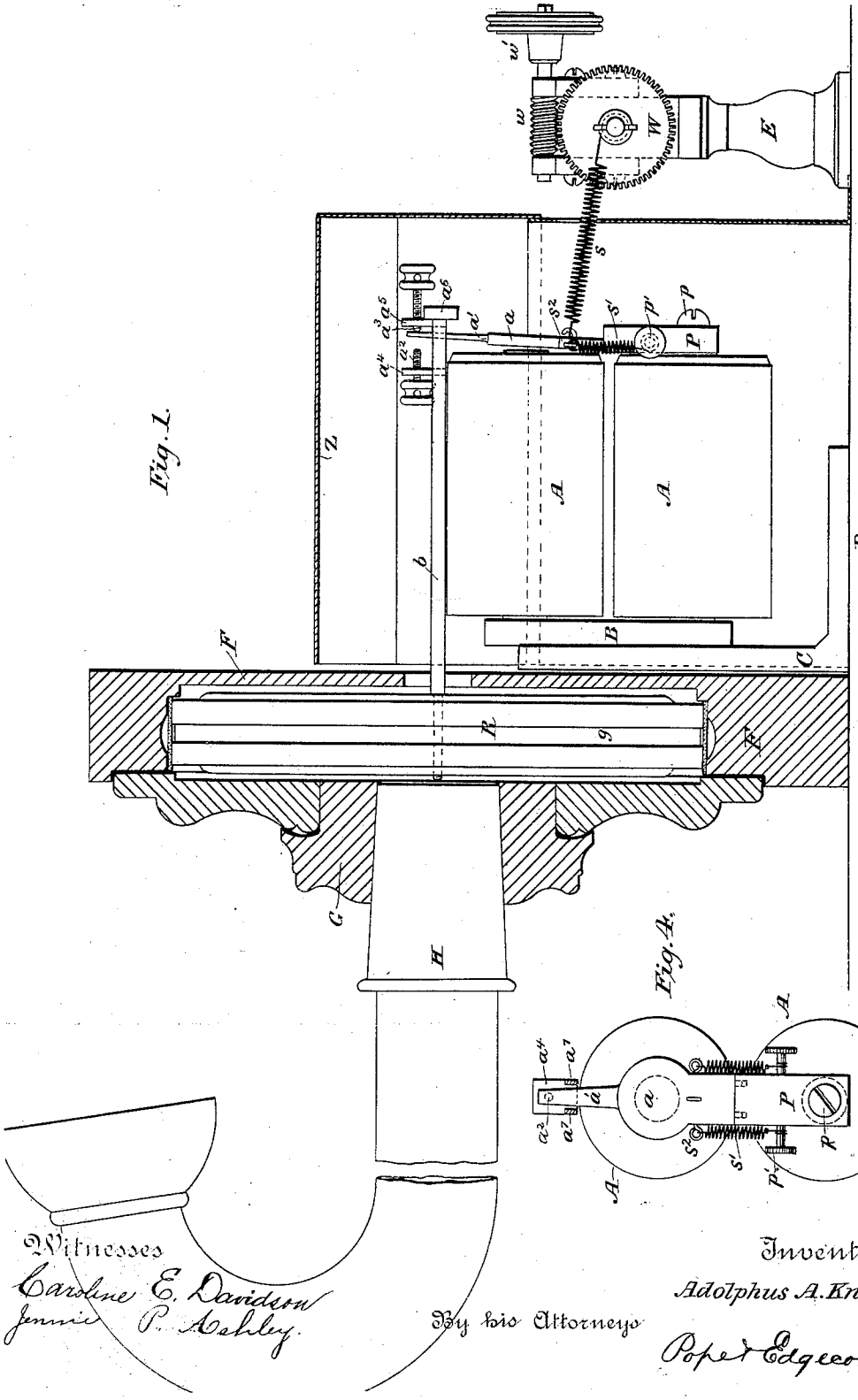
(No Model.) 2 Sheets—Sheet 1.

A. A. KNUDSON.

ELECTRO ACOUSTIC APPARATUS.

No. 360,308. Patented Mar. 29, 1887.



Witnesses
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(No Model.) 2 Sheets—Sheet 2.

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Fig. 2.

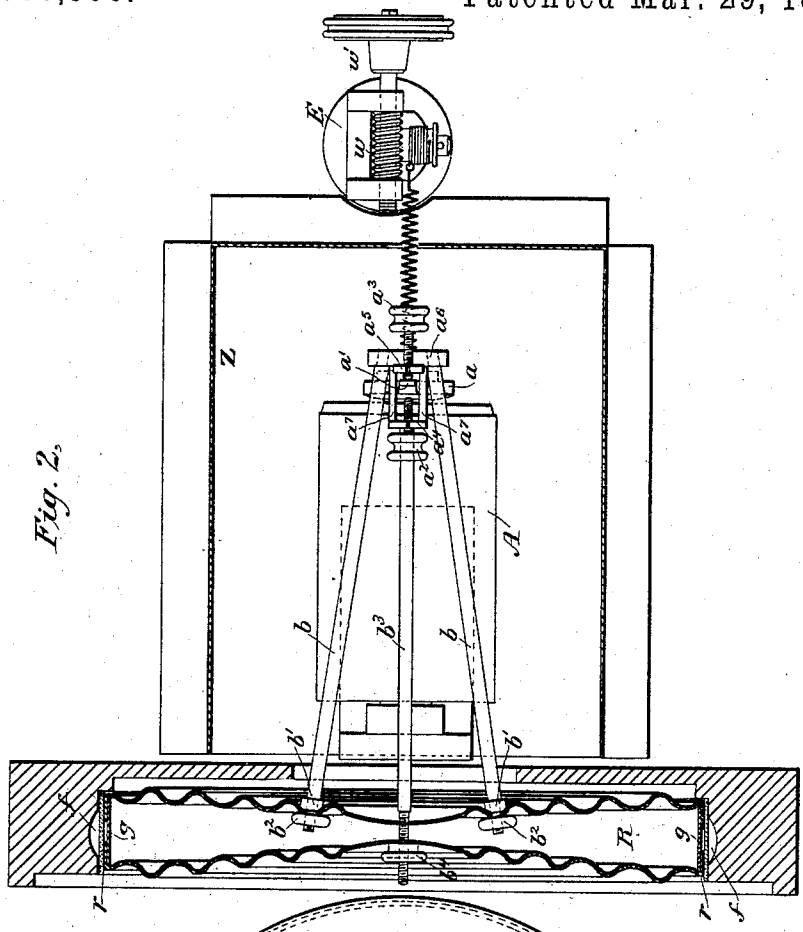
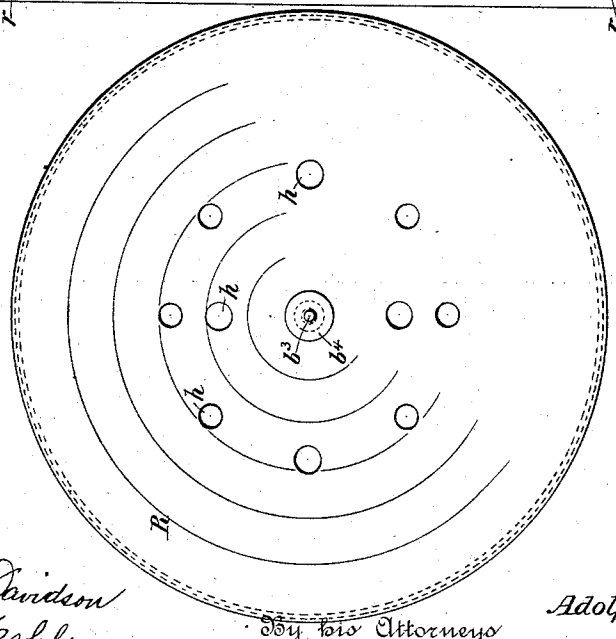


Fig. 3.



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UNITED STATES PATENT OFFICE.

ADOLPHUS A. KNUDSON, OF BROOKLYN, NEW YORK.

ELECTRO-ACOUSTIC APPARATUS.

SPECIFICATION forming part of Letters Patent No. 360,308, dated March 29, 1887

Application filed June 15, 1886. Serial No. 205,189. (No model.)

To all whom it may concern:

Be it known that I, ADOLPHUS A. KNUDSON, a citizen of the United States, residing in Brooklyn, in the county of Kings and State of New York, have invented certain new and useful Improvements in Electro-Acoustic Apparatus, of which the following is a specification.

The object of my invention is to provide an apparatus whereby the sounds produced by an electrical instrument when actuated by currents of very feeble intensity may be rendered audible and the signals may be interpreted, as in the case of telegraph-instruments worked on very long lines or when there is great escape of current, and whereby the use of relays and local batteries may be generally dispensed with.

My invention consists in the combination, with an electrical receiving-instrument, of an acoustic apparatus, the latter being so connected with the movable or operative parts of the former as to intensify the sounds produced, rendering them audible when otherwise they would be entirely inappreciable; and my invention also consists in the application to such receiving-instruments of a diaphragm or resonator of novel form and material.

In the accompanying drawings, which illustrate my invention, Figure 1 is a side view, partly in section, of a telegraphic instrument. Fig. 2 is a plan view of the same, also partly in section. Fig. 3 is an elevation of the diaphragm; and Fig. 4 is an end view of the electro-magnet, showing armature.

In the drawings, A represents an electro-magnet; B, the yoke; C, the angular brass support for the magnet, attached to the base D.

E is the standard for the adjusting device.

F is the case for the diaphragm or resonator R. This case may be of wood or similar material.

G is an auxiliary piece attached to the case F and of the same material, adapted to receive the end of the ear-tube H.

The armature *a* of the electro-magnet A, with its lever *a'*, is made as light as possible, and its motion is limited in the usual manner by the stops a^2 and a^3. The armature is held back by the spring *s*, and proper tension is given to the latter by means of the cog-wheel W, tangent-screw *w*, and milled wheel *w'*. As the cord attached to the spring *s* winds around the arbor of the wheel W, it will be seen that this device will enable the operator to obtain a very delicate adjustment of the armature. The armature *a* plays preferably in front of one core only of the electro-magnet. The lower core in the drawings has the pole-piece P attached to it by means of the screw *p*. On the top of the pole-piece P the armature rests, and is kept in place by one or more small pins extending from the lower end, which loosely enter corresponding holes in the upper end of the pole-piece. These are shown in Fig. 4. Light spiral springs *s'* are attached to each side of the armature by the hooks s^2 and to the arbor of the small adjusting-screw *p'* on the pole-piece P. These springs hold the armature in position with a gentle pressure downward.

Z represents a metallic case, with which the electrical portions of the instrument are preferably covered. The forward and backward screws or stops, between which the end of the armature-lever *a'* plays, are held by the upright pieces a^4 and a^5, and these are supported by the piece a^6. The piece a^5, through which the back contact-screw passes, is attached directly to a^6. The piece a^4, through which the front contact-screw passes, is held by the two side pieces, a^7 a^7, Fig. 2. The piece a^6 is supported by the two bars *b b*, which diverge, as shown in Fig. 2, and are firmly attached to the diaphragm by passing through the latter, the connection being made rigid by the nuts *b' b²* on the inside and outside. Again, the bar b^3 has one end firmly attached to the lower end of the piece a^4, (which holds the contact-screw a^2,) and the other end passes through the diaphragm, and is firmly joined to the latter at its center by the small nut b^4. It will therefore be seen that by means of the bars *b b* and b^3, the rectangular frame within which the armature-lever *a'* plays, and which carries the contact or limiting stops a^2 a^3, all the parts which are affected by the motion of the armature are directly supported from the diaphragm or resonator R. The resonator is held in position at the two sides *r r*, where its edge fits into the recess *f f* in the wooden case F. At the edges *r r*, where the resonator fits and is held in the case F, small pieces of felt or other suitable sound-insulating material are placed, which prevent vibrations from being

communicated to the wooden case, and hence all the sound is confined to the resonator itself. Very faint sounds, therefore, caused by the motion of the armature and its impact against its stops are communicated to the resonator, and are capable of being heard at its side opposite the magnet, where the ear may be directly applied, or where the tube H may be conveniently attached. This tube I prefer to have of the usual flexible form, as such form accommodates any desirable position of the operator.

It remains now to describe the diaphragm or resonator R. I make this of thin aluminium. The qualities of lightness and electrical conductivity of this metal are well known. Its resonance is also well understood; but I have found that when a very thin sheet is spun into a circular form, and especially when corrugations are formed in its sides, as shown in the drawings, its ability to take up and give off sounds is largely increased. Such a diaphragm increases to a considerable degree the sensitiveness and practical value of any acoustic or telephonic instrument to which it may be applied.

The electro-acoustic instrument herein described has shown by actual experiment that a current may give motion to the armature, and Morse signals be read thereby, while the needle of a sensitive galvanometer inserted in the circuit will not be affected. The form of magnet, the means for delicate adjustment, the method of supporting the limiting-stops from the resonator, and the nature of the resonator itself all contribute to this result.

It will be obvious that the diaphragm may be stamped into the required shape as well as spun. Another quality which fits the metal alluded to for the resonators for electrical and acoustic instruments of all kinds is that of resisting corrosion. It may be kept for any length of time in a damp atmosphere, and remains unaffected, so that instruments having aluminium diaphragms may be used in such places without change in their performance. When spun or stamped, it may be made very thin indeed for use as a resonator. I have found that one-hundredth of an inch will give good results. When holes are made in the sides of the diaphragm, as shown at *h h*, &c., in Fig. 3, its performance is improved.

A ring or hoop of some other material—such as brass—may conveniently be used for the rim of the resonator. Thus *g g* in Fig. 2 is a hoop of brass, over which the aluminium disks or sides of the resonator are drawn. This decreases the cost without affecting the performance of the device.

I claim as my invention—

1. The combination, substantially as hereinbefore set forth, of an electro-magnet, its armature and armature-lever, limiting-stops therefor, a resonator or diaphragm of aluminium from which said stops are supported, and means for adjusting the said armature according to the attraction exerted upon it by said electro-magnet.

2. In an instrument adapted to receive and transmit sounds, a resonator or diaphragm formed of two disks of aluminium secured to the edges of a ring or hoop of different material and thicker than said disks.

3. The combination, substantially as hereinbefore set forth, with an electro-magnet, of a pole-piece attached to one of the cores thereof, an armature held against said pole-piece by springs or their equivalents in such position as to face the other core of said magnet, limiting-stops for said armature, a diaphragm or resonator from which said stops are supported, and means for adjusting said armature according to the attraction exerted upon it by said electro-magnet.

4. The combination, substantially as hereinbefore set forth, with an electrical receiving-instrument, of a diaphragm or resonator which supports the stops limiting the movement of the armature of said instrument, said diaphragm consisting of two disks of aluminium with corrugated surfaces secured to the edges of a ring or hoop of different material and thicker than said disks.

5. The combination, substantially as hereinbefore set forth, with an electro-magnet, of a pole-piece attached to one of the cores thereof, an armature resting upon said pole-piece and held in place by springs in such position as to face the other core of said magnet, limiting-stops for said armature, and a diaphragm or resonator supporting said stops, said diaphragm consisting of two disks of aluminium secured to the edge of a ring or hoop of different material and thicker than said disks.

In testimony whereof I have hereunto subscribed my name this 12th day of June, A. D. 1886.

ADOLPHUS A. KNUDSON.

Witnesses:
DANL. W. EDGECOMB,
CHARLES A. TERRY.