March 21, 1933. T. LINDENBERG 1,902,250

SOUND AMPLIFIER

Filed Dec. 1, 1931 2 Sheets-Sheet 1

Fig. 1.

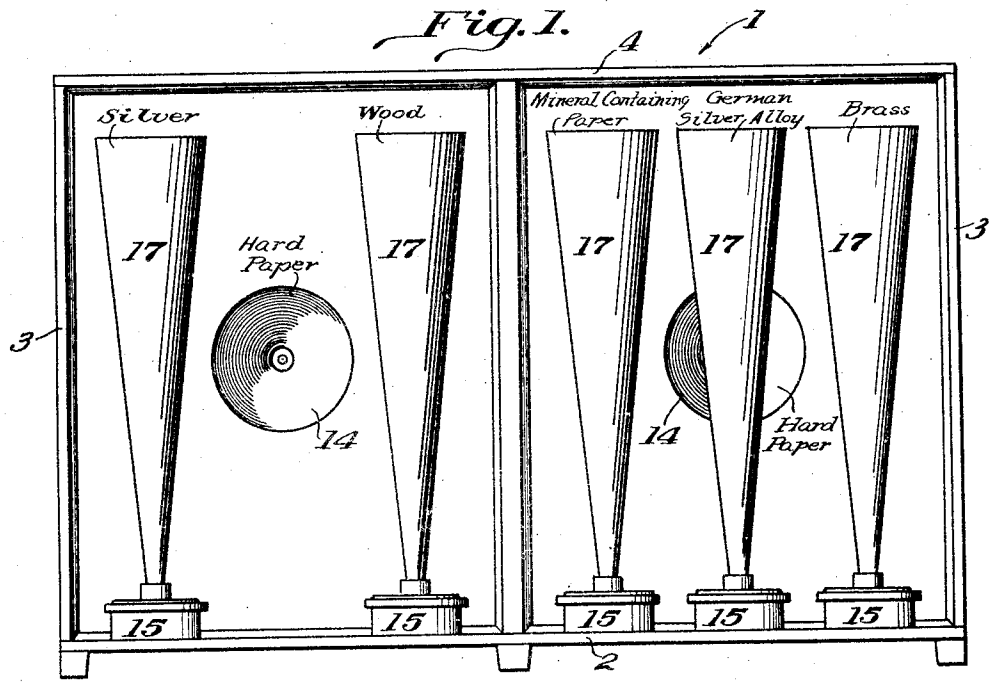
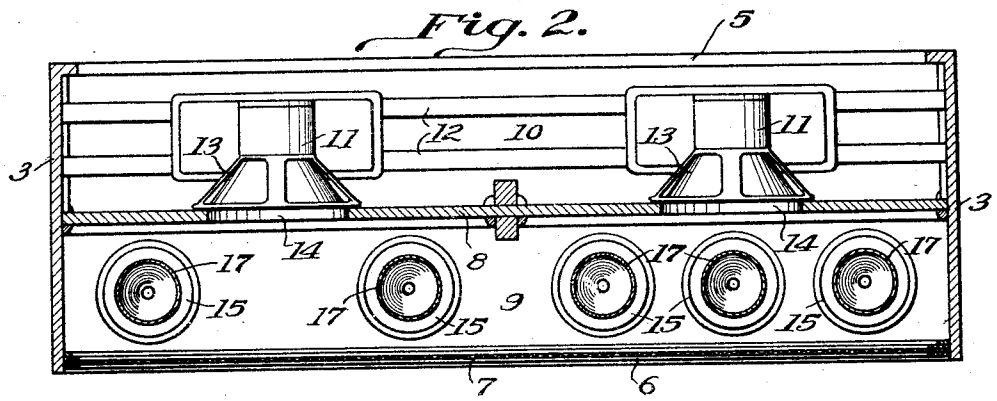


Fig. 2.



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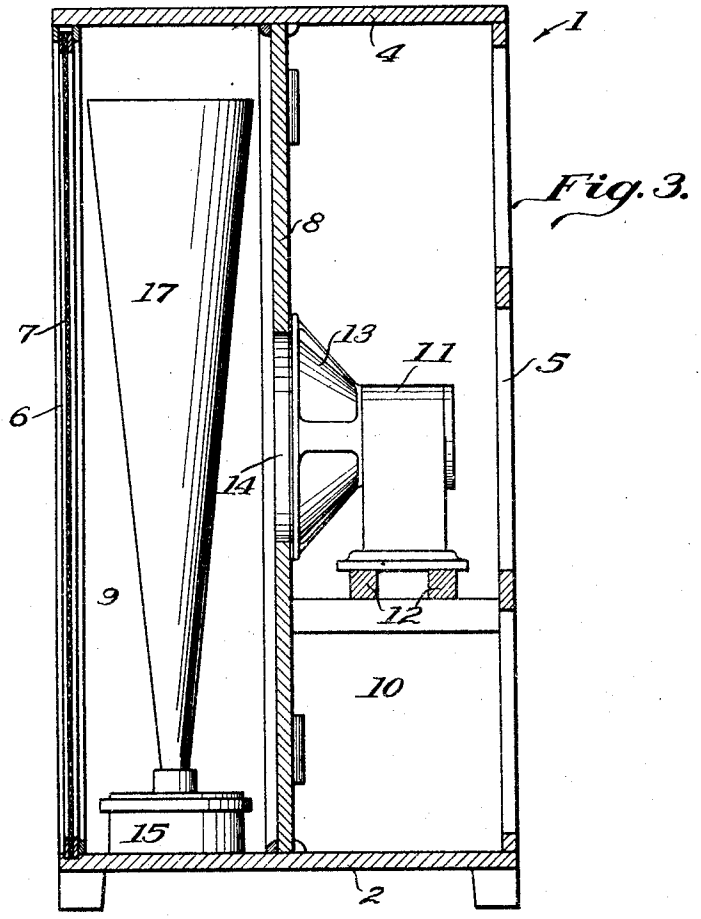
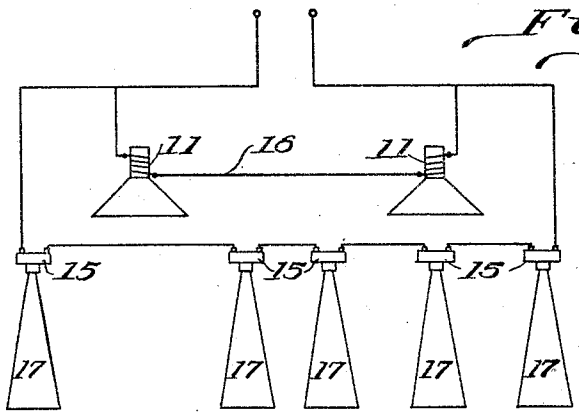


Fig. 3.

Fig. 4.



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UNITED STATES PATENT OFFICE

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SOUND AMPLIFIER

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This invention relates to improvements in a sound reproducing apparatus and, more particularly, to an improved acoustical amplifier especially suitable for use in the field of transmitting, reproducing or amplifying audible sound energy developed by associated mechanical or electrical mechanisms, such as film or disk records, radio or telephone instrumentalities. In the development of my improved sound amplifier, I have proceeded upon the theory that the present electrical and mechanical mechanisms for effecting the actuation of sound reproducing diaphragms have now reached a high stage of perfection and produce clear sound energy without substantial distortion, the present general use in sound reproducing instruments of the so-called power or dynamic speakers of the electrically operated type is given as an example of the high degree of development of the art.

The present invention, therefore, deals with the amplification of sound energy developed by such reproducers to the end of effecting a more natural enlargement to desired volume of re-created sound whereby to retain the fundamental tones and developing within the walls of the amplifier itself high frequency values, harmonics or over-tones by which pleasing and natural effects are produced and which are underdeveloped or missing in sound reproducers or amplifiers of which I am now aware.

It is considered that the problem of reproducing sound of whatever kind, audible to the human ear in the original body and color of tone, as well as volume, is substantially one of acoustics, beginning where the electrical vibrations imparted to the moving coils of a so-called electro-dynamic speaker or the armature of a magnetic speaker end. In the production of my improved amplifier, I have approached the problem upon the theory that no single diaphragm or multiplicity of resonating diaphragms or resonators of the same resonating characteristics could respond to the demand made upon them in an attempt to reproduce accurately the tone colors of the various instruments or voices of, for example, a symphony orchestra, band, organ, piano or the human voice, speaking or singing, and that in order to produce and properly control the fundamental tones and the overtones characterizing the strings, brasses, wood-winds, percussion instruments, organ pipes, human voices and the like, it is necessary to employ a number of vibrating membranes, diaphragms and air columns, the vibrating walls of each being composed of different materials having varying natural periods. In accordance with my invention, these membranes, which constitute the walls of air columns, are to be operated at different electrical intensities and each material having inherent tone characteristics is selected in a manner that when sounded together, the resultant fused tone may be heard as that of the original sound energizing the microphone or received on a record.

The present invention therefore resides in the provision of an amplifier containing a pluarality of reproducer units which operate a plurality of especially selected resonant materials to produce improved reproduction of tone, musical or otherwise, wherein the emerging blended sounds possess to an extremely high degree the same peculiar properties of the original rendition.

Broadly, these results are secured by the provision of an amplifier formed to comprise a cabinet divided by a baffle wall into front and rear compartments, the rear compartment containing one or more dynamic type sound reproducers while the front compartment is provided with a plurality of vertically disposed reproducer actuated horns constituting air columns, the several horns being each formed from a material differing in resonance or vibratory period from the remaining horns and operating under conditions of lower electrical intensity than the dynamic unit or units arranged in the rear compartment whereby when said reproducer units are simultaneously energized or operated, the resonating walls of different materials selectively vibrate to develop fully and completely those tones corresponding to their natural vibratory periods so that the blended sounds, emerging from

the outlet of the amplifier, possess natural and unusual tonal properties in the art of reproduced sound.

For a further understanding of the invention, reference is to be had to the following description and the accompanying drawings wherein:

Fig. 1 is a view in front elevation of a sound amplifier constructed in accordance with the features of the present invention, the screen of the amplifier being removed to disclose the interior structure;

Fig. 2 is a horizontal sectional view taken through the amplifier;

Fig. 3 is a vertical transverse sectional view thereof, and

Fig. 4 is a diagrammatic view disclosing the wiring circuit for the electrically actuated reproducers of the amplifier.

Referring more particularly to the specific form of the invention herein selected for illustration and description, the numeral 1 designates the cabinet of the amplifier which may be formed to include a base 2, upstanding end walls 3, a top 4, and open back wall 5 and open front 6. The latter is preferably covered by a grille or screen 7 and centrally, the interior of the cabinet is provided with a baffle wall 8 formed from a substantially non-resonant composition material such as wall-board. The baffle 8 divides the interior of the cabinet into front and rear compartments 9 and 10 respectively.

Arranged in the rear compartment 10 is one or more of the conventional dynamic type loud speakers or reproducers, as indicated by the numeral 11. These speaker units are supported in the central portion of the rear compartment, above the base 2, by longitudinally extending supporting sills 12 so that the substantially conical diaphragms 13 of these speaker units will be disposed in registration with openings 14 formed in the baffle wall 8. The baffle board 8 is installed to prevent the air waves on both sides of the conical diaphragms of the speaker units from alternately neutralizing and reenforcing each other and thus interfering with the operation of each unit. It is also made of a non-resonating material to minimize echo.

Arranged in the front compartment 9 of the amplifier are a plurality of dynamic or magnetic type reproducer units indicated by the numeral 15. As shown in Fig. 4, units 15 are wired in series with a main receiving circuit, whereas the speaker units 11 are arranged in a parallel shunt circuit 16 and operated at a higher electrical intensity than the units 15. Each of the units 15 has connected therewith an amplifier in the form of a slightly tapering horn as indicated at 17. I have secured the best results by using horns having a straight line taper and have found this type of horn to be greatly preferred over the usual exponential type. One of the outstanding characteristics of my present invention resides in forming each of the horns 17 from a material different from that found in the remaining horns. In this connection I employ horns composed of wood, paper, silver, brass and German silver. To obtain desired tone values, the paper horn may be formed from materials containing a high percentage of mineral matter, obtained by the introduction of lime therein and which are generally referred to as a hard paper. Other horns or resonant walls may be formed from a softer paper obtained by the introduction of animal wool therein. For instance, one of the loud speakers 17 may be composed of hard paper and the other of a soft paper. I find that this specially prepared paper possesses the desired resonance or vibratory period necessary in producing the high frequency audible vibrations which I desire to build up certain tone values. Preferably, one of the horns 17 is formed from silver in a pure state, while the wooden horn, if only one is used, is preferably formed from maple.

It will be observed that each of these horns therefore contains a resonant wall structure having an individual characteristic natural period of vibration. Operated singly, the reproducer units 15 and their associated horns 17 would not be adequate for sound reproduction, and it is only by their collective operation that blended or merged sounds are produced having the fundamentals and harmonics which I consider necessary for successful sound reproduction. The sounds issue from the cabinet through the screened front wall 7 and are devoid of the muffled characteristics or the deep low tones usually produced from cabinet type amplifiers. It will be understood that the horns 17 produce confined air columns which vibrate with the diaphragms of the reproducer and the resonant materials from which the walls of the horns are formed.

A speaker constructed in accordance with the disclosure herein is characterized by the production of its very great clearness of tone, also, by the maintenance of full quality through the entire musical range. Thus the high soprano voice reproduced at full volume keeps the brilliance as well as the natural softness of the tone so characteristic of our greatest lyric and coloratura sopranos. The violin tones also preserve their qualities into the upper harmonics of the string. With reference to the piano, the amplifier produces a perfect reproduction with all of the metallic clearness in the upper register and an even scale to its lower note and the notes of the pipe organ are

reproduced from the diapason to the highest pitched section.

In orchestral reproduction, I obtain an unusual instrumental definition in ensemble playing and various choirs stand out very clearly contrary to the usual confusion from the ordinary speaker. The amplifier as shown operates on a low consumption of power, for example, an auditorium speaker may operate on about nine watts output with the production of tone capable of satisfying the requirements of anything but the very largest theaters. My amplifier is particularly suitable for use in motion picture theaters and other large auditoriums where faithful sound reproduction at high volume is required although it may be used quite advantageously in homes and in small rooms.

What is claimed is:

1. In a sound amplifier, a cabinet having open front and rear sides, a baffle arranged centrally of said cabinet and dividing the latter into front and rear compartments, said baffle having an opening formed therein, a reproducer unit arranged in said rear compartment and disposed in registration with the opening, and a plurality of reproducer units disposed in said front compartment, each of the reproducing units in the front compartment being provided with a tapered resonator.

2. In a sound amplifier, a cabinet having open front and rear sides, a baffle situated within said cabinet and dividing the latter into front and rear compartments, said baffle being provided with an opening, a dynamic speaker unit mounted in the rear compartment in registration with the opening formed in said baffle, a plurality of reproducer units disposed in said front compartment, and vertically upstanding resonant horns mounted on the reproducer units in the front compartment.

3. In a sound amplifier, a cabinet having open front and rear sides, a baffle situated within said cabinet and dividing the latter into front and rear compartments, said baffle being provided with an opening, a dynamic speaker unit mounted in the rear compartment in registration with the opening formed in said baffle, a plurality of reproducer units disposed in said front compartment, and vertically upstanding resonant horns mounted on the reproducer units in the front compartment, said horns being formed from materials possessing different resonating properties.

4. In a sound amplifier, a cabinet, a dynamic loud speaker unit mounted in said cabinet, a plurality of reproducer units mounted in said cabinet, and horns defining air columns connected with said reproducer units and disposed contiguous to the dynamic speaker unit.

5. In a sound amplifier, a cabinet, a dynamic loud speaker unit mounted in said cabinet, a plurality of reproducer units mounted in said cabinet, and horns defining air columns connected with said reproducer units and disposed contiguous to the dynamic speaker unit, each of said horns being formed from a resonant material different from that found in the remaining horns.

6. In a sound amplifier, a cabinet formed to include top, bottom and end walls, the front and back sides of said cabinet being open, a baffle disposed within said cabinet, said baffle being formed from a non-resonant material and having an opening formed therein, a major reproducer unit arranged in said cabinet on one side of said baffle and in registration with the opening, a plurality of minor reproducing units mounted in said cabinet on the other side of said baffle, said minor reproducer units being each provided with upstanding horns, and means for simultaneously energizing said reproducer units.

7. In a sound amplifier, a cabinet formed to include top, bottom and end walls, the front and back sides of said cabinet being open, a baffle disposed within said cabinet, said baffle being formed from a non-resonant material and having an opening formed therein, a major reproducer unit arranged in said cabinet on one side of said baffle and in registration with the opening, a plurality of minor reproducing units mounted in said cabinet on the other side of said baffle, said minor reproducer units being each provided with upstanding horns formed from materials having different resonating periods, and means for simultaneously energizing said reproducer units.

8. In a sound amplifier, a cabinet formed to include top, bottom and end walls, the front and back sides of said cabinet being open, a baffle disposed within said cabinet, said baffle being formed from a non-resonant material and having an opening formed therein, a major reproducer unit arranged in said cabinet on one side of said baffle and in registration with the opening, a plurality of minor reproducing units mounted in said cabinet on the other side of said baffle, said minor reproducer units being each provided with upstanding horns formed from materials having different resonating periods, and means for simultaneously energizing said reproducer units, the upper ends of said horns terminating immediately below the top wall of said cabinet.

9. In a sound amplifier, a cabinet, a baffle situated within said cabinet and dividing the latter into front and rear compartments said baffle being provided with an opening, a major reproducer unit disposed in the rear compartment in registration with the opening formed in said baffle, a plurality of reproducer units mounted on the bottom wall

of said cabinet in the front compartment, amplifying resonators defining air columns carried by the reproducers in the front compartment, each of said resonators having a distinctive vibratory period, and means for simultaneously operating said reproducers.

10. In a sound amplifier, a cabinet, a baffle situated within said cabinet and dividing the latter into front and rear compartments, said baffle being provided with an opening, a major reproducer unit disposed in the rear compartment in registration with the opening formed in said baffle, a plurality of reproducer units mounted on the bottom wall of said cabinet in the front compartment, amplifying resonators defining air columns carried by the reproducers in the front compartment, each of said resonators having a distinctive vibratory period, and means for simultaneously operating said reproducers, said means providing for the operation of the major reproducer at higher intensities than the minor reproducers.

11. In sound reproducing apparatus, a primary electro-responsive sound reproducer of the dynamic type, a plurality of secondary electro-responsive sound reproducers simultaneously operable in the same sound exciting circuit as the primary reproducer, and a horn type resonator having substantially straight tapering walls associated with each of the secondary reproducers, said resonators being each formed from a material differing in resonance for a natural vibratory period from the remaining resonators.

12. In sound reproducing apparatus, a primary electro-responsive sound reproducer of the dynamic type, a plurality of secondary electro-responsive sound reproducers simultaneously operable in the same sound exciting circuit as the primary reproducer, and a horn type resonator associated with each of the secondary reproducers, said resonators being each formed from a material differing in resonance for a natural vibratory period from the remaining resonators.

13. In sound reproducing apparatus, a primary electro-responsive sound reproducer of the dynamic type, a plurality of secondary electro-responsive sound reproducers simultaneously operable in the same sound generating circuit as the primary reproducer, and a horn type resonator associated with each of the secondary reproducers, said resonators being formed from materials differing in resonance or natural vibratory period from other resonators of the same group, the secondary reproducers operating under conditions of lower electrical intensity than the primary reproducer.

In testimony whereof I affix my signature.

THEODORE LINDENBERG.