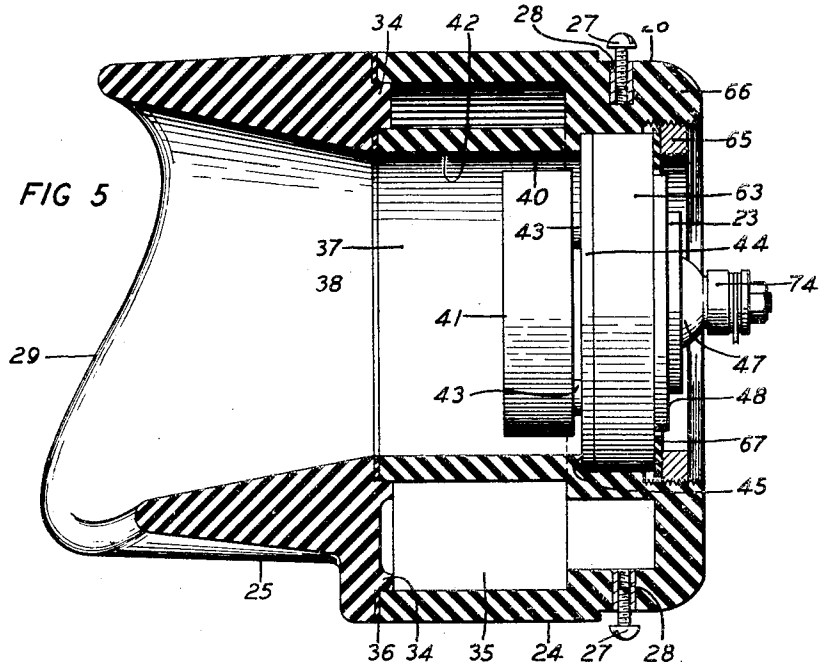
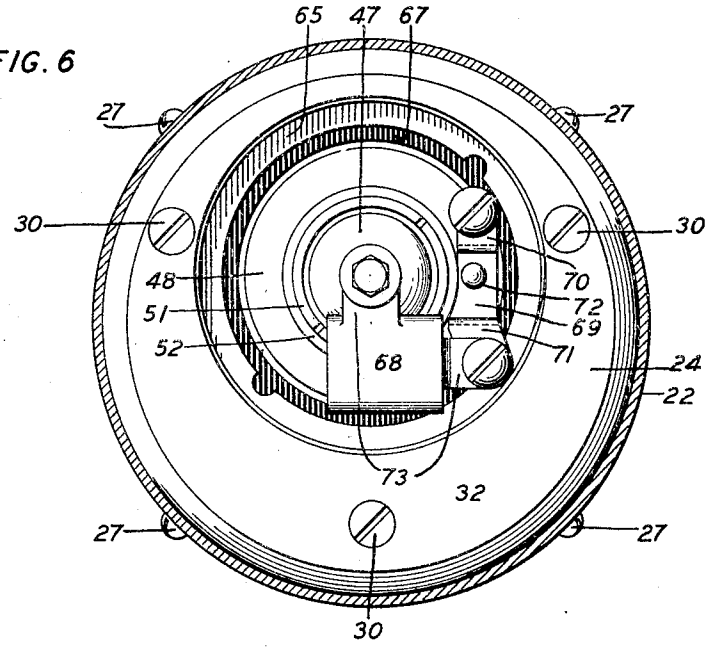


FIG. 6



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ACOUSTIC DEVICE

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FIG. 8

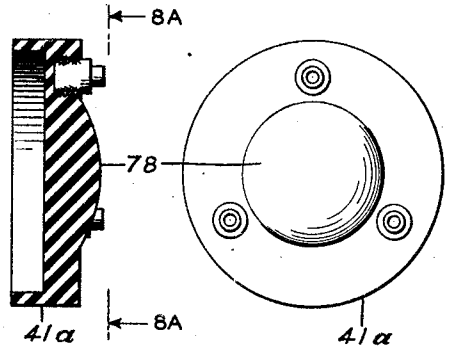


FIG. 8A

FIG. 9

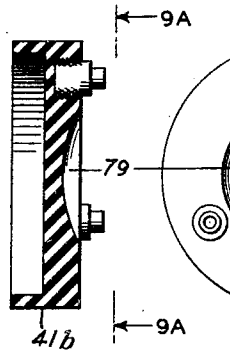


FIG. 9A

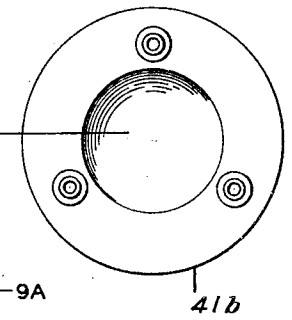


FIG. 10

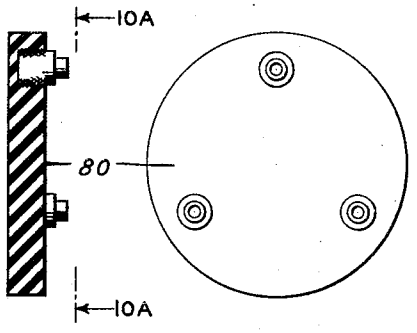


FIG. 10A

FIG. 11

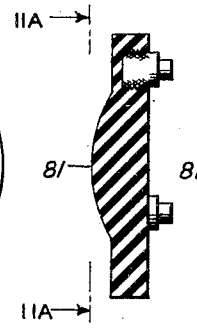


FIG. 11A

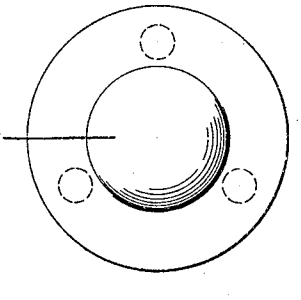
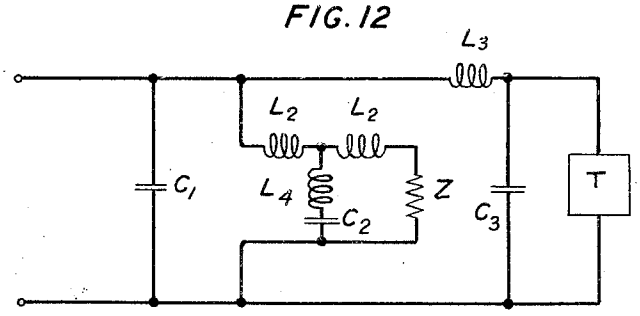


FIG. 12



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Patented May 16, 1933 1,909,375

UNITED STATES PATENT OFFICE

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ACOUSTIC DEVICE

Application filed May 29, 1931. Serial No. 540,828.

This invention relates to acoustic devices and more particularly to telephone transmitters of the voice silencing type which enable one to speak into a transmitter without being overheard by by-standers.

An object of this invention is to improve the quality of transmission of voice silencing devices and to increase the response thereof within the audible frequency range.

A feature of this invention resides in the use of a baffle or other member in the sound passageway of a voice silencing device to divide the passageway into a plurality of compartments or chambers, one of which is between the baffle or other member and the diaphragm of a sound translating device or transmitter, the chambers being connected through a restricted path between the baffle or other member and the wall of the sound passageway, one of the chambers and the restricted path acting to provide a resonance element to increase the response of the device.

Another feature of this invention resides in dimensioning the restricted path formed by the baffle or other member and the sound passageway wall and the chamber between the baffle or other member and the diaphragm of a sound translating device or transmitter such that the restricted path and chamber act as acoustic mass and acoustic stiffness elements, respectively, causing an acoustic resonance which increases the response of the device in the region of the resonant frequency of these elements.

In accordance with this invention, a voice silencing acoustic device comprising a transmitter and a voice muffling housing therefor, which housing defines a sound passageway leading to the diaphragm of the transmitter, is provided with a baffle or other member in a sound passageway, in spaced relation to the wall thereof and to the diaphragm, to divide the passageway into two compartments or chambers connected by a restricted path. The restricted path and the chamber between the baffle member and the transmitter diaphragm are dimensioned to have such acoustic mass and acoustic stiffness, respectively, that they act as an acoustic resonance element increasing in the region of their resonant frequency the response of the acoustic device. In one embodiment the baffle or other member comprises a shallow, cup-shaped, plane-base member. In another embodiment it may comprise a flat plate including, if necessary and desired, means to stiffen it so that it will not act as a vibrating member. It is apparent, also that, in either embodiment, the surface of the baffle or other member opposite the diaphragm of the transmitter may be ridged or raised, or grooved or depressed, to control the acoustic stiffness of the chamber between the baffle and the diaphragm.

A more complete understanding of this invention will be obtained from the detailed description which follows taken in conjunction with the appended drawings, wherein:

Fig. 1 is a view in perspective of a voice silencing acoustic device comprising this invention and is shown mounted on a fragment of the standard of a telephone desk stand;

Fig. 2 is an enlarged front elevational view of the acoustic device shown in Fig. 1;

Fig. 3 is a sectional view of the acoustic device of this invention along the line 3—3 of Fig. 2;

Fig. 4 is a front elevational view of the acoustic device shown in Figs. 1, 2 and 3 with the mouthpiece removed;

Fig. 5 is a view, partially in section, of the acoustic device of this invention with the bell portion removed, along the line 5—5 of Fig. 2;

Fig. 6 is a rear view, partially in section, of the acoustic device of this invention along the line 6—6 of Fig. 3;

Fig. 7 is an exploded view in perspective of the baffle or other member positioned in the sound passageway of the acoustic device of Fig. 1 and forming a feature of this invention;

Figs. 8 and 8A show a sectional view and a rear view along the line 8A—8A, respectively, of a modification of the baffle shown in Figs. 1 to 7;

Figs. 9 and 9A show a sectional view and a rear view along the line 9A—9A, respec-

tively, of another modification of such baffle member;

Figs. 10 and 10A illustrate in a sectional view and a rear view along the line 10A—10A, respectively, another embodiment which the baffle member may take;

Figs. 11 and 11A illustrate in a sectional view and a front view along the line 11A—11A, respectively, how the baffle member of Figs. 10 and 10A may be stiffened so that it will not act as a vibratory member; and

Fig. 12 is an electrical circuit analogue of the acoustic network of the acoustic device comprising this invention.

There is shown in the drawings an acoustic device of the voice silencing type supported, for instance, on the standard 20 of a telephone desk stand and which comprises a housing or casing 21, a bell portion 22, preferably of stamped metal, and a sound translating unit or transmitter 23. The housing is formed preferably as a two piece structure comprising a body portion 24 and a mouthpiece portion 25 and preferably of a phenol plastic product. The body portion 24 is provided with a shoulder portion 26 which fits in the open end of the bell 22 and is secured therein by suitable means, for instance, the screws 27, which extend through appropriate drillings in the bell and thread into tapped bushings 28 which, preferably, are integral with the housing by being molded therein.

The forward edge 29 of the mouthpiece is of a contour preferably to fit the face of a user thereof about his mouth so that the mouthpiece opening is closed when the device is in use. The mouthpiece is secured to body portion 24 by suitable means, for example, by screws 30 extending through drillings 31 from the rear surface 32 of the portion 24 and threading into tapped bushings 33 which are formed integrally preferably with the mouthpiece by being molded therein. The mouthpiece is provided with a raised portion or ridge 34 in alignment with and adapted for engagement with the cavity or chamber 35 in the body portion 24. A washer or gasket 36 of a resilient material, such as soft rubber, or a fibrous material, such as varnished cloth, is disposed between the adjacent surfaces of the mouthpiece and body portions to provide an airtight joint thereat. The mouthpiece and body portions together define a sound passageway 37 leading to the transmitter diaphragm which passageway comprises a plurality of compartments or chambers 38 and 39 connected, in a preferred embodiment of this invention, by a narrow restricted annular path 40. This division of the sound passageway into a plurality of chambers is accomplished by mounting therein an obstruction, baffle or other member 41 in spaced relation to the wall 42 of the sound passageway and to the diaphragm of the transmitter unit 23. This baffle or other member is shown in Figs. 1 to 6 as a circular, shallow, cup-shaped plane-base structure formed, preferably, of a phenol plastic material, and provided with a plurality of stepped inserts 43 which secure it and maintain it in spaced relation to a centrally apertured plate member 44 which is secured against the annular shoulder 45 of the body portion 24 in a manner now to be explained. The baffle member and its mounting plate are shown in perspective and exploded detail in Fig. 7.

The sound translating device or transmitter 23 is assembled, preferably, as a unit adapted to be inserted in the open rear end 46 of the body portion 24. It comprises a dome shaped or rear electrode 47; a comparatively large plate or front electrode 48 maintained in insulated and spaced relation to the rear electrode by washers 49 and 50 of insulating material and the exteriorly threaded ring 51 engaging with the interiorly threaded flanged portion 52 of the large electrode; a diaphragm 53 preferably of a lightweight high-strength material, such as aluminum or aluminum alloy, and having a plurality of spaced perforations 54 therein leading into a chamber 55 formed by the diaphragm and the large electrode; a plurality of paper washers 56 on opposite surfaces of a U shaped flanged peripheral portion of the diaphragm and other washers 57 between the portion 58 of the large electrode and the central portion of the diaphragm; a moisture proof membrane 59 of a material such as oiled or varnished silk; variable resistance material 60 in the chamber provided between the electrodes and the diaphragm; and a protector screen 61, for instance of wire gauze. These elements are securely held together, in the manner clearly shown in Fig. 3, by an L shaped annulus 62 interiorly threaded on its leg portion 63 to engage with the exteriorly threaded portion 64 of the large electrode. After assembly, the transmitter unit is inserted in the open end 46 of the body portion 24 adjacent the rear surface of the plate member 44 and is clamped thereagainst by the tightening of an exteriorly threaded clamping ring 65 engaging with the interiorly threaded portion 66 of the body portion 24 and insulatedly spaced from the unit by an annulus or washer 67, for instance, of a phenol fabric material. It will be apparent that the transmitter unit described is substantially similar to that described in United States Patent 1,756,705, granted April 29, 1930, to W. F. Smith, Jr. et al. In accordance with the teachings of that patent, the perforations in the diaphragm 53 and the chamber 55 are dimensioned so that when sound waves are impressed on the exposed side of the

diaphragm some of the low frequency energy has access to the rear side of the diaphragm so that there may be a partial equalization of the low frequency pressure acting on the diaphragm. The pressure produced by the high frequencies has access to one side only of the diaphragm, the dimensions of the perforations and of the chamber being such that the path to the rear surface of the diaphragm is of high impedance to high frequencies.

To prevent electrical packing of the variable resistance material in the transmitter unit 23 when switching apparatus in its circuit is operated, a condenser 68 is connected in shunt to the transmitter in accordance with the teachings of United States Patent 1,762,139, granted June 10, 1930, to A. F. Bennett et al. Such a condenser element forms a part, preferably, of the transmitter unit and may be fastened thereto in the following manner shown most clearly in Fig. 6. A preferably U shaped metallic member 69 having flaring arm portions 70 and 71 is secured to the large electrode of the transmitter by suitable means, for instance, a rivet 72. The condenser is provided with the flat terminals 73, one of which is secured, for instance, by a screw, to the arm 71 and the other to the terminal cap 74 threaded on the electrode 47. The conductors, not shown, connecting the transmitter unit to an outside circuit are to be connected to the terminal cap 74 and the arm 70 of the member 69.

The cavity or chamber 35 in the body portion 24 of the acoustic device surrounds the sound passageway and is entirely confined except for the passageways or vents 75 which connect it with the breath exhaust passages 76 leading from the sound passageway 37 to the atmosphere. These breath exhaust passageways are provided to enable the user of the acoustic device of Fig. 1 to breathe freely without removing the mouthpiece from about his mouth and to allow condensed breath vapors to drain off. To prevent intelligible sounds from escaping through these passages, the chamber 35 and the vents 75 are employed as elements to attenuate or suppress the higher voice frequencies which give intelligibility to speech sounds but to allow the low speech frequencies to pass to the atmosphere with the breath. It will be understood of course that the cavity 35 may take any desired shape so long as its acoustic properties are of the desired character but the arrangement shown and described has been found to permit a compact, symmetrical, voice silencing, acoustic device.

Referring now particularly to Fig. 3, it is seen that the chamber 39 comprises the volume between the rear plane-base portion 77 of the member 41 and the diaphragm 53. This chamber is proportioned, preferably, such that it provides an acoustic stiffness the restricted path 40 defined by the wall 42 and the baffle member 41 is proportioned, preferably, such that it provides an acuostic mass coupled to the chamber 39. The mass of the path 40 and the stiffness of the chamber 39 resonate when sound waves act thereon and increase the response of the device in the region of their resonant frequency.

Fig. 12 illustrates the electrical circuit analogue of the acoustical network leading to the diaphragm 53 of the transmitter unit 23. The acoustical element comprising the compartment or forward chamber 38 of the sound passageway is C_1. The chamber 35 and passages 75 are L_2, L_2 and C_2, and Z is the impedance into which the exhaust from the acoustic device works. L_3 represents the mass of fluid in the restricted path 40 connecting the chambers 38 and 39 and C_3 represents the stiffness of the compartment or rear chamber 39 between the baffle member and the transmitter diaphragm L_4 is the mass of the fluid in the passages 75. The transmitter unit is represented by the small rectangle lettered T.

When a baffle or other member is introduced into the sound passageway 37 to provide the elements L_3 and C_3, the resonance element introduced thereby has been found to increase the response of the device in the region of their resonant frequency. If it should be desired to alter the resonance characteristic of the resonant element comprising L_3 and C_3, this may be done by altering either the dimensions of the restricted path 40, or of the chamber 39, or of both. If the proportions of the path 40 are maintained constant, those of the chamber 39 may be varied by replacing the baffle member 41 with the baffle member 41*a* shown in Figs. 8 and 8A, which member is provided with a raised portion 78 whereby the acoustic stiffness of the chamber 39 is increased, or with the baffle member 41*b* shown in Figs. 9 and 9A, which member is provided with a depressed portion 79 whereby the acoustic stiffness of the chamber 39 is decreased.

It will be understood of course that the baffle or other member 41 need not necessarily comprise the cup-shaped member described with reference to Figs. 1 to 7, but may take the form of a flat disc, such as shown in Figs. 10 and 10A, provided the thickness thereof is sufficient to provide the necessary value of acoustic mass in the connecting path between the compartments of the sound passageway. If it should be determinated that this disc member acts as a vibrating element and such condition is not desired, it may be stiffened by forming it with a raised portion 81 on the surface di-

rected toward the source of sound waves to be transmitted, as indicated by Figs. 11 and 11A.

While the features of this invention have been disclosed with reference to a specific embodiment, it is understood of course that various modifications may be made in the details of construction without departing from the scope of the invention as defined in the appended claims.

What is claimed is:

1. An acoustic device comprising a transmitter having a diaphragm, and a housing therefor, said housing having a mouthpiece shaped to fit against the face and about the mouth of the user of the device, said housing having a sound passageway leading to said diaphragm, and a plate member in said sound passageway forming a restricted portion therein and dividing it into two chambers, said member being co-extensive with and spaced from said diaphragm and presenting a substantially flat surface to said diaphragm and to incoming sound waves.

2. An acoustic device comprising a telephone transmitter unit having a diaphragm, a housing for said unit comprising a mouthpiece, a hollow member providing a continuation of the mouthpiece, said hollow member having a shoulder portion at one end, a centrally apertured plate member mounted against said shoulder, and a plate member spaced from the hollow member and from one side of the apertured member and supported by the apertured member, said transmitter unit being mounted adjacent the other side of the apertured member.

3. An acoustic device comprising a transmitter having a diaphragm, a housing for said transmitter having a mouthpiece shaped to fit against the face and about the mouth of a user of the device and a sound passageway leading to said diaphragm, a plate member in said passageway dividing it into two chambers, said member being substantially flat and coextensive with the diaphragm and having a peripheral flange extending toward the mouthpiece.

In witness whereof, I hereunto subscribe my name this 21st day of May, 1931.

GEORGE G. MULLER.