June 25, 1929. M. R. HUTCHISON 1,718,357

MECHANICAL MOVEMENT FOR SOUND PROPAGATION

Filed May 27, 1927

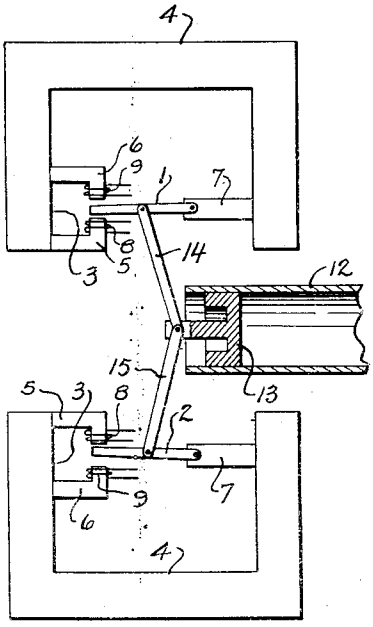


Fig 1

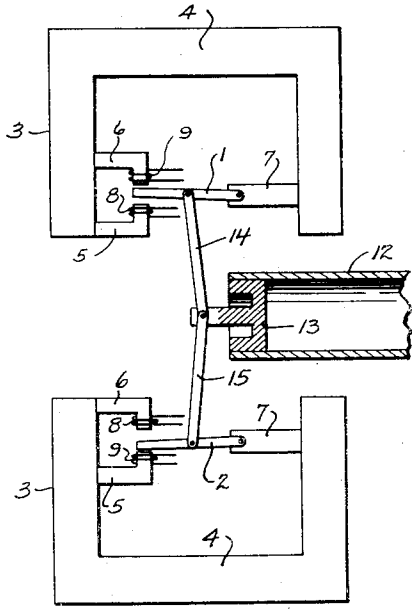


Fig 2

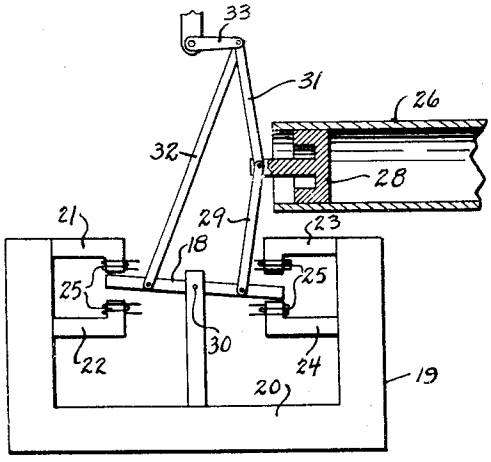


Fig 3

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UNITED STATES PATENT OFFICE.

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MECHANICAL MOVEMENT FOR SOUND PROPAGATION.

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The invention relates generally to acoustic devices, and, more particularly, to a mechanical arrangement for a horn or loud speaker whereby a source of energy capable of exerting a comparatively large force through a comparatively small amplitude may be used to impart a relatively large movement to the sound initiating element.

According to the invention, a loud speaker may be provided which may be relatively large and therefore require a sound initiating element describing a comparatively large amplitude of vibration. The large amplitude may be necessary to set the column of ponderable medium, such as air, within the horn into pendulic vibration to give the necessary large volume. The smaller end of the horn may be in the form of a cylinder, and a piston of light weight may be fitted therein snugly to prevent leakage of sound but yet without binding.

An electromagnet may be provided as a source of mechanical energy, the electromagnet being of any desired construction but having a characteristic inherent to most electromagnets, viz, that of exerting a relatively large force having a relatively small amplitude of vibration. Suitable linkage may be provided between the armature and the piston so arranged as to make use of the well known toggle action whereby the piston will have a relatively large amplitude of vibration at the expense of a reduction in the force applied thereto. The linkage is preferably of such nature that no rattle will be produced, and the sound waves will be transmitted thereby from the armature to the piston faithfully. Furthermore, the linkage may be such that the resultant force applied to the piston is in line with the axis of the cylinder, thereby obviating any tendency of the piston to bind in the cylinder.

If desired, two armatures, preferably forming parts of two separate electromagnets, may be provided for initiating the mechanical movement. As an alternative construction a single armature may be used, operated preferably by a single electromagnet, this armature being pivoted and having a modified linkage for communicating the motion of the armature to the piston.

Various other features and advantages of the invention will be apparent from the following particular description and from an inspection of the accompanying drawings.

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 represents diagrammatically a mechanical arrangement according to the invention, the parts being shown in one of their extreme positions;

Fig. 2 is a diagrammatic representation of the mechanical system shown in Fig. 1, but in the other of its extreme positions; and

Fig. 3 is a diagrammatic representation of a modified form of construction using a single armature.

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.

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

Referring now to Figs. 1 and 2, two separate armatures 1 and 2, are shown for initiating the mechanical movement. Each armature is associated with an electromagnet 3, which may be of any desired construction. In the form illustrated, each electromagnet comprises a permanent horseshoe magnet 4, having, at one side, pole pieces 5 and 6, with an air gap therebetween, and at the other side a single pole piece 7, to which is pivoted the armature 1 or 2, the other end of the armature being positioned between the two pole pieces 5 and 6. The pole pieces have suitable windings 8 and 9, thereon for conducting the electric current which is used to energize the magnet. It will be understood that the windings 8 and 9, will be so connected that current in one direction will cause the armature to be pulled toward one pole piece, and current in the other direction will cause

the armature to be pulled toward the other pole piece. The two electromagnets will be connected up in such manner as to operate upon the armatures 1 and 2, to simultaneously pull them apart and simultaneously push them together.

The smaller end of the horn is shown ending in a cylindrical portion forming a cylinder 12. The horn may be that of a loud speaker used for giving very large volumes, if desired. Snugly fitting within the cylinder 12, is a piston 13, of light weight construction but having such connection with the cylinder as to be easily movable thereon. Pivotally connecting the center of the pistol 13, and the approximate center of each of the armatures 1 and 2, is a connecting link 14 and 15.

As the two armatures are forced toward each other by the magnets, they will exert forces upon the links 14 and 15. The force applied by each link to the piston may be resolved into two components, one parallel to the axis of the cylinder 12, and the other perpendicular thereto. The components of force exerted by the links perpendicularly to the axis will balance each other and the components in line with the axis will add to give the desired motion to the piston. It will be understood that, due to the fact that the obtuse angle between links 14 and 15 is relatively large, a reverse toggle action obtains and the relatively small movement of the armatures will produce relatively large movement of the piston. The proportionate length of movement between the piston and armatures may be varied by varying the angle between links, and in practice the proportion which gives the best operating results will be the one that will be used.

Referring now to Fig. 3, a single armature 18, is shown pivoted in the center to a suitable support on a pivot 30, and operated by a single electromagnet 19. This electromagnet may be of any common construction, and the form shown diagrammatically for illustration comprises a permanent magnet 20, having at each end a pair of pole pieces 21, 22 and 23, 24, each pair having an air gap therebetween. Disposed within the air gaps are the ends of the armature 18. Each of the pole pieces will have a winding 25 thereon, and the several windings will be connected in such relation that the forces exerted by the pole pieces will add, to cause the armature to rotate in one direction when the current is in one direction, and to cause the armature to rotate in the other direction when the current is in the opposite direction.

A horn is shown having its end in the form of a cylinder 26, and having a piston 28, fitting therein, this construction being similar to that shown in Fig. 1.

A first link 29, is shown pivotally connecting the center of the piston 28, and the armature 18, at one side of the armature pivot 30. A second link 31, of equal length is pivotally connected to the center of the piston, and extends in the opposite direction forming an obtuse angle with the first link. A connecting rod 32, pivotally connects the end of the second link and a point on the armature equally spaced from the armature pivot 30, with the first link. A radius rod 33, is pivoted to a pivot on a line perpendicular to the axis of the cylinder and passing through the armature pivot 30, said pivots being equally spaced from the cylinder axis. The radius rod 33, is pivoted to the pivot point of the second link 31, and connecting rod 32.

It will be seen that, when the armature rotates in one direction, the first link will be moved upwardly while the connecting rod will pull the second link downwardly, the motion applied to the links being similar to that described in connection with Fig. 1. Components of force applied to the piston perpendicular to its axis will be balanced and the components in line with the axis of the cylinder, will add.

Thus it will be seen that an efficient and simple arrangement has been provided for giving the necessary relatively large movement to the piston from a source of energy having a relatively small movement. The arrangement multiplies the amplitude of the movement at the expense of the force. In operation, a relatively large movement is required in order for the piston to set into pendulic vibration the relatively large column of ponderable medium, such as air, in the horn, to give a large volume of sound, and, when once this air is set into pendulic vibration, the amount of force required to keep it in vibration is decreased.

The arrangement is such that the operating forces are applied to the piston in such manner that there will be no tendency for the piston to bind in the cylinder. Furthermore, the links are of such nature that there will be not rattle to give a disagreeable sound due to loose connections or other causes. The devices are simple and efficient, have but few parts, cannot easily get out of order, and will have relatively long life. The result on the ear, of music or speech, propagated by such an arrangement will be pleasing and will be faithful reproduction of the electric sound waves applied to the electromagnets.

It will be understood that, although the device has been described principally as a loud speaker, it may also be used as a transmitter for changing the energy in a vibrating ponderable medium into other kinds of energy such as electrical energy.

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. In combination, a horn having one end terminating in a cylinder, a piston of light weight fitting said cylinder, a pair of oppositely disposed armatures spaced on opposite sides of the axis of said cylinder, a pair of connecting links defining an obtuse angle and articulated to said piston, one link being articulated to each armature, and a separate electro-magnet co-operating with each armature.

2. In acoustic apparatus, a horn having one end terminating in a cylinder, a piston fitting said cylinder and capable of setting the medium in the horn into pendulic vibration, a pair of oppositely disposed armatures spaced on opposite sides of the axis of said cylinder and pivoted to their ends, a pair of links defining an obtuse angle and pivoted to said piston, one link being pivoted to each armature midway between the ends of said armature, and a separate electromagnet for exerting operating force on the free end of each armature.

3. In combination, a horn having one end terminating in a cylinder, a piston of light weight snugly fitting said cylinder, a pair of oppositely disposed armatures spaced equally from and on opposite sides of the axis of said cylinder, a pair of connecting links defining an obtuse angle and articulated to the center of said piston, one link being articulated to each armature, and a separate electro-magnet co-operating with each armature, said electromagnets being connected to cause said armatures to move simultaneously towards each other and simultaneously away from each other.

4. In combination, a horn, a sound initiating element disposed at one end of said horn, a pair of connecting links defining an obtuse angle and articulated to said element, and means connected to the outer ends of said links for exerting forces simultaneously on said links to and away from said axis.

Signed at New York in the county of New York and State of New York this 26th day of May A. D 1927.

MILLER REESE HUTCHISON.