July 8, 1930. L. C. GRANT 1,770,234

APPARATUS FOR REPRODUCING SOUND

Filed July 6, 1928

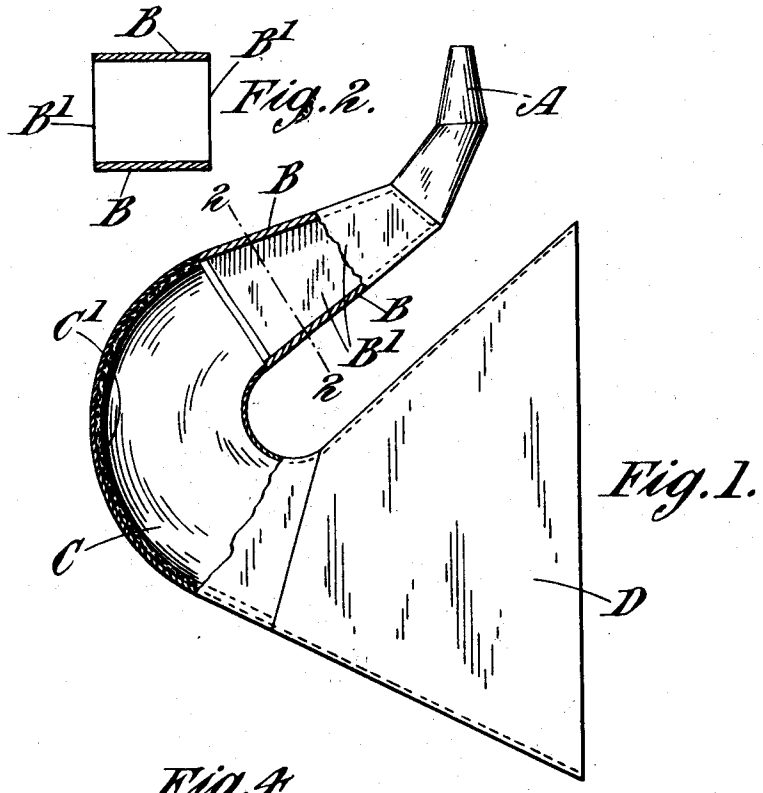


Fig. 1.

Fig. 4.

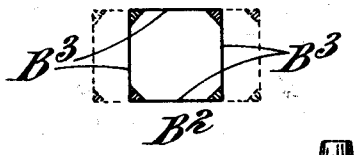
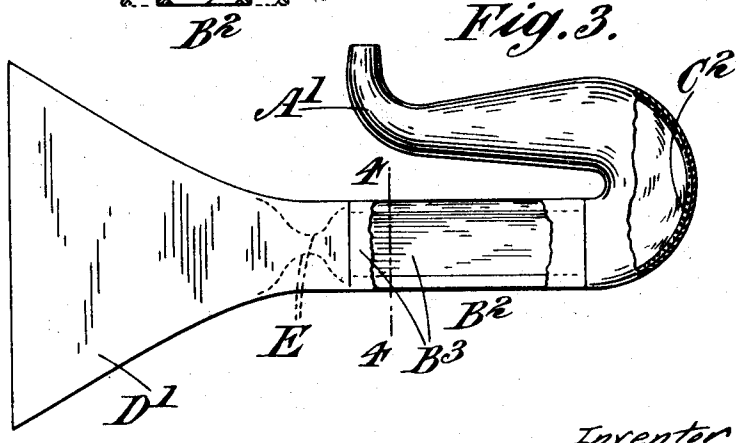


Fig. 3.



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UNITED STATES PATENT OFFICE

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APPARATUS FOR REPRODUCING SOUND

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This invention relates to apparatus for reproducing sound, for example gramophones, loud speaking telephones and the like.

It is well known that such apparatus as usually made does not give a true reproduction of the original sound but distorts it by amplifying vibrations at certain frequencies more than those at other frequencies. Generally it is the lower frequency vibrations which are lost or but slightly amplified. Such lower tones can be reproduced by the employment of a horn of great length and large outlet area but apart from the disadvantage of size, such horns suffer from the defect of being but slightly responsive to vibrations of higher frequency.

The object of the present invention is the construction of a horn or resonator tube which is free from such disadvantages, and whilst of a size suitable for ordinary commercial use, amplifies much more equally vibrations whose frequencies extend over a wide range.

This is accomplished according to the present invention by so constructing the horn or resonator tube that it has a natural peridicity different from that of the air column contained in it. This natural peridicity of the horn itself is preferably, though not necessarily, lower than that of the air column in order to amplify the lower tones which, owing to the natural period of vibration of the comparatively short air column in a horn of normal size, are not reproduced at all.

One or more of the walls or sides of the horn or resonator tube or a portion thereof may be made responsive to vibrations which are lost or only slightly amplified in the sound due to the normal vibration of the air column.

The resonant portion is preferably made by forming it of flexible or thin material, such for instance as paper, treated fabric or thin wood, its dimensions being such as to give it the desired natural frequency. There may be more than one such portion and they may be arranged to respond to different frequencies or bands of frequencies.

These flexible portions provide a large area of coupling to the air outside the walls, such large area being required to produce lower frequency tones satisfactorily.

In some cases the area of the air column within the horn or resonator tube may be restricted either by making the horn itself or portions thereof of comparatively small dimensions in cross-section or my forming or placing in the horn an internal restriction or orifice. The object of this is to enable the low frequency energy to set up an increased air pressure within the horn or tube to act on the flexible portions and enhance their effect.

The desired object of equalizing the amplification of the various frequencies throughout the range may be further assured by making use of the well known properties of certain materials for reflecting or absorbing vibrations of various frequencies. Thus felt and like substances tend to reflect low frequency vibrations and absorb those at higher frequencies whilst hard polished surfaces have the opposite tendency. In a horn or resonator tube according to this invention there may be parts made of or lined with substances having these properties.

The member which transmits the vibrations which are amplified by the improved horn or resonator tube may be a diaphragm, a reed, or a piston but with the details of construction of this member itself and the means for setting it in motion, the present application is not concerned.

In one construction of horn according to this invention the smallest portion of the neck adjacent to the diaphragm or like member is made of polished metal. Following this is a portion preferably square in cross-section made of a wooden framing with either all four sides or two opposite sides of thin flexible material stretched over the framing and secured to it. A third portion is of metal lined wholly or partially with baize, felt or similar material and this portion leads to a flared mouth which may be of metal or wood and may, if desired, form part of an enclosing cabinet.

The horn as a whole increases in cross-sectional area from the neck onwards in accordance with known practice and its axis

may be straight, but it is preferred to shape the various sections so that the axis is curved to enable the horn to occupy less space and to be contained easily in a gramophone or loud speaking telephone cabinet.

In the accompanying drawings,

Figure 1 is an elevation partly in section of one construction of horn according to this invention,

Figure 2 is a cross-section on the line 2—2 of Figure 1,

Figure 3 is an elevation of another construction of horn also according to this invention, and

Figure 4 is a cross-section on the line 4—4 of Figure 3.

With reference first to Figures 1 and 2, A is the small or inlet end of the horn which receives the vibrations from the diaphragm or like member. It is made of polished metal and leads into the adjoining section two sides B of which are made of wood and the other two sides B^1 of fabric, paper or other flexible material to furnish a large area of coupling to the air outside. From this flexible walled section a curved metal section C leads to a flared mouth D which may be of wood and is preferably rectangular in cross-section. The orifice of this mouth section may constitute the open front of the containing cabinet and its dimensions may be, for instance, 34 inches high and 27 inches wide. The horn is of gradually increasing cross-sectional area from the inlet to the mouth and the rate of increase is preferably such as to follow the well known logarithmic or exponential law.

As indicated in Figure 1 the curved section C may be lined as at C^1 with baize or like material which tends to absorb some of the higher frequency vibrations.

The horn illustrated in Figures 3 and 4 comprises a metal inlet section A^1, an intermediate section B^2 with all four walls B^3 of flexible material (Figure 4) and a flared mouth section D^1. The dotted lines at E in Figure 3 indicate a constriction in the portion of the mouth section where it joins the intermediate section B^2. Such a constriction may be provided to increase the air pressure acting on the flexible walls B^3 and thus enhance the effect of the low frequency vibrations. This effect may also be produced by enlarging the area of the flexible walls B^3 relatively to the rest of the horn as, for instance, is indicated in dotted lines in Figure 4. The curved portion of the inlet section A^1 in Figure 3 is shown as lined as at C^2 with baize or like material to absorb some of the higher frequency vibrations.

The orifice of the mouth section D^1 of the horn shown in Figure 3 may be say 15 to 18 inches square and the other dimensions in proportion, but it is to be understood that all the dimensions given are merely by way of example.

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

1. In apparatus for reproducing sound, a resonator tube comprising an inlet, a flared mouth, a portion made of flexible material between said inlet and said flared mouth, and a constriction between said portion made of flexible material and said mouth.

2. In apparatus for reproducing sound, a resonator tube comprising an inlet, a flared mouth, a portion made of flexible material between said inlet and said flared mouth, a constriction between said portion made of flexible material and said mouth, and another portion lined with material to absorb some of the higher frequency vibrations.

In testimony whereof I have signed my name to this specification.

LEWIS COLIN GRANT.