Aug. 1, 1933. S. COUMBOPOULOS 1,920,631

SOUND AMPLIFYING HORN

Filed June 29, 1932 2 Sheets-Sheet 1

Fig. 1

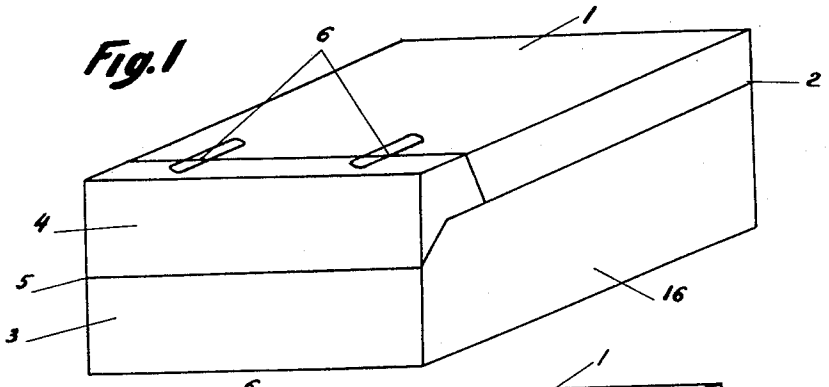


Fig. 2

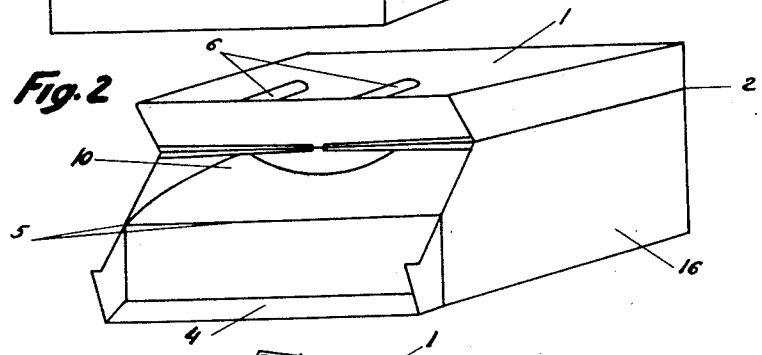


Fig. 3

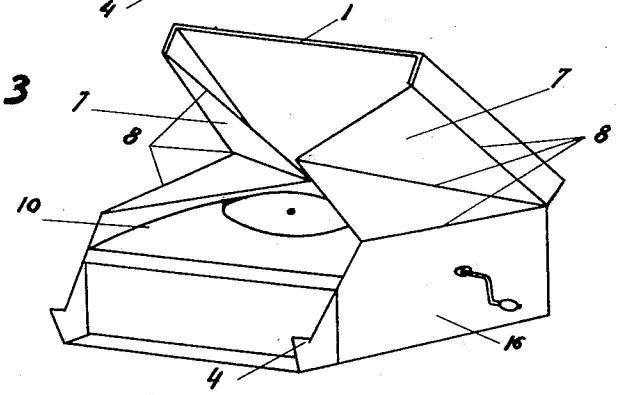
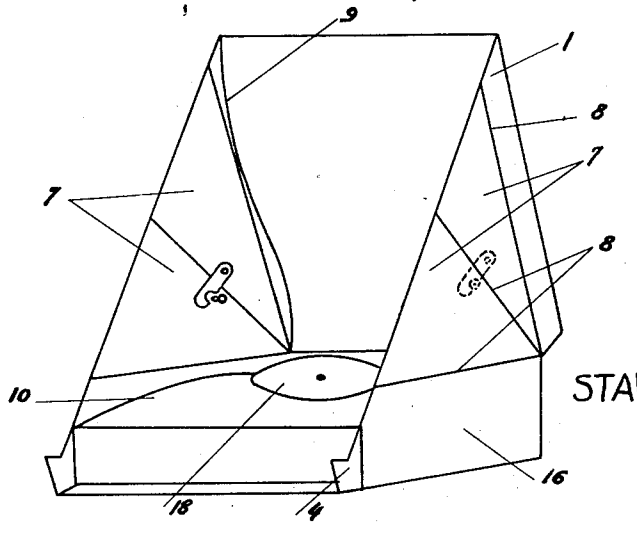


Fig. 4



STAVROS COUMBOPOULOS
INVENTOR

BY Haseltine, Lake, & Co.
ATTORNEYS

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Fig. 6

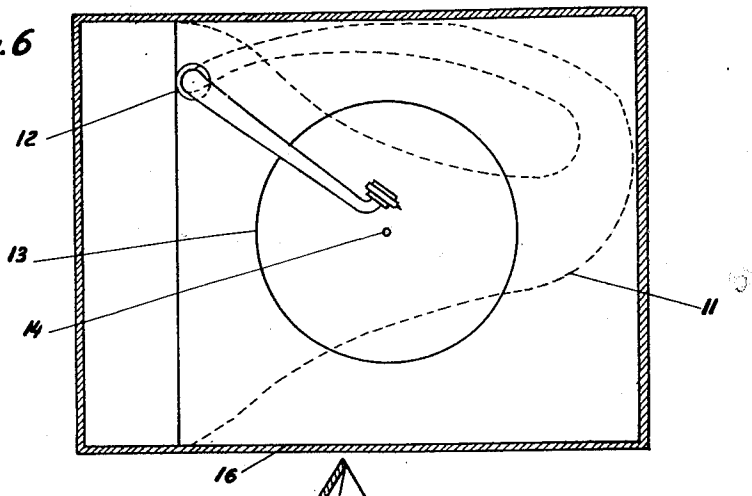


Fig. 7

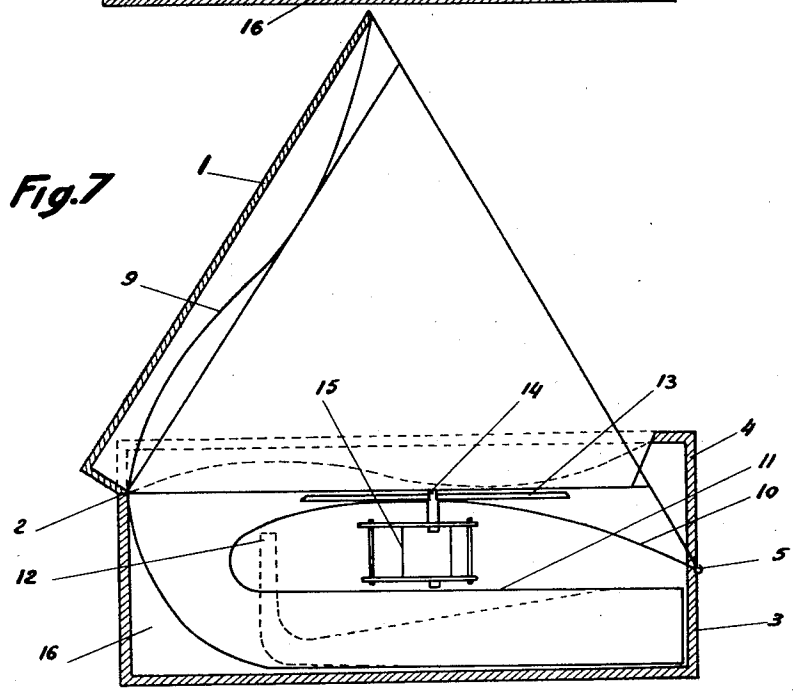
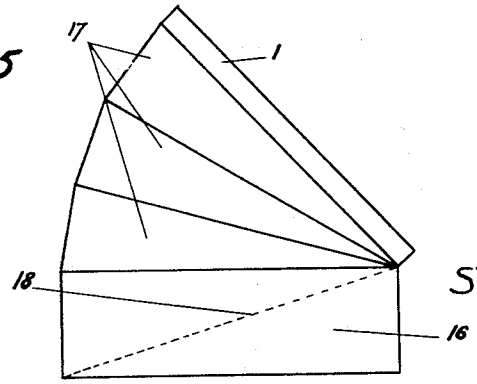


Fig. 5



STAVROS COUMBOPOULOS
INVENTOR

BY Haseltine, Lake & Co.
ATTORNEYS

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SOUND AMPLIFYING HORN

Stavros Coumbopoulos, Paris, France

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7 Claims. (Cl. 274—2)

The present invention relates to a new type of sound amplifying horn.

The invention consists in forming the wider end of a horn of this description by means of collapsible walls, the interior configuration of which is such that in the opened position, the section of the sound channel varies in accordance with a given law (for example, the exponential law), the exterior configuration of the walls, on the other hand, being such that in the collapsed position the assembly of the apparatus assumes the form of a parallelepiped box, and does not exceed the ordinary volume of phonographs or radio-receivers of the folding or portable type.

The invention aims also at the application of the horn so formed to phonographs, to loud speakers and to radio-receivers; to this end, the fixed body of the apparatus serves to receive together with a fixed shaped portion of the horn, members such as an electric or mechanical motor, speed regulator, turn-table, reproducing diaphragm or pick-up, movable arm, amplifier-detector with electrotonic tubes or other apparatus.

It is well known that the efficiency of the reproduction of portable phonographs is defective as regards the lower notes; this is due to the generally accepted form of construction of this type of apparatus according to which, by reason of the space limitation of the fixed part of the cabinet, the horn delivers the sound to the air through an opening, the section of which is much too small for the transmission of the lower notes. By means of the invention, on the other hand, it becomes possible to impart to the mouth of the horn of a portable apparatus all the enlargement desirable and notably to satisfy the conditions by which the exponential type of apparatus may be obtained, which, as is known, has afforded faithful reproduction of the total range of acoustic frequencies.

As regards loud speakers combined or not with radio-receivers, although the qualities of the horn types of loud speakers are known, preference is at present given to the types having sound radiating membranes, principally from the point of view of economizing in space. The invention enables loud speakers of an efficient horn type, for example, of the exponential type, to be employed in home or portable installations, by reason of the facility of installation and transport which is made possible.

The invention may further be understood by reference to the accompanying drawings and to the following description relating thereto.

In the drawings, Figures 1 to 4 represent in perspective various views of a horn constructed according to the invention and illustrating its adaptation to a portable gramophone; Figure 1 shows the apparatus closed, Figures 2 and 3 two successive stages of opening, and Figure 4 the apparatus completely opened. Figure 5 represents a modified construction of the folding sides and Figures 6 and 7 represent in plan and sectional side elevation respectively the configuration of the same apparatus.

The apparatus comprises walls, which when closed form a parallelepiped box. The upper part forms a lid 1 hinged at 2 to the main body of the box. The front wall 3 is divided midway of its height by a hinge 5 so as to permit the lowering of its upper part around the said hinge, as shown in Figure 2. The upper part of the wall 3 carries elements of fastening means 6 arranged to engage with other elements on the lid 1, to enable the whole to be fastened and maintain the assembly closed. The lateral walls of the horn, in the part thereof which may be opened out, are constituted by sheet members cut in the form of a triangle 7, the inside edges of which are connected to one another and the outer edges of which are connected to the edges of the box and of the lid, by means of the hinges which may with advantage be of the type termed piano hinges extending along the whole length of the connected edges of the various members. The interior of the lid is appropriately shaped by means of a wall 9, having the desired curvature and the upper side of the bottom of the box is closed by a curved wall 10. The curvature of the walls 9 and 10 together are arranged so that the interior of the mouth of the horn possesses the desired configuration, preferably a configuration in conformity with the exponential law. The walls 9 and 10 are joined in continuity with a sound conduit 11 arranged interiorly of the bottom of the box in volute form (Figure 6) and which is formed in accordance with the same laws as the mouth of the horn, for example, the exponential law. The conduit 11 extends from an orifice 12 with which in the case of a phonograph a tone arm (not shown) carrying the sound reproducing device is arranged in communication. In this particular application of the invention, a turn-table 13 carried by a shaft 14 of a motor 15, may be located directly above the upper wall 10 of the horn, whilst the motor 15 is located below this

wall, in the space between the same and the conduit 11. By reason of the large opening of the funnel, the turn-table remains perfectly accessible for the purpose of changing records, as may be observed by reference to Figure 4. For rendering the drawing clear, illustration of other accessory members of the apparatus has been dispensed with, that is to say, levers, such as for a turn-table brake, for controlling the speed regulator, speed indicator or other device which may easily be fitted in the vicinity of the turn-table.

Figure 5 shows a modification of the folding lateral walls of the horn mouth which close the side openings between the lid 1 of the box and the body 16 thereof. In this modification, the side walls are each formed of a plurality of triangular segments 17 which fold or slide one upon the other in the manner of the elements of a fan, so that in the closed position, they occupy the position indicated in dotted lines at 18 adjacent to the vertical side walls of the body 16 of the box.

For the application of the invention to loud speakers, the turn-table 13 and the motor 15 are omitted, and the orifice 12 of the conduit 11 which remains within the bottom of the box, is connected to the casing of a telephone type of receiver of any desired kind so that the sound reproduced thereby is communicated to the conduit.

When applying the invention to a radio-receiver of the portable type, the receiving, detecting and amplifying apparatus as also the necessary batteries, are housed in the bottom portion of the box.

It is, moreover, possible by appropriate design to retain in the portable radio-receiver construction, the turn-table 13 and motor 15, and to add a pick-up, thus providing a combined radio-gramophone apparatus fitted with the improved horn according to the invention. Also the members included in the apparatus may be limited to the turn-table, the pick-up, the motor (either mechanical or electric) and an amplifier, thus producing an electric gramophone.

It will be appreciated that the invention is capable of various constructional forms and the dimensions and configuration of the constituent members of the horn and the kind of materials employed for their construction may be selected as desired. In particular the body of the box as well as the lid, the fixed and collapsible walls and the lower fixed sound conduit 11 may be made either of wood (solid or ply) or in metal (drawn, stamped or cast) or in moulded or synthetic material (fibre, bakelite or the like) or wholly or in part of these various materials. In a cheap construction, the collapsible lateral walls may even be formed of light materials such as covered cardboard, the hinge connections being, for example, constituted by sized cloth. In any event, it is to be understood that one of the advantages of the invention and especially of the modes of construction, as indicated, is to permit in a reduced volume of the assembly of parts sufficiently thick in order to be solid and non-resonant, which are connected together by stout connections, with the object of assuring the best technical conditions for the reproduction of sound, by means of a compact and durable apparatus.

What I claim and desire to secure by Letters Patent is:—

1. Sound reproducing apparatus comprising a box consisting of a fixed portion and a lid articulated thereto, fixed partial side walls extending a limited distance upward, upward extensions of the side walls extending between the partial fixed side walls and said lid when the box is open, means for locating said upward extensions of the side walls within the box when the same is closed, an amplifying sound conduit within the box below the level of the upward extensions of said side walls, and a fixed portion in said box facing the lid but spaced from the same, which sound conduit together with the space defined between said fixed partial side walls, fixed portion, upward extensions of the side walls and the lower side of said lid forms a practically integral and acoustically continuous sound amplifying horn whereof the section along the longitudinal axis of the horn varies in a predetermined manner according to the laws of the progressive amplification of sound and propagation of low frequency sound waves.

2. Sound reproducing apparatus comprising a box consisting of a fixed part and a lid articulated thereto, of side walls extending between the fixed part and the lid when the box is open, of means for locating the said walls within the box when the same is closed, a surface member forming a portion of the fixed part of the box and being at all times spaced from the bottom of the lid, and a sound conduit disposed within the box, and which together with the space defined between the bottom of the lid, said surface member of the fixed part of the box arranged to face the lid and said side walls forms an acoustically continuous and integral sound amplifying horn whereof the section varies along the longitudinal axis of the horn according to a predetermined law for the propagation of sound waves of the lower frequencies.

3. Sound reproducing apparatus comprising a box consisting of a fixed part and a lid articulated thereto, of side walls extending between the fixed part and the lid when the box is open, of means for locating the said walls within the box when the same is closed, a surface member forming a portion of the fixed part of the box and being at all times spaced from the bottom of the lid, and a sound conduit disposed within the box, and which together with the space defined between the bottom of the lid, said surface member of the fixed part of the box arranged to face the lid and said side walls forms an acoustically continuous and integral sound amplifying horn whereof the section varies along the longitudinal axis of the horn according to an exponential law for the propagation of sound waves of the lower frequencies.

4. Sound reproducing apparatus comprising a box consisting of a fixed part and a lid articulated thereto, of side walls extending between the fixed part and the lid when the box is open, of means for locating the said walls within the box when the same is closed, a surface member foming a portion of the fixed part of the box and being at all times spaced from the bottom of the lid, a sound conduit disposed within the box and which together with the space defined between the bottom of the lid, said surface member of the fixed part of the box arranged to face the lid and said side walls forms an acoustically continuous and integral sound amplifying horn conductive of sound waves of the lower frequencies, means con-

tained within said box for producing sound waves and means for communicating said waves to the smaller end of said horn.

5. Sound reproducing apparatus comprising a box composed of a fixed part and a lid articulated thereto, of side walls extending when the box is open between the fixed part and the lid, said walls being constituted by a plurality of boards of triangular configuration and articulated one to the other, the two end boards of each wall being articulated respectively to the lid and to the said fixed part, said boards being foldable whilst closing the box so as to locate them within the confines of the closed box, and a sound conduit located within said box and which together with the space defined between the bottom of the lid, said surface member of the fixed part of the box arranged to face the lid and said side walls when the lid is open, forms an acoustically continuous and integral sound amplifying horn for the lower frequencies.

6. Sound reproducing apparatus comprising in combination a boxed formed of a fixed part and a lid articulated thereto, of side walls extending, when the box is open, between the fixed part and the lid, said walls being constituted by a plurality of boards in the form of triangular segments arranged to slide one over the other to collapse the walls when closing the box so that the segments are located within the confines of the closed box, a surface member forming a portion of the fixed part of the box and being at all times spaced from the bottom of the lid, and a sound conduit located within said box and which together with the space defined between the bottom of the lid, said surface member of the fixed part of the box arranged to face the lid and said side walls when the lid is open, forms an acoustically continuous and integral sound amplifying horn for the lower frequencies.

7. A portable phonograph comprising in combination a box constituted by a fixed part and a lid articulated thereto, of side walls extending when the box is open, between the lid and the fixed part, means for locating said walls within the confines of the closed box, a turntable disposed adjacent to one surface member of the fixed part, a motor for rotating the turntable fitted inside the box, a device for producing sound waves from a gramophone record carried by said turn-table, a tone arm arranged to receive said sound waves, and a sound conduit arranged within said box to receive the sound waves from said tone arm and which together with the space defined between the bottom of the lid, the surface member of the fixed part disposed adjacent to the turn-table and said lateral walls when the lid is open, form an acoustically continuous and integral sound amplifying horn whereof the section of which varies according to a predetermined law for the propagation of the lower sound frequencies.

STAVROS COUMBOPOULOS.