Nov. 14, 1939. G. BUCKY 2,179,840

LOUDSPEAKER ARRANGEMENT

Filed May 3, 1938 2 Sheets-Sheet 1

Fig. 1.

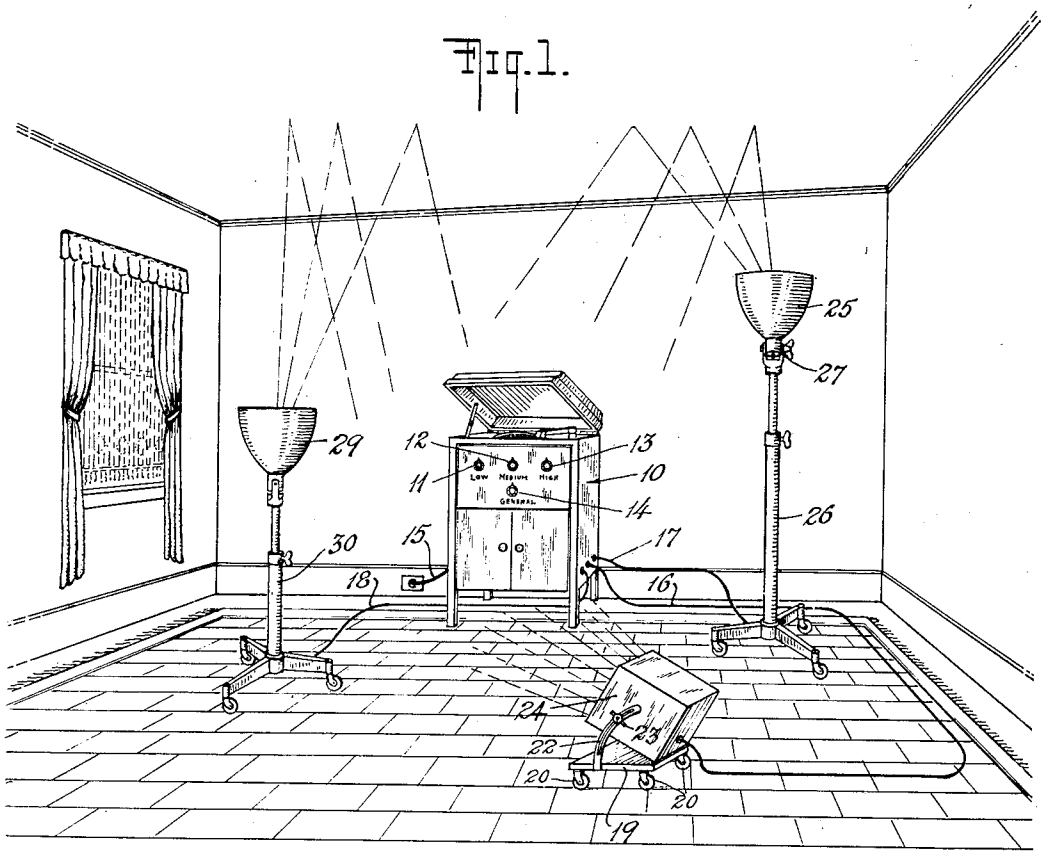
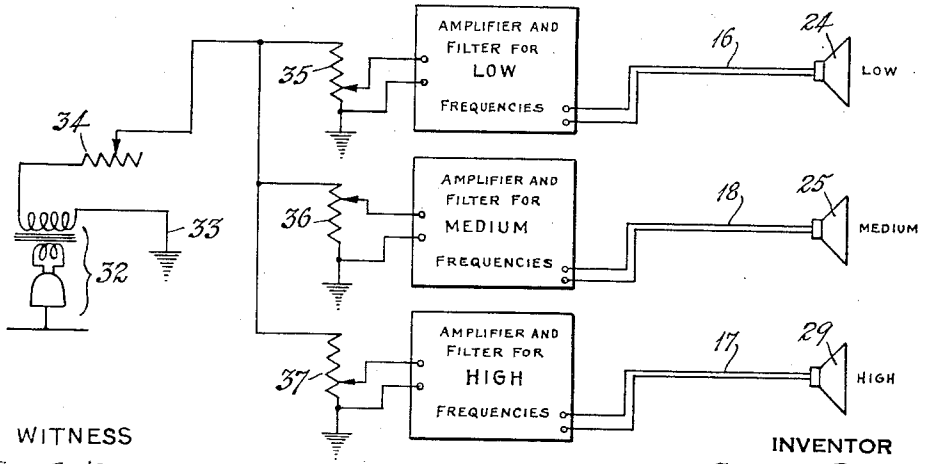


Fig. 2.



WITNESS

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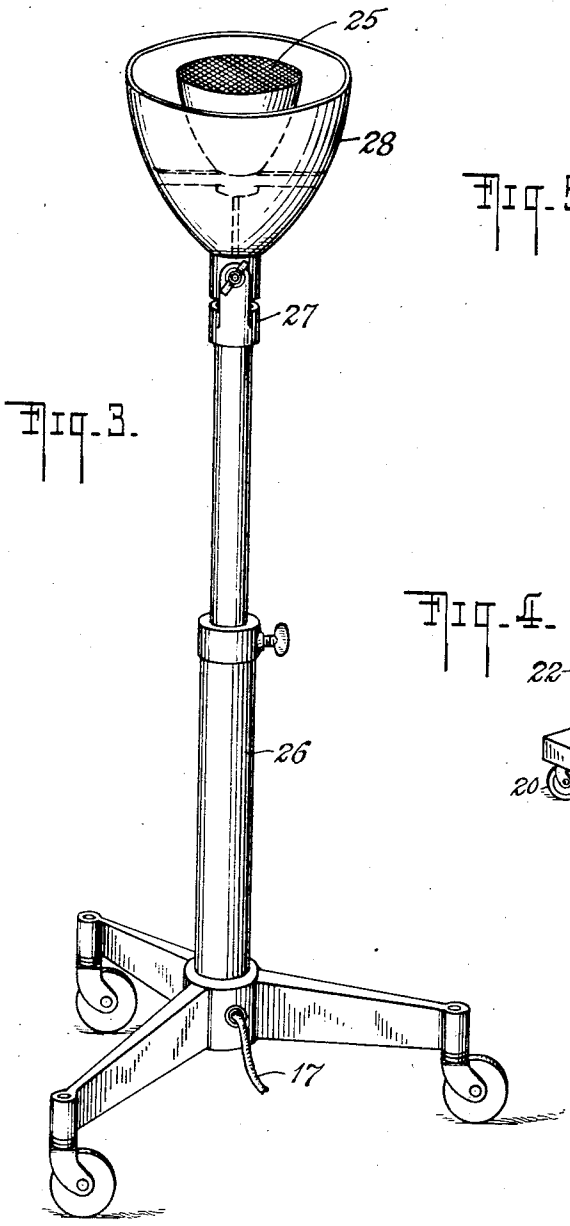

Fig. 3.

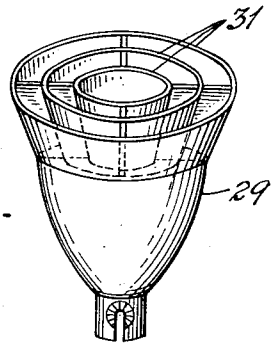

Fig. 5.

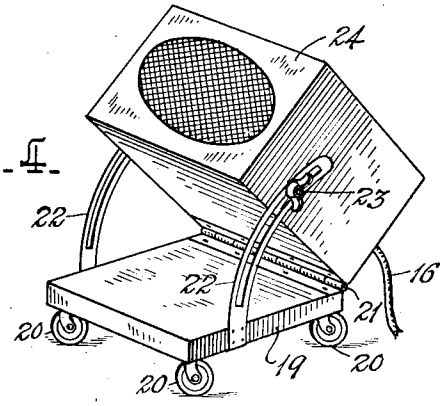

Fig. 4.

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LOUDSPEAKER ARRANGEMENT

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Application May 3, 1938, Serial No. 205,699

7 Claims. (Cl. 179—1)

The invention relates to loudspeakers and to an arrangement thereof, the loudspeakers being such as are conventionally used with a sound reproducing unit such as a phonograph or radio. More particularly, the invention relates to novel structures of such loudspeakers and to a novel method of arranging and placing a plurality of such loudspeakers in a chamber, whether a room in a residence, or in a public hall.

In the operation of a sound reproducing unit such as a radio or an electric phonograph, the fidelity of the reproduction is frequently destroyed because the particular acoustical characteristics of the room or chamber are not consonant with the best tonal effects that could be secured from the reproducing unit because of the particular positions of the loudspeakers which may not be precisely the positions most effective to obtain a brilliant reproduction of the music being played or rendered. The ordinary transmitted composition is not capable of exact and fine reproduction as to tonal quality and blending of the musical components, it being necessary to adapt the positions and distribution of the loudspeakers throughout the chamber in which the reception is to be effected in accordance with the special conditions as to sound absorbing and re-echoing properties of furniture, fixtures, etc., that may be distributed in the chamber. Even with a plurality of loudspeakers, the distribution thereof in a particular room, in order to effect the best tonal reproduction, is a difficult task, and the distribution may be effectively altered in accordance with the acoustical conditions of the room.

In accordance with my invention, three ranges of frequencies of the tone emanating from the sound reproducing unit are dealt with selectively so that each of such three ranges of frequencies, namely the high, medium and low, is transmitted to its own loudspeaker, in accordance with the effect to be desired, distributed and positioned throughout the chamber. From these various loudspeakers, the tones emitted are merged in the room, with the volume of the various component frequencies controlled as desired by the auditor Each one of the loudspeakers so constituted and distributed throughout the room, may be controlled directly from the sound reproducing unit so that the effect of the merged sounds can be controlled by the auditor at one station to bring out more pronouncedly a solo part or any particular section, for instance, of a symphony orchestra. The listener may thus secure an effect which is quite different from that of the ordinary transmitted composition. By means of my novel arrangement of loudspeakers and their individual control, it is virtually possible for an auditor to control, by means of the amplifiers of each of such loudspeakers, the music which he wishes to hear, much in the manner that a conductor controls such music in a concert hall. Furthermore, this new arrangement makes it unnecessary to supply the loudspeaker for the low frequencies with a baffle board that may increase the volume of that range, because of the independent volume control of the three frequency ranges.

In order to accomplish this general desired result, I utilize the expedient of directing or projecting the sound emanating from each of the loudspeakers or any desired number thereof against the ceiling of the room so that the sound beam emanating from the loudspeaker is directed against the ceiling of the room and from thence to the ears of the listener. The second expedient for accomplishing this desired composite result is to place each speaker on a separate movable stand with the loudspeaker so mounted thereon as to be capable of being raised or lowered or having the sound beam therefrom directed in any desired direction.

I have found that by directing the beam of sound emanating from the loudspeaker or speakers against the ceiling of the room, a much better and more uniform distribution of the sound waves throughout the entire room is capable of attainment. With the beam directed towards the center of the room, as is conventional in the operation of a sound reproducing unit, the volume, as well as the tonal effect, is comparatively small outside of the ambit of the direct beam. This condition is especially true of the sound beams in the higher frequencies. With my novel type of loudspeakers and their arrangement, the sound beams are directed against the ceiling, the reflected waves of sound being heard more than the direct, and since such reflected waves are distributed substantially uniformly throughout the entire room, a finer reproduction is secured. With such a distribution, the sound impression becomes "round", comparable to a stereo-picture in comparison with an ordinary flat picture. This effect is probably due to the small time difference in which the reflected sound waves strike the ear. I have found also that with the new arrangement, the noise made by the phonograph needle in a phonograph structure, is much less noticeable and therefore considerably less disturbing to a true reception and appreciation than with any prior arrangement.

In order to increase the effect and to secure a complete distribution of the reflected sound waves, I provide those of the loudspeakers constituting elements in my novel arrangement as are designed to direct the sound waves against the ceiling, with appurtenances functioning as diffusers.

The mounting of the loudspeakers in accordance with my arrangement upon portable stands

facilitates in great measure the task of the auditor or the person making the initial arrangement to find the right place for each loudspeaker in the room. The directing of the sound beams against the ceiling makes this task not only convenient but comparatively simple to a musically sensitive ear, as it is not necessary, as in former arrangements, to permanently position a speaker or speakers near the wall. The arranger can thus avoid a condition in which any portion of the room is not reached by the sound waves. The proper location of the individual loudspeakers according to their position in the room and especially to their position in height can hardly be accomplished without the described arrangement. It is impossible to get the optimum effect if the position of the loudspeaker cannot be changed at will and can be brought back to the prior position without time delay for comparative purposes. The technical advantages of the arrangement in this respect can only be appreciated in practical experience.

In accordance with my invention, the amplifier of the sound reproducing unit is provided with three different ranges, with a separate control for each amplifier. The various frequencies are selected by the filters of such amplifiers, the filters being in the output portion of the amplifier. Each of the loudspeakers in my novel arrangement is thus selected for a different frequency of tone, with each one separately controllable as to volume from the master station conveniently located at the sound reproducing unit, such as the radio or phonograph.

In the accompanying drawings, in which I have illustrated one particular embodiment of an arrangement of loudspeakers and particular forms of such loudspeakers, constructed in accordance with my invention, Fig. 1 is a view of a room in which has been arranged a plurality of loudspeakers connected and controlled from a single sound reproducing unit, such as an electric phonograph; Fig. 2 is a schematic diagram of the electrical circuit with one loudspeaker being connected to each range in the circuit; Fig. 3 is a view of a loudspeaker and portable stand therefor for the medium and high frequencies of tone; Fig. 4 is a perspective view of a portable loudspeaker for the low frequencies; and Fig. 5 is a form of diffuser which may be used in conjunction with a portable loudspeaker of the type shown in Fig. 3.

Referring more particularly to the drawings, in which similar reference characters identify similar parts in the several views, a sound reproducing unit, such as an electric phonograph, is enclosed in a conventional cabinet **10** placed anywhere within a room illustrated in Fig. 1. It is to be understood, of course, that the showing of an electric phonograph type of reproducing unit is merely illustrative, the invention being equally applicable to the reproduction of sound from any conventional type of radio receiving set which may be housed within the cabinet **10**. The sound reproducing unit, in accordance with my invention, is provided with a plurality of control knobs including knob **11** for the low frequency sound waves, knob **12** for the medium frequency, knob **13** for the high frequency, and a knob **14** for general volume control. The electric connection to the sound reproducing unit is designated at **15**, there being three outlets in the cabinet **10**, from each of which extend cables **16**, **17**, and **18** for the low, medium and high frequency loudspeakers respectively. These cables may be of any desired length, preferably sufficient to enable one arranging the disposition of the loudspeakers throughout the room, to place them in any desired location, it being understood that for any loudspeaker, the total length of the cable should be maintained constant, to keep the output resistance of the amplifier constant, even if it is necessary to wind up unused portions of such cable.

The amplifier and filter for each of the three loudspeakers are, in accordance with my invention, as shown in Fig. 2, positioned in the output circuit of the sound reproducing unit, the sound frequencies from such unit being separated into the low, medium and high ranges, and thence conducted to the respective loudspeakers.

The loudspeaker for the low frequencies is, in accordance with my preferred embodiment, supported upon an ambulant base **19** provided with casters **20** to which base the loudspeaker box may be hingedly secured as at **21**, the box being capable of being placed in any desired angular relationship with the base **19** by means of two arcuate slotted arm members **22** through the slots of which are passed bolts having lock nuts **23**, the bolts extending from the loudspeaker box **24**. This low frequency loudspeaker is preferably mounted near the floor of the room so as to have the tones emitted therefrom directed upwardly into the room.

The loudspeaker **25** for the medium frequencies is preferably mounted upon a portable stand **26** by means of a telescopic arrangement so that the height of the loudspeaker may be adjusted. The loudspeaker housing itself is preferably mounted by means of a pivot joint **27**, so that the loudspeaker itself may be adjusted by means of such joint to have the sound emitted therefrom directed substantially vertically or slightly inclined from the vertical. It is to be understood, of course, that any conventional form of movable and portable stand may be used for any of the loudspeakers. By reference to Fig. 3, it will be noted that the loudspeaker per se is enclosed in a casing **28** which might well be utilized for the purpose of concealing an electric lighting unit for indirect lighting, or flower pots and the like, for decorative effect.

The high frequency speaker **29** is similarly mounted upon a portable and adjustable stand **30**.

Either or both of the loudspeakers **25** and **29** may be provided with a plurality of concentrically arranged conical members **31** surmounting the loudspeaker for effecting a diffusion of the sound waves emanating therefrom and to direct such waves or beams upwardly against the ceiling from which such sound beams are reflected and uniformly distributed throughout the room. The distribution of such reflected sound waves from the ceiling is illustrated generally in Fig. 1.

Referring now more particularly to the schematic circuit diagram of Fig. 2, the elements of the sound reproducing unit are generally designated as **32**, the ground as **33**, with an adjustable resistance **34** for general volume control by means of the knob **14**. In each of the amplifier and filter combinations, separate potentiometers **35**, **36**, and **37** are included in the circuit so that the volume of each loudspeaker for each frequency may be individually controlled by the knobs **11**, **12**, and **13**. The filters are positioned in the output from the sound reproducing unit, the separated frequencies being conducted to the different loudspeakers.

By the above described arrangement, a loudspeaker for each of the different frequencies is

separately controllable with respect to volume, the frequencies being selected by the amplifiers and filters.

It will be understood, of course, that for best results the speakers for the medium and high frequencies should be positioned somewhat higher than the ears of the auditor and that for any particular room, depending upon the size and configuration thereof, the disposition of articles of furniture therein, the quantity and distribution of draperies, tapestry and carpets, will control the disposition of the plurality of loudspeakers throughout the room in a manner to get a re-integration of the various frequencies to secure the most pleasing and highest fidelity of reproduction.

I claim:

1. Sound reproducing apparatus comprising a cabinet, a sound reproducing unit housed therein, a plurality of amplifier and filter circuits in the output of said sound reproducing unit, one for each of a plurality of selectively disintegrated frequencies of sound waves, a plurality of loudspeakers, one for each of said selected frequencies, and means for individually and selectively controlling the volume of sound emitted from each of said loudspeakers, whereby the selected frequencies are re-integrated throughout an audition chamber, depending upon the acoustical characteristics thereof and the effect as to volume of any of the component frequencies desired by the auditor.

2. Sound reproducing apparatus comprising a cabinet, a sound reproducing unit housed therein, a plurality of amplifier and filter circuits in the output of said sound reproducing unit, one for each of a plurality of selectively disintegrated frequencies of sound waves, a plurality of loudspeakers mounted upon portable and adjustable stands, one for each of said selected frequencies, and means for individually and selectively controlling the volume of sound emitted from each of said loudspeakers, whereby the selected frequencies are re-integrated throughout an audition chamber, depending upon the acoustical characteristics thereof and the effect as to volume of any of the component frequencies desired by the auditor.

3. Sound reproducing apparatus comprising a cabinet, a sound reproducing unit housed therein, a plurality of amplifier and filter circuits in the output of said sound reproducing unit, one for each of low, medium and high selectively disintegrated frequencies of sound waves, a plurality of loudspeakers, one for each of said selected frequencies, the loudspeakers for the medium and high frequencies being disposed so as to have the sound waves emanating therefrom directed against the ceiling of the audition chamber to be reflected therefrom uniformly in all directions throughout such chamber, and means for individually and selectively controlling the volume of sound emitted from each of said loudspeakers, whereby the selected frequencies are re-integrated throughout an audition chamber, depending upon the acoustical characteristics thereof and the effect as to volume of any of the component frequencies desired by the auditor.

4. Sound reproducing apparatus comprising a cabinet, a sound reproducing unit housed therein, a plurality of amplifier and filter circuits in the output of said sound reproducing unit, one for each of a plurality of selectively disintegrated frequencies of sound waves, a plurality of loudspeakers, one for each of said selected frequencies, means for individually and selectively controlling the volume of sound emitted from each of said loudspeakers, and means for directing the sound waves from loudspeakers of certain of the plurality of selectively disintegrated frequencies against the ceiling of the audition chamber, whereby the selected frequencies are re-integrated throughout an audition chamber, depending upon the acoustical characteristics thereof and the effect as to volume of any of the component frequencies desired by the auditor.

5. Sound reproducing apparatus comprising a cabinet, a sound reproducing unit housed therein, a plurality of amplifier and filter circuits in the output of said sound reproducing unit, one for each of a plurality of selectively disintegrated frequencies of sound waves, a plurality of loudspeakers, one for each of said selected frequencies, means for individually and selectively controlling the volume of sound emitted from each of said loudspeakers, and means for directing the sound waves from loudspeakers of certain of the plurality of selectively disintegrated frequencies against the ceiling of the audition chamber, said loudspeakers having means associated therewith for effecting a diffusion of the sound waves emanating therefrom, whereby the selected frequencies are re-integrated throughout an audition chamber, depending upon the acoustical characteristics thereof and the effect as to volume of any of the component frequencies desired by the auditor.

6. Sound reproducing apparatus comprising a cabinet, a sound reproducing unit housed therein, a plurality of amplifier and filter circuits in the output of said sound reproducing unit, one for each of a plurality of selectively disintegrated frequencies of sound waves, a plurality of loudspeakers, one for each of said selected frequencies, and means for individually and selectively controlling the volume of sound emitted from each of said loudspeakers, the loudspeakers being mounted upon portable and adjustable stands and the selected frequencies being low, medium, and high, the loudspeakers for the medium and high frequencies being disposed so as to have the sound waves emanating therefrom directed against the ceiling of the audition chamber to be reflected therefrom uniformly in all directions throughout such chamber, whereby the selected frequencies are re-integrated throughout an audition chamber, depending upon the acoustical characteristics thereof and the effect as to volume of any of the component frequencies desired by the auditor.

7. Sound reproducing apparatus comprising a cabinet, a sound reproducing unit housed therein, a plurality of amplifier and filter circuits in the output of said sound reproducing unit, one for each of a plurality of selectively disintegrated frequencies of sound waves, a plurality of loudspeakers, one for each of said selected frequencies, and means for individually and selectively controlling the volume of sound emitted from each of said loudspeakers, the loudspeakers being mounted upon portable stands, and including means for directing the sound waves from loudspeakers of certain of the plurality of selectively disintegrated frequencies against the ceiling of the audition chamber, whereby the selected frequenies are re-integrated throughout an audition chamber, depending upon the acoustical characteristics thereof and the effect as to volume of any of the component frequencies desired by the auditor.

GUSTAV BUCKY.