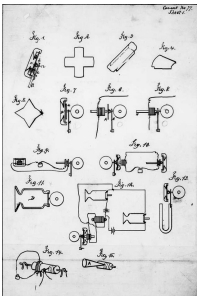
–1227–

Caveat: Phonograph



New York, N.Y., February 28th, 1878.[1a]

To all whom it may concern:

Be it known that I, Thomas A. Edison, of Menlo Park, in the county of Middlesex, and State of New Jersey, have invented an Improvement in Phonographs, of which the following is a specification:

The object of this invention is to record and reproduce

from such records or a copy thereof, the human voice or other sounds.

The invention relates to the devices to accomplish this object, and I have set forth some of the details of the same and the incidental modifications employed or tested by me.

In my application, No. 149, filed December 24, 1877,[2] I have shown a cylinder rotated by hand and moving longitudinally at the same time by a screw.

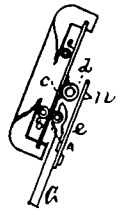
The circumferential surface of the cylinder have a grooved spiral cut from end to end, having the same number of spirals per inch as the thread or screw on the shaft upon which the cylinder is secured, and on one side of the cylinder is a speaking tube, diaphragm and indenting point, immediately opposite the grooves on the cylinder. The movement of the diaphragm being recorded by indenting a material placed on the cylinder; on the opposite side is a similar apparatus provided with a diaphragm and point, also opposite the grooves which serves to produce the sound recorded by indentations. I have now dispensed with the extra apparatus employed for reproducing and now use the apparatus that records also for reproducing from its own records. After the record has been made the cylinder or plate is turned back to its original position and re-started when the indenting points riding in and out of the indentations originally made, set the diaphragm in motion and reproduce all the sounds. At the present moment I am not fully satisfied that using the same diaphragm, both for recording and reproducing, gives better articulation than when double instruments are used, it is certainly more simple. It is probable that a double instrument will have to be used to obtain loud reproductions.

The recording diaphragm being arranged with the spring containing the embossing or indenting point so that there is no lost motion between it and the diaphragm, the latter being a small and stiff diaphragm; on the other hand, the reproducing diaphragm is of very thin material, with a very elastic thin spring, such as the hair-spring of a watch, with a very fine point; by using a very delicate reproducing diaphragm and spring but little pressure is necessary against the indented material; hence, the point will not destroy the finer spaces between the indentations like the rigid system for recording.

It may be arranged so that one single spring can be used, both for indenting and reproducing, double diaphragms on one mouthpiece being arranged with a double lever to connect the spring with one or the other, at pleasure. I find that the

smaller the diaphragm the better is the articulation; however, the amplitude is insufficient to give very prominent records, hence I use a moderately-sized diaphragm, dampening it on one or both sides as in Figure 1;[b]

Fig. 1.



e is the spring having an indenting point n; the spring is fastened to the upright arm, G; d is a rubber tube about one-fourth of an inch in length, connecting the spring with the diaphragm, c. It is fastened permanently.

A and B are also pieces of rubber tube placed on each side of the diaphragm and serve to dampen the diaphragm and prevent squeaking noises and improve the articulation by causing the diaphragm to return immediately to its normal position after each vibration— stiff springs, felting, water, mercury, air valve, magnetism, are among the means which may be employed for dampening the diaphragm. Even a rubber strip stretched tightly across the diaphragm on both sides may be used; a fiddle string may be also used on both sides provided with tightening screws to give it great tension that the diaphragm may be brought quickly to its normal position. It is not absolutely essential that a diaphragm for taking up the sound vibrations should be used, as strips as in Figs. 2, 3, and 4 and 5, may be used;

Fig. 2.

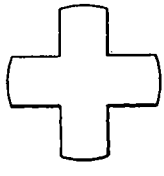


Fig. 3

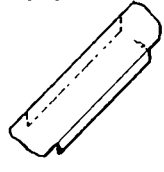
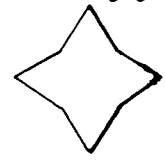


Fig. 4.

Fig. 5.



in fact, thin sheets of metal corrugated or having their edges turned over may be used in innumerable shapes; neither is it absolutely essential in recording or reproducing that the diaphragm should be in actual contact or be connected in any way to the spring e.

Fig. 6.

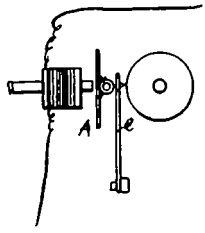
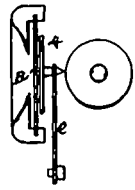


Fig. 7

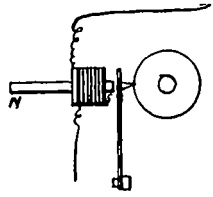


A small disc A, of mica or other stiff and light material is secured to the spring e, Figs. 6 and 7, which disc is immediately opposite the diaphragm B (Fig. 7), but not touching the air waves serving to give the requisite motion.

The disc may be iron and the diaphragm, or vice versa, polarized by a permanent magnet so that the motions are given to the spring through the medium of magnetic attraction and air as in Fig. 6.

The speaking and hearing diaphragm may be connected to the spring in various ways, such as a tightly-stretched thread, or telephonically by causing the spring which should be of steel magnetized, or of iron or capped with a disc of iron to be opposite a magneto telephone; its motion will give rise to induction currents in the magneto generator and these may be used in another telephone, as in Fig. 8.

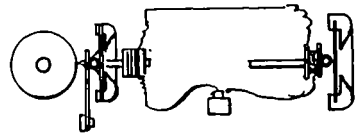
Fig. 8.



When the carbon telephone is used, the spring is connected by a piece of rubber tubing to the two platina discs between which is the carbon all placed in a circuit containing a battery and receiver, as in Fig. 9. Of course, the line may be of any required length with complete apparatus at each end, the phonograph merely replacing the person talking.

Fig. 9.

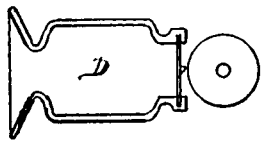
Fig. 10.



When it is desired to record speech from a distance, I arrange it as in Fig. 10; an electro-magnet in the line serves to give motion to the indenting spring directly or from a diaphragm.

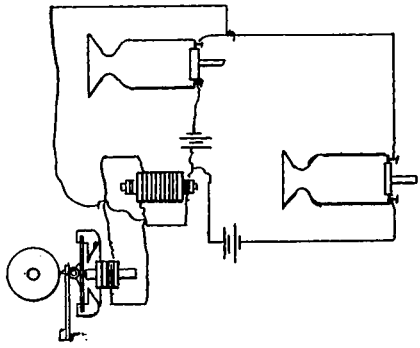
When it is desired to collect speech several feet from the instrument, I arrange the diaphragm as in Figs. 11 and 12, a large chamber D, Fig. 11,

Fig. 11.



being used to collect the sound; this it does with great power; several of them may be connected together; another plan is to use several chambers in different parts of the room and connecting by tubes to the recording diaphragm; still another plan is to connect several of my carbon telephones, Fig. 12,

Fig. 12.



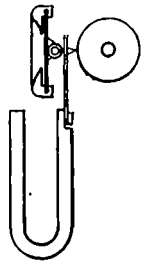
with the induction coils and batteries with these collectors and convey wires from each coil to a common magnet working the indenting point.

Another arrangement is to use but one coil and place it[s] secondary in connection with the magnet working the indenting point and all the carbon transmitters in one primary circuit of the coil with one battery. Many kinds of material may be used for diaphragm, such as mica, glass, porcelain, cork, rubber (soft and vulcanized), aluminum and other metals, parchment made impervious to moisture by a varnish, celluloid, guttapercha, sulphur, isinglass, gelatin paper cloth stiffened by varnishes and other materials, woods of various kinds, ivory, balato bone.

The material for recording upon may be various metallic foils or sheets, such as tin-foils of various compositions, iron, copper, brass, lead, tin, cadmium, zinc; also, paper and various other absorbent materials may be used and coated with paraffine and other hard hydrocarbons, waxes, gums, lacs, and

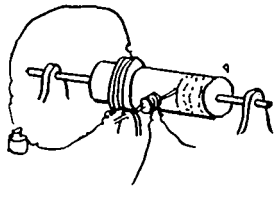
these may be used to record on directly, or they may have a metallic surface; for instance, paper may be made to pass through a bath of hot paraffine, thence between scrapers; immediately after passing the scrapers thin metallic foil is placed on it from a continuous roll and again passed through rollers or scrapers, thus giving a beautiful surface and preventing the material from clogging the indenting point. The paper may be coated with gutta-percha or substances which become soft by heat, then in the act of indenting, it may be rendered plastic by heat, either by hot air or a lamp under the cylinder or plate. If thin iron-foil is employed, the indentation may be made in the usual way, but a novel plan may be adopted for reproducing the undulations of the diaphragm as illustrated in Fig. 13,

Fig. 13.



in which the spring-arm of the reproducing point connected to the diaphragm is highly magnetized, or the iron-foil may be magnetized, as in Fig. 14;

Fig. 14.



then when an indentation passes the point the attraction will be less than when no indentation passes; this will give good articulation, free from the scraping noise of the point on the foil, for in this case it does not touch the foil, but is worked by magnetic attraction.

If very thin foil is used with wide grooves in the cylinder, the indenting point may be dispensed with altogether and the indenting made directly by the force of the air-waves as in Fig. 15.

Fig. 15.

A is a funnel, ending with a very fine hole at the end of the funnel, almost in contact with the cylinder containing the foil. The force of the air-waves serves to force the foil inward between the edges of the grooves and thus record each vibration; these are reproduced by the disturbance of the air at the small end of the tube. A diaphragm closes the large end of A, thus creating a suction to raise the spaces between; the point may be even rounded and be in contact with the foil and produce the same effect.

The sheet to be recorded upon may be prepared with gelatine and bichromate of potash, and the diaphragm control a source of light, and thus record the vibrations, or the diaphragm may control a self-feeding pen, which deposits a fluid in more or less quantity, according to the amplitude of the diaphragm, and this fluid may combine with a material on the paper to make an insoluble compound, whereas the parts not touched with it may be washed away. Duplicate copies may be made with foils by using several together. The indenting point indents all at the same time.

The apparatus I propose to use for dictating letters is shown in Figs. 16, 17, 18, 19, 20.

Fig. 16

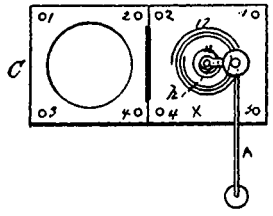


Fig. 17

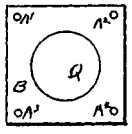


Fig. 18.

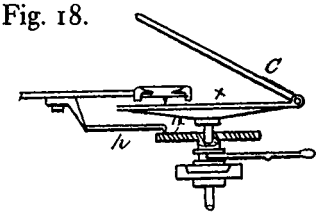


Fig. 19.

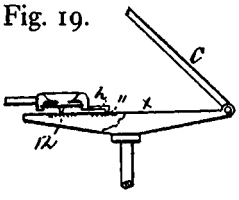


Fig. 20.

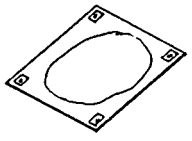
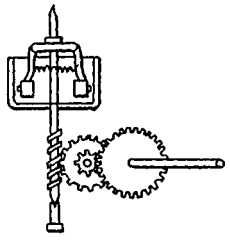


Fig. 21.



X, Figs. 16 and 19, is a plate revolved horizontally by a train of gear as shown in Fig. 21; this plate has two volute spirals cut from the center outward; the inner spiral 11, Fig. 16, is used for the purpose of carrying the arm A outward; this arm has upon its extremity the diaphragm and guide or carrying arm n;[3] the other spiral 12 is used to lay the foil or material

to be indented upon; the point worked by the diaphragm is immediately over the grooves.

C is a frame hinged to X, and is used to secure the material to the plate X.

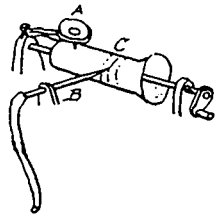
This frame is provided with 4 holes, 1, 2, 3 and 4, which, when closed on X, fit exactly over four pins 1, 2, 3 and 4, on X.

These pins are used to register the foil which is previously indented to go over the pins; the holes so punched in the record sheet I propose to eyelet. The sheet prepared for use is shown in Fig. 17. B is thick paper with a large hole in it equal to the size of the grooves in X; stretched over the frame work of paper is foil Q, with a small hole in the center. A^1, A^2, A^3, A^4, are holes punched to insure registration on the pins 1, 2, 3, 4 of X. It is not essential that the plate X should be square, it may be octagon or round; the spiral 11 may be dispensed with and cut underneath the plate, and the whole plate, two inches from the center, used for recording.

Even a separate plate on the same shaft may be used, this having the spirals for guiding the arm upon it, as in Fig. 18. A double spiral may be cut, one within the other, from near the center to the circumference of X, one being used to move the arm, the other to record in.

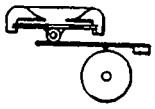
Even spirals may be dispensed with at 12, the guiding spiral alone being used, the foil being placed on a polished surface of glass, steel, or even a yielding material; the guiding spiral may be dispensed with and a worm used, connected to the driving gear, for giving a slow outward motion to the arm.

Fig. 22.



In Fig. 22 is shown a method of recording and reproducing the sounds on the principle of a sirene; A is a diaphragm which makes great amplitude; the grooves are so narrow and the point upon the diaphragm so sharp that the indentations are punched clear through the material. C is a cylinder, hollow, with a funnel-shaped face. B is an air tube connected to a source of compressed air or steam; it ends with a very small point immediately opposite the perforations; every time a perforation passes the hole it allows a puff of air to pass within C,

and thus a sound is given. A flap may be used around the point of B to prevent leakage.

Fig. 23. 

In Fig. 23 is shown a method of obtaining the advantage of leverage to indent a hard material.

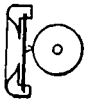
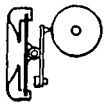
Fig. 24 

Fig. 25. 

In Fig. 24 is shown the method of recording and reproducing by a point direct upon the diaphragm. Fig. 25 shows another arrangement to obtain the advantages of leverage. Fig. 26 shows a method whereby several persons may speak and have it recorded simultaneously.

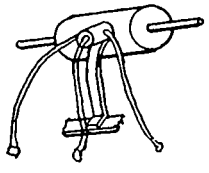
Fig. 26. 

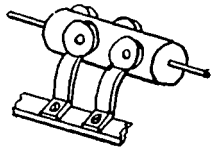
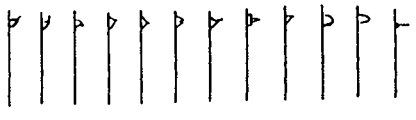
Fig. 27. 

Fig. 27 shows another arrangement whereby several persons may speak simultaneously, but their record will be in separate spirals, the cylinders being provided with double thread or spirals.

Figs 28 29 30 31 32 33 34 35 36 37 38 83



Figs. 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38 and 83 show different indenting and reproducing points.

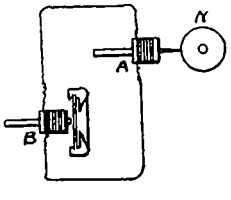
Fig. 39. 

Fig. 39 shows a cylinder which has upon it iron-foil, indented by a separate mouthpiece. A is a permanent magnet close to the indentations; around the magnet is a coil of wire. B is a polarized receiving instrument. The rotation of N causes the indentations to throw inductive currents into B, and thus reproduce the speaking or other sounds; although the point of A does not touch N, the approach and recession of the iron causes the currents to be set up.

Fig. 40.

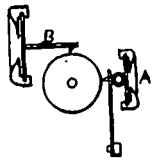


Fig. 40 shows both a recorder A, and a reproducer B A acts direct, while the lever of B cannot of itself indent the foil, yet falls into the indentations made by A.

Fig. 41.

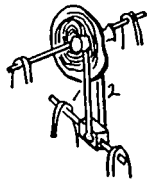


Fig. 41 shows a plate with spirals cut on each side with double reproducers, 1 and 2. This will be useful in toys, the sentence or sound being indented permanently on each side of the plate and the arms 1 and 2 being thrown in and out automatically.

Fig. 42 shows a reproducing apparatus for toys, etc., using a continuous indented band.

Fig. 42.

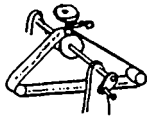


Fig. 43.

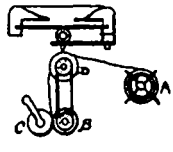


Fig. 43 shows a long strip or roll like that of a Morse register. A is a roll of the material, D the drum, B the reel upon which the material is wound, C, a roller which keeps the material smoothly on B.

A is rotated by friction and a belt from D.

Fig. 44

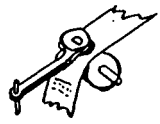


Fig. 44 shows a reciprocating lever and a continuous roll of material for recording and reproducing.

This system I am now engaged in perfecting.

Fig. 45.

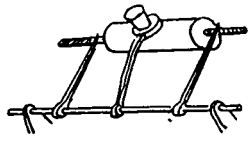


Fig. 45 shows an indenting and reproducing apparatus carried back and forward automatically by a double thread, one right hand on the front and left hand on the back of the machine.

Fig. 46.

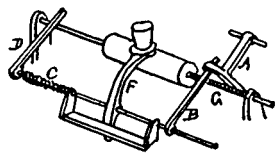


Fig. 46 shows an automatic machine suitable for advertising purposes: the arm F is carried forward by the screw G, in going forward it lifts up A, until A drops back, then the spiral spring, c, causes B to run over A, back to its starting point again.

D runs upon the smooth shaft, keeping F and its devices at a proper distance from the cylinder.

Fig. 47

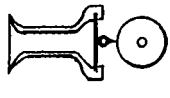


Fig. 47 shows a peculiar mouth-piece.

Fig. 48. Fig. 49. Fig. 50.

Figs. 48, 49, 50, 51 are mouth-pieces; the sharp edged holes are for the purpose of reinforcing the hissing consonants.

Fig. 51.  Fig. 52 

Fig. 52 shows a mouth-piece with the orifice of soft rubber and fitting in the mouth to the lips.

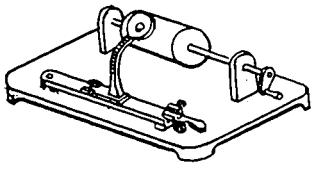
Fig. 53. 

Fig. 53 shows the machine which I make for experimental illustration of the invention

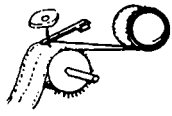
Fig. 54. 

Fig. 54 shows a continuous roll of material with holes punched in each edge fitting over pins upon the drum to insure accurate registration of the ribbon.

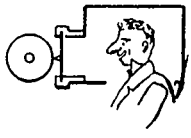
Fig. 55. 

Fig. 55 shows a speaking box, where the whole head of the person speaking is confined.

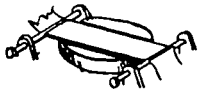
Fig. 56. 

Fig. 56 shows a stretched sheet for insuring the reproduction and recording of high notes.

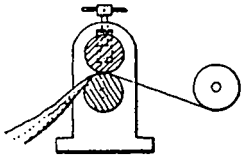
Fig. 57. 

Fig. 57 shows a method of preparing bands of material already indented with the proper indentations for reproducing any kind of sounds, one roller having an original made by coating tin foil with copper and then steel, or making a plaster of

paris mould from an original, then plating or casting from it and plating with steel or using soft iron and indenting, then placing it around a cylinder, backing it up with copper and case-hardening or carbonizing it so as to make it hard.

Fig. 58.

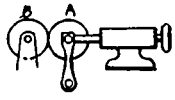


Fig. 58 shows a plan of using a wheel so prepared to knurl the indentations in by rotating A against a wheel B of soft material.

Fig. 59.

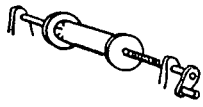


Fig. 60.

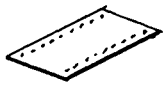


Fig. 59 shows a drum with sides and provided with pins for registering the sheet, as shown in Fig. 60.

Fig. 61.

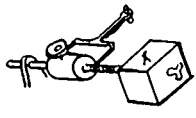


Fig. 61 is a toy apparatus; X, a clock-work rotating the cylinder continuously; an arm carrying the reproducing diaphragm is reciprocated by a double-threaded screw right and left on the shaft.

Fig. 62 shows almost the same thing; the double thread being on the drum.

Fig. 62.

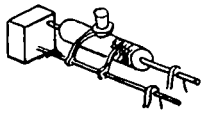


Fig. 63.

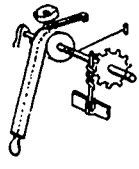


Fig. 63 shows a pull strip upon which the indentations are, pulling the strip downward, winds up a rubber elastic; when the strip is let go of the worm and fan regulates the power of the elastic.

Fig. 64.

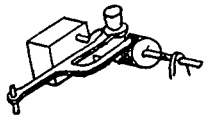


Fig. 65.

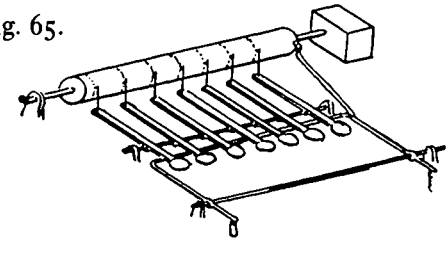


Fig. 64 is similar to 62. Fig. 65 is a cylinder and key board, around the cylinder opposite the keys are the necessary indentations to form a letter of the alphabet or a tone or note of the scale.

There are 26 keys for the alphabet, and for music several octaves.

The cylinder continuously rotates; the depression of any key causes the production of a musical note, or if for alphabets, the letter of the alphabet; it is very useful in the last instance to learn children the names of the letters.

Fig. 66 shows double indenting points and double thread or grooves on the cylinder,

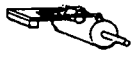
Fig. 66. 

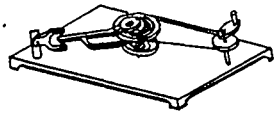
Fig. 67. 

Fig. 67 shows a plate for recording upon, with plate underneath for guiding the speaking tube.

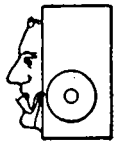
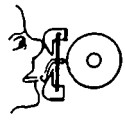
Fig. 68. 

Fig. 69 

Figs. 68 and 69 show a method of recording the movements of the lips and reproducing the same upon the same material as the talking is recorded.

Fig. 70 shows a raised screw on cylinder with a recording point like a W.

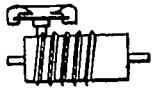
Fig. 70. 

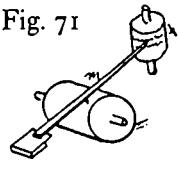
Fig. 71 

Fig. 71 shows a method of obtaining amplified records from the indented sheet. M is the lever, X a lamp-blacked cylinder; both are rotated slowly.

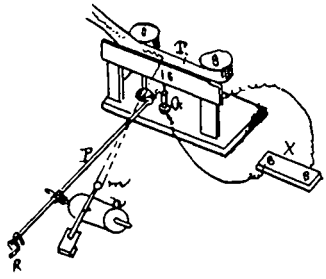
Fig. 72. 

Fig. 72 shows a method of amplifying the records and photographing the same; n is the cylinder containing the indentations; m a small mirror; G a stand holding an electric or other light which passes through a slot 3 to the mirrors m, and is reflected back upon the paper T, which, with the cylinder N, is rotated by a shaft P, handles R, and worm at each end.

The paper T is photograph paper. X is the battery for giving the electric light.

Fig. 73.

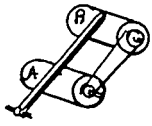


Fig. 73 is a plan for amplifying and reindenting.

This amplification is obtained by leverage. B is the cylinder containing the material to be reindented; it is rotated by a belt and pulley slightly faster than A, the extra movement of the lever B going faster gives longer and deeper indentations before the amplification takes place; the material on A should be stiffened by plating up it.

Fig. 74 shows double diaphragms.

Fig. 74.

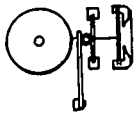


Fig. 75.

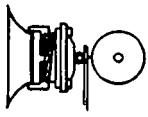
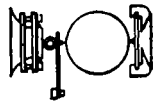


Fig. 76



Figs. 75 and 76 show stretched diaphragms.

Fig. 77 a double apparatus for recording and reproducing, the change from one to the other being made quickly by a lever.

Fig. 77.

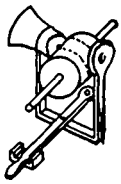


Fig. 78.

Fig. 78 shows a method of recording on smoked glass, for stereopticons.

Fig. 79

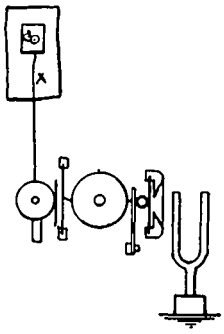


Fig. 79 a method of recording the sound, and[4] tuning-forks and obtaining their vibrating time, X being a pendulum to give the time.

Fig. 80.

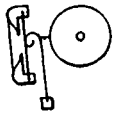


Fig. 81.

Fig. 80 shows a bent spring to replace the rubber tube usually employed.

Fig. 81 an indenting spring with three points.

Fig. 83.

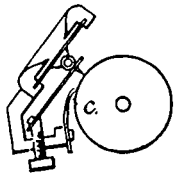


Fig. 83 shows an extra point c, for slightly grooving the foil before the indenting point; this takes part of the work off the indenting point.

I will mention that my latest experiments prove that it is not necessary that grooves should be used opposite the indenting point, as a cylinder or plate of polished metal, glass, or other material may be used and thick foil or sheet metal laid upon it to receive the indentation. Even the indentations may be made in solid cylinders or plates of metal, such as type metal, copper, iron (this may be case hardened). I propose to use ruby or agate indenting points; I will mention that I have succeeded in engraving the indentations in metal from looking at an amplified record, and have succeeded in producing musical notes by drilling numerous holes close together around cylinders; these may be made to work the reproducing point of the diaphragm and give a loud noise suitable for awakening persons, attached to a clock.

Fig. 82.

Fig. 82 shows a strip of paper secured at one end to the indenting diaphragm.

By drawing back the diaphragm and indenting point and bending the strip of paper, as shown by dotted lines in said Fig., so that the end of the strip is in the line of the indentations, the sounds recorded upon the foil will be reproduced by the same diaphragm that caused the sounds to be recorded.

Signed by me, this 28th day of February, 1878.

THOS. A. EDISON.

Witnesses: GEO. T. PINCKNEY. WILLIAM G. MOTT.[5]

PD (transcript) and D (copy), NjWOE, Lit., *American Graphophone Co. v. United States Phononograph Co.*, Edison Caveat of March 8th 1878, Defendant's Exhibits, p. 330 and PS, Caveat Drawings, Caveat No. 77 (*TAEM* 116:341, 8:890). Petition and oath omitted. The historic transcription was entered in evidence as an accurate reproduction, but many extant slips probably were not in the original text; obvious cases have been ignored or silently corrected. Inconsistent italicization of figure labels has not been reproduced. [a]Place and date from petition. [b]All figures are on four separate sheets.

1. Edison executed this caveat on 28 February. He filed it and a caveat on telephones, probably executed on the same day, at the Patent Office on 8 March (neither is in the existing National Archives file of Edison caveats; TAE to Painter, c. 8 Mar. 1878, UHP). Edison had essentially completed the designs in this document by 20 February, when he sent materials to Lemuel Serrell for preparation of the official copy (TAE to Serrell, 20 Feb. 1878, Lbk. 1:343 [*TAEM* 28:216]). Surviving sketches from 3, 4, and 8 February were clearly intended for this caveat (NS-78-007, Lab. [*TAEM* 7:862–70]; NS-78-007 (misidentified as NS-78-001), Supp. III [*TAEM* 162:552]). The three large sheets of drawings sent to Serrell on 20 February (Caveat Drawings, PS [*TAEM* 8:894–96]) contain only two sketches not repeated in the official caveat.

This was initially referred to as Edison's Caveat 77 (the telephone caveat of the same date was number 76). However, those numbers had already been used (Doc. 715 is Caveat 77). After the duplication was noticed this caveat became 77A.

2. Edison's U.S. Patent 200,521 had actually issued nine days before the execution of this caveat.

3. Should be "h."

4. Probably "of" in the original.

5. Unidentified.