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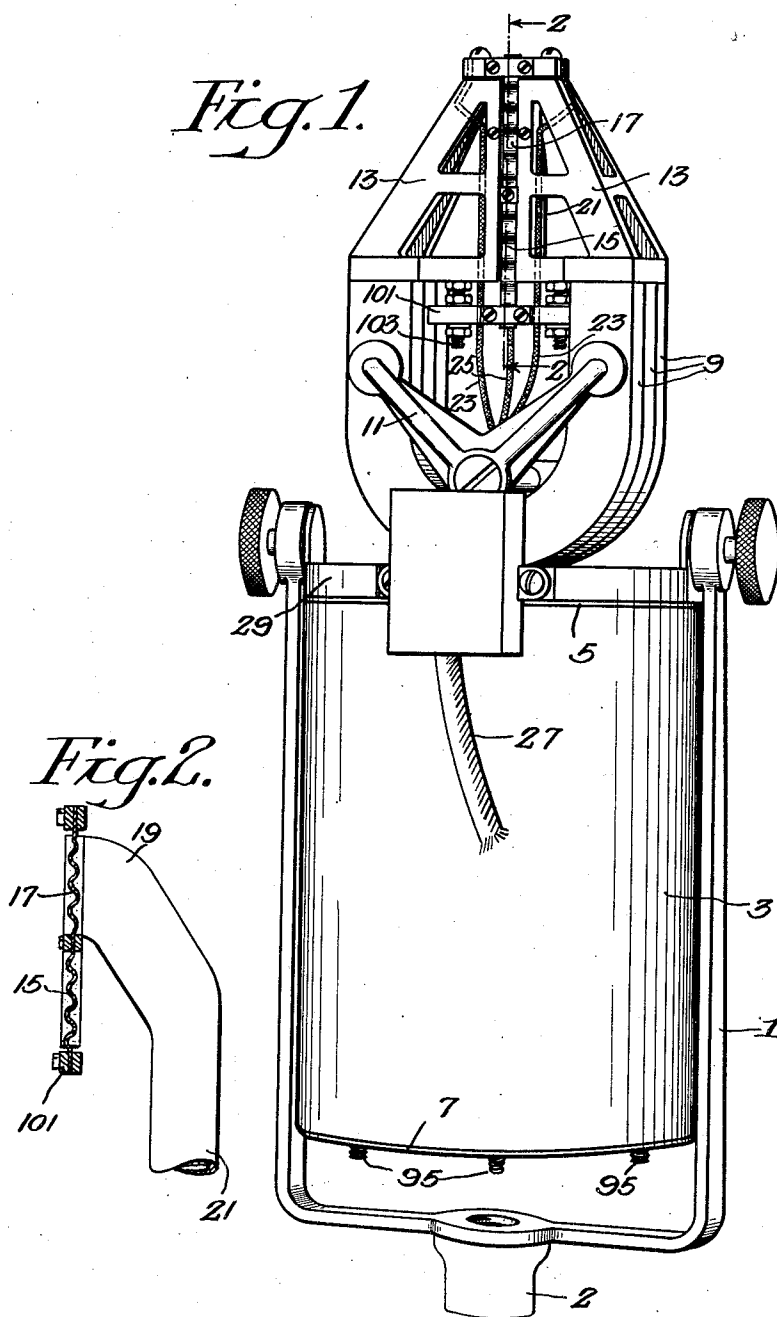
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2,178,216

ELECTROACOUSTICAL APPARATUS

Filed June 30, 1936

3 Sheets-Sheet 1



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Fig. 3

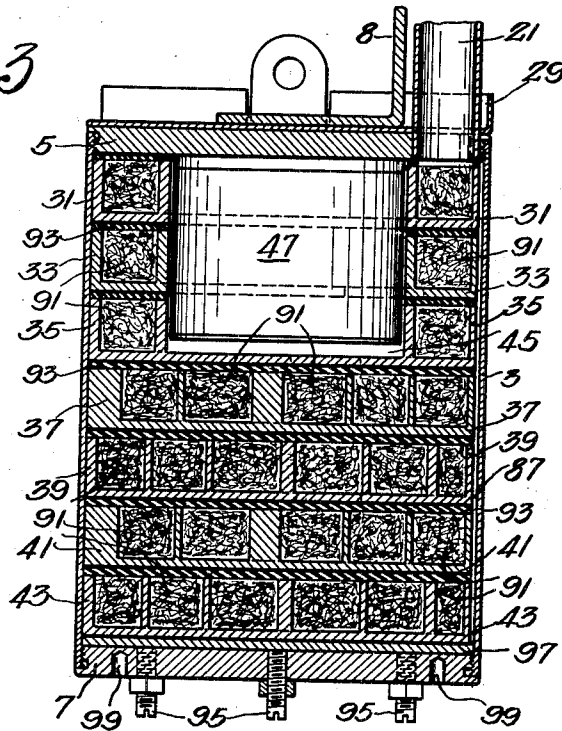
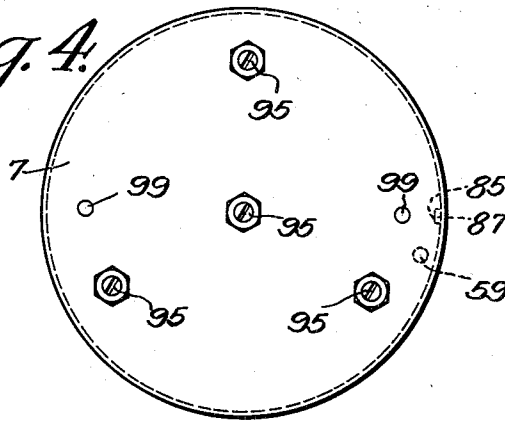


Fig. 4



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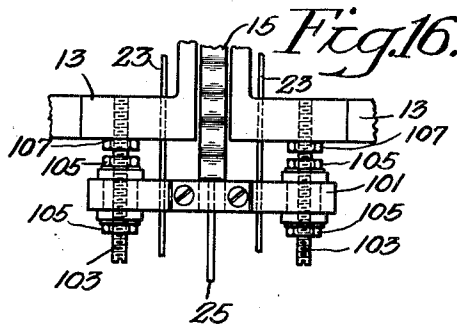
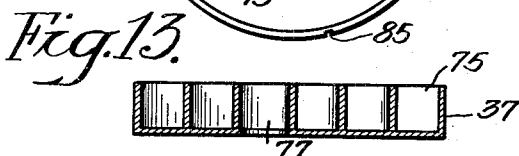
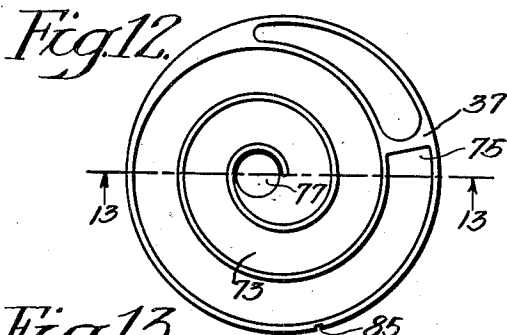
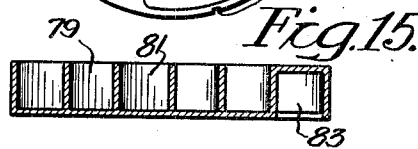
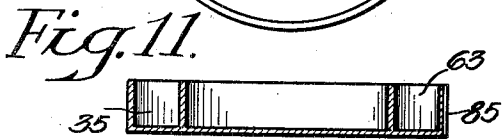
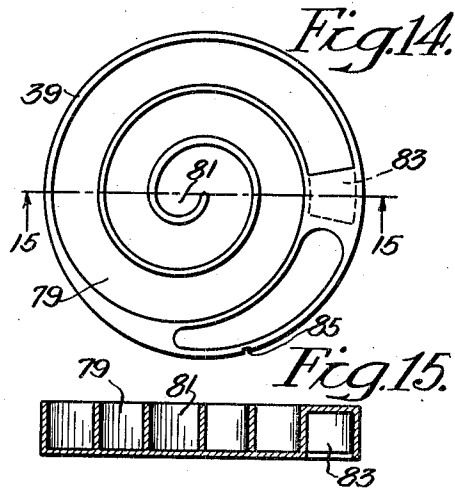
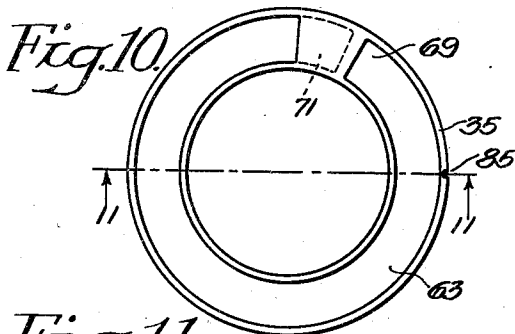
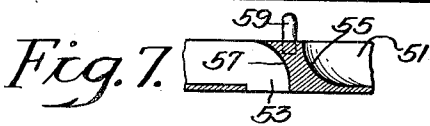
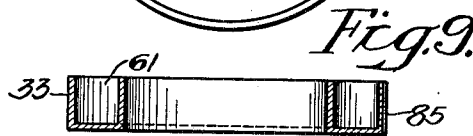
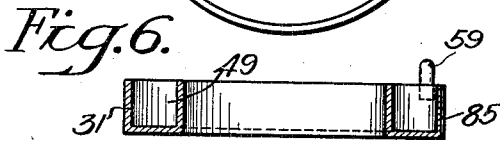
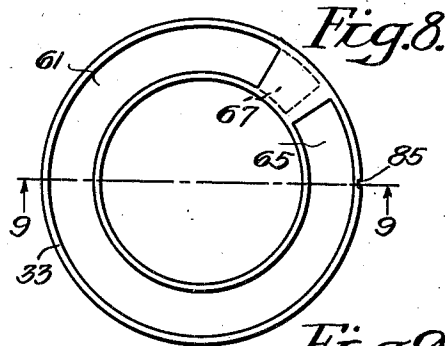
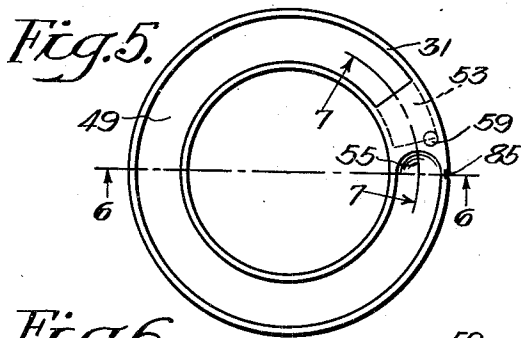
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ELECTROACOUSTICAL APPARATUS

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3 Sheets-Sheet 3



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2,178,216

ELECTROACOUSTICAL APPARATUS

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Application June 30, 1936, Serial No. 88,174

10 Claims. (Cl. 179—138)

This invention relates to electroacoustical apparatus of the type disclosed in United States Reissue Patent No. 19,115 of Harry F. Olson and Julius Weinberger, and has for its principal object the provision of an improved arrangement of the acoustic labyrinth of the pressure responsive element of such devices.

As pointed out in the aforesaid patent, a sound pickup device or microphone of the ribbon type may be operated partly in response to the pressure of a sound wave and partly in response to the pressure gradient of the sound wave by terminating a portion of the ribbon diaphragm in a pipe or tube containing damping material. Such a microphone has the advantage that its response is substantially uniform throughout a comparatively wide angle.

The tube into which the pressure responsive part of the ribbon terminates in the construction of the above-noted patent has resulted in increasing the bulk of the microphone and militating somewhat against its appearance and portability. To overcome these disadvantages, it has been proposed to make the pipe or tube as a labyrinth formed by assembling a plurality of block-like rectangular members within a casing secured to the frame structure of the microphone, the blocks being grooved to provide communicating passages. Such a device is described on page 145, volume 5 of the Journal of Acoustical Society of America (October, 1935) in an article by Weinberger, Olson and Massa entitled "A Uni-directional ribbon microphone." The right angled bends at the turns of this labyrinth, however, produce reflections which are unfavorable to the proper operation of the microphone. Moreover, no provision is made to prevent leakage of air from the labyrinthian tube, and another disadvantage of the structure disclosed in the foregoing article is that the coupling transformer between the microphone and the amplifier is so located that the leads from it to the ribbon are quite long, thereby introducing unnecessary resistance in what should be a low impedance circuit.

It is a further object of my invention, therefore, to provide an improved uni-directional microphone of the ribbon type which will be free from the foregoing disadvantages.

Another object of my invention is to provide an improved microphone as aforesaid in which the pipe or tube which loads the pressure actuated section presents no abrupt changes in direction for the passage of the waves.

Still another object of my invention is to pro-

vide, in a microphone of the type described, a labyrinthian loading tube constituted by a plurality of sections assembled in predetermined relation and between which no leakage of air will take place.

A further object of my invention is to provide an improved labyrinthian structure as aforesaid which can be readily assembled in proper relation and adjustably pressed firmly together.

Still a further object of my invention is to provide an improved microphone of the type set forth in which the ribbon tension may be readily adjusted to obtain suitable tension thereon.

Another object of my invention is to provide an improved microphone as described above in which the transformer is so arranged that the leads therefrom to the ribbon are of minimum length.

It is also an object of my invention to provide an improved microphone of the type set forth which is simple and compact in construction, which is comparatively light in weight and easily portable, which is economical of manufacture, which can be readily assembled even by unskilled workers without danger of improper assembly, and which is highly efficient in use.

In accordance with my present invention, I make the major portion of the aforementioned tube in which the pressure actuated portion of the ribbon terminates of a plurality of cylindrical sections arranged to provide a continuous tubular path which is partly substantially helical and partly spiral. The use of cylindrical sections instead of rectangular sections permits a much simpler construction, and the combined helical and spiral path eliminates the right angled bends at which reflections take place. The coupling transformer is placed in a cylindrical case formed by several of the uppermost sections, which lie adjacent the field structure or ribbon, instead of near the lowermost sections, as in the construction described above, whereby only very short leads are required from the transformer to the ribbon. Leakage between sections is prevented by means of resilient gaskets disposed between the cylindrical sections. These gaskets may be of rubber, for example, and may be conveniently cemented to the bottom of each section. Proper alignment of the sections is maintained by providing a key slot in the periphery of each one and fitting each slot onto a guide rod, and a plurality of set screws associated with a pressure plate at the bottom of the assembly may be employed for pressing the sections firmly against each other after assembly.

The novel features that I consider characteristic of my invention are set forth with particularity in the appended claims. However, the invention itself, both as to its organization and method of operation, as well as additional objects and advantages thereof, will best be understood from the following description of one embodiment thereof, when read in connection with the accompanying drawings in which

Figure 1 is a perspective view of one form of my improved microphone,

Figure 2 is a fragmentary section taken on the line 2—2 of Fig. 1.

Figure 3 is a central section of the acoustic labyrinth of my invention arranged to cooperate with the pressure responsive portion of the microphone ribbon.

Figure 4 is a bottom plan view thereof,

Figure 5 is a plan view of the uppermost section of the acoustic labyrinth,

Figure 6 is a central sectional view thereof taken on the line 6—6 of Fig. 5,

Figure 7 is a detail sectional view taken on the line 7—7 of Fig. 5,

Figure 8 is a plan view of the next lower section of the acoustic labyrinth,

Figure 9 is a central sectional view thereof taken on the line 9—9 of Fig. 8,

Figure 10 is a plan view of the third lowest section of the acoustic labyrinth,

Figure 11 is a central sectional view thereof taken on the line 11—11 of Fig. 10,

Figure 12 is a plan view of the fourth and sixth lowest sections of the acoustic labyrinth,

Figure 13 is a central sectional view thereof taken on the line 13—13 of Fig. 12,

Figure 14 is a plan view of the fifth and seventh lowest sections of the acoustic labyrinth,

Figure 15 is a central sectional view thereof taken on the line 15—15 of Fig. 14, and

Figure 16 is a detailed fragmentary elevation showing the ribbon tensioning means according to my invention.

Referring more particularly to the drawings, wherein similar reference characters designate corresponding parts throughout, there is shown, in Fig. 1, a supporting yoke 1 provided with an internally threaded mounting socket 2 which is suitable for mounting on a stand, the yoke 1 carrying a cylindrical casing member 3 which is closed at each end by the end plates 5 and 7 threadedly received thereon. The upper end plate 5 supports a bracket 8 on which are mounted one or more permanent magnets 9, a clamping member 11 serving to clamp the magnets 9 together if more than one magnet is employed. The bracket 8 also supports a pair of pole pieces 13 in contacting relation with the magnets 9 and in spaced relation to each other to provide an air gap therebetween in which a conducting element is mounted for vibratory movement.

The conducting element may comprise a thin, elongated, transversely corrugated ribbon clamped at each end and also at its center to provide two independently actuable ribbon portions 15 and 17, the portion 15 being freely accessible to sound waves from both the front and the back whereby it is responsive to the pressure gradient, or velocity, component of a sound wave, and the portion 17 being covered at its rear by the somewhat expanded end 19 of a tube or pipe 21 whereby the portion 17 is accessible to sound waves only from the front and therefore is responsive only to the pressure component thereof. A pair of conductors 23 connected to

the upper end of the ribbon portion 17 and a conductor 25 connected to the lower end of the ribbon portion 15 couple the conductive element 15—17 to a coupling transformer (not shown) which in turn connects the microphone to suitable amplifying means (also not shown) through a cable 27, the conductors 23 and 25 being, preferably, arranged in the manner set forth in the United States patent of Harry F. Olson and Barton Kreuzer, No. 1,897,732. Preferably, also, the parts just described are housed within a perforated protecting casing (not shown) adapted to be fitted into a cup-like member 29 on the plate 5.

The pipe or tube 21 terminates into a labyrinthian acoustic loading tube constituted by passages formed in a plurality of cylindrical sections 31, 33, 35, 37, 39, 41 and 43 housed within the cylindrical casing 3. The uppermost sections 31, 33 and 35, which are nearest to the vibratile conducting ribbon 15—17, are toric in shape and enclose a space 45 within which is placed a cylindrical casing 47 of highly permeable material for housing the aforementioned coupling transformer. By reason of the proximity of this transformer to the ribbon 15—17, it will be obvious that the leads 23 and 25 may be made very short in length, and therefore no unnecessary resistance is introduced into the microphone circuit.

The passage 49 in the section 31 is generally circular in shape and has an inlet 51 and an outlet 53. As seen in Figure 7, the inlet 51 is provided with a smooth curve 55 and the outlet 53 with a smooth curve 57 so that there are no abrupt bends in the section 31. A pin 59 serves to properly locate the section 31 within the casing 3 with respect to the tube 21, whereby the latter will accurately communicate with the inlet 51.

The sections 33 and 35 are quite similar to the section 31, each being also toric in shape and respectively having the generally circular passages 61 and 63 therein similar to the passage 49. The passage 61 has a smoothly curved inlet 65 with which the outlet 53 communicates, and a smoothly curved outlet 67 which communicates with the smoothly curved inlet 69 of the passage 63, while the smoothly curved outlet 71 of the passage 63 communicates with the passage 73 of the next succeeding section 37. By reason of the toric configuration of the sections 31, 33 and 35, it will be observed that their communicating passages 49—61—63 constitute substantially a helix within the convolutions of which the space or chamber 45 is provided.

Of the sections 37, 39, 41 and 43, the sections 37 and 41 are identical with each other, and the sections 39 and 43 are substantially identical to one another, and for this reason only the sections 37 and 39 will be described in detail. The section 37 is made substantially cup-shaped and its passage 73 has a smoothly curved inlet 75 adjacent the periphery and a smoothly curved outlet 77 at the center of the section, the passage 73 being in the form of an inwardly wound spiral, i. e., one starting at the periphery and extending inwardly to the center. In the section 39, however, of which the passage 79 is also spiral, the passage 79 starts at the center and travels outwardly to the periphery, its inlet 81 and outlet 83 being also smoothly curved. From the outlet 71, therefore, the labyrinthian passage or tube continues through the inlet 75, the spiral passage 73, the outlet 77, the inlet 81 of the section 39, the spiral passage 79, and through the outlet 83. Here the labyrinth again continues through the

spiral passages of the sections 41 and 43 in precisely the same way as through the sections 37 and 39, respectively, and terminates adjacent the periphery of the section 43, since the spiral passage in the section 43 comes to a dead end instead of having an outlet. Thus, the shape of the labyrinth is in part substantially helical and in part spiral, and throughout its entire length from the inlet 51 of the section 31 to the dead end of the spiral passage in the section 43, it constitutes a circuitous passage of gradually changing direction and entirely free from any abrupt bends, the labyrinth being made up wholly by the assembly of the sections 31, 33, 35, 37, 39, 41 and 43 in the manner described.

In order to insure accurate assembly of these sections, their peripheries may be marked with suitable indexing means. As shown in the drawings, each section has a notch or key slot 85 formed in its periphery and a guide rod 87 is inserted through all the slots 85 to accurately line up the several sections. Theoretically, the labyrinthian passage should be of infinite length, but since this is impossible, each section may have its passage filled with suitable damping material 91, such as loosely packed, uniformly distributed hair felt, in order to simulate the effect of a loading tube of infinite length. This effect is further approached if leakage of air between the several sections is prevented. For this purpose, there may be cemented or otherwise suitably secured to the closed bottom of each section a rubber, leather, cork or other similar gasket 93, each gasket having an opening therein coinciding with the outlet opening of the section to which it is secured and another opening therein coinciding with the inlet opening of the next succeeding, or next lowermost, section. The tops of the respective sections are all open and their upper edges dig into the resilient gaskets when pressed together. Pressure may be applied to the several sections by means of a plurality of set screws 95 threaded into the bottom end plate 7 and bearing against a pressure plate 97, the pressure being applied after the end plate 7 has been screwed into place, as by means of a suitable tool inserted into the openings 99 thereof.

From the foregoing description, it will be apparent that I have provided an improved acoustic labyrinth for the pressure responsive portion 17 of the conductive ribbon. This portion of the ribbon is preferably initially arranged as to tension during manufacture and maintained in initially set condition. Under certain circumstances, however, it has been found desirable to change the tension of the velocity actuated portion 15. This may be accomplished in a facile manner by clamping the central portion of the ribbon between a pair of fixed members and its lowest end between a pair of bridge elements 101 through which a pair of set screws 103 pass, being locked thereto by the nuts 105. The screws 103 are threadedly received in the pole pieces 13 and may be adjustably fixed therein by means of the nuts 107. By properly manipulating the nuts 105, the desired tension may be applied to the ribbon portion 15 in a longitudinal direction.

Although I have shown and described but one form of my invention, I am fully aware that many modifications and changes therein are possible. I therefore desire that only such limitations be imposed thereon as are necessitated by the prior art and by the spirit of the appended claims.

I claim as my invention:

1. In electroacoustical apparatus, a vibratile element, and means associated with at least a portion of said element for rendering said portion responsive to the pressure of a sound wave, said means comprising a plurality of assembled sections each provided with a circuitous passage of gradually changing direction throughout its length, the passages of adjacent sections communicating with each other whereby to provide a continuous passage.

2. The invention set forth in claim 1 characterized in that certain of said sections have their passages formed adjacent their peripheries, and certain other of said sections have their passages extend between their respective peripheries and their centers.

3. The invention set forth in claim 1 characterized in that certain of said sections have their passages circularly formed adjacent their peripheries, and certain other of said sections have their passages formed spirally between their respective peripheries and centers.

4. The invention set forth in claim 1 characterized in that said sections are each open at one end and substantially closed at the other end, said closed ends each having an outlet opening therein terminating the passages in the respective sections, and characterized further by the addition of means between adjacent sections adapted to prevent the leakage of air from between said sections.

5. The invention set forth in claim 1 characterized in that said sections are each open at one end and substantially closed at the other end, said closed ends each having an outlet opening therein terminating the passages in the respective sections, characterized further by the addition of resilient means between adjacent sections for preventing the leakage of air from between said sections, and characterized still further by the addition of means for adjustably pressing said sections into firmly engaging relation.

6. The invention set forth in claim 1 characterized in that each of said sections is provided with peripheral indexing means whereby said sections may be assembled in proper relation to each other.

7. The invention set forth in claim 1 characterized in that each of said sections is provided with a peripheral key slot, and characterized further in that guiding means extends through all of said slots whereby to insure proper assembly of said sections.

8. The invention set forth in claim 1 characterized in that said section passages are individually so formed as to provide a continuous passage which is partly substantially helical and partly spiral, said helical part being located nearest to said vibratile element and the space within the convolutions thereof providing a chamber for housing a transformer.

9. The invention set forth in claim 1 characterized in that several adjacent sections are toric in shape and enclose a space adapted to house a transformer.

10. The invention set forth in claim 1 characterized in that those several of said sections which are nearest to said vibratile element are toric in shape and enclose a space adapted to house a transformer.

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