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APPARATUS FOR REPRODUCING SOUND

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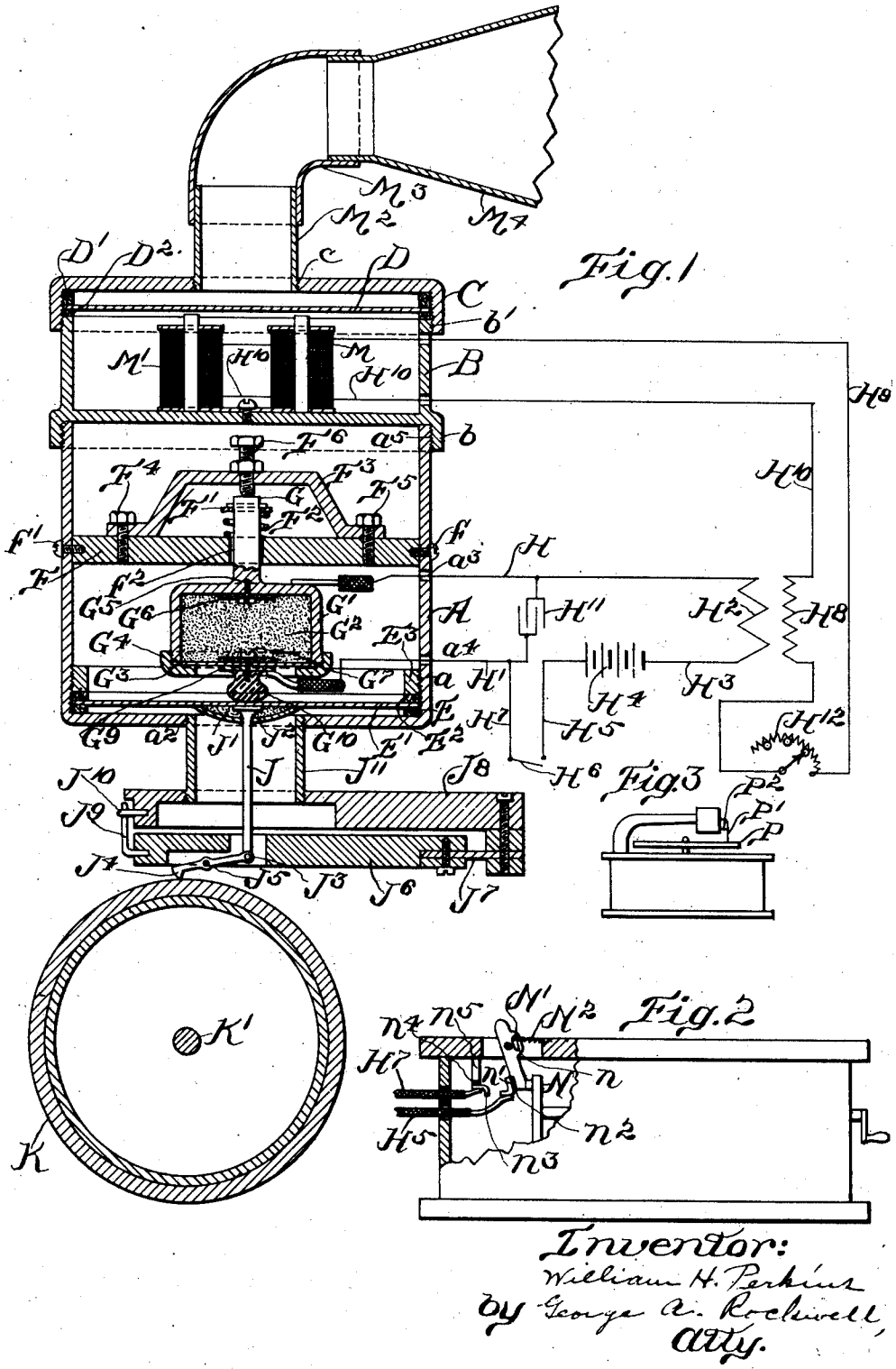


Fig. 1

Fig. 3

Fig. 2

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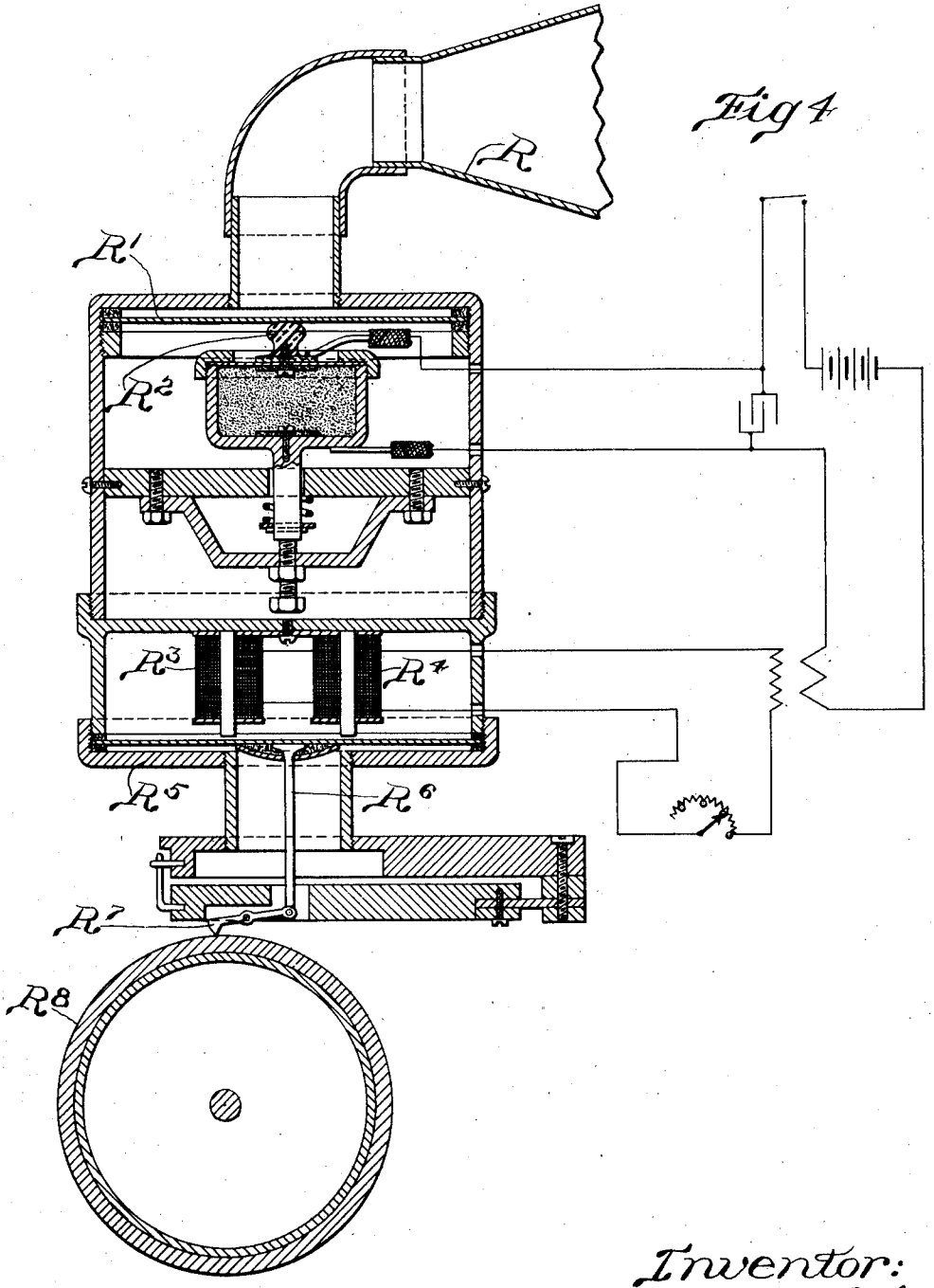
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Fig 4



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UNITED STATES PATENT OFFICE.

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APPARATUS FOR REPRODUCING SOUND.

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In the prior art reproduction has been accomplished in most cases entirely mechanically, and in some cases transmission has been accomplished electrically but in these latter cases the development has been mechanical and not electrical and usually this development is by means of a column of air. The result is that certain sounds have not heretofore been audibly reproduced at all and others have been very imperfectly reproduced, this being mainly on account of the slow mechanical development.

The principal objects of my invention are to overcome these defects and to reproduce sounds which have not heretofore been audibly reproduced and also to materially improve the development and transmission of other sounds which have been imperfectly reproduced.

A feature of my invention is electrical development of sound whether recorded permanently or to be recorded permanently, and preferably this development is entirely electrical.

Another feature is electrical means for partial or entire development of recorded sound as well as for transmission thereof.

Another feature is the combination of a record-operated diaphragm, the latter being mechanically connected with the actuator used to vary the resistance in an electric circuit, and preferably this connection is by direct contact and the circuit is preferably balanced this feature being particularly important if my invention is embodied in a phonograph.

In connection with my reference to a balanced circuit I may explain that the effect of capacity introduced into an alternating current circuit is to produce a lead in phase, since the reaction of a condenser instead of tending to prolong the current tends to drive it back. Since capacity and inductance produce opposite effects they can be used to neutralize each other. They exactly balance if impedance equals the inductance and if the current were led into a condenser of small capacity the current running in and out of the condenser would be governed only by capacity and frequency and not by the resistance. Variable resistance is used only to start oscillations, the condenser balancing and continuing them automatically, cutting out the resistance and thus making a resonant or balanced circuit.

Another feature is a pressure or tension device to provide mechanical pressure for the actuator and to provide electrical means for controlling the amount of current suitable for the development and transmission desired.

Another feature is the construction of said pressure or tension device.

Another feature is a rigid arm to actuate the diaphragm, which arm has a fixed connection with said diaphragm.

Another feature is having the record-operated diaphragm preferably of the same size as the receiver diaphragm.

Another feature is the combining of the receiver with the case containing the diaphragm and microphone in one compact structure.

Another feature is a switch controlled by a brake, the latter controlling the mechanism which operates the record.

Other features will be pointed out below.

Figure 1 is a central vertical section of a phonograph in which my invention is embodied;

Figure 2 is a diagrammatic view of one form of switch for making and breaking the circuit; and

Figure 3 is a diagrammatic view of a phonograph of a different form; and

Figure 4 is a modification described below.

I illustrate my invention as embodied in a phonograph which has a casing in three parts A, B and C. Part A is cylindrical and is interiorly annularly threaded at a, said part A having a threaded opening a^2 and having side perforations at a^3 and a^4 to permit entrance of the wires as described below. Part B has a depending annular flange b which is interiorly threaded to engage the threading a^5 of member A, said part B engaging the top of part A and being exteriorly threaded at b' this threading engaging the interior threading of cap part C which is screwed down to hold metal diaphragm D in place between annular washers D′ and D² of fibre or other suitable material, the cap C having a threaded perforation c to aid in holding the tone arm as described below.

Upon the bottom of part A rests annular washer E of fibre or other suitable material supporting mica diaphragm E′ and upon the latter is placed washer E² similar to washer E, these two washers and the diaphragm

being held in position by ring E^8 exteriorly threaded to engage threading *a*.

Member F is held to member A by screws *f f'* and has a central perforation f^2 to permit movement of the guiding portion G of the electrical actuating mechanism, this portion G being integral with the housing portion G' for the carbon granules G^2, the latter being held under adjustable pressure within the housing by mica diaphragm G^3, which, in turn, is held in place by cap ring G^4 screwed on housing G'. Screw G^5 connects carbon contact plate G^6 to the inside of housing G', the latter being at the outside electrically connected by solder or otherwise with wire H which runs out through perforation a^3. Screw G^7 holds carbon contact plate G^8, metal plate G^9 and flat button G^{10} to diaphragm G^3, said button being the actuator of said actuating mechanism for varying electrical resistance, and being in direct contact with diaphragm E' so as to partake of all the movement of said diaphragm. Wire H' is suitably connected to metal plate G^9 and runs out through perforation a^4.

A rigid steel needle J is held firmly to diaphragm E' by cement J' and the cement is preferably held in place by a mica cup J^2, perforated centrally to receive the shank of said needle, which is pivotally connected to one end of lever J^3, the other end carrying a diamond point J^4 moved by the indentations, undulations or other recording character on the record cylinder K, which has sound directly recorded thereon and which is mounted to rotate on shaft K'. Lever J^3 is pivotally mounted at J^5 on member J^6 connected through flat spring J^7 with member J^8, member J^6 having a yoke J^9 to engage pin J^{10} on member J^8 and thereby limit the movement of member J^6. Member J^8 has an interiorly threaded perforation to engage the exterior threading of tube J^{11} which is exteriorly threaded to engage the threading a^2.

The portion G has a collar F' fixed thereto, said collar serving as one abutment of spring F^2 coiled around portion G, the top of member F serving as the other abutment, and in this way I provide a very efficient tension or pressure device. A bridge member F^3 is held by screws F^4, F^5 to member F and has a threaded passage for screw F^6 which bears upon and adjusts portion G.

The balanced circuit which I prefer comprises wire H; wire H^2, being the primary of the induction coil; wire H^3; battery H^4; wire H^5; switch H^6; wire H^7 and wire H' and the electrical actuating mechanism; and also includes wire H^8, being the secondary of the induction coil, and wires H^9 and H^{10} running to the receiver coils M and M'; and also includes condenser H^{11}. A rheostat H^{12} is preferably used in the secondary of the induction coil so as not to affect the character or quality of the reproduced sound but to reduce the volume to the degree desired. The receiver coils M and M' are supported on the transverse portion of member B and actuate diaphragm D, which is of substantially the same size as diaphragm E', this being an important feature of my apparatus as explained below. Centrally disposed with relation to diaphragm E is tube M^2 threaded to engage threading *c* and flexible tube M^3 frictionally grips tube M^2 and also tone arm M^4 to hold the latter in position.

In view of my use of electrical means it is desirable that the circuit be made only when the sound is being reproduced and I therefore prefer to use a switch of the character shown in Figure 2 in which N represents the rotary member to carry the record and N' represents the brake, compression spring N^2, tending in the position shown, to hold the brake against member N. When brake N' is swung out of contact with member N said spring slides along slot *n* and tends to hold the brake out of contact with the rotary member. Brake N carries a bridge piece *n'* insulated at n^2, the bridge piece being electrically connected with wire H^5, corresponding with wire H^5 of Figure 1. When the brake is swung out of contact with member N it carries bridge piece *n'* into contact with terminal n^3, insulated at n^4 from, but connected to, support n^5, said terminal being electrically connected with wire H^7, corresponding to wire H^7 of Figure 1. With this construction the circuit can only be made when the rotary member is freed for operation.

In Figure 3 I show diagrammatically my apparatus used with a record plate or disk instead of a record cylinder, the plate P actuating the needle P' which may bear against a fulcrum P^2, the diaphragm, corresponding with diaphragm E' in Figure 1, being vertical, instead of horizontal as in Figure 1.

In using my apparatus it will be clear that the sound recorded on the cylinder K will be reproduced by the diaphragm E' and will then be reproduced, developed and transmitted by my electrical means, the direct contact of said diaphragm with the button in combination with the balanced circuit and particularly when also combined with my tension device producing results never before attained, particularly in automatic music. As instances of these results I may point out that the record of the sound of a bass drum has been fully reproduced and developed by the tests made with my apparatus while such sound has never been audibly reproduced before and my tests have reproduced with marvelous clearness the music of a piano while it is well known that the reproduction of such music has hereto-

fore been extremely indistinct and unsatisfactory. One reason that I am able to accomplish my results is that I use electrical means to develop the record sound, that is to say, the complete record of the sound is made audible whereas, when mechanical development is attempted, all the recorded sound is not made audible or at least is not distinctly audible and one reason for this is that mechanical devolopment is too slow and also, as in the case of a column of air, some of the sound is dissipated in development and not conserved as in my apparatus.

A particular feature of advantage of my apparatus is that the actuator is held under pressure against the diaphragm E′ under all conditions of vibration, this being due to the adjusting screw F^6, the diaphragm G^3 vibrating in synchrony with diaphragm E′ during such holding under pressure, and this pressure is preferably longitudinal and substantially in line with needle J to keep the actuator in line with the needle J. The spring F^2 holds portion G firmly against screw F^6.

In Figure 4 I have shown my invention embodied in an apparatus in which the sound entering the horn R vibrates mica diaphragm R′ which is in direct contact under pressure with button R^2 which is part of the actuating mechanism for the electric circuit, the wires of the circuit leading to the receiver coils R^3 and R^4 which vibrate diaphragm R^5 and thereby needle R^6 and consequently recording point R^7 which permanently records the sound on rotary record cylinder R^8. The parts of Figure 4 to which reference characters have not been applied are the same as the corresponding parts of Figure 1 and it is therefore considered unnecessary to describe them in detail. It will be clear that in Figure 4 the sound of the voice or musical instrument or other sound will enter the horn R and be recorded on diaphragm R′ and then be developed and reproduced in permanent form on cylinder R^8.

What I claim is:

1. An apparatus for reproducing sound comprising a diaphragm; an electric circuit for developing the sound recorded on said diaphragm; actuating means for said circuit; a casing for said actuating means; a screw to adjust said casing to hold said actuating means in contact with said diaphragm under pressure; and resilient means to hold said casing in contact with said screw.

2. An apparatus for reproducing sound comprising an electric circuit for reproducing sound; a movable member adapted to carry a record; and another movable member having a portion which acts directly as a brake for the record-carrying member and also having a portion which acts as a bridge to control the making of said circuit.

3. An apparatus for reproducing sound comprising an electric circuit; a movable member adapted to carry a record; another movable member having a portion rigidly connected to it which normally holds the record-carrying member mechanically against movement, said other movable member having another portion rigidly connected to it which acts directly as a bridge to make said circuit when said first-mentioned portion is moved to release the record-carrying member; and means to hold said other member with the first-mentioned portion in its position of release.

4. An apparatus for reproducing sound comprising a diaphragm; means to hold the edge of said diaphragm stationary; a member having sound recorded thereon; mechanical means to reproduce on said diaphragm the sound recorded on said member; an electric circuit for developing the sound recorded on said diaphragm; a microphone, including a casing, separate from said diaphragm and having a flexible element; an actuator having fixed connection with said flexible element but unconnected to said diaphragm for varying the resistance in said circuit; a screw to adjust said casing to hold said actuator in contact with said diaphragm under pressure; and resilient means to hold said casing in contact with said screw.

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