PATENT SPECIFICATION

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PROVISIONAL SPECIFICATION

Improvements in and relating to Baffles and Containers for Loud Speakers

We, PHILIP KESTON TURNER, a British Subject, of 73, Osborne Road, Windsor, Berkshire, and HARTLEY TURNER RADIO LIMITED, a British Company, whose registered office is at Dome Buildings, The Square, Richmond, Surrey, do hereby declare the nature of this invention to be as follows:—

The present invention relates to baffles of forms other than flat, either as separate boxes or containers for loud speakers, or as part of a cabinet containing the amplifier or other apparatus actuating the loud speaker, a familiar example being what is usually known as a radio-gramophone cabinet.

It is well known that a loud speaker of the type employing a "small" diaphragm, i.e. a cone or diaphragm whose diameter is of the order of a foot or less, fails to reproduce bass notes adequately unless the cone or diaphragm is surrounded by a baffle of sufficiently large size. The simplest such baffle is a rigid flat surface several feet in diameter, but this is often inconvenient and is sometimes replaced by a box, the diaphragm usually being placed near the centre of the front surface.

When this is done, it is found that certain low notes are greatly accentuated, the effect being known in the art as "box resonance." This accentuation may in part be due to vibration or drumming of the sides of the box, but even if the sides are too rigid to vibrate, there is still a box resonance due to the definite volume of air enclosed in the box. This is less severe if the back of the box is left open, but is still sufficient to spoil the smooth response of a good loud speaker.

According to the present invention, the space within the box is provided with layers of sound absorbing material alternating with air spaces.

One method of carrying out the invention is to provide a number of light frames, of dimensions slightly less than the front of the box, and of back to front thickness, say, one inch or one and a half inches. There may be from, say, six to twenty of these frames, depending on the depth of the box. Each frame is covered on one side and round the edges with a sheet of gumgee tissue or cotton wool of thickness, say, half an inch in the uncompressed state. A hole of appropriate size is then cut in each cotton wool screen to clear that part of the loud speaker which it will surround, and the frames are placed in the box one after another, in contact one with another and parallel to the front of the box. Those frames which will lie altogether behind the speaker are provided with holes of progressively diminishing size, the last of all having no hole or one of an inch or less in diameter.

In this manner it is ensured that waves of substantially all important audio frequencies will be so heavily damped in travelling about the interior of the box that by the time they have progressed from the diaphragm, been reflected from the rigid box and returned to the cone, their amplitude will be negligible as regards reinforcing or interfering with the motion of the cone or diaphragm, so that there will be no perceptible resonance

For waves of high frequencies are known to be rapidly absorbed in the small air spaces between the individual fibres of such materials as cotton wool and the like, while long waves of low frequency are absorbed in the larger air spaces between the separate sheets.

To avoid box resonance, it is sufficient that all sound waves emanating from the cone be reduced to a negligible fraction of their original amplitude before again reaching the diaphragm after reflection. But, if the damping is increased so that this reduction takes place before the waves reach the walls of the cabinet, the condition is that in which there can be no interference at all between the waves emitted from the front and the back of the diaphragm: that is, such a box has the properties of an infinite baffle.

Other methods of fixing the material and other arrangements of the sheets may be adopted. For example, a material may be chosen with sufficient stiffness to dispense with the frames, these stiff sheets

being separated by suitable distance pieces. The essence of the invention is the alternation of several sheets of absorbing material and thin or flat air passages, the thickness of the sheets and the air passages being of the same order.

Dated this 13th day of August, 1931.
P. K. TURNER,
For HARTLEY TURNER RADIO LIMITED,
H. A. HARTLEY, Director

COMPLETE SPECIFICATION

Improvements in and relating to Baffles and Containers for Loud Speakers

We, PHILIP KESTON TURNER, a British Subject, of 73, Osborne Road, Windsor, Berkshire, and HARTLEY TURNER RADIO LIMITED, a British Company, of Dome Buildings, The Square, Richmond, in the County of Surrey, do hereby declare the nature of this invention and in what manner the same is to be performed to be particularly described and ascertained in and by the following statement:—

This invention relates to baffles for loud speakers. It is well known that loud speakers of the type having "small" diaphragms, of the order of one foot or less in diameter, fail adequately to reproduce sounds of low frequency unless the one side of the diaphragm be more or less isolated acoustically from the other, the greater the extent to which isolation is effected the better being the reproduction of low frequency sounds.

Flat rigid members or boards used as baffles for effecting the necessary isolation must be of large dimensions, of the order of four feet or more in diameter for high fidelity reproduction. Moreover, boxes or cabinets, especially those of wireless receiving sets, which are sometimes used as baffles for compactness, greatly modify the results obtained from an associated loud speaker; the effect being known in the art as "box-resonance." Making the sides of the box rigid enough not to vibrate does not eliminate the box-resonance effect because of resonance of the body or column of air within the box, which, even if the back of the latter be left open, is sufficient to spoil the performance of a good loud speaker. For good results a box baffle lined with material which is absorbent or of low conductivity to sound must be so rigid and must contain so much sound absorbent material as to be very heavy and expensive. Further, the effect of a thick sound absorbent lining is to raise the frequency of, rather than to eliminate altogether, the undesirable air column resonance.

The present invention has for an object to provide an improved method and means for more effectively and conveniently acoustically isolating the two sides of the diaphragm of a loud speaker of the type referred to, and to this end and in accordance with the invention the two sides of a loud speaker diaphragm are acoustically isolated from one another by acoustically enclosing one side of the diaphragm by means of a series of air-spaced layers of material which is absorbent or of low conductivity to sound, some or all of said air-spaced layers being formed with openings to afford easy access for sound waves from the acoustically enclosed side of the diaphragm to the air spaces between said layers.

Preferably these air-spaced layers are parallel, the thicknesses of the layers and of the air spaces therebetween being of the same order. Some of the air-spaced layers will, in general, be formed with openings to present a cavity for the accommodation of the body of a loud speaker and some of them may be formed with openings to present one or more air cavities which is or are preferably of decreasing transverse dimensions in a direction away from the loud speaker diaphragm.

In general, the air-spaced layers will be disposed substantially in planes to which the axis of the loud speaker diaphragm is normal, the rearmost layer being continuous or formed with a small aperture. Preferably, where many of the layers are disposed completely in rear of the loud speaker, some of such rear layers are apertured so that an air cavity is presented immediately behind the loud speaker.

Three baffles according to the invention are illustrated in sectional side elevation by Figures 1, 2 and 3, of the accompanying diagrammatic drawings, Figures 4 and 5 thereof being fragmentary views showing, in sectional side elevation and in perspective, respectively, one way of mounting non-rigid layers of sound absorbent material in parallel spaced relationship.

As shown in Figure 1 a loud speaker indicated generally at 11 is mounted in register with an opening 12 in the centre of the front wall 13 of a substantially cubical box 14 which, except for said opening 12, is closed at all six sides, and layers 15 of material which is absorbent

or of low conductivity to sound are mounted within the box 14 in parallel spaced relationship and so that the axis of the loud speaker 11 is normal thereto. Of the layers 15, those in the forward part of the box 14 are apertured centrally to accommodate the loud speaker 11, two immediately in rear of the latter are formed with smaller apertures, and the remainder, except the rearmost which is continuous, are formed with apertures of progressively decreasing transverse diameter. There is thus provided an air cavity 16 immediately in rear of the loud speaker 11. A modified arrangement may be exactly similar to that shown in Figure 1 except that the rear wall of the box is omitted, the rear of the box being closed simply by the rearmost layer 15 of sound absorbent material.

The arrangement shown in Figure 2 is similar to that shown in Figure 1, a loud speaker 21 being mounted in register with an opening 22 in the front wall 23 of a box 24 containing parallel spaced layers 25 of sound absorbent material. The box 24, however, has no rear wall and there is no air cavity such as 16 of Figure 1. The rearmost layer 25 is shown as having a small central opening, but it may if desired be continuous.

In the arrangement of Figure 3 of the drawings a loud speaker 31 is mounted in register with an opening 32 in the front wall 33 of a box 34 having no rear wall and containing parallel spaced layers 35 of sound absorbent material. The dimension from front to rear of the box 34 is little more than just sufficient for the accomodation of the loud speaker 31 and some of the spaced layers 35 of sound absorbent material are apertured so as to provide a number of air cavities 36 disposed symmetrically around the loud speaker 31.

Any known or convenient material, rigid or otherwise, which is absorbent or of low conductivity to sound may be employed according to the invention, and sheets thereof may be mounted or supported in fixed spaced relationship in any known or convenient manner, e.g. by clamping together an assembly of distance pieces and layers of sound absorbent material. As shown in Figures 4 and 5, however, a series of open light wooden frames 41 covered each at one side and around its periphery with a sheet 42 of gamgee tissue or cotton wool are placed side by side in a box 43, the dimensions of the frames 41 and the thickness of the sheets 42 being such that the margins of the sheets 42 are compressed between the frames 41 and the box walls. The frames 41 with the sheets 42 carried thereby are maintained in place by fillets 44 at the rear of the box 43 at such distance from the front wall (not shown) of the latter that the margins of the sheets 42 are further compressed as at 45 between adjacent frames 41. In this way the frames 41 are supported resiliently within the box 43.

It is found that with a box baffle such as those described there is no perceptable box-resonance effect; sound waves travelling about the interior of the box being so heavily damped that by the time they have progressed from the diaphragm of the loud speaker, been reflected from the box walls, and returned to the diaphragm, they are so much reduced in amplitude that any effect thereof upon the motion of the loud speaker diaphragm is negligible. Sound waves of high frequency are readily absorbed in the small air space between the individual fibres of sound absorbent material, such as cotton wool, and low frequency sound waves are absorbed in the larger air spaces between the separate layers. So long as all sound waves emanating from the loud speaker diaphragm are reduced to a negligible fraction of their original amplitude before again reaching the diaphragm from the box walls there will be no resonance due to air within the box. It will be seen, moreover, that it is possible, e.g. by employing sufficiently large layers of sound absorbent material, to ensure that the amplitude of sound waves emanating from the loud speaker diaphragm shall be reduced to such negligible amplitude even before they reach the walls of a box baffle within which such layers are disposed. Thus a box baffle according to the invention may be formed from wood which is much thinner and less rigid than could normally be employed successfully, and, further, it is possible to dispense entirely with an actual box. Where it is the case that sound waves emanating from the loud speaker diaphragm are reduced to a negligible fraction of their original amplitude before reaching the margins of the layers of sound absorbent materal, the arrangement has the properties of a flat baffle of infinite extent, and, so far as acoustic isolation of one side of a loud speaker diaphragm from the other is concerned, no box is required, it being sufficient to have a loud speaker and a series of air spaced layers of sound absorbent material mounted in such relationship that one side of the loud speaker diaphragm is acoustically enclosed.

In all cases it is desirable that the thicknesses of the alternate layers of sound absorbent material and air should be of the same order.

Having now particularly described and

ascertained the nature of my said invention and in what manner the same is to be performed we declare that what we claim is:—

1. A method of acoustically isolating the one side of the diaphragm of a loud speaker of the type referred to from the other, which consists in acoustically enclosing one side of the diaphragm by means of a series of air-spaced layers of material which is absorbent or of low conductivity to sound, some or all of said air-spaced layers being formed with openings to afford easy access for sound waves from the acoustically enclosed side of the diaphragm to the air spaces between said layers.

2. For carrying out the method according to claim 1, a baffle comprising a series of apertured or locally cut-away air-spaced layers of material which is absorbent or of low conductivity to sound.

3. A baffle for a loud speaker of the kind referred to comprising a series of air-spaced layers of material which is absorbent or of low conductivity to sound, and means for mounting a loud speaker in such relationship to the series that one side of its diaphragm is acoustically enclosed thereby, some or all of said air-spaced layers being formed with openings to afford easy access for sound waves from the acoustically enclosed side of the diaphragm to the air spaces between said layers.

4. A baffle as claimed in either of claims 2 or 3, wherein the air-spaced layers are parallel, the thickness of the layers and the air-spaces therebetween being of the same order.

5. A baffle as claimed in any of claims 2, 3 and 4, wherein the openings in some of the air-spaced layers are such as to provide a cavity for the accommodation of the body of the loud speaker.

6. A baffle as claimed in any of claims 2 to 5, wherein the openings in some of the air-spaced layers are such as to provide one or more air cavities.

7. A baffle as claimed in claim 6, wherein the transverse dimensions of such air cavity or cavities decrease in a direction away from the loud speaker diaphragm.

8. A baffle as claimed in any of claims 4 to 7, wherein parallel air-spaced layers are disposed substantially in planes to which the axis of the loud speaker diaphragm is normal, the rearmost layer being continuous or formed with a small aperture.

9. A baffle as claimed in claim 8, wherein of a number of layers disposed completely in rear of the loud speaker some layers are apertured so that an air cavity is presented immediately behind the loud speaker.

10. A baffle as claimed in any of claims 4 to 9, wherein open frames covered each at one side and around its periphery with a sheet of non-rigid material which is absorbent or of low conductivity to sound are placed side by side within a box, the arrangement being such that the margins of said sheets are compressed not only between said frames and the walls of the box but also between adjacent frames.

11. A method of acoustically isolating the one side of a diaphragm of a loud speaker of the type referred to from the other, substantially as hereinbefore described with reference to the accompanying diagrammatic drawings.

12. A baffle for a loud speaker, substantially as hereinbefore described with reference to the accompanying diagrammatic drawings.

Dated this 28th day of March, 1935.

For the Applicants,
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Fig. 1.

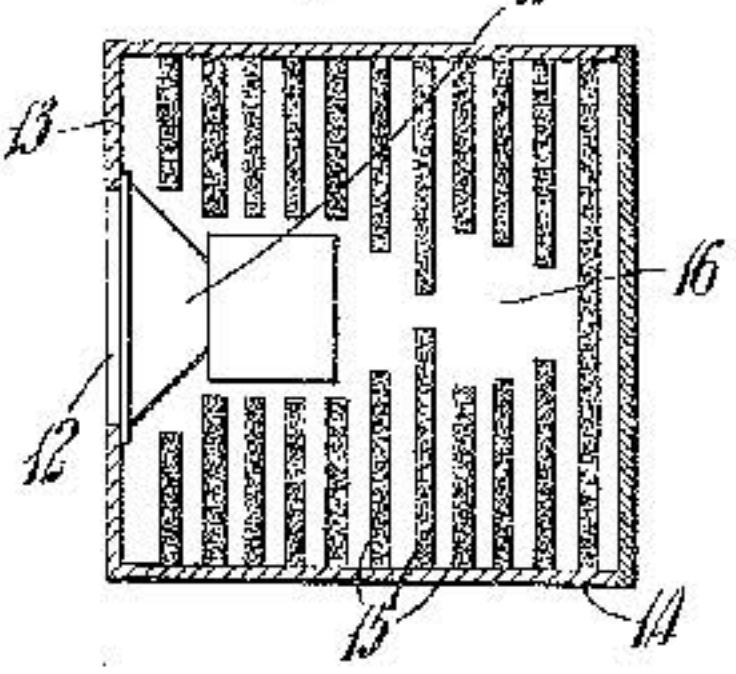


Fig. 2.

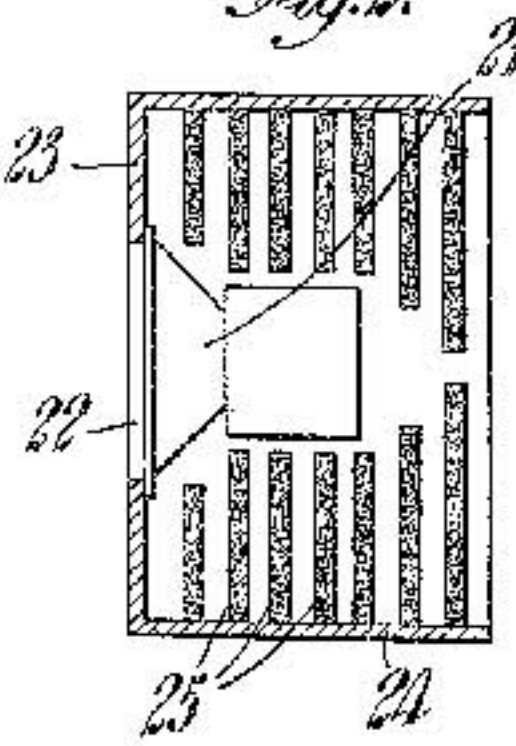


Fig. 3.

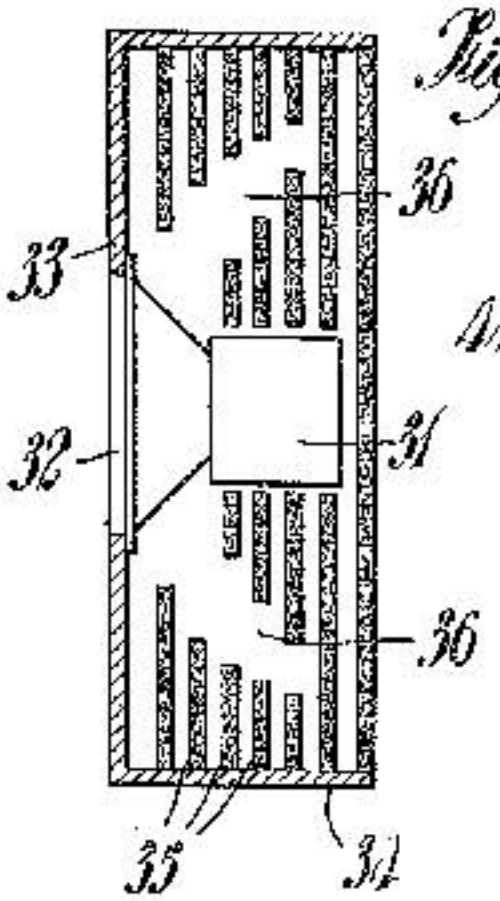


Fig. 4.

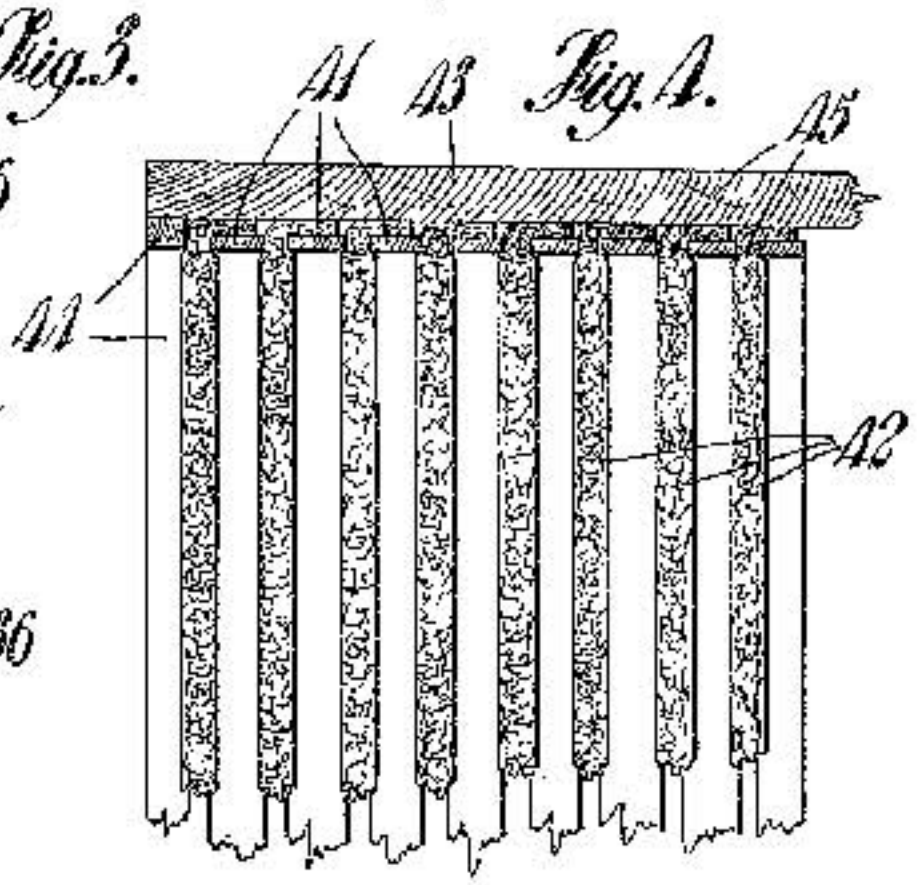
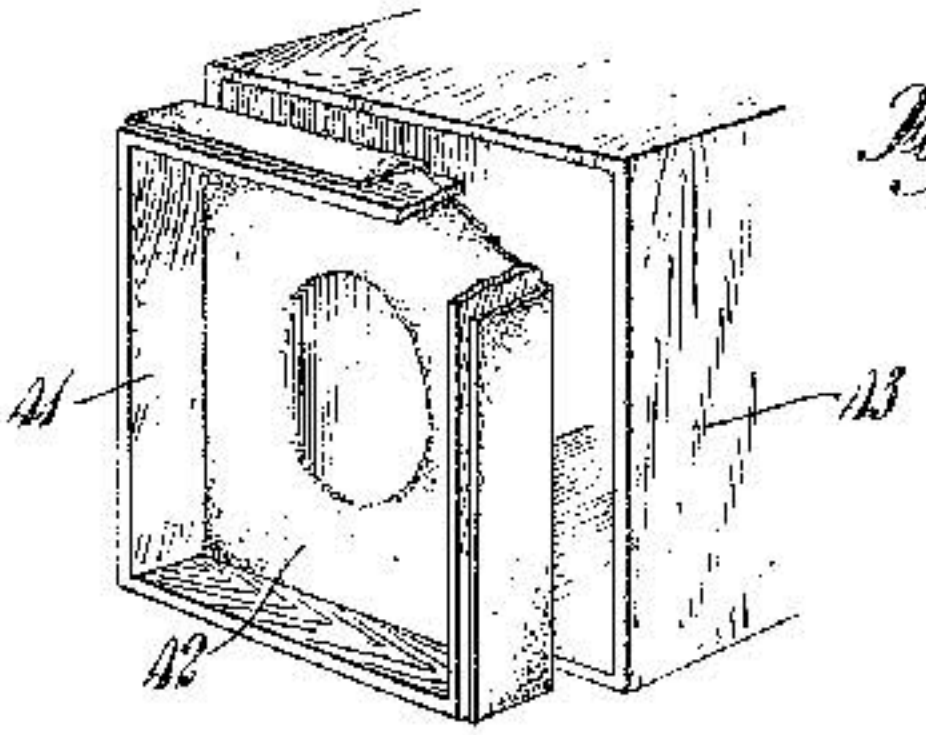


Fig. 5.



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