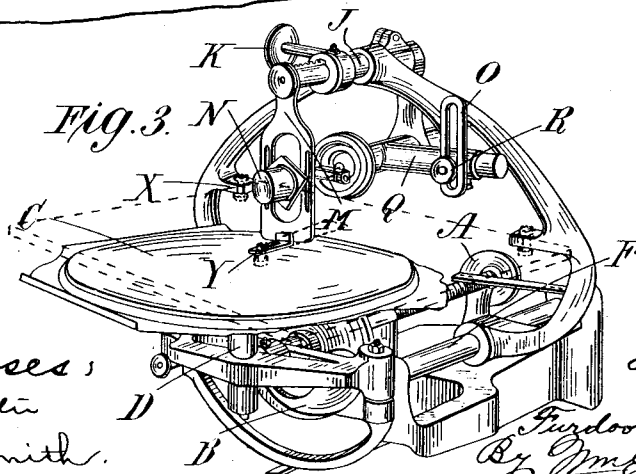
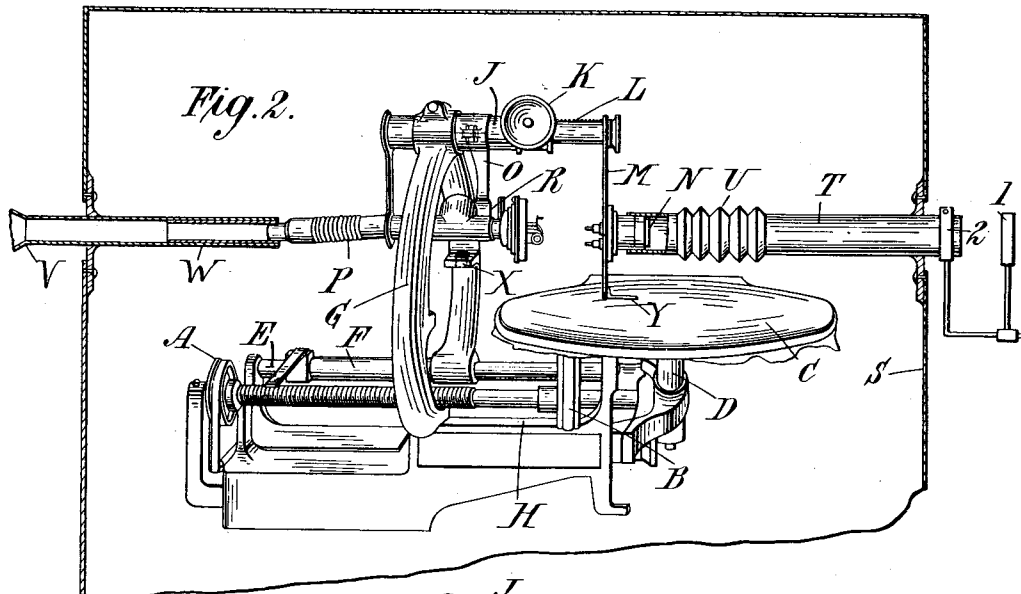
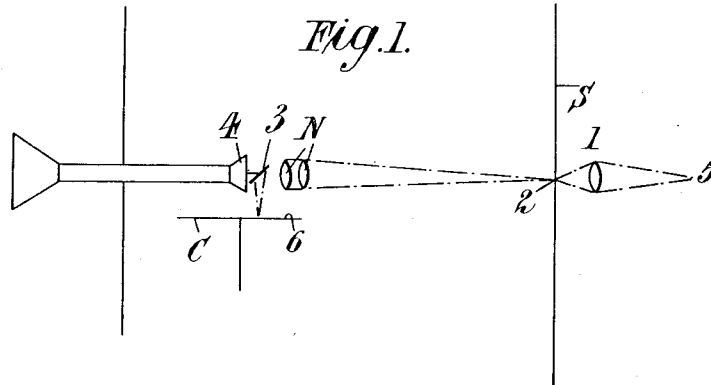


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SOUND RECORDING APPARATUS.
APPLICATION FILED MAY 20, 1911.

1,051,513.

Patented Jan. 28, 1913.



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UNITED STATES PATENT OFFICE.

FURDOONJEE DORABJEE PUDUMJEE, OF BOMBAY PRESIDENCY, INDIA.

SOUND-RECORDING APPARATUS.

1,051,513.

Specification of Letters Patent.

Patented Jan. 28, 1913.

Application filed May 20, 1911. Serial No. 628,399.

To all whom it may concern:

Be it known that I, FURDOONJEE DORABJEE PUDUMJEE, a subject of the King of England, residing at Bombay Presidency, India, have invented certain new and useful Improvements in Sound-Recording Apparatus, of which the following is a specification.

The invention refers to an improved method and apparatus for recording sound and is particularly applicable to the manufacture of gramophone records.

The method as at present used consists in cutting or engraving the vibrations produced by sound on a rotating disk of specially prepared hard wax by means of a sharp point or cutting edge attached in a particular way to a membrane which vibrates in unison with the sound produced in front of it. The vibrations are engraved parallel to the surface of the disk in the shape of a spiral, and the engraving thus forms the original record from which duplicates are made by pressing ebonite or similar composition disks on a matrix which is made from the original wax record by the process of electrotyping. The principal disadvantages of the process as at present worked reside in the fact that considerable resistance is offered to the engraving point by the substance engraved so that the vibrating membrane to which the engraving stylus is attached is not free to vibrate as desired, and to respond to the minutest variations of sound. Hence the deformations due to the engraving are great enough to render the voice unrecognizable and in most cases not clear. Moreover, the amplitudes of the vibrations engraved on the wax plate are limited in extent, depending upon the character of all three, the membrane, the disposition and length of the engraving stylus and the hardness of the substance engraved. These amplitudes cannot be increased beyond what has been attained in practice up to now, and so the intensity of the sound reproduced is limited. Again, the mechanical vibrations produced by the act of cutting or engraving on the surface of the wax plate are superimposed on the original vibrations due to sound and therefore the record is imperfect and is not free from disturbing and secondary or unnecessary scratching sound-vibrations.

It is the object of this invention to remove the disadvantages above set forth and this

invention consists in the process of recording sound by the aid of light, a ray of light being caused to vibrate in unison with a vibrating membrane by means of a mirror attached thereto, and then allowed to impinge on a rotating photographic sensitized plate, whereby the vibrations due to the sound waves produced on the membrane are fixed on the sensitive plate by the chemical action of light, and the photographic plate after development by any of the known photographic methods carries a record of the original sound.

The process of recording will be explained clearly by Figure 1 of the accompanying drawings, in which—

Figure 1 is a diagrammatic view of a suitable apparatus for carrying out the method according to the invention. Figs. 2 and 3 are side and end views respectively of a constructional form of the apparatus above-mentioned.

Referring to Fig. 1, 5 is a powerful and actinic source of light as for example the sun or an electric arc or a magnesium burner whose rays are allowed to condense by means of an achromatic lens 1, on to a very small circular aperture 2 in the opaque screen S. On the other side of the screen the rays enter a photographically dark chamber or box wherein they pass through a photographic lens N placed at a suitable distance from the aperture, and then strike on a small mirror 3. This mirror is inclined to the horizontal at an angle of 45° and is so fixed that it is free to vibrate on a horizontal axis exactly in unison with the vibrating membrane 4 which is stretched across one end of a tube, the other end of which terminates in a horn or mouthpiece V preferably outside the dark chamber. The rays of light striking on the mirror are reflected vertically downward and are brought to a focus on the photographic sensitive plate 6 placed on the horizontal rotating table C, so that a minute but brilliant spot of light, being the reduced image of the circular aperture 2, strikes on the surface of the sensitive plate. The lens N, the mirror 3, and the membrane 4 are (without disturbing their relative positions and in their same vertical plane) made to move gradually in a direction parallel to the surface of the rotating table from its circumference to its center inward while the plate is made to rotate. So long as no

sound is produced the mirror remains at rest and the spot of light merely traces a fine regular line on the sensitive plate forming the figure of a spiral. But when sound is produced in front of the mouthpiece, the membrane and the mirror vibrate in unison and the line traced by the spot of light is no longer regular but undulates and records faithfully the vibrations of the sound produced in front of the membrane. The record on the sensitive plate is made permanent by the usual photographic process of developing and fixing. For the reproduction of sound thus recorded a matrix may be made from the negative either by etching on a metal plate by any of the methods usual in line photo engraving, or the matrix may be made by electrotyping a photogelatin relief produced from the negative by the Woodbury or similar process, or by any other known photo-chemical methods. From this matrix impressions may be pressed in great numbers on ebonite, celluloid or similar composition disks as now made, and these disks may be used in any suitable gramophone.

It will be obvious that the disadvantages hereinbefore mentioned are removed by the process according to the present invention which also provides that records can be made not only on flat disks as hitherto but also on any length of strips of substance which is elastic so that it can be rolled up and hard like celluloid or similar substances, or on metal or on an endless band of any length and breadth of similar substance as above, on the surface of which the vibrations may be recorded in the form of a helix.

The constructional form of apparatus shown in Figs. 2 and 3 will now be described. The apparatus is driven by the pulley A either by clock work or a weight, or an electric motor by a strap or a belt. The pulley is fixed on a shaft which runs on pivots at both ends. On the end of the shaft near the pulley is cut a very fine screwthread. The other end of the shaft carries a pulley B which can be fixed by a screw on the shaft in any position required. C is a rotating table on which the sensitized plate is placed, being fixed in position by means of the raised ends of the table. The table rotates horizontally on a vertical bearing supported by the frame D, and is driven by friction of the pulley B on which the table rests, the bottom of the table being faced with leather to insure smooth running. Parallel to the shaft which carries the pulleys is a bar E on which can slide a sleeve F which carries at one end a rigid curved frame or bracket G. On the other end of the sleeve is a spring underneath which is attached a portion of a nut bearing on the corresponding screw cut on the pulley shaft,

so that as the pulley rotates, the screw moves or slides the sleeve toward the rotating table and with it the frame G, whose free end rests on a plate H, the surface of which is planed parallel to the plane of the table. On the top of the frame G is a clamp which carries a tube J in the same vertical plane as the pulley shaft and parallel to the plane of the table. The tube J can be fixed in the clamp where desired and carries at one end a pinion K working a rack L which supports the vertical frame M. The lens N is held by this frame in slots so that it can be lowered or raised at will of the operator, while the rack and pinion afford means for focusing. The rack is supported inside the tube J, in which it slides. On the tube J is clamped the bracket O, which supports the soundbox and the mirror arrangement. This soundbox may consist of the usual vibrating membrane stretched across or covering the open end of a tube P, and the mirror may be simply fastened to the membrane at its center or may be pivoted on supports attached to the body of the tube and joined to the membrane with a tender material, or the mirror may be formed on the membrane itself. The tube P carrying the membrane is supported by a cross tube Q, Fig. 3, which is held by an adjustable clamp R, which can be fixed in any position in the slot made for the purpose at the vertical bend of the support O. The membrane and the mirror arrangement can therefore be adjusted vertically with reference to the lens N, and the table C and their relative adjustment in a horizontal direction can be effected by means of the parts J, K, L, above described. Thus, longer or shorter undulations of vibrations can be recorded at the will of the operator as the distance between the mirror from the sensitized plate is increased or decreased. The pitch of the spiral record can also be varied by varying the position of the pulley B in relation to the table C so as to suit longer or shorter undulations of the vibrations recorded. The apparatus is inclosed in a photographically dark chamber or box which may be conveniently made large enough to hold the operator. At the end S of the box on the outer side is a condenser 1 and the arrangement for the light, the ray of light entering the tube T through the small aperture 2 which is joined to the lens N by the intervening bellows U, so as to allow free lateral movement of the lens system. The tube T keeps off light from the dark chamber. At the other end of the box and outside it is fixed the mouthpiece or horn V which is connected with the said box by a flexible coupling and a sliding tube W. A light board shown in dot-and-dash lines Fig. 3 in the drawings may be suspended underneath the lugs X, X and Y. The board is held clear of the sensitized

plate slightly above it, and protects the plate from all other reflections of light while it allows the vibrating rays to pass through a narrow slit made in the board for the purpose. The lug Y is slotted to allow of the movement of the lens during focusing.

What I claim as my invention and desire to secure by Letters Patent is:—

In a sound recording apparatus, the combination with a sound receiving horn, a sound box attached thereto and comprising a membrane, a mirror connected to said membrane at an angle therewith, means for projecting a ray of light on said mirror comprising an apertured diaphragm, a photographic lens and means for adjusting said parts relatively to one another, of a bracket carrying the membrane mirror and lenses in unvarying relation to one another and in

a common plane, a rotating table adapted to carry a photographic plate, a fixed bearing for said rotating table, a spindle, a pulley adjustable thereon engaging and driving said table, a driven pulley at the end of the spindle opposite to the first mentioned pulley, a screw-thread on said spindle, a bar parallel to the latter, a sleeve sliding on said bar and fixed to the bracket and means causing the motion of said screw to be transmitted to said sleeve.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

FURDOONJEE DORABJEE PUDUMJEE.

Witnesses:

JEHANGIR M. RUTNAGUR,
LALLA DOOLAB.