Dec. 25, 1928.

1,696,304

M. R. HUTCHISON

MULTITUNED HORN

Filed May 24, 1927

Fig 1

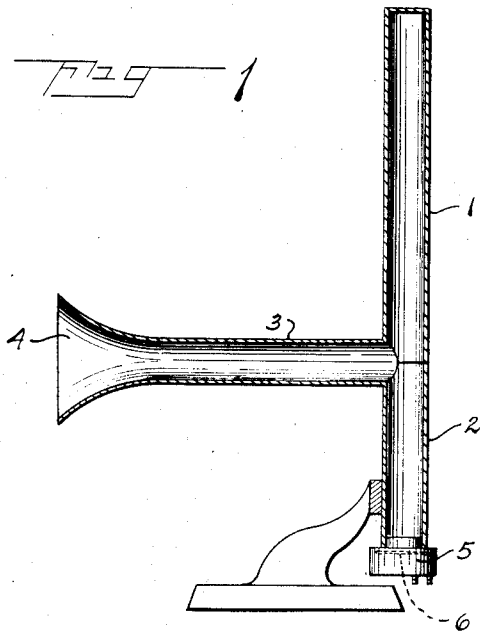
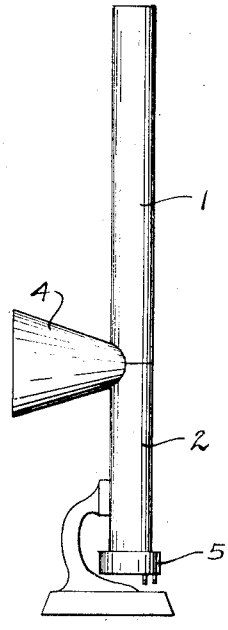


Fig 3



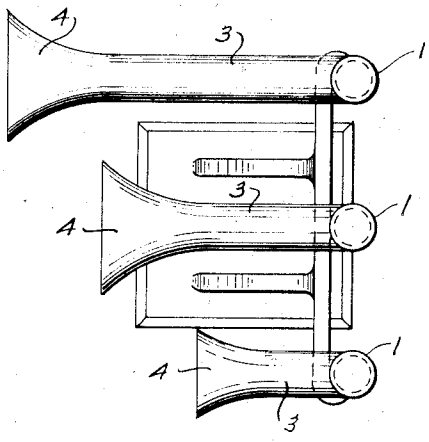


Fig 2

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UNITED STATES PATENT OFFICE.

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MULTITUNED HORN.

Application filed May 24, 1927. Serial No. 193,813.

This invention relates to sound propagating devices of the electromechanical type, in which sound waves produced by a vibrating diaphragm are selectively re-enforced by resonating chambers and impressed upon the surrounding medium.

In an acoustic device of the type employing an open end horn and a mechanical vibrating diaphragm for imparting sound waves thereto, the horn operates in a manner similar to an open end organ pipe, being resonant to a wave having a length twice that of the horn. Such a device has the property of re-enforcing most strongly notes of its fundamental frequency and of responding less strongly to the various overtones thereof. It, however, is practically incapable of reproducing notes below its fundamental frequency and responds but feebly to notes of frequencies other than its fundamental and overtones.

Since the timbre of a note is determined largely by the presence or absence of the various overtones or harmonics, it is desirable to accurately reproduce such overtones in order that the propagated sound does not lose its original timbre, and is not distorted.

The present invention therefore, provides a horn capable of re-enforcing the fundamental note and the various overtones thereof in substantially the same degree. Consequently, by employing a bank of twelve such horns, each being tuned to a different note comprising an octave in the chromatic scale, the complete range of musical frequencies may be accurately reproduced together with the various overtones which are originally present.

This is accomplished by providing a horn having a plurality of resonating chambers which are tuned respectively to the fundamental and various harmonics, such as the second and fourth. The chambers may be inter-communicating, and sound waves comprising compressions and rarefactions may be set up in the enclosed medium by any suitable means, such as a vibrating diaphragm forming a part of an electromagnetic reproducing unit. The resonating chambers will then serve to select the various notes to which they are tuned which notes will be re-enforced thereby and impressed upon the surrounding medium as sound waves. Waves of other frequencies, however which may be impressed upon said chambers by the mechanical diaphragm will not be re-enforced to any appreciable extent, and consequently will not be propagated with sufficient amplitude to interfere therewith.

The resonating chambers may be arranged in any desired relationship to the vibrating diaphragm which is utilized for producing sound waves therein. One form which has been found to produce satisfactory results comprises an open pipe and a closed pipe, joined end to end, with an aperture for communicating with the surrounding medium located at the junction point thereof. A third resonating chamber comprising an open end pipe may be inserted in said aperture and provided at its free end with a flared bell. The various pipes thus constructed may have free periods of vibration which are multiples of one another, as will be hereinafter explained.

The invention also consists in certain new and original features of construction and combinations of parts hereinafter set forth and claimed.

Although the novel features which are believed to be characteristic of this invention will be specifically pointed out in the claims appended hereto, the invention itself, as to its objects and advantages, the mode of its operation and the manner of its organization, may be better understood by referring to the following description taken in connection with the accompanying drawing forming a part thereof, in which like reference characters have been used to denote like parts in the various figures. Since such illustration is, however, primarily for purposes of disclosure, it will be understood that the structure and the method of operation thereof may be modified in various respects without departing from the broad spirit and scope of the invention.

One embodiment of the invention has been shown for purposes of illustration in the accompanying drawing, in which

Fig. 1 illustrates an acoustic device constructed in accordance with this invention;

Fig. 2 illustrates a plurality of such devices tuned to the different notes of the chromatic scale; and

Fig. 3 illustrates a modified form of device which may be employed.

In the following description and in the claims the various parts of the apparatus and details of the invention will be identified by specific names for convenience, but they are intended to be as generic in their application as the art will permit.

Referring to the drawings more in detail, and in particular to Fig. 1, an acoustic device is disclosed comprising a plurality of pipes 1, 2 and 3 forming resonating chambers, which are arranged in inter-communicating relationship. Pipes 1 and 2 may be joined end to end, and pipe 3 extended at right angles thereto at the junction point of said first mentioned pipe. The end of pipe 1 furthest from the junction point of said pipes may be closed to form a closed resonating chamber, and the corresponding end of pipe 3 may be provided with a bell 4 to facilitate the propagation of the sound waves from said chambers to the surrounding medium.

An electromagnetic unit 5 of any well known construction having a vibrating diaphragm 6, may be located across the open end of pipe 2 and utilized for imparting vibrations to the various chambers. Unit 5, the details of construction of which form no part of the present invention, may be of the type having a plurality of pole pieces which are energized in response to a pulsating electric current, and produce a magnetic field of varying intensity. Diaphragm 6 is attracted toward the pole pieces by a force proportional to the strength of the magnetic field, and consequently is displaced from its normal position of rest by a distance proportional to the applied current.

The vibrating diaphragm produces compressions and rarefactions in the contacting gaseous medium, which travel as waves in the various resonating chambers. Assuming by way of example, that chamber 1 is tuned to a definite frequency, such as note C which corresponds to a wave having 512 vibrations per second, it will respond most strongly to that note and re-enforce the same, and impress the re-enforced sound waves through chamber 3 and bell 4 on to the surrounding medium.

Pipe 1 having a closed end will operate as a closed organ pipe, and consequently will be resonant to a wave having a length four times that of the pipe. Chamber 2 will, however, operate as an open pipe, and will be resonant to a wave twice the length thereof. Pipe 2 may, therefore, be made half the length of pipe 1, and will then be resonant to note C^2 having 2048 vibrations per second, which is two octaves above the note C.

Pipe 3 may be given a length equal to that of pipe 1, but being an open end pipe will respond to a wave double its own length, or to the note C′ having 1024 vibrations per second, which is one octave above the note C.

In the operation of this device, should the note C be impressed upon diaphragm 6 the fundamental will be re-enforced and amplified by resonating chamber 1. The first harmonic thereof, however, will be re-enforced by resonating chamber 3, and the second harmonic, should such be present, will be re-enforced by chamber 2. The device is, therefore, capable of reproducing both the fundamental and the various overtones in the same proportion in which they are originally present, and consequently the resultant music is not distorted and the original timbre thereof is preserved.

As disclosed in Fig. 2, in diagrammatic form, a plurality of the above described devices may be employed for the reproduction of an entire musical scale, each of the devices being tuned to a different note. Since there are twelve different notes in the chromatic scale, twelve such devices may be employed, and when tuned respectively to the various notes comprising one octave of the scale, will serve for the amplification of the entire musical range. Each individual device comprises three resonating chambers which are respectively tuned to three successive octaves, and each of the chambers is resonant to the various overtones thereof. Consequently, the device will serve for the production of notes occurring in any octave of the musical scale.

Since the resonating chambers are practically non-responsive to notes lower than their fundamental, any extraneous influences, such as those produced by static, or by spark disturbances, are effectively suppressed and prevented from interfering with the resultant music.

In the modification shown in Fig. 3, resonating chambers 1 and 2 are constructed similar to corresponding chambers illustrated in Fig. 1. Chamber 3 is, however, omitted and bell 4 applied directly to the junction point of the first mentioned chambers. Such an arrangement may have the respective chambers tuned to both the fundamental and the second harmonic, and due to the ability of each of said chambers to respond to the various overtones, and particularly the first overtone, may operate in a manner similar to the above described device.

The acoustic properties of a sound propagating device constructed as above are materially superior to those of a simple horn which is incapable of reproducing notes of various frequencies with the same efficiency. Obviously, if the overtones are not preserved in their original proportion to the fundamental note, the quality of the music is lost. This device, however, not only produces a pleasing effect due to its ability to preserve

the original timbre in musical notes, but also due to its ability to suppress extraneous noises which are not of a musical pitch.

While certain novel features of the invention have been shown and described and are pointed out in the annexed claims, it will be understood that various omissions, substitutions and changes in the forms and details of the device illustrated and in its operation may be made by those skilled in the art without departing from the spirit of the invention.

What is claimed is:

1. A sound reproducing device comprising a plurality of resonating chambers, one of said chambers being tuned to a definite fundamental frequency, and the others of said chambers being tuned to overtones thereof, and means for imparting sound waves to each of said chambers.

2. An acoustic device comprising a plurality of resonating chambers tuned to different frequencies whereby a plurality of notes may be re-enforced thereby, one of said chambers being tuned to a definite note, and the others of said chambers being tuned to harmonics thereof.

3. An acoustic device comprising a vibrating diaphragm and a plurality of resonating chambers operatively associated therewith, said chambers being tuned respectively to a given frequency and different overtones thereof.

4. A device for propagating the various notes of a chromatic scale, comprising a plurality of groups of resonating chambers, each chamber in each of said groups being tuned to a different fundamental frequency corresponding to a not in the chromatic scale.

5. A sound reproducing device comprising a closed end pipe and a pair of open end pipes, said pipes being joined end to end whereby two of said pipes extend on the same axis and the other of said pipes extends at right angles thereto, means for imparting vibrations thereto, each of said pipes comprising a resonating chamber and being tuned to a different frequency whereby said various frequencies are reproduced in substantially their original proportion.

6. A sound reproducing device comprising a plurality of pipes, said pipes being joined end to end whereby two of said pipes extend on the same axis, means for imparting vibrations thereto, each of said pipes comprising a resonating chamber and being tuned to a different frequency whereby said various frequencies are reproduced in substantially their original proportion.

7. A sound reproducing device comprising a plurality of pipes, said pipes being joined end to end whereby two of said pipes extend on the same axis and another of said pipes extends at right angles thereto, means for imparting vibrations thereto, one of said pipes terminating in a bell for allowing sound waves to be impressed upon the surrounding medium, each of said pipes comprising a resonating chamber and being tuned to a different frequency whereby said various frequencies are reproduced in substantially their original proportion.

8. A sound reproducing device comprising a closed end pipe and a pair of open end pipes, said pipes being joined end to end whereby two of said pipes extend on the same axis and the other said pipes extends at right angles thereto, said last mentioned pipe terminating in a bell for allowing sound waves to be impressed upon the surrounding medium, means for imparting vibrations thereto, each of said pipes comprising a resonating chamber and being tuned to a different frequency whereby said various frequencies are reproduced in substantially their original proportion.

9. A device for reproducing musical notes comprising a plurality of groups of resonating chambers, one chamber in each of said groups being tuned to a different fundamental note, each of the other chambers of said groups being tuned to a harmonic thereof, and means associated with each of said groups for imparting sound waves thereto.

10. A device for reproducing musical notes comprising a plurality of groups of resonating chambers, each of said groups being tuned to a different fundamental note of the musical scale, and the harmonics thereof, and means associated with each of said groups for imparting sound waves thereto.

Signed at New York, in the county of New York and State of New York, this 23rd day of May, A. D. 1927.

MILLER REESE HUTCHISON.