T. A. EDISON.
REPRODUCER FOR PHONGRAPHS.
(Application filed Mar. 24, 1906.)

Fig. 5

Fig. 6

Witnesses:

Inventor:

By: Rob. H. Dyce
Att'y

THE NORT'S PETERS CO., PATENTED, WASHINGTON, D. C.
To all whom it may concern:

Be it known that I, THOMAS A. EDISON, a citizen of the United States, residing at Llewellyn Park, in the county of Essex and State of New Jersey, have invented a certain new and useful Improvement in Reproducers for Phonographs, of which the following is a specification.

My invention relates to improvements in reproducers for phonographs and other talking-machines.

The object I have in view is to provide a sound-reproducer for the purpose by which the record on the blank will be closely and accurately followed by the reproducer-point, so as to result in the better reproduction of the original sounds, and wherein false vibrations will be eliminated to a large extent.

In carrying out my invention I support and arrange the reproducing arm or lever relatively to the blank that the friction between the reproducer ball or point and the blank may be utilized in effecting vibration of the diaphragm. The friction with the record, therefore, instead of being a source of objection is by my invention effectively utilized in the reproduction. This friction may alone be relied upon to effect vibration; but I prefer to construct the device in such a way that the vibration of the reproducer ball or point will be directly communicated to and assist in the vibration of the diaphragm.

A further important feature of my invention relates to the construction and mounting of the diaphragm, whereby slight false vibrations are largely eliminated and the true vibrations largely amplified.

In the production of what I consider to be the best form of my invention I provide a reproducing-arm or lever arranged at an angle to the diameter of the blank, so that it will travel easily and smoothly upon its surface, said reproducing-lever being pivoted at its upper end to a slightly-overbalanced weight, by which the reproducer-point will be kept always in contact with the blank, but will be free to accommodate itself to irregularities and eccentricities therein, said weight possessing sufficient inertia to be uninfluenced by the vibrations of the reproducing-point, and I connect said reproducing-arm or lever with the diaphragm by a single link, which may work within a slot in the weight, said diaphragm being provided, preferably on its under side, with a series of radial stiffening-ribs gradually decreasing in thickness from their point of intersection at the center of the diaphragm, and the plate or disk to which the diaphragm is secured being arranged very closely to the diaphragm, so that the said disk and diaphragm will constitute a dash-pot, whereby a retarded movement of the diaphragm will be obtained. The advantages of these special constructions and their cooperation in the carrying out of my object to obtain a more perfect reproducer will be hereinafter explained.

In order that my invention may be understood, attention is directed to the accompanying drawings, forming part of this specification, and in which—

Figure 1 is a plan view of parts of a well-known form of phonograph, showing the preferred form of my present invention applied thereto. Fig. 2 is a section through the same on the line 22; Fig. 3, a section on the line 33 of Fig. 2; Fig. 4, a perspective view of the preferred form of diaphragm; Fig. 5, a diagrammatic view illustrating a modification of my invention wherein friction alone is relied upon to effect the vibrations of the diaphragm, and Fig. 6 a diagrammatic view illustrating the operation of the preferable form of my invention.

In all of the above views corresponding parts are represented by the same characters of reference.

A represents the feed-shaft of an ordinary phonograph, and B the blank mandrel thereof.

C represents the phonogram-blank carried on said mandrel.

D represents the main operative parts of the improved reproducer, carried on an arm a, connected to a sleeve b, the latter working on a stationary rod c at the back of the instrument. The reproducer is fed longitudinally of the blank B by a nut d, cooperating with the feed-screw A. The arm a is supported at its forward end by an antifriction-roller e, working on a track f. The reproducer in this instance comprises a flanged annular ring, carried by the bifurcated arms h h of the arm a. The diaphragm i is sup-
ported on the flange of the ring \( g \), and above
said diaphragm is the plate \( j \), held in place
by a clamping-ring \( k \). The plate \( j \) is provided
with a hollow nipple, to which the listening
tubes or horn are or is attached. Mounted
upon the arms \( h \) \( h \) is a weight \( l \), carried on
horizontal pivots \( m \) and overbalanced at its
rear end either by placing the pivots \( m \) for-
ward of the center of gravity or by employing
an auxiliary weight \( n \), cast integral there-
with, as shown. The weight \( l \) is formed with
a slot \( o \) therein. The reproducer arm or le-
ver \( p \) is pivoted at its upper end to the weight
\( l \), and its lower end is formed in a small
ball, jewel, or other suitable surface for co-
operation with the record. The reproducer
arm or lever \( p \) will be maintained in contact
with the record by reason of its connection
with the weight \( l \), which possesses sufficient
inertia to be un influenced by the vibrations
of the record, but which at the same time will
be affected by any inequalities or eccentrici-
ties of the blank. The reproducer arm or le-
ver \( p \) is shown as extending at an angle to the
diameter of the blank \( B \), so that it will trail
smoothly and easily thereon without chattering.
The said reproducer arm or lever is con-
ected to the diaphragm \( \varepsilon \) at its central
part by a link \( q \), passing through the slot \( o \) in
the weight. By employing a weighted retard-
ing device, as explained, in connection with a
reproducer arm or lever, arranged at an angle
with respect to the diameter of the blank, the
effect of the weight is to move or slide the re-
producer-point relatively to the blank, tend-
ing to increase the angle of inclination and
producing a normal strain or tension upon
the diaphragm, so that any vibrations of the
point will be communicated to the diaphragm
without lost motion and the elasticity of the
diaphragm will maintain the reproducing-
point always in contact with the record.
When it is desired to give to the diaphragm
\( \varepsilon \) a retarded movement to form false vibra-
tions, as will be explained, the plate or disk
\( j \) is arranged in such proximity to the dia-
aphragm that the film of air between the two
will in being rapidly compressed and expanded
under the vibrations of the diaphragm
effect the necessary retardation thereof. In
order, however, to increase this effect and at
the same time to produce increased effect of
the true vibrations, the diaphragm is prefer-
ablelly stiffened, so that it will move bodily
under the effect of the vibrations, and in Fig.
4 I illustrate the preferred way of effecting
this result. In this figure the diaphragm \( \varepsilon \)
is shown as being provided on its underside
with a series of radial ribs \( r \), converging at
the center and impinging against a pivot \( a \),
to which the link \( q \) is secured. These radial
ribs \( r \) are secured to the diaphragm in any
suitable way, and they are preferably of a
gradually-decreasing thickness from the cen-
ter toward the periphery. The said ribs may
be made of wood, metal, or other material.
In operation the overbalanced weight \( l \) will,
as stated, cause the reproducer-point to be
always maintained in engagement with the
record, irrespective of imperfections and oc-
centricities therein. The blank \( B \) in revolv-
ing beneath the point will cause an additional
outward stress on the diaphragm other than
that produced by the effect of the weight, an
action which, so far as I am aware, has
never before been secured in this art. When
an undulation occurs on the blank, the fric-
tion on the reproducer point or ball is nearly
obiterated, because the inertia of the weight
is such that it cannot cause the depression of
the lever \( p \) and reproducer-point with suffi-
cient rapidity to follow the record. Hence
this is effected by the elasticity of the dia-
aphragm, which, as stated, is under the ten-
sion of the weight and of the friction with
the blank. This reproducer point or ball
having been forced by the elasticity of the
diaphragm to the bottom of the indentation,
the riding up against the incline of the in-
dentation by the reproducer point or ball
produces a great increase of friction, (in ex-
cess of the normal friction which would re-
sult from the engagement of the reproducer
with a smooth blank \( B \)), and this causes the
diaphragm to be again placed under tension.
When the lever \( p \) is not oblique, as in Fig. 5,
the only motion which the diaphragm can re-
ceive must be due entirely to the action of
friction between the reproducer and the re-
cord, since no vertical motion of the repro-
ducer will give any appreciable movement to
the diaphragm. I consider it preferable, how-
ever, to supplement the friction due to the rise
and fall of the producer on the blank by the variations in the blank being communicated
directly to the diaphragm, as is possible with an
inclined reproducer, as described. This ac-
tion is clearly illustrated in Fig. 6. The lever
\( p \) being pivoted to the weight swings on prac-
tically a fixed pivot due to the inertia of the
weight. From the top \( I \) of the undulation to
the bottom \( 2 \) thereof the lever is moved by
the elasticity of the diaphragm, while in be-
ing moved back to its original position the
friction is sufficient to again place the dia-
aphragm under tension, the effect of the weight
on the inclined lever \( p \) producing a much
greater stress on the diaphragm than would
be produced by friction alone, as in Fig. 5.
With the form shown in Fig. 6, therefore, the
vibrations of the diaphragm will be very pow-
erful, and at the same time the original sound-
waves will be faithfully and accurately re-
produced.
The improved diaphragm is made, prefer-
abley, of very thin mica, and the radial ribs extending very close to the edge. The radial arms are provided in quantity to the thickness of the diaphragm, so that the areas between
said arms may not vibrate independently. When properly proportioned, almost all of the
elasticity will be obtained in the edge portion
of the diaphragm, and the motions produced
by the record can nearly the whole surface
of the diaphragm to move with the same amplitude and not at the central portion only, as is now the case. Such a diaphragm will therefore result in very powerful reproduction.

In order to reduce false vibrations, the amplitude of which is very slight, I arrange the diaphragm, as stated, adjacent to the plate or disk, so that a retarded movement of the diaphragm will be secured by causing the diaphragm itself to act as the piston element of the dash-pot, the other element of the dash-pot being the said disk or plate. It will thus be seen that the thin film of air which exists between these two elements will be rapidly compressed under the vibrations of the diaphragm, acting to retard the same and eliminating the small false vibrations, though not affecting the true vibrations. This retardation of the diaphragm is enhanced if the diaphragm moves bodily, as stated, rather than simply buckling at its central part, as is now the case.

Having now described my invention, what I claim as new, and desire to secure by Letters Patent, is as follows:

1. In a phonograph, the combination with a phonograph-record, of a reproducing-lever carrying a reproducing device cooperating with said record, a weighted retarding device connected with said lever at its end, a diaphragm, and a link connecting said diaphragm with said lever between the reproducing device and said weight, whereby the friction between the reproducing device and the rotating record will impose stress on the diaphragm, substantially as and for the purposes set forth.

2. In a phonograph, the combination with a phonograph-record, of a reproducing-lever carrying a reproducing device which cooperates with the record, said lever being arranged at an angle to the diameter of the record, a weighted retarding device connected to said lever at its end, a diaphragm, and a link connecting said diaphragm with the reproducing-lever between the reproducing device and said weight, whereby the effect of the weight tends to increase the inclination of said lever to impose tension on the diaphragm, substantially as and for the purposes set forth.

3. In a phonograph, the combination with a phonograph-record, of a reproducing-lever carrying a reproducing device cooperating with said record, a pivoted retarding-weight to which the lever is pivoted at its end, a diaphragm, and a link connecting the diaphragm with said lever between the reproducing device and said weight, substantially as and for the purposes set forth.

4. In a phonograph, the combination with a phonograph-record, of a reproducing-lever carrying a reproducing device cooperating with said record, a pivoted retarding-weight to which the lever is pivoted at its end, a diaphragm, and a link connecting the diaphragm with said lever between the reproducing device and said weight, said link passing through a slot in the weight, substantially as and for the purposes set forth.

5. In a phonograph, the combination with the record, of a reproducing-point, a diaphragm connected to the reproducing-point, a stationary casing with respect to which said diaphragm vibrates, the diaphragm being located sufficiently close to the casing as to allow for a thin film of air between the two, whereby the vibrations of the diaphragm will be retarded, and radial ribs secured to said diaphragm for stiffening said diaphragm so as to produce bodily movements thereof, substantially as set forth.

6. In a phonograph, the combination with the record, of a reproducing-point, a diaphragm connected to the reproducing-point, a stationary casing with respect to which said diaphragm vibrates, the diaphragm being located sufficiently close to the casing as to allow for a thin film of air between the two, whereby the vibrations of the diaphragm will be retarded, and radial ribs of gradually-decreasing thickness secured to said diaphragm for stiffening said diaphragm so as to produce bodily movements thereof, substantially as set forth.

7. An improved diaphragm for phonographs comprising a plate, and radial ribs secured to the same on one side thereof, substantially as set forth.

8. An improved diaphragm comprising a plate, and radial ribs of gradually-decreasing thickness secured to the same on one side thereof, substantially as set forth.

This specification signed and witnessed this 21st day of March, 1898.

THOMAS A. EDISON.

Witnesses:

S. O. EDMONDS,

J. F. RANDOLPH.