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H. F. OLSON ET AL
LOUDSPEAKER STRUCTURE

2,815,823

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2 Sheets-Sheet 1

Fig. 1.

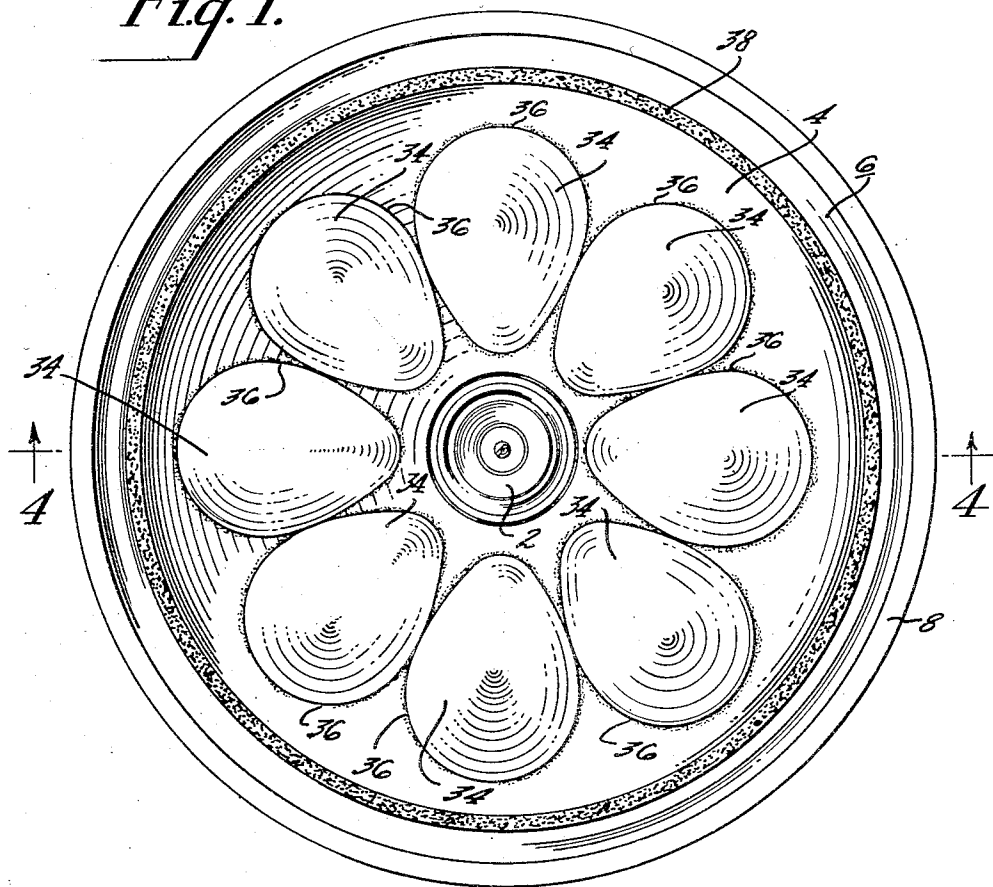


Fig. 2.

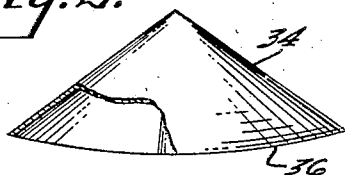
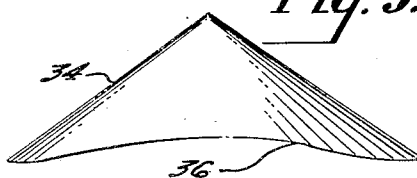


Fig. 3.



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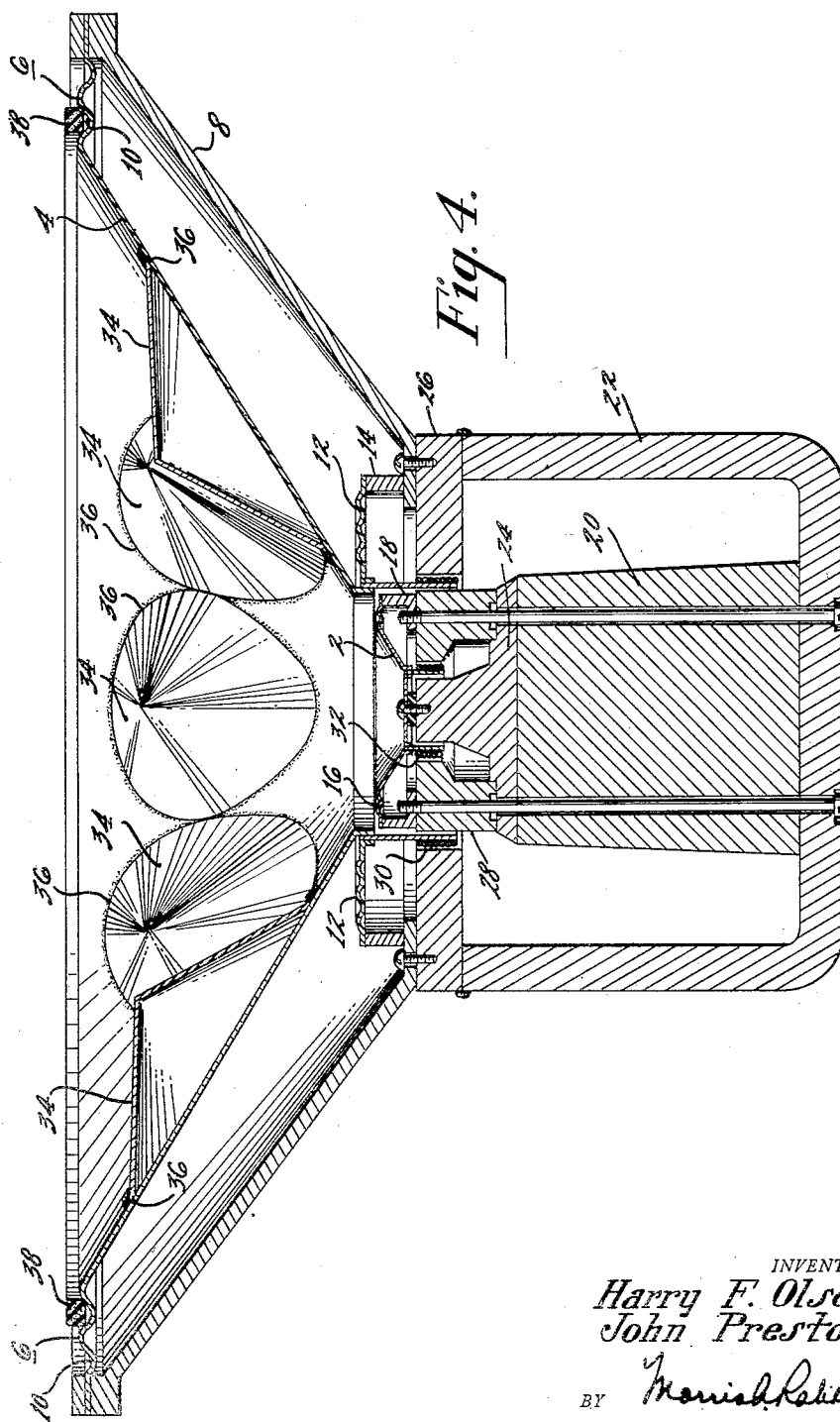
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LOUDSPEAKER STRUCTURE

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8 Claims. (Cl. 181—32)

This invention relates to acoustics and more particu-
larly to loudspeakers.

There has been developed and marketed a wide fre-
quency range loudspeaker which is characterized in that
the single speaker has a low frequency cone and a high
frequency cone. The low frequency cone is truncated.
The high frequency cone is arranged centrally of the
larger, low frequency cone, constituting substantially a
continuation of the conic surface of the larger cone. An
example of such a speaker is known, commercially, as
the RCA Duo-Cone. Although the speakers of the type
give excellent results and have found wide acceptance on
the market, it has been found that the response of the
speaker in the range of 2500 to 8000 cycles/sec. was
somewhat low. Signals in that frequency range are sup-
plied by the high frequency or smaller cone. The output
of a direct radiator loudspeaker can be increased by reduc-
ing the solid angle into which the speaker radiates. How-
ever, a symmetrical reduction of the solid angle, in the
case of speakers of the type under consideration, would
mean a reduction of the angle of the low frequency cone.
Such an expedient would, obviously, impair the broad
directivity pattern of the low frequency cone.

It is, accordingly, an object of the present invention
to provide means for improving the output of the high
frequency cone of a double-cone speaker without impair-
ing the output of the low frequency cone.

It is another object of the present invention to provide
an improved double cone, wide frequency range loud-
speaker which is characterized in that the output of the
high frequency cone is improved without impairing the
output of the low frequency cone.

It has also been noticed that slight dips occur at certain
frequencies along the axis of the speaker. These dips, it
was determined by the present inventors, are caused, at
least in part, by sound waves from the small, high-fre-
quency speaker being reflected by the surface of the
larger, low frequency speaker.

It is a further object of this invention to provide an
improved double cone loudspeaker in which the foregoing
difficulty is overcome.

A still further object of this invention is to provide
an improved speaker as set forth in which the reflecting
surface of the low frequency cone is broken up.

A further irregularity in the output of the speakers was
noted with respect to the low frequency cone. The outer
periphery of the large cone is supported by a corrugated
annulus which provides a flexible connection between the
cone and the usual fixed support. This corrugated annulus
resonates at certain frequencies of operation of the large
cone. Sometimes this resonant vibration is out of phase
with the large cone and sometimes it is in phase with the
vibration of the large cone. Such operation results in
irregularities in the response characteristic of the speaker.

Yet another object of the present invention is to pro-
vide an improved loudspeaker in which the foregoing dif-
ficulty is overcome.

Still another object of the present invention is to pro-
vide an improved loudspeaker as set forth wherein means
are provided which prevent the suspension annulus from
resonating.

In accomplishing these and other objects, there has been
provided, in accordance with the present invention, a
loudspeaker of the type having a large, low frequency

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cone and a smaller, high frequency cone, the small cone
being substantially a continuation of the conic surface of
the larger cone. A number of small cones are secured
to the front face of the conic surface of the large cone.
These small cones are arranged in a non-symmetrical
array with respect to the axis of the speaker and with
their vertices directed toward the front of the speaker.
In addition, a soft foam rubber or sponge annulus is se-
cured in energy absorbing relation to the surface of a
corrugated annulus supporting the periphery of the larger
cone.

A better understanding of the present invention may be
had from the following detailed description when read in
connection with the accompanying drawing in which:

Figure 1 is an elevational view of the loudspeaker con-
structed in accordance with the present invention,

Figure 2 is an end view partly broken away of one of
the diffusing cones secured to the speaker cone,

Figure 3 is a side view of cones shown in Figure 2,

Figure 4 is a cross-sectional view taken along the line
4—4 of Figure 1.

Referring now to the drawing in more detail, there is
shown a loudspeaker of the type having a high fre-
quency sound radiating cone 2 and a low frequency
sound radiating cone 4. The low frequency cone 4 is
secured at its periphery to compliant member 6 which is
in turn supported by a rigid cone supporting member 8,
commonly referred to as a dishpan. The compliant mem-
ber may be integral with the cone member and constitute
an annulus having a plurality of concentric corrugations
10. The inner end of the low frequency cone is supported
by a substantially similar compliant member 12 which is
secured to a supporting ring 14 carried by the aforesaid
dishpan 8. The high frequency cone 2 is supported at its
periphery by a compliant member 16 which is carried by
a supporting ring 18.

A motor unit for this type loudspeaker is shown and
claimed in copending application Ser. No. 51,962, filed
September 30, 1948 in the name of the present inventors
now abandoned. That motor consists of a permanent
magnetic member 20 mounted in an outer magnetic shell
22. A pole cap 24 and members 26 and 28 define a pair
of cylindrical annular air gaps in which the voice coils
30 and 32, respectively, operate.

It may be seen from an examination of the drawings,
particularly reference to Figure 4, that the high frequency
cone 2 is mounted coaxially with the low frequency cone
and constitutes substantially a continuation of the conic
surface of the low frequency cone. Thus the high fre-
quency cone defines the solid angle into which the high
frequency cone radiates. In order to reduce that solid
angle without appreciably altering the radiation charac-
teristic of the low frequency cone a plurality of small
conical members 34 are secured to the concave surface
of the low frequency cone. It may be seen that these
conical members substantially reduce the solid angle into
which a high frequency cone radiates. However, since
the low frequency cone operates as a piston the conical
members do not appreciably affect the radiation charac-
teristics of the low frequency cone.

As has been previously pointed out, when the high fre-
quency cone is operating, reflections of the sound waves
generated thereby are reflected from the surface of the
low frequency cone. Since the two cones are mounted
coaxially the low frequency cone is symmetrical about
the axis of the high frequency cone. Therefore, the re-
flections from the low frequency cone will be uniform
and will meet at a point on the axis on the cones. If
the conical members 34 are symmetrically arrayed about
the axis of the cone, the reflections from the low fre-
quency cone may be somewhat diffused but there will be
interference patterns set up. Consequently, to more
effectively diffuse the reflections from the low frequency

cone the conical members are arrayed asymmetrically with respect to the axis of the cone. The conical members, shown more clearly in Figures 2 and 3 are made of substantially the same material as the loudspeaker cone. It may be noticed from the drawings that the periphery 36 of the conical members 34 is shaped to conform to the concave surface of the large low frequency cone. Thus, the conical members may be placed on the surface of the cone and cemented. The asymmetrical disposition of the conical members 34 about the axis of the low frequency cone 4 is provided, as may be best observed in Fig. 1 of the drawing, by placing different ones of the conical members 34 at different distances from the inner end of the low frequency cone 4. The one of the conical members 34 located to the right, as viewed along the line 4—4 of Fig. 1, is closest to the inner end of the low frequency cone 4. It may be seen, as viewed by proceeding counterclockwise around the axis of the cone 4 from the just mentioned one of the conical members 34, that each of the other conical members 34 are disposed at progressively greater distances from the inner end of the low frequency cone 4. The slightly added mass due to the conical members does not have a deleterious effect upon the response characteristic of the lower frequency cone. Alternatively, the smaller conical members may be protuberances formed in the surface of the speaker cone while it is being molded.

It was also previously indicated that when the large cones are supported from the periphery by compliant member such as the corrugated annulus 6, the compliant member resonates and produces spurious response characteristics. To overcome such resonant vibrations of the compliant support member, an annulus of sponge or foam rubber 38 is employed to absorb the acoustical energy of the compliant member. The energy absorbing annulus 38 may be rectangular in cross section as shown in Figure 4 or it may be round or the like. Whatever the cross sectional configuration may be the dimension is such that when the annulus is placed in one of the corrugations of the compliant member 6 it does not fit into the bottom of the corrugation but leaves an air space between the bottom of the corrugation and the surface of the annulus. Thus the annulus is mounted in the corrugation in bridging relation thereto. The points of contact between the annulus and the compliant member are cemented together. Thus arranged the annulus absorbs acoustical energy coupled to the compliant member and accordingly prevents the compliant member from resonating within the audible range.

Thus it may be seen that there has been provided in accordance with the present invention an improved loudspeaker wherein the irregularities and response characteristics are substantially improved.

What is claimed is:

1. In a double cone loudspeaker assembly having a low frequency concave cone and a high frequency cone mounted coaxially with said low frequency cone, said low frequency cone defining a solid angle into which said high frequency cone radiates, means for reducing said solid angle without altering the radiation characteristics of said low frequency cone, said means comprising a plurality of conical diffusion members associated with the concave surface of said low frequency cone in asymmetrical array about the axis of said low frequency cone.

2. In a double-cone loudspeaker assembly having a low frequency concave cone and a high frequency cone mounted coaxially with said low frequency cone, diffusion means associated with said low frequency cone for limiting reflection from said low frequency cone of sound waves emitted by said high frequency cone, said means comprising a plurality of protuberances arranged in asymmetrical array about the axis of said low frequency cone.

3. In a double-cone loudspeaker assembly having a

low frequency concave cone and a high frequency cone mounted coaxially with said low frequency cone and constituting substantially a continuation of the conic surface of said low frequency cone, means for reducing the solid angle into which said high frequency cone radiates, said means comprising a plurality of conical diffusing members secured to the concave surface of said low frequency cone in asymmetrical array about the axis of said high frequency cone, said conical diffusing members being arranged with their vertices oppositely directed from that of the low frequency cone.

4. In a double-cone loudspeaker assembly of the type having a low frequency concave cone and a high frequency cone mounted coaxially with said low frequency cone and constituting substantially a continuation of the conic surface of said low frequency cone, diffusing means including asymmetrical array of conical members associated with said low frequency cone for reducing the solid angle into which said high frequency cone radiates without altering the radiation characteristics of said low frequency cone.

5. In a double-cone loudspeaker assembly having a low frequency concave cone and a high-frequency cone mounted coaxially with said low frequency cone and constituting substantially a continuation of the conic surface of said low frequency cone, means for reducing the solid angle into which said high frequency cone radiates, said means comprising a plurality of conical diffusing members secured to the concave surface of said low frequency cone in asymmetrical array about the axis of said high frequency cone, said conical diffusing members being arranged with their vertices oppositely directed from that of the low frequency cone.

6. A loudspeaker comprising, in combination, low frequency concave cone, a separate high frequency cone, said high frequency cone being supported substantially coaxially with said low frequency cone with its conical surface constituting substantially a continuation of the conical surface of said low frequency cone, a plurality of asymmetrical array of conical members associated with said low frequency cone for reducing the solid angle into which said high frequency cone radiates without appreciable changing the radiation characteristics of said low frequency cone.

7. In a double-cone loudspeaker assembly having a low frequency cone and a high frequency cone mounted coaxially with said low frequency cone, diffusion means associated with said low frequency cone for limiting reflection from said low frequency cone of sound waves emitted by said high frequency cone, said means comprising a plurality of protuberances, each of said protuberances being disposed at different azimuthal positions around the axis of said low frequency cone and at different altitudes measured along the axis of said low frequency cone whereby said protuberances are arranged in asymmetrical array about the axis of said low frequency cone.

8. The double-cone loudspeaker assembly according to claim 7, wherein said protuberances are conical members secured to the concave surface of said low frequency cone.

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