

April 15, 1930.

C. R. ALBERTUS

1,754,928

LOUD SPEAKER

Filed July 28, 1927

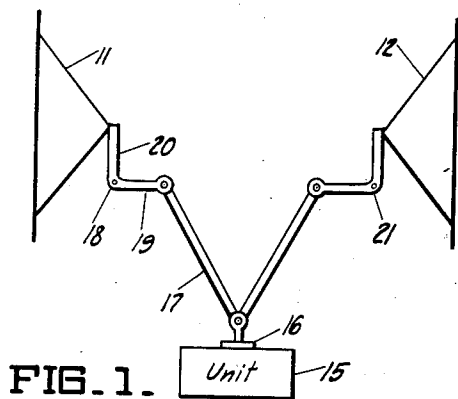


FIG. 1.

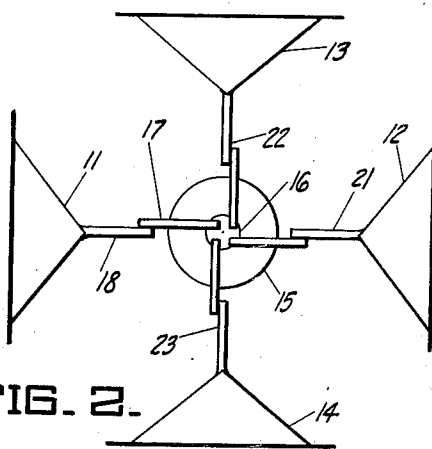


FIG. 2.

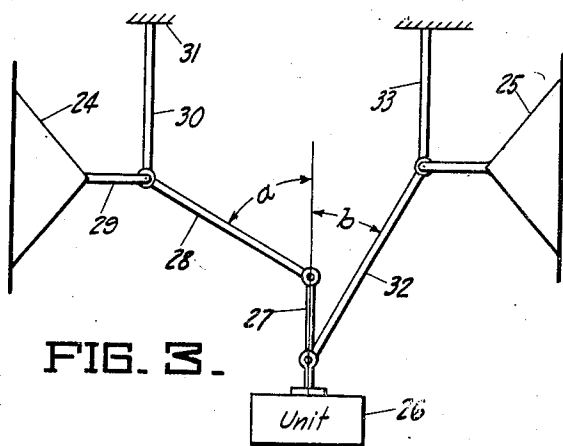


FIG. 3.

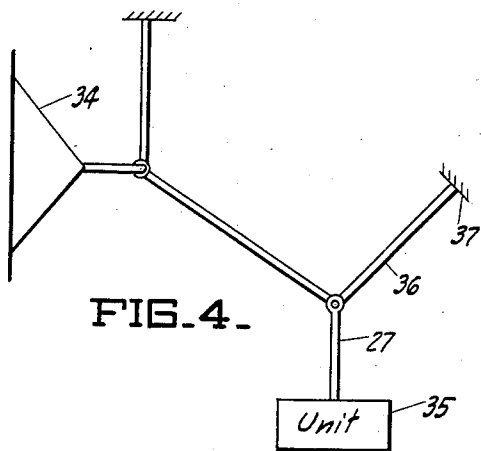


FIG. 4.

INVENTOR
C. R. Albertus
BY *John Flam*
HIS ATTORNEY

UNITED STATES PATENT OFFICE

CARL R. ALBERTUS, OF SAN LEANDRO, CALIFORNIA, ASSIGNOR TO THE MAGNAVOX COMPANY, OF OAKLAND, CALIFORNIA, A CORPORATION OF ARIZONA

LOUD-SPEAKER

Application filed July 28, 1927. Serial No. 209,092.

This invention relates to loud speakers, and especially to the mechanism whereby the air actuating unit is vibrated.

In loud speakers as now commonly found on the market, use is made of a member that serves to produce sound waves. This member is usually in the form of a diaphragm or a cone. A diaphragm ordinarily serves to pass air impulses to a horn, while the cone usually transmits the vibrations directly to the air. The diaphragm or cone can be vibrated for this purpose by a unit having a member mechanically vibrated in accordance with current variations in an electric circuit. Since such loud speaker units are now quite well known and readily available on the market, further description thereof is not essential.

The manner in which the loud speaker unit operates the air actuating unit is of considerable importance, for it is essential that the electrical impulses in the loud speaker circuit must be properly synchronized with the motion of the air actuator, as well as with the air vibrations produced thereby. I have found that the kind of response produced by the air actuator depends a good deal upon the extent of its mechanical motion, produced by the loud speaker unit. Thus if the motion is large relative to the motion of the loud speaker unit, the device will favor the low pitched sounds; and on the contrary, if the motion is relatively small, the device will favor the high pitched sounds. Thus the drive ratio between the loud speaker unit and the actuator becomes important, for by proper choice of drive ratios, several cones for example, can be made to cover the entire tonal range.

It is one of the objects of my invention to make it possible to vary the pitch of the cone in this way, especially without it being necessary to vary the size of the cone.

It is another object of my invention to make it possible to actuate a plurality of cones or other air actuators by a single loud speaker unit, whereby this unit alone can efficiently cover the entire desired tonal range.

It is still another object of my invention to

improve in general, loud speakers of this character.

It is still another object of my invention to provide a compact and simple loud speaker that can efficiently cover the desired tonal range.

My invention possesses many other advantages, and has other objects which may be made more easily apparent from a consideration of several embodiments of my invention. For this purpose I have shown a few forms in the drawings accompanying and forming part of the present specification. I shall now proceed to describe these forms in detail, which illustrates the general principles of my invention; but it is to be understood that this detailed description is not to be taken in a limiting sense, since the scope of my invention is best defined by the appended claims.

Referring to the drawings:

Figure 1 is a diagram showing how a plurality of cones, substantially free edged, can be actuated in accordance with my invention;

Fig. 2 is a diagrammatic plan view of the system shown in Fig. 1, illustrating the manner in which the plurality of cones can be arranged;

Fig. 3 is a diagram of a modified form of drive; and

Fig. 4 is form of the invention applied to a single cone.

In Fig. 1 I show a plurality of air actuators, such as the cones 11 and 12 which face in different directions; there may be as many of these cones spaced around a circle as desired; for example, in the plan view of Fig. 2 I show how four such cones 11, 12, 13 and 14 can be distributed to form a substantially square arrangement. I show also, a vibrator or loud-speaker unit 15 of any appropriate design. The cones 11, 12, 13 and 14 can be of the free edge type.

The important feature of this invention resides in the manner in which the cones are actuated by the vibrating element 16 of the unit 15. For this purpose, cone 11 has associated with it, a member 17 which transmits the motion of the element 16 to the cone, this member having its axis disposed at an angle with respect to the axes of the unit 15 and

cone 11. One end can be pivotally or otherwise flexibly connected to element 16; and the other end similarly connected to one arm 19 of a bell crank 18. The other arm 20 is connected to the apex of cone 11.

Vertical vibratory movement of element 16 due to energization of unit 15 will cause bell crank 18 to actuate the cone 11. The extent of motion of cone 11 is, however, dependent upon the relative proportions of arms 19 and 20. Thus if arm 19 is longer than arm 20, there is a step-down effect; if shorter, a step-up effect; and if the arms are the same length, the cone moves just as much as the element 16. By proper proportioning of arms 19 and 20, therefore, it is possible to make cone 11 most responsive to either high or low pitch sounds.

The other cones 12, 13, and 14 can be driven substantially in the same manner as just disclosed in connection with cone 11, but the bell cranks 21, 22, and 23 can be made of the proper proportions to make the drive ratio such that each one will respond best to sounds within a range of pitch assigned to it by the designer. In this way, each cone will best operate within its own definite range, and all of them simultaneously will produce a system substantially equally responsive to the entire tonal range of the whole system.

Of course the showing of Figs. 1 and 2 is mainly diagrammatic; other forms of drives in which the desired ratio can be obtained could be substituted for that shown. Another of such forms is illustrated in Fig. 3. In this figure, cones 24 and 25 are shown as actuated by the common unit 26. Of course, as before, four or more cones could be simultaneously operated. The unit 26 is diagrammatically shown as having a vertical extension 27 which is vibrated axially as the unit 26 operates. The cone 24 is driven from this extension by a link 28, connected at one end to extension 27, and at the other to a member 29 rigidly connected to the apex of cone 24.

In order that vertical movement of extension 27 be translated into horizontal movement of member 29, I provide a device for ensuring horizontal movement only of member 29, although the force exerted on it by link 28 is at an angle therefrom. For this purpose, there is a flexible support 30, anchored at its upper end, as indicated at 31, and pivotally connected at its lower end with the member 29. This flexible support can be made from resilient metal. As link 28 is actuated, this support being long, swings in a large radius, keeping its lower extremity moving in substantially a horizontal direction, and restraining the movement of member 29 in that horizontal path.

It can readily be shown by mathematics, that the drive ratio between the cone 24 and unit 26 depends upon angle α , that exists between the direction of movement of extension

27, and the direction of movement of link 28. If this angle is 45 degrees, the horizontal movement of member 29 is equal to the vertical movement of extension 27. If this angle is greater than 45 degrees, then the horizontal movement is less than the vertical movement, and there is a step-down ratio, causing a small motion of the cone but with increased power. If this angle is less than 45 degrees, then the horizontal movement is greater than the vertical movement, and there is a step-up ratio, causing a large motion of the cone, but with less power.

Cone 25 can be actuated by a similar mechanism including link 32, and flexible support 33. However, angle b between this link and the axis of unit extension 27 is shown as smaller than angle a . Thus cone 25 can be made to have a different drive ratio than cone 24, and between the two, a good tone range can be obtained. Of course, still other cones such as 24 and 25 could be actuated by the common unit 26 to take care of a still broader tonal range.

In Fig. 4, one of the cones is omitted, showing that a single cone, such as 34, could be actuated by unit 35. In this case, link 36, the equivalent of link 32, can be anchored at its free end as indicated at 37. In this way, it is ensured that the part 27 will be restrained to move in a substantially vertical direction.

It is evident that I have provided a simple and highly advantageous drive for an air actuator, by the aid of which it can be determined to what range of audio frequencies the loud speaker will respond to most readily.

I claim:

1. In combination, an actuating unit, an air actuator, and a rigid driving element for transferring energy between the unit and actuator, the direction of transmission through said element being oblique both to the direction of movement of the unit, and that of the air actuator.

2. In combination, an actuating unit, a plurality of air actuators, the directions of movement of the unit and of the actuators being non-parallel, and a driving element between the unit and each of the air actuators, the direction of transmission through each of said elements being oblique both to the direction of movement of the unit, and that of its associated air actuator.

3. In combination, an actuating unit, an air actuator, the directions of motion of the unit and actuator being non-parallel, and means for transferring energy from the unit to the actuator, comprising a rigid link oblique to both of said directions, one end of the link moving in the direction of movement of the unit, and the other in the direction of movement of the air actuator.

4. In combination, an actuating unit, a plurality of air actuators, said actuators being arranged around a circle and having separate

and distinct directions of movement, the vibrating unit also having a direction of movement distinct from any of the actuators, and a driving element for each actuator for transferring energy from the unit thereto.

5 5. The combination as set forth in claim 4, in which the driving elements are links oblique to the direction of movement of the unit and also to the direction of movement of the associated actuator.

10 6. In combination, an actuating unit, an air actuator, the direction of movement of the unit being non-parallel to that of the air actuator, and means for transferring energy between the unit and the air actuator, comprising a link connecting the unit to the actuator and oblique to the directions of movement of both the unit and actuator, and means constraining the movement of that end of the link adjacent the air actuator to be substantially parallel to the desired movement of the actuator.

25 7. In combination, an actuating unit, an air actuator, the direction of movement of the unit being non-parallel to that of the air actuator, and means for transferring energy between the unit and the air actuator, comprising a link connecting the unit to the actuator and oblique to the directions of movement of both the unit and actuator, and means constraining the movement of that end of the link adjacent the air actuator to be substantially parallel to the desired movement of the actuator, comprising a long flexible member anchored at one end and connected at its other end to the said end of the link, the arc described by that end of the link as this member flexes being substantially in line with the desired air actuator movement.

40 8. A cone, an actuating unit, the axis of the cone being non-parallel with the direction of movement of the unit, and an oblique link connecting the apex of the cone with that of the unit.

45 9. A cone, an actuating unit, the axis of the cone being non-parallel with the direction of movement of the unit, an oblique link connecting the apex of the cone with that of the unit, and means restraining that end of the link adjacent the cone to move substantially in the direction of the cone axis.

50 10. A plurality of cones having axes angularly spaced, an actuating unit having a direction of movement non-parallel with all of the axes, and a link for each cone, connecting it to the unit, all of said links being oblique.

55 11. The combination as set forth in claim 10, with the addition of means restraining the movement of that end of each link connected to its cone, to the direction of the associated cone axis.

60 12. The process of transferring energy from an actuating unit to an air actuator, which comprises transmitting a force from the unit to the actuator along a straight line

that is at an angle to the desired actuator movement and also to the direction of vibration of the unit, whereby the angularity determines the ratio of transmission.

13. In combination, a plurality of air actuators having substantially similar characteristics, a common actuating unit for operating said actuators, and means whereby each of said actuators is caused to respond most favorably to a definite tonal range.

14. A loud speaker system having a series of substantially identical air actuators, and a common actuating unit for operating all of said actuators, characterized by the fact that connections are provided from the unit to the actuators, which connections determine the best tonal range of each actuator.

15. In combination, a plurality of air actuators, a common actuating unit for operating said actuators, and means whereby each of said actuators is caused to respond most favorably to a definite tonal range, comprising for each actuator a link oblique to its direction of movement and also to the direction of vibration of the unit and transferring energy from the unit to the actuator, the obliquity of the link determining the tonal range.

16. In a loud speaker system having a series of substantially similar air actuators and a common actuating unit for operating said actuators; the process of covering the desired tonal range, which comprises transferring energy to each of said actuators from the unit, and causing each of said energy transfers to be set either to step down or step up the degree of movement of the associated unit.

17. The method of varying the tonal response of a sound reproducing diaphragm having an electro-magnetic actuating member, which comprises varying the angle of force application with respect to the axis of the diaphragm.

In testimony whereof I have hereunto set my hand.

CARL R. ALBERTUS. 110

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