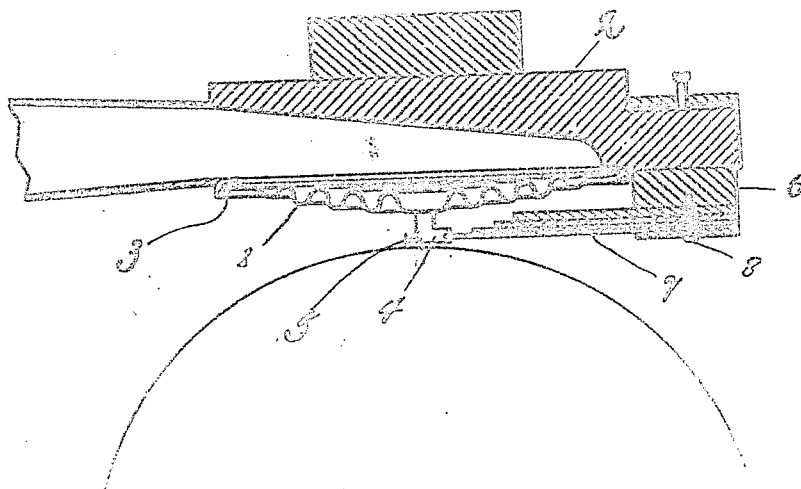


T. A. EDISON.  
PHOTOGRAPHIC RECORDING APPARATUS.  
APPLICATION FILED MAY 24, 1905.

Patented Feb. 22, 1910.

950,236.



Attest:  
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# UNITED STATES PATENT OFFICE.

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## PHONOGRAPHIC RECORDING APPARATUS.

950,226.

Specification of Letters Patent. Patented Feb. 22, 1910.

Application filed May 24, 1908. Serial No. 261,952.

*To all whom it may concern:*

Be it known that I, THOMAS ALVA EDISON, a citizen of the United States, residing at Llewellyn Park, Orange, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Phonographic Recording Apparatus, (Case D,) of which the following is a description.

My invention relates to various improvements in phonographic recording apparatus, and my object is to provide an apparatus for the purpose, wherein superior results can be obtained.

I find that vibrations of abnormal amplitude, caused by very high, shrill tones, like those of a soprano voice, or resulting from abnormal reinforcements of certain tones by the tone due to the resonance of the air column in the funnel, result in the cutting stylus leaving the record surface, producing the disagreeable effect of blasting. This result is due to the fact that the diaphragm in vibrating toward the record surface encounters the very considerable resistance imposed upon the stylus in effecting the cutting of the material, while in vibrating in the opposite direction, the diaphragm encounters little or no resistance. Consequently, under the effect of condensations of sound waves, the movement of the diaphragm is limited; while under the effect of the rarefaction of sound waves, the movement of the diaphragm becomes abnormal and permits the stylus to jump free of the record surface.

To carry my invention into effect, I arrange the cutting stylus and the parts with which it operates, so that the resistance imposed on the diaphragm shall be approximately the same in moving away from, as when moving toward the record surface, whereby the stylus will be prevented from leaving the record surface, and blasting will be eliminated. I attain this result by employing a compound spring, which coöperates with the diaphragm and having the capacity of absorbing energy by friction. This compound spring offers a very small and negligible resistance to the movement of the diaphragm toward the record surface, and consequently, in such movement, practically the only resistance encountered is that due to the cut-

ting action of the stylus, which as stated, increases with the amplitude. In moving in the opposite direction (*i. e.* away from the record surface) the compound spring imposes a resistance upon the diaphragm likewise increasing with the amplitude, and the energy of the diaphragm in such movement is largely absorbed as friction in the spring itself, as will be explained. By absorbing energy as friction, instead of as elasticity, I prevent the spring from imparting stored up energy to the diaphragm to distort its movements. By imposing a great retardation to the abnormal movements of the diaphragm away from the recording surface, I prevent the stylus from leaving the record material and confine the record to the material, without diminishing the sensitiveness of the recording mechanism, a result not heretofore achieved.

In order that the invention may be better understood, attention is directed to the accompanying drawing, forming part of this specification, and in which I illustrate a sectional view of a recording mechanism equipped with the improved compound spring.

The diaphragm 1 is provided with concentric corrugations, so as to be very rigid, and is secured within the head 2 by means of a ring 3, preferably of soft rubber, as I describe in applications filed contemporaneously herewith, Serial Nos. 261,949 and 261,950. A magnesium foot 4, carrying a suitable recording stylus 5, is cemented or otherwise secured to the diaphragm. Extending between the foot 4, and an arm 6, depending from the head 2, is a compound spring 7, composed of a plurality of leaves, like a wagon spring, and formed preferably of bamboo. These leaves are of reduced length and of increased cross-section upward from the lowermost, which connects directly with the foot 4, by being cemented in a recess therein. The spring leaves are held together at their anchored end by a screw 8, but are free to move independently at their other end. Consequently, the movement of the stylus toward the record surface will flex only the lowermost and weakest spring leaf with little or no retardation from that cause, but movements in the op-

posite direction, when the tracking depth is passed, will result in a flexing of one or more of the other leaves, to impose a resistance which increases with the amplitude, since the leaves are of increasing stiffness toward the uppermost. In thus flexing the several leaves, the latter are moved or rubbed longitudinally over one another, so as to absorb energy by friction.

In assembling the parts, the foot 4 is first secured to the compound spring, the diaphragm is cemented in place, and the spring fastened at its anchored end to the arm 6. When the diaphragm and spring are thus unstrained, the foot is cemented to the center of the diaphragm by melted shellac, leaving the whole recorder free from abnormal strains. By extending the spring between the foot 4 and the arm 6, it acts as a rod to take up the thrust imposed upon the stylus.

In recording, the stylus is allowed to track into the recording material to the proper depth by any suitable mechanism (not shown) for adjusting the cut. This produces a slight upward flexing of the diaphragm and compound spring. The spring offers scarcely any retardation to the progression of the stylus into the recording material, and practically all the resistance is that imposed by the cutting action. In moving in the opposite direction the compound spring creates as nearly as possible, a corresponding retardation, and thus one defect balances the other and true waves are recorded, since the friction of the leaves moving on each other results in a loss of energy substantially equivalent to that lost in performing a cutting operation. For waves of small amplitude, such as harmonics, the recorder loses none of its sensitiveness, but for prime tones of great amplitude (for instance, the notes of a piece of music played on a piano, which are in resonance with the tone of the recording funnel, and which result in amplitudes more than twice as great as the other tones) the increasing power to flex the compound spring as the diaphragm moves upward is sufficient to reduce the amplitude to such a degree as will prevent the stylus from leaving the record surface, and thereby prevent blasting.

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

1. A phonographic sound recording apparatus, comprising in combination a diaphragm, a stylus connected therewith, and means for imposing a resistance to the movements of the diaphragm away from the recording surface, said resistance increasing with the amplitude with acceleration throughout the whole of each such move-

ment of considerable amplitude, substantially as set forth.

2. A phonographic sound recording apparatus, comprising in combination, a diaphragm, a recording stylus connected therewith, and spring means for retarding the diaphragm in its movement away from the recording surface, arranged to dissipate as friction a considerable part of the energy of the diaphragm in such movement, substantially as set forth.

3. A phonographic sound recording apparatus, comprising in combination a diaphragm, a recording stylus connected therewith, and means for causing the diaphragm in its movement away from the recording surface to develop friction and thereby retard the same, such retardation increasing with the amplitude with acceleration throughout the whole of each such movement of considerable amplitude, substantially as set forth.

4. A phonographic sound recording apparatus, comprising in combination a diaphragm, a recording stylus connected therewith, and a compound spring anchored at one end and secured at the other to said stylus, substantially as set forth.

5. A phonographic sound recording apparatus, comprising in combination a diaphragm a recording stylus connected therewith, and a compound spring anchored at one end and secured at the other to said stylus, the leaves of said spring being of progressively decreasing length, substantially as set forth.

6. A phonographic sound recording apparatus, comprising in combination a diaphragm, a recording stylus connected therewith, and a compound spring anchored at one end and secured at the other to said stylus, the leaves of said spring being of progressively increasing thickness, substantially as set forth.

7. A phonographic sound recording apparatus, comprising in combination a diaphragm, a recording stylus connected therewith, and a compound spring made of bamboo anchored at one end and connected at the other to said stylus, substantially as set forth.

8. A phonographic sound recording apparatus comprising in combination a diaphragm, a recording stylus connected therewith and means for imposing a resistance to the movement of the diaphragm away from the recording surface corresponding throughout the movement to the resistance imposed by the cutting action of the stylus to the movement of the diaphragm toward the recording surface throughout such movement, substantially as set forth.

9. Phonographic sound recording appara-

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120

tas comprising in combination a diaphragm, a recording stylus connected therewith and means for dissipating as friction on the movement of the diaphragm away from the recording surface an amount of energy substantially equivalent to that lost in the cutting operation on a movement of the stylus toward the recording surface equal in ampli-

tude to the first mentioned movement, substantially as set forth.

This specification signed and witnessed this 20th day of May, 1901.

THOS. A. EDISON.

Witnesses:

FRANK L. DYER,  
ANNA R. KLEIN.