No. 833,689. PATENTED OCT. 16, 1906.

I. KITSEE.

APPARATUS FOR DUPLICATING PHONOGRAPH RECORDS.

APPLICATION FILED APR. 20, 1901.

2 SHEETS—SHEET 1.

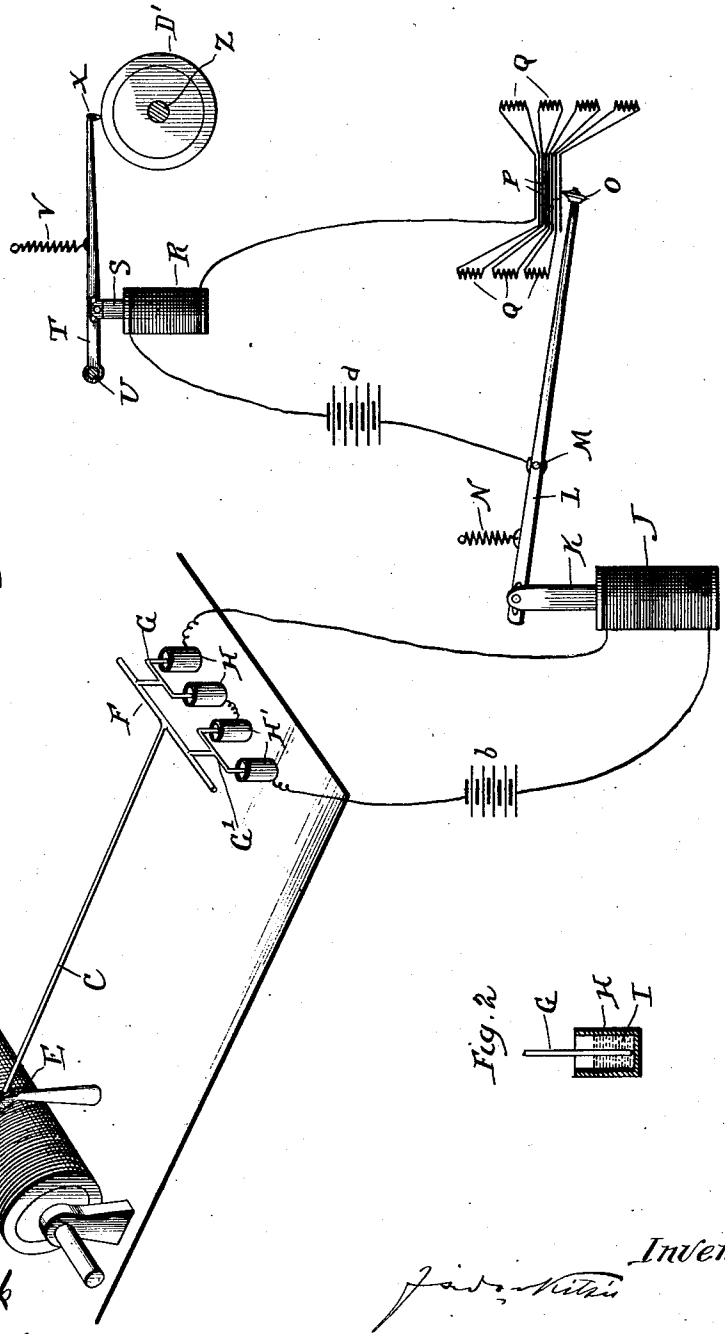


Fig. 1.

Fig. 2.

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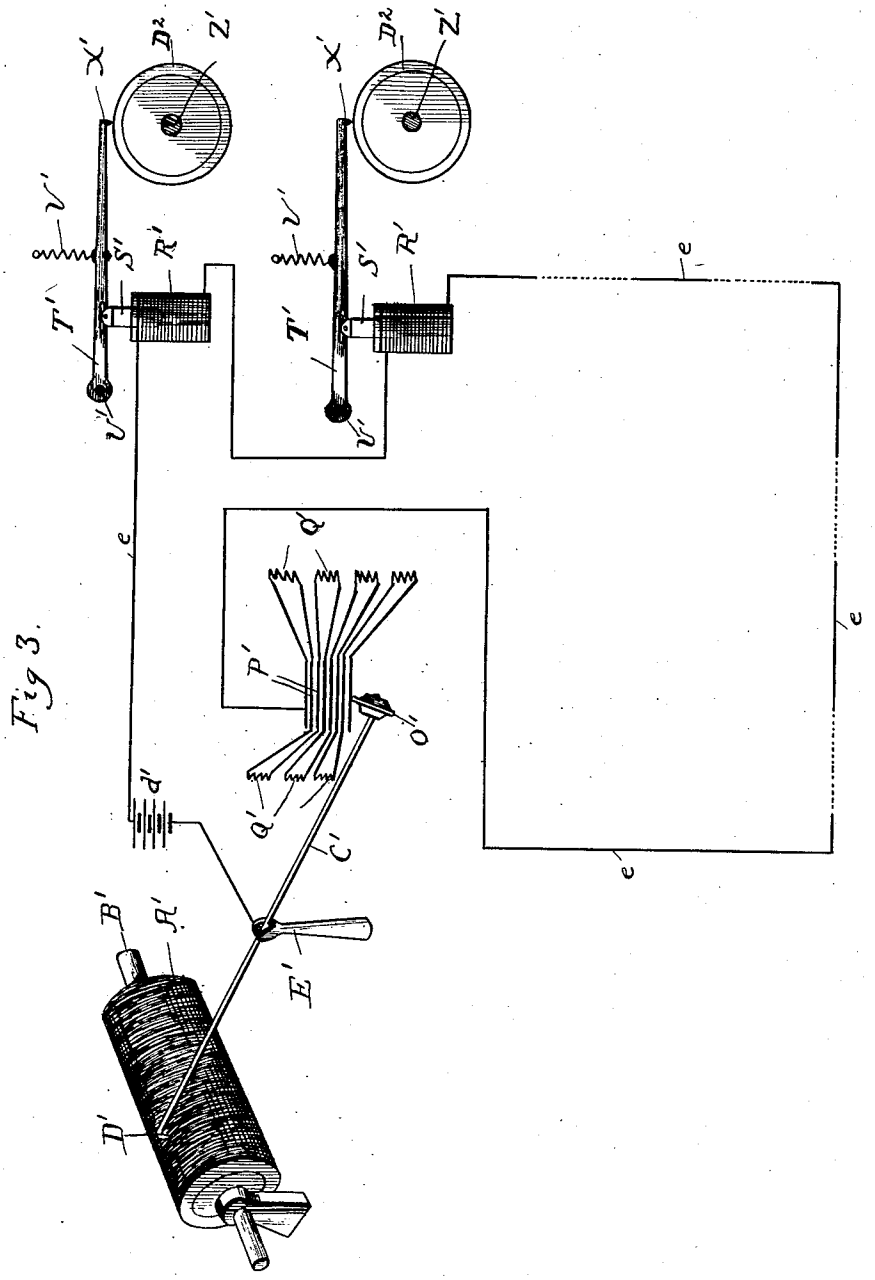


Fig 3.

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APPARATUS FOR DUPLICATING PHONOGRAPH-RECORDS.

No. 833,689. Specification of Letters Patent. Patented Oct. 16, 1906.

Application filed April 20, 1901. Serial No. 56,755.

To all whom it may concern:

Be it known that I, ISIDOR KITSEE, of the city and county of Philadelphia, State of Pennsylvania, have invented certain new and useful Improvements in Apparatus for Duplicating Sound-Records, of which the following is a specification.

My invention relates to an improvement in apparatus for duplicating phonograph-records.

In the duplication of phonograph-records it is of great advantage to have the depressions of the original record corresponding to the sound-waves enlarged on the master-record, from which copies are to be made. It is also of great importance that it should be possible to make any desired number of copies at one and the same time from one master-record.

The two processes, mechanical as well as the process of electroplating, used to-day are inconvenient and not economical.

It is the aim of my invention to overcome the objections to the processes as carried out to-day, as well as to make use of the advantages above enumerated.

Referring now to the drawings, Figure 1 is a diagrammatic view of the circuits and mechanism for producing from the original the master-record. Fig. 2 is a vertical sectional view of one of the resistance-cups containing acid or other liquid. Fig. 3 is a diagrammatic view of the circuits and mechanism for producing a series of record copies from the master-record.

In Fig. 1, A is a phonograph-record from which the master-records are adapted to be made. B is the shaft upon which the same revolves, which shaft is fed transversely by means of screws or other mechanism. C is a lever which has the point D adapted to travel in the grooves of the record. This lever C is pivoted at E. F is a cross-bar on the outer end of the lever C, which has the downwardly-depending forks G and G'. Each prong of the fork G enters a resistance-cup H, and each prong of the fork G' enters a resistance-cup H'. Each of these cups contains a preferable liquid resistance I. The outside cup H' is connected, with the interposition of the battery *b*, to one end of a coil surrounding a solenoid J, and the outside cup H is connected to the other end of the coil surrounding the solenoid J. The two inside cups are connected together in series. K is the armature adapted to be attracted by the solenoid J. The upper end of this armature is pivotally connected to the lever L, which lever is pivoted at M and adapted to be held in its normal position by the spring N. O is a contact secured to the end of the lever L. P represents conductors, preferably bars or wires set close together, all the wires being connected in series to the resistance Q. One terminal of these bars or wires is connected to one end of the coil surrounding the solenoid R, and the other end of the coil is connected, with the interposition of the battery *d*, to the lever L. S is an armature adapted to be operated upon by the solenoid R, being pivotally connected at its upper end to the lever T, which is pivoted at U. V is a spring for holding this lever in its normal or upper position. X is an engraving-point. D' is a cylinder of suitable material adapted to be engraved and to be used in the later process as the master-record. Z is the shaft upon which this cylinder rotates.

In Fig. 3, A' is the master-record, from which the record copies are adapted to be made. B' is the shaft of the master-record. C' is the lever with its reproducing-point D'. This lever is pivoted at E' and provided with the wheel or other suitable contact O'. P' represents conducting wires, bars, or plates in proximity to the contact O'. These wires are connected together through resistance Q'. The lever E' is connected to one pole of the battery *d'*, the other pole of which is connected to the circuit *e*, in which circuit are placed the reproducing devices, consisting each of the solenoid R', armature S', and lever T', the lever being pivoted at U' and held in its upward position by the spring V'. This lever is provided with the engraving-point X'. In proximity to this point is the cylinder D^2, adapted to have depressed or engraved thereon a reproduction of the depression of the master-record D'. This cylinder is provided with the shaft *z'*.

In the circuit *e* the dotted lines represent spaces wherein one or more of the reproducing devices may be placed. The terminal of the circuit is connected, preferably, to the upper conducting-wire P'.

I will now describe the operation of producing the master-record from the original record. The original record is produced in the usual manner. The first aim in producing a master-record from an original record is to

enlarge the undulations of the original record, due to the engraving-tool actuated according to the sound-waves, or to have the cutting-tool of the master-record to act on the same with sufficient force so as to make depressions on a material tough or hard enough to withstand the wear and tear to which the master-record has to be subjected.

If the cylinder of the master-record consists of a material easily to be defaced—such, for instance, as the soap-wax composition usually employed in producing phonograph-records—then it is best to enlarge the undulations, for the reason that such a cylinder should be provided with a surface not so easily defaced as the waxy cylinder. This can be done by either electroplating the surface or providing the same with a film of celluloid in a manner as is set forth in my Letters Patent No. 583,686, of June 1, 1897, the film not to be removed from the cylinder, or the film may consist of any other suitable material.

The undulations of the cut-away parts of the original cylinder differ in depth; but it is taken for granted that the least variation is equal to about 0.001 of an inch. To increase this difference or to produce through this variation a stronger force, with the aid of electric currents, two means can be employed: First, the lever with the stylus can be pivoted in a manner so that that part which is adapted to vary the strength of the electric current employed should be greater than that part which bears the reproducing-stylus. Second, a resistance may be employed which, offering the least resistance to the variation of the upward and downward movement of the lever, is adapted to give a comparative great variation of the current through a comparative slight movement of the conductor. This resistance may be multiplied. In the drawings this resistance is illustrated as consisting of non-conducting cups H H′, provided with the conducting-bottoms filled with the liquid. This liquid may consist of very diluted sulfuric acid or any other suitable liquid, as any of the salt solutions—such, for instance, as a solution of chlorid of sodium or even a sulfate of copper, the only drawback to the last-named solution being that through the deposition of the copper the space between the lower end of the fork and the bottom of the cup may be decreased.

Let it be supposed, as stated above, the least variation in the grooves is about 0.001 of an inch and that the ratio in length of the stylus part and the conducting part of the lever or rod is one to ten. Let it also be supposed that there are ten pairs of resistance-cups employed, each cup filled with water acidulated with five per cent. sulfuric acid, and the conducting-rods are of a diameter not larger than one-eighth of an inch.

To give an illustration of the variation of the current, and therefore the variation of the pull of the solenoid J on the core K, I cite the following:

The resistance of an acidulated solution of about one-fourth-inch diameter is about seventy-five ohms per inch. If now the ends of the forks are normally about one-sixteenth of an inch from the conducting-bottom and ten pairs of cups are inserted in the circuit, then the combined resistance of these cups will be in round numbers about ninety ohms, and taking the coil of the solenoid as twenty ohms we have a total resistance of one hundred and ten ohms. If the least variation in the movement of the stylus D is 0.001 of an inch and the resistance variation of the forks therefore one one-hundredth of an inch, it follows that the combined variation of the twenty forks (two in each of the ten pairs) is one-fifth of one inch, which will give a variation of fifteen ohms, or about one-seventh of the whole resistance of the circuit. Assuming now that the pull of the core in the solenoid is (the whole current flowing) one inch, then it follows that the pull into the solenoid if only six-sevenths of the current value is flowing is about one-seventh of an inch less, (not taking into consideration that the ratio of pull somewhat differs with the length of core inserted.) It is now supposed that the conducting-strips P consist of very thin platinum-foil separated from each other by a non-conducting film—such, for instance, as shellac—and that twenty-one layers of these foils, with their insulation, will equal one inch in thickness, and it is further supposed that the connection between one foil and the next succeeding foil includes a resistance of about five ohms. It follows that every movement of the core K, causing, as it does, a corresponding movement in the lever L, will increase or decrease the resistance of the circuit with about fifteen ohms for every one-seventh of an inch distance, and if the circuit consists of ten foils connected together through five-ohms resistance each and the coil of the solenoid R is of about twenty-ohms resistance it follows that the least variation in the stylus D will induce a variation of nearly one-fifth of the total resistance of the circuit actuating the core S. The pull on this core S can be made to suit through the increase or decrease of the battery *d* in the circuit. I have given this illustration only to show what degree of flexibility can be obtained from the device as illustrated. It is self-evident that the ratio of any one of the devices to each other can be changed at the will of the operator. The variation of the depressions on the cylinder D′, therefore, due to the variation of the pressure of stylus X on said cylinder, can also be varied at will and can be made to suit requirements.

I will now describe the manner in which the record copies can be prepared from the master-record. The stylus E′ is made part of a circuit in which are placed the electromagnetic devices, with the aid of which the depressions of the master-record are duplicated. In this circuit any desired number of such devices can be placed either in multiple arc or in series; but I prefer that they shall be placed in series, it being understood that the more devices there are in series the greater the electromotive force of the battery employed should be, and if too great a number are to be made at one and the same time for one circuit then it is necessary that two or more circuits are employed. The farther end of the lever C′ is provided with the contact-wheel O′, and this contact-wheel is adapted to make connection between one or the other of the contact-strips P′. The whole arrangement so far is a duplicate of the arrangement as shown in Fig. 1.

Through the variation of the resistance in the circuit due to the up-and-down movement of the contact-wheel O′ the position of the levers S S′ is also varied, and the depressions made by the stylus X′ X′ on the cylinders D^2 D^2 are then duplicates of the depressions made on the cylinder A′.

If it is desired that the copy-records should be permanent ones, then it is best, as stated above, to either electroplate the surface of these cylinders or to paint them with a film durable and compact enough so as to withstand ordinary wear and tear.

It is unnecessary for me to go into detail as to the process of electroplating, as such process is so well known to persons versed in the art as to require no further explanation.

In some cases—for instance, where the outer cylinder consists of gutta-percha or a like material—it is best to place this cylinder in hot water and produce the impression as long as the gutta-percha or a like material is made pliable with the aid of heat and moisture.

It is of great importance that in the production of the master-record the original record should be revolved at a very slow speed, because the effects of the fluctuation of the current will not produce the desired effect in the solenoids if the variations follow each other in quick succession.

It is obvious that the speed of the cylinder adapted to become the master-record should be in unison with the speed of the original cylinder. The same precautions should also be taken in producing the record copies from the master-record.

The variations of the depressions on the master-record made according to this my invention are of such magnitude that any suitable device, mechanical or otherwise, may be substituted for the device as illustrated in Fig. 3, it being understood, however, that without the master-record only very delicate instruments can be used in connection with the stylus of the original record.

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

1. A phonographic reproducing device, comprising a master-record, a stylus associated therewith, an electric circuit, a source of current for said circuit, a variable resistance included in said circuit and of which said stylus forms a part, an electromagnet in said circuit, a cutting-stylus, and a blank in operative relation to said cutting-stylus, said electromagnet controlling the action of said cutting-stylus.

2. A phonographic reproducing device, embracing a master-record, a stylus, an electric circuit, a generator for said circuit, a series of electromagnets in said circuit, each of said electromagnets being in operative relation to a cutting-stylus, a series of blanks in operative relation to said cutting-styluses, and means whereby through the movement of the first-mentioned stylus the flow of the current through the different electromagnets is varied in accordance with the position of said stylus, the master-record and the blanks being rotated at substantially the same speed.

In testimony whereof I hereby sign my name, in the presence of two subscribing witnesses, this 17th day of April, A. D. 1901.

ISIDOR KITSEE.

Witnesses:
EDITH R. STILLEY,
CHAS. KRESSENBEECH.