July 12, 1932. W. C. STENGER 1,866,913

SOUND DELIVERY CONSTRUCTION

Filed April 3, 1930 2 Sheets-Sheet 1

Fig. 1

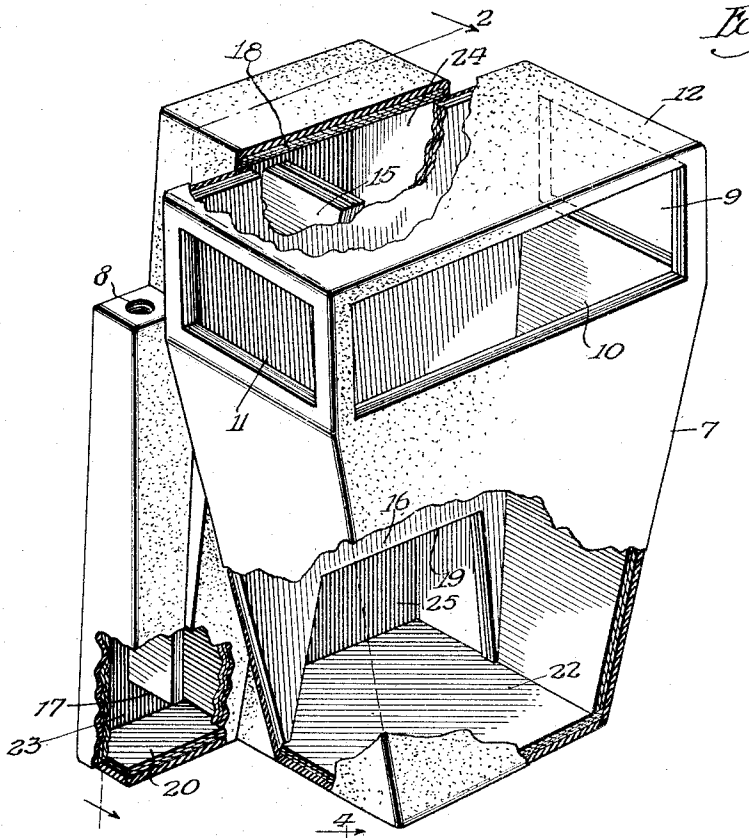
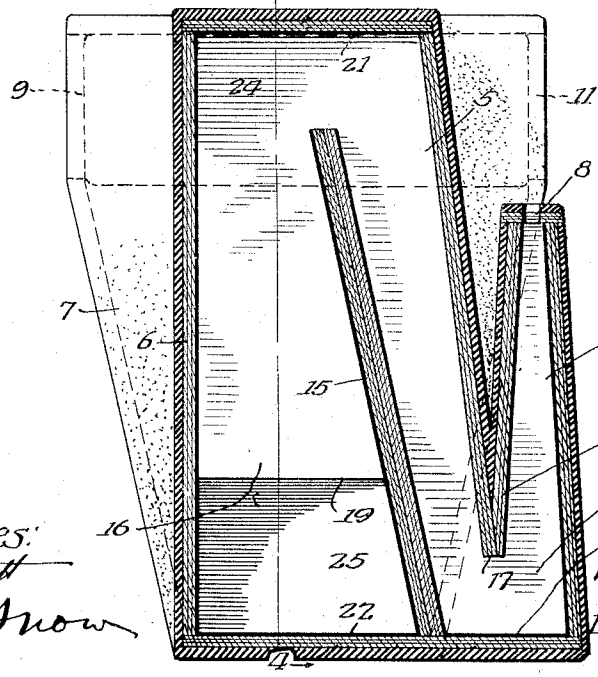


Fig. 2



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Fig. 3

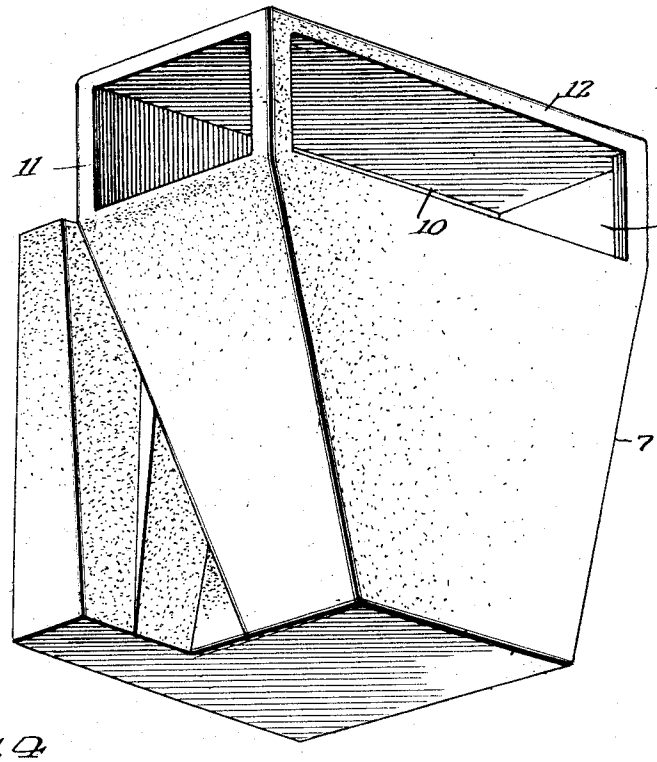


Fig. 4

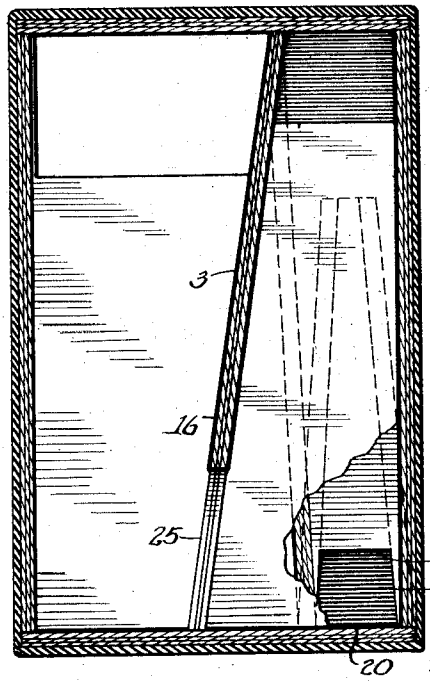
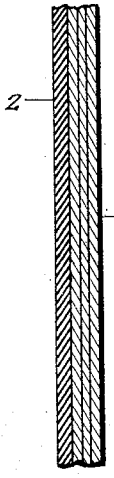


Fig. 5



Fig. 6



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UNITED STATES PATENT OFFICE

WILLEBALD CONRAD STENGER, OF CHICAGO, ILLINOIS

SOUND DELIVERY CONSTRUCTION

Application filed April 3, 1930. Serial No. 441,334.

This invention relates to sound delivery means for use with sound producing devices such as the speaker constructions for auditorium purposes, or in connection with speakers of less capacity, used for similar reproduction of sound and phonographic records, or for radio reproduction, or in connection with musical instruments.

A principal object of the invention is to provide a means for receiving sound and musical tones and to treat in such a manner as to preserve and intensify their basic and resultant elements, while at the same time eliminating or refining out all tones of extraneous and non-symphonic quality.

A further object of the invention is to provide an air column construction of non-resonant character, in which sound and musical tones may be conducted faithfully without distortion or interference.

The objects of the invention are accomplished by means of a construction such as is illustrated in the accompanying drawings, in which:

Figure 1 is a perspective view of the improved construction, partly broken away to show the arrangement of air chambers intermediate the tubular sections which serve to amplify the sound.

Fig. 2 is a longitudinal vertical sectional view taken on the line 2—2 of the construction shown in Figure 1.

Fig. 3 is a perspective view taken from a different angle than the perspective shown in Figure 1.

Fig. 4 is a transverse sectional detail taken on the line 4—4 of Fig. 2.

Fig. 5 is a fragmentary section to illustrate the construction of the upper reflecting wall of the sound delivery chamber.

Fig. 6 is a fragmentary sectional view to illustrate the side wall construction of the amplifier.

The purposes of the invention are obtained by means of a construction involving a plurality of tubular sections, which are rectangular in cross section, uniformly flared from end to end in definite ratio, and are in substantial reversed relationship with one another as to their large and small ends, and are connected together by intermediate air chambers, which afford a multitude of resonance values. The end wall of these air chambers constitutes a barrier for deflecting the sound waves from one tubular section to another. The entire construction is made rigid, preferably of laminated wood walls, reinforced on their exterior surfaces by cement, and having their inner surfaces coated with a semi-plastic substance for the purpose of giving the surface of the walls a pliable and elastic texture, thereby absorbing all harshness of sound and tones. Whatever the effect of the air chambers and the exact action of the reversal of the waves may be, it appears that with this construction interference and distortion such as take place in ordinary curved elbows or reverse bends, is avoided, and experience in the use of the construction demonstrates that it has the effect of maintaining distinctly music from separate instruments simultaneously playing the same music, and agreeably improves tones of some instruments over that which is directly delivered by the same.

The general proportions and arrangement of the improved instrument substantially correspond to a tube, rectangular in cross section and increasing in diameter from its small end to its large end in the ratio of one inch of diameter to approximately six or eight inches in length. This is a mean for the normal tone range required. If such a tubular construction is transversely cut at intervals of uniform length and the sections so formed are placed side by side in reversed relationship so that the large end of the first section or the one of smallest diameter is adjacent the small end of the section of next larger diameter, etc., and provision is made for air chambers to provide communication between the large end of one tubular section and the small end of the next section, the desired improvement is accomplished.

A further desired arrangement is to provide a rigid sound deflecting wall squarely across the outlet end of the amplifier and sound outlet openings in the side walls of the last section adjacent this deflecting end wall.

This construction provides for air columns

and intermediate rigid deflecting surfaces and air chambers affording communication between the different sections of the amplifier, and enables such treatment of the tones received by the apparatus that when delivered the tones are audibly enhanced and of augmented resonance, power, amplitude and timbre. The term "resonance" as here used is with the meaning of uniform and sustained vibrations, and multiple deflections and reflections of sound waves in close proximity—the overtone effect. "Power" is used in the sense of energy and quantity. "Amplitude" enlargement and carrying power, or the extent of sound movements measured from their starting point. "Timbre" is used in the usual sense of tone qualities distinguishing tone elements in voices and instruments.

The air chambers are compartments opened on one side, or enclosed space having an opening for the ingression and egression of sound movement. The manner of constructing the air chambers and air columns in relation to one another, as herein set forth, give greater flexibility and elasticity to all vibratory movements.

Referring to the drawings the entire structure is made completely rigid. This may be accomplished satisfactorily by forming the walls of the amplifier or air column construction with wood laminations 1, which are preferably backed exteriorally by a coating of hard cement 2, for the purpose of imparting rigidly to the structure and thus limit the possibilities of the walls of the device being set in vibration by the sound waves passed through the instrument. The inner surface of the walls is preferably softer than the remainder of the structure, as may be provided for by a wax-like coating 3. The walls of the structure are so formed as to provide a plurality of tubes 4, 5, 6 and 7, each of which is rectangular in cross section and uniformly enlarged from their throats to their opposite ends. Sound is received by the apparatus at the throat 8 of tubing 4 and delivered, augmented and enhanced in tonal qualities through the outlet openings 9, 10 and 11 in the side walls of the largest tube 7. These openings are just beneath the end wall 12 of tube 7. The end wall 12 is made especially rigid by the thick coating of cement 13 as indicated in Figure 5. The walls which form the partitions 14, 15 and 16 between adjacent tubular sections terminate at 17, 18 and 19, opposite sound reflecting surfaces 20, 21 and 22, and are spaced away therefrom in order to provide air chambers 23, 24 and 25. These air chambers are approximately equal distances from one another in the line of travel of the sound waves and provide enlarged spaces at equal distances along the length of the amplifier.

In the operation of the construction above described it becomes apparent that the condensation and rarefaction of the atmosphere within the amplifier under the action of entering tones and as influenced by the particular construction of the different air column sections, the intermediate air chambers, and rigid end walls at these chambers, results in the delivery of clarified and separable sounds and tones of a pleasing, mellow and flexible nature.

The air contained within the air column is energized by sound vibrations entering the throat 8. The sound waves may be received from a vibrating diaphragm or some other source opposite the throat. As the sound waves proceed from the field of excitation they are driven into and through the air column, first striking the inner walls of the air column formed by the tubular section 4 deflecting and continuing onward to the rigid barrier 20, and onward in a similar manner through the tubular sections 5, 6 and 7 to the rigid barrier 12 from which the waves are deflected through the outlet openings 9, 10 and 11. Presumably they agitate and excite into movement all of the air contained in the air column and are continuously supplemented by the activity from the centralized field of excitation as long as the amplifier is in operation. It is also presumed that the sound waves, upon striking the barriers in the air chambers are deflected in various directions from passing on through the air chamber and into the next tubuluar section while others undoubtedly rebound toward their place of origin before colliding with oncoming waves and being again driven forward.

Whatever the precise action may be, the condensation and rarefaction of the atmosphere which takes place in this sectional amplifier with the intermediate air chambers enhances the apparent power or audibility and finer qualities in tone to a far greater degree than would be the case if the air chambers were omitted.

The effect which this instrument has upon qualities of tone passing therethrough is to impart a characteristic richness to the tone and to keep the tones distinct and powerful. The inside walls throughout are covered with waxlike plastic substance. The movements of the sound waves agitating the particles of air, forces direct contact with said plastic substance, thus assuming pliability and flexibility. This pliability is likewise imparted to the general mass of air within the air column and has the effect of a pleasing, mellow, and flexible tone quality.

The proportions of the device may be varied somewhat, thus altering maximum resonance to different points in the scale, but it is preferred to keep the total length of the air column from approximately seventy-four inches to 132 inches, having an air volume

of from three and one-half to eight cubic feet.

I claim:

1. A sound conducting construction comprising a plurality of flared adjacent tubes rectangular in cross section, and in reverse relationship as to their large and small ends, and a connection between the adjacent ends of said tubes providing an air chamber, including an end wall angularly disposed with respect to the axes of the sections for diverting sound waves from one tubular section to another, the inner surfaces and end walls being coated with a plastic substance.

2. A sound delivery construction comprising a plurality of flaring tubular sections with their axes in angular relationship, means affording an air chamber communicating with the large end of one tube section and the small end of another tube section, said tubular sections being reinforced on their outer surfaces with a hard cement coating and having on their inner surfaces a coating of plastic material.

3. A sound conducting construction affording an air column rectangular in cross section and having flared side walls and means for providing spaced enlargements along the length of the column, said construction having on its inner surfaces a coating of plastic material.

4. A sound conducting construction formed to provide a plurality of gradually enlarging passageways in reverse relation as to their large and small ends, each of said passageways being rectangular in cross section, said sound conducting construction also being formed to provide air chambers between adjacent ends of said passageways, said air chambers being partly formed by a rigid sound deflecting end wall extending in a plane transversely to the axes of said passageways for causing sound waves to be deflected in a reverse direction into both of the passageways communicating with the chamber partly formed by the end wall, the sound outlet end of said sound conducting construction being provided with a rigid wall extending transversely across the direction of movement of the sound for deflecting the sound backwardly, and an outlet opening for sound at the side of said conducting construction.

Signed at Chicago this first day of April, 1930.

WILLEBALD CONRAD STENGER.