Dec. 15, 1931. M. R. HUTCHISON, JR 1,836,075

STACKED SPIRAL RESONATOR

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Fig. 1

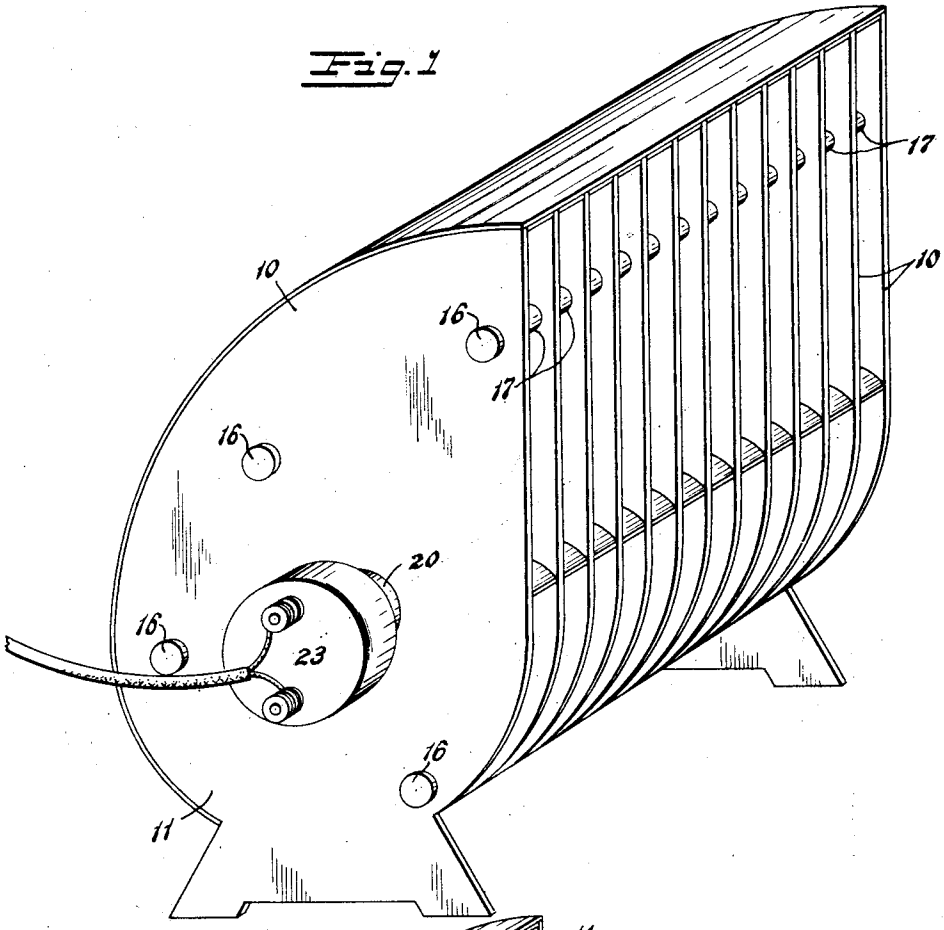

Fig. 9

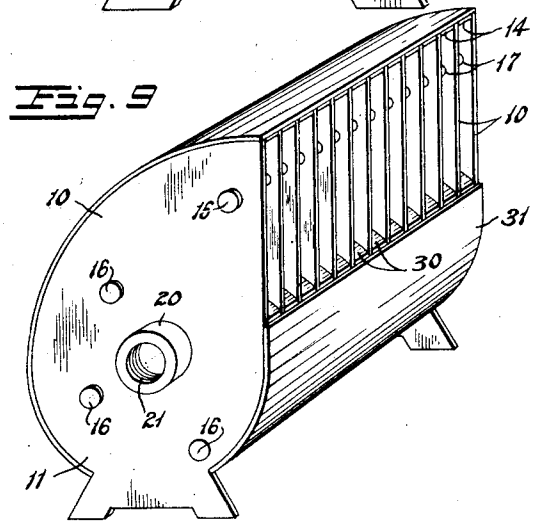

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Fig. 2

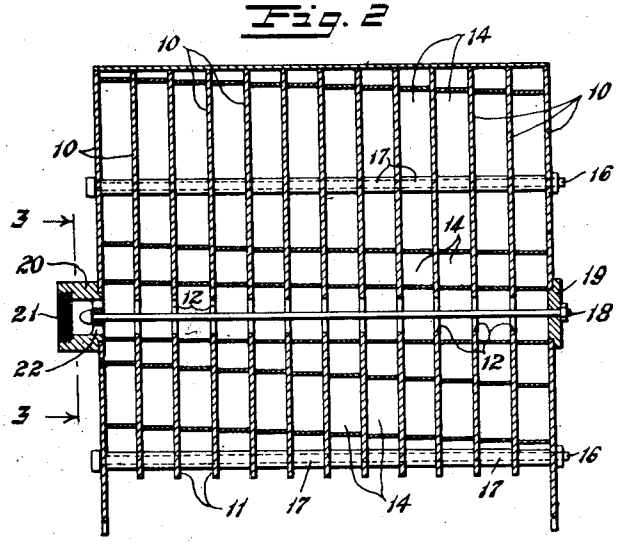


Fig. 3

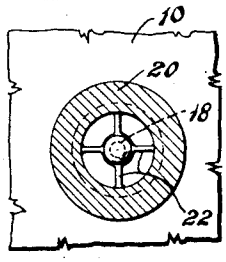


Fig. 4

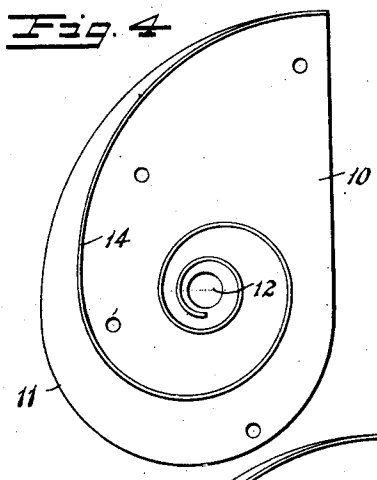


Fig. 5

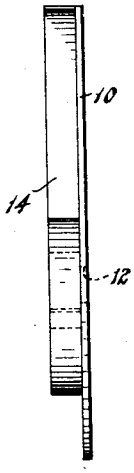


Fig. 6

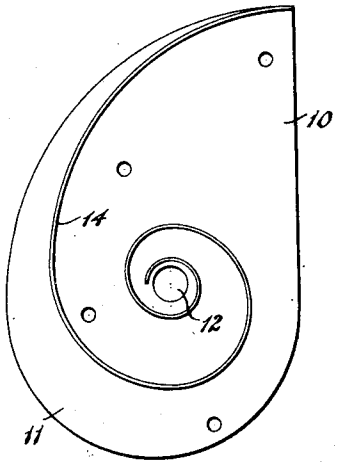


Fig. 8

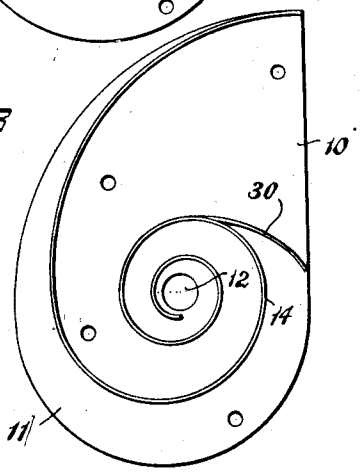
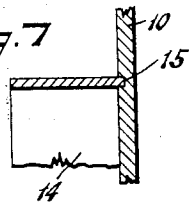


Fig. 7



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Patented Dec. 15, 1931

1,836,075

UNITED STATES PATENT OFFICE

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STACKED SPIRAL RESONATOR

Application filed August 6, 1927. Serial No. 211,020.

This invention relates to sound propagating devices and, more particularly, to apparatus for translating electromagnetic impulses into sound vibrations.

In electromagnetic sound propagating devices vibrations are set up in a mechanical diaphragm which fluctuates in position in accordance with an applied electric current. The diaphragm is displaced in space to produce vibrations of an amplitude proportional to the instantaneous value of the applied electric current and, in so vibrating, operates on the adjacent fluid medium to produce compressions and rarefaction therein which travel as sound waves and produce corresponding vibrations in the human ear drum.

In order to assist the propagation of the above mentioned sound waves in a fluid medium, it is desirable to provide resonating devices such as horns, which are capable of receiving waves produced by the vibrating diaphragm and amplifying the same before impressing them upon the surrounding atmosphere. Horns of the usual type amplify most strongly waves of a definite frequency to which they are resonant. For example, an open end organ pipe will amplify most readily a wave of twice its own length.

In addition to its fundamental note, various overtones and harmonics thereof are amplified by a resonating device. However, notes of a frequency lower than the fundamental are largely suppressed. In order to accurately reproduce notes throughout the musical range it is therefore necessary to design the resonating chamber to transmit the lowest desired fundamental since the attenuation of the higher notes of such a horn is less than the attenuation of notes below the fundamental frequency.

In order to reproduce the various notes of the chromatic scale, it has been found desirable to provide a plurality of horns, each of which is resonant at a different frequency in said scale. When sound waves representing music are impressed on a bank of such horns, each will amplify most strongly notes of its own fundamental frequency and harmonics thereof. Consequently each musical note will be selected and amplified by a different individual horn. Since the notes of the chromatic scale are twelve in number, it has been found desirable to employ a series of twelve horns, each tuned to a different note of one of the lower octaves of a chromatic scale.

This invention provides a series of sounding chambers which are ranged in compact form and occupy a minimum amount of space. The chambers are especially designed to propagate efficiently sound waves of the various frequencies and to impress such waves upon the surrounding fluid medium such as air.

In accordance with this invention, a plurality of spiral chambers are provided through which the sound waves of various frequencies are selectively amplified and propagated. The spiral chambers may be arranged in parallel planes with their openings facing in the same direction whereby the desirable directional characteristics usually required of horns and other sound propagating devices may be obtained.

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 particularly 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 drawings forming a part thereof, in which

Fig. 1 is a perspective view of a sound propagating device constructed in accordance with this invention;

Fig. 2 is an elevation thereof;

Fig. 3 is a section taken on the line 3—3 of Fig. 2 showing details of the clamping means;

Fig. 4 is a side elevation of a plate and spiral spacing ribbon forming a chamber, resonant at a definite frequency;

Fig. 5 is an end elevation thereof;

Fig. 6 is a side elevation of a plate and spac-

ing ribbon forming a chamber resonant at a different frequency;

Fig. 7 is a detail view of one means for attaching the spiral ribbon to the plate;

Fig. 8 is an elevation of a plate and spacing ribbon formed with a flaring outlet; and

Fig. 9 is a perspective view of a plurality of resonating chambers constructed in accordance with Fig. 8.

Like reference characters denote like parts in the several figures of the drawings.

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

Referring to the drawings more in detail, in which a particular embodiment of the invention is disclosed for purposes of illustration, the reproducing device is shown as comprising a plurality of plates 10 having an irregular contour, a portion 11 of which may be in the form of a spiral. Plates 10 are provided with an opening 12 through which the sound waves produced by the electromagnetic means, which will be hereinafter described, may pass. Spiral spacing members 14 are located between adjacent plates 10 and in conjunction therewith form spiral sounding chambers of constantly increasing cross section. Spacing members 14 may be formed of any desired material such as a flat ribbon which has been bent in the spiral form. Metallic ribbons have been found preferable although other materials may be used if desired.

Logarithmic spirals have been formed to possess the characteristics desired in sound propagating devices and to be particularly adapted to the transmission of sound waves. Spirals of other forms may be used, however, for the transmission of sound waves and may approximate the results obtained by the logarithmic spiral.

Ribbon 14 may be attached to plates 10 by any desirable means as for example by grooves 15 (Fig. 7) which may be cut in the face of said plates, said ribbons being pressed into and rigidly held by said grooves. If desired, however, plates 10 may be covered with a coating of an adhesive material such as shellac and ribbons 14 pressed in firm engagement with the face of said plates and held in such position by the adhesive properties of the material.

A plurality of plates 10 and ribbons 14 may be placed in stacked formation as shown in Fig. 2 and firmly secured together as by rods 16 passing through aligned holes in said plates, suitable bushings 17 being provided for properly spacing and clamping the various elements. The assembly may be further clamped by means of rod 18 passing through aligned holes 12 and co-operating with clamping disc 19 and open tubular member 20 having means thereon such as threads 21 for supporting an electromagnetic reproducing unit. Internal ribs 22 (Fig. 3) may be provided in said member 20 for co-operating with clamping rod 18 and causing the member 20 to be firmly held in position against the face of plate 10.

An electromagnetic unit 23 of any desired type, having a vibrating diaphragm operated by electromagnetic means may be supported by member 20 and so positioned that the vibrating diaphragm may produce compressions and rarefactions in the air column formed within aligned openings 12 of plates 10. The particular form of reproducing unit, however, forms no part of the present invention and consequently will not be described herein in detail.

The various spiral chambers formed between said plates 10 may be designed to be resonant to waves of various frequencies by suitably controlling the convolutions of spiral ribbons 14. In the interest of the outside appearance of the completed assembly, the outer portion of said ribbons 14 should be located at corresponding places on the various plates 10 as for example of the upper corner thereof. The length of the ribbon, however, and the length of the air column enclosed thereby may be varied by terminating the inner end of said ribbon at various points around the periphery of opening 12. Figs. 4 and 6 show, by way of example, ribbons in which different total lengths are obtained by varying the rate of curvature and the angular position of the inner end thereof.

The outer opening of the air columns may be formed of the same size by the addition of spacing member 30 (Fig. 8) formed as a continuation of a portion of spiral ribbon 14 and extending between said ribbon and the front portion of plates 10. Said member 30, in conjunction with the outer portion of spiral ribbon 14, forms a flare through which the sound waves from the spiral chambers will be impressed on the surrounding medium. Cover member 31 (Fig. 9) may be located around the various plates 10 between the outer end of ribbon 14 and the corresponding end of member 30 in order to produce a neat and pleasing finished appearance.

The fundamental note which may be propagated by a given air chamber is determined by the rate of increase in cross section of said chamber as well as by the total length thereof. Spiral members 14 should preferably be so designed that the air chambers will be of the proper length and of the required cross sections to produce high quality of reproduction. A plurality of such devices, constructed in accordance with the present invention, each of which is differently characterized, will serve to selectively amplify and reproduce the various musical notes which may be impressed thereon and to propagate

such notes to the surrounding medium. Sound waves comprising compressions and rarefactions produced by the diaphragm of the electromagnetic unit will be propagated through the various alinged openings 12 in plates 10 and will act upon the various spiral resonating chambers opening thereon.

Since the outer portions of spacing members 14 are located in aligned position, the various air columns will open in the same direction and simultaneously propagate the waves upon the surrounding medium in that direction.

This invention has been described as comprising a bank of 12 chambers. However, other numbers of chambers may be employed if desired and the above-mentioned conditions approximated thereby. For example, seven chambers may be so selected as to propagate substantially equally the various musical notes. It has been found that in order to properly transmit notes at the lower end of the musical scale, the rate of increase in area of the resonating chambers per unit of length should be low. The spiral chamber should therefore be formed with a plurality of convolutions of slowly increasing cross sections and member 30 designed to cooperate with the outer portion of spacing member 14 to obtain the same increment in cross section.

The device constructed in accordance with the present invention is compact and occupies a minimum amount of space consistent with the accurate reproduction of the various musical notes. The assembly is entirely self-contained and by reason of its rigid construction may be moved from place to place without danger of injury. Furthermore, a neat appearance is produced since the various resonating columns are contained in a single unitary structure. It has been found that a logarithmic spiral is particularly adapted for the efficient propagation of sound waves although various modifications may be employed without appreciably affecting the quality of the reproduced notes.

In the drawings accompanying and forming part of this specification, a practical commercial embodiment of the invention is shown, but as such illustration is primarily for purposes of disclosure, it will be understood that the structure may be modified in various respects without departure from the broad spirit and scope of the invention as hereinafter defined and claimed.

What is claimed is:

1. A sound propagating device comprising a plurality of spaced plates arranged in stack formation, flat spiral spacing members therebetween, said plates having aligned openings at the innermost ends of said spacing members whereby sound waves may be propagated therethrough and impressed upon the spiral chambers produced by each of said members.

2. A sound propagating device comprising a plurality of spiral chambers formed by flat plates and spiral spacing means therefor, said chambers having aligned openings, aligned openings in said plates at the innermost ends of said chambers and means for impressing sound waves thereon.

3. A spiral resonating chamber comprising a pair of flat plates and a flat spiral member therebetween and a spacing member forming with the outer portion of said spiral member a flared opening.

4. A sound propagating device comprising a plurality of flat plates arranged in spaced and parallel relationship, flat spiral spacing members therefor, clamping means comprising rods extending through said assembly, a reproducing unit and an open tubular support therefor, a rod extending through aligned openings in said plates for clamping said support thereto, each of said spiral members forming in connection with the adjacent plates a spiral air column resonant to a different note in the chromatic scale.

5. In combination with a sound reproducing device, a plurality of resonating chambers in the form of logarithmic spirals, each of said chambers being resonant to a different note in the chromatic scale.

6. A sound propagating device comprising a plurality of logarithmetically determined spiral sound propagating chambers, each tuned to a separate note of the chromatic scale, and a single vibration imparting unit for all of said chambers.

7. A sound propagating device comprising a plurality of flat sided spiral wall sound propagating chambers, each of said chambers being tuned to a separate note of the chromatic scale, and a single vibration imparting unit for all of said chambers.

Signed at New York, in the county of New York and State of New York, this 5 day of August A. D. 1927.

MILLER REESE HUTCHISON, JR.