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METHOD OF RECORDING SOUND BY TRANSFERENCE

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Fig. 1.

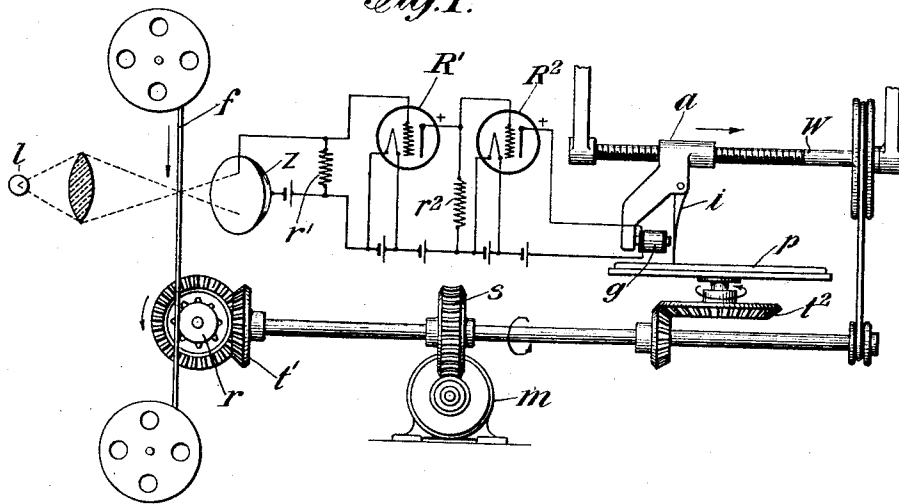
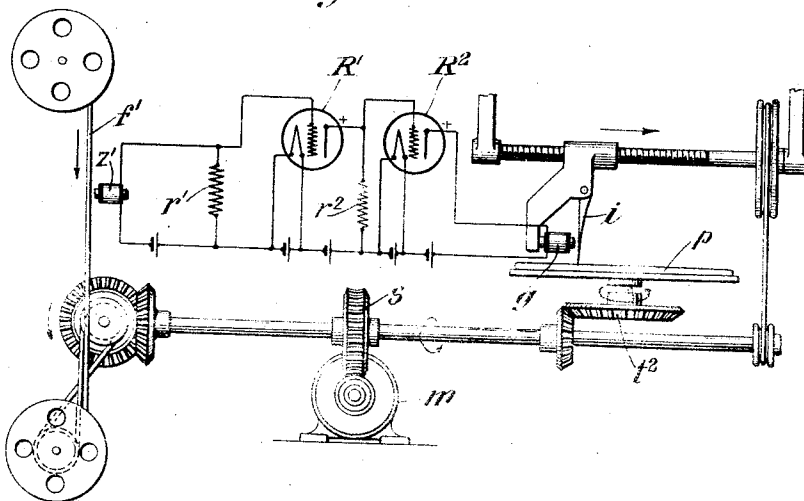


Fig. 2.



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METHOD OF RECORDING SOUND BY TRANSFERENCE.

Application filed July 18, 1924. Serial No 726,831.

To all whom it may concern:

Be it known that we, JOSEF ENGL, JOSEPH MASSOLLE, and HANS VOGT, citizens of the German Republic, residing, respectively, at Berlin-Grunewald, Germany, and Berlin-Grunewald, Germany, and Berlin-Wilmersdorf, Germany, have invented certain new and useful Improvements in Methods of Recording Sound by Transference, of which the following is a specification.

This invention relates to the art of producing records of sound vibrations photographically or magnetically and transferring the same to any other suitable carrier. In the art, however, as hitherto practiced the form of the sound waves recorded is distorted and particularly the high frequencies which are characteristic of the sound waves, are neglected. For this reason the production of say a sound plate or record for the reproduction of the characteristic tone and timbre of a musical instrument or, in case of language, of the consonants, is very difficult.

This invention renders it feasible to produce an unobjectionable sound record, suitable for reproduction, for example, in an ordinary talking machine, if, or when the sound of any origin has already been recorded on another carrier, as for example, photographically, free from distortion and having all of the constituents of highest frequency. The possibility of such distortion-free recording, last mentioned, resides, for example, in the photographic fixation of sound waves on films, wherein microphones free from inertia, amplifiers having no resonance notes in the acoustic range and luminous gas discharge recording lamps are employed, as described for example in our various copending applications, or in a registration according to Poulsen's telegraphic principle or in any other method answering the requirements (curve free from distortion). These methods produce sound registrations in a form which cannot be utilized for making records for gramophones or the like.

In order to illustrate, by way of example, the registering operations or proceedings, it is necessary to point out what occurs in the method of producing acoustic films. The registering process is essentially char-

acterized by the employment of a sensitized film which is influenced, exactly proportional to the sound sources, by a source of light free from inertia and varying, as regards its intensity, in accordance with the sound sources. Upon the development of the sensitized film the sound records appear in the form of variable blackenings showing all of the details of the original sound up to the highest frequencies. A positive print of the photographic sound record negative thus made may then be produced.

An object of this invention is to convert sound registrations of the stated unobjectionable kind and of any form into a commercial record, suitable for reproduction on an ordinary gramophone, or talking machine. The apparatus required for the reproduction of the commercial records are so widely used that a record produced in the manner to be explained hereinafter and having all of the particularities and details of the original sound, will find the most favourable conditions for reproduction. The idea on which the preferred form of the present invention is based is as follows:

If one has a perfectly correct sound registration or record it is possible to let such a sound carrier run off with an essentially reduced speed, so that even the highest frequencies which may occur in the sound registrations and which must be reproduced to give a correct rendition of the sound, are transformed into so low a frequency range that a distortion due to the oscillations of the registering needle cannot occur. That is to say, the sound vibrations which have been recorded on the film are converted into a fluctuating electric current, or serve to cause the modulation of an electric current, so that the latter will vary or fluctuate in proportion to the variations of the original sound, but at a greatly-reduced frequency. These low frequency currents are caused to control the operation of a recording stylus which will make a sound record on a suitable record blank, which also is moved at a correspondingly low speed. Accordingly, the sound vibrations will be correctly recorded since the movements transmitted to the stylus are of so small a frequency as to cause no distortion of the record, which otherwise would be caused with high fre-

quency movements, because of the inertia of the mass of the moving parts.

The invention consists in an improved method in accordance with the foregoing and as will be more fully pointed out hereinafter and particularly pointed out in the appended claims. Objects of the invention consist in the provision of improved methods and steps thereof, all as will be more fully described hereinafter.

In order that the invention may be more clearly understood attention is hereby directed to the accompanying drawings forming part of this application and illustrating two ways in which the method may be carried out.

In the drawings, Figure 1 represents diagrammatically one form of apparatus by which the method may be practiced; and Fig. 2 is a similar view of a modified form of apparatus by which the method may be practiced.

Let us suppose that the sound marks are different blackenings on a sound carrier such as a film band of the kind made for realizing the photographic acoustic film. The film band f , which may be the positive of a photographic sound record negative made as above indicated, is uniformly moved by means of a suitable driving mechanism comprising say a toothed roller r , bevel gear t' , worm gear s and a motor m , and the speed of the movement is a hundred times less than that at which the photographic sound record negative moved at the time of the production of such negative by acoustically modulated light. A constant source of light l throws light on the film on a small area of the photographic sound record, the light passing through the film being varied in intensity in exact accordance with the variation of blackening, that is, the variation in opacity of the film. The light which has passed through the film falls upon a light-sensitive member z , say a selenium cell, or a photo-electric cell with alkali metal cathode, in which continuous currents are produced which are variable in accordance with the changes of the blackening on the film, that is, these current fluctuations vary in accordance with the acoustically-varied light, by which the photographic sound record was produced, if no errors have been introduced into the system. The frequency of the change of the continuous current, therefore, is a hundred times less than that of the original sound. A frequency of 10,000 which is the practically highest possible blackening value in photographic acoustic proceedings thus is changed into a frequency of 100.

The photographic currents may be strengthened, if desired or required, preferably by means of an amplifying device $R^1 R^2$ e. g. through usual vacuum ampli-

fying tubes, but the connections of said device must be such, that even very slow changes will be intensified in exact proportion, which condition may be realized, for example, by resistance couplings, these being indicated at r' and r'' in Fig. 1, between cell z and tube R^1 and between tubes R^1 and R^2 , respectively. These intensified electric currents are caused to flow to the recording member a . The latter may comprise an engraving or cutting stylus or tool such as a needle i controlled electromagnetically by means of an electromagnet coil g or electrostatically, to bring about amplitudes of movement of needle i corresponding to the original oscillations, but of a frequency reduced in proportion to the reduction of speed of the film f in comparison with its speed, or that of the negative from which it was made, when the original sound was photographically recorded. The needle may be moved in a path to produce a spiral groove on the record blank p , by means of the feed screw w driven through any appropriate intermediate transmitting means from the motor m , or any suitable means may be employed for causing the current fluctuations to operate a recording stylus which will form a sound record groove in the record blank. The latter may be, for example, a plate p of waxlike or usual record composition driven to rotate, by means of the bevel gear t'' , from the shaft bearing worm gear s by which the film f is moved. But also a plate made of any material of greater resisting capacity may be employed since, according to the present invention, the sound waves alone are not the sole source of energy, as in the art hitherto practiced. In case a record of the hill and valley type is to be produced the amplitude movements of the needle would have to take place perpendicularly to the surface of the record blank.

The method described will have the effect of moving the record stylus at such a slow rate that distortions due to the inertia of the stylus will not occur. The record blank is rotated at a correspondingly slow speed during the recording. When the record, or a copy made therefrom, is reproduced, it will be rotated at the proper, greatly increased speed, so that the sounds will be reproduced at the proper frequency rates corresponding to those of the original sound.

A device similar in principle to that hereinbefore described may be employed in case of starting from a magnetic registration, for example, that of the Poulsen telegraphone (see, for example, Poulsen Patent 661,619, November 13, 1900) instead of the photographic registration. In such a case, as is indicated in Fig. 2, a magnetized ribbon or wire f' is to be substituted for photographic

sound record film f above described. This telegraphone magnetized member, as is well known, may be moved past an electro-magnet, indicated in Fig. 2 at z' , and will cause a current to be set up in the circuit connected with the electro-magnet, which is acoustically modulated in accordance with the varying magnetization on the wire. The electro-magnet will in this case be substituted for the photo cell z previously described. On running the magnetized wire or ribbon at a relatively slow speed, as described in connection with the photographic sound record, the current produced will vary in exactly the same way as has been described above and will control the needle i similarly. Other parts of the apparatus, as shown in Fig. 2, are the same as those described in connection with Fig. 1. Similar changes will also have to be made in case of registering any other sounds.

It will be noted that the light-sensitive cell z may be referred to as a current producing device, when used in connection with the photographic sound record through which light passes on to the cell; and that similarly an electro-magnet past which the magnetized strip or wire passes, in the second form of device referred to, may be referred to as a current producing device.

It will also be noted by the term "primary sound record" in the claims, we mean a record which is formed by acoustically-modulating energy, such as the radiant energy of the recording light source, or the energy of the magnetic recording device in the modified process described, and causing such modulated energy to act directly upon the carrier, i. e., without interposition of a mechanical record-forming stylus or the like, to form the primary sound record on the carrier. In our process the record is changed by varying energy received thereby, as by the photographic record impressed on it, if it is a sensitized strip, or by the magnetic record impressed on it, if it is a magnetizable strip and receives magnetic energy. The energy which acts upon the carrier is transmitted thereto by an energy-transmitting device, such as the recording light-source in the first form of the invention described, or the recording electromagnet in the second form of invention described.

From the foregoing it is believed that the advantages and novel features of the present invention will be readily understood and, therefore, further detail description is deemed unnecessary, yet it is not to be understood that the invention is limited to the particular features disclosed, it being rather obvious that various modifications of the details of the method described may be made by those skilled in the art without departure from the present invention.

What we claim is:

1. A method of making sound records, comprising, forming a photographic sound record by causing acoustically-modulated light to fall upon a sensitized strip while progressing the latter at desired speed, thereafter moving the record strip at greatly reduced speed, in comparison with the speed when the record was made, causing light from a fixed source to pass through the record and fall on a light-sensitive cell and to thereby set up in a circuit currents which vary proportionately to the variations of the original sound but with a greatly reduced frequency, and causing such currents to control the operation of a mechanical recording stylus mounted adjacent to a suitable record blank, to thereby mechanically form a record on said blank.

2. A method of making sound records, comprising, progressing at a desired speed a carrier adapted to be changed by varying energy received thereby, acoustically-modulating energy transmitted by an energy-transmitting device and causing such energy to act directly upon the carrier to form a primary sound record thereon, thereafter moving the said primary record, or copy thereof, at greatly reduced speed in comparison with the speed when the record was made, past a current-producing device to produce in a circuit currents which vary proportionately to the variations of the original sound but with a greatly reduced frequency, and causing such currents to control the operation of a mechanical recording stylus mounted adjacent to a suitable moving record blank to thereby mechanically form a record groove on said blank, the said reduced speed of said primary record being so chosen as to largely eliminate errors in the formation of said final record due to inertia and momentum of the moving parts concerned in the formation thereof.

3. A method of making sound records, comprising, forming a photographic sound record by causing acoustically-modulated light to fall upon a sensitized strip while progressing the latter at desired speed, thereafter moving the record strip at greatly reduced speed in comparison with the speed when the record was made, causing light from a fixed source to pass through the record and fall on a light-sensitive cell and to thereby set up in a circuit currents which vary proportionately to the variations of the original sound but with a greatly reduced frequency, causing such currents to control the operation of a magnetically-controlled mechanical recording stylus mounted adjacent to a suitable record blank, while moving said blank at a greatly reduced speed in comparison with that which the record formed thereon, or copy thereof, is to have when subsequently reproduced.

ing, the reduced speed of said photographic sound record being so chosen as to largely eliminate errors in the formation of said final record due to inertia and momentum of the moving parts concerned in the formation thereof.

4. A method of making sound records, comprising, progressing at a desired speed a carrier adapted to be changed by varying energy received thereby, acoustically-modulating energy transmitted by an energy-transmitting device and causing such energy to act directly upon the carrier to form a primary sound record thereon, thereafter moving the said primary record, or copy thereof, at greatly reduced speed in comparison with the speed when the record was made, past a current-producing device to produce in a circuit currents which vary proportionately to the variations of the original sound but with a greatly reduced frequency, amplifying this current, and causing the amplified currents to control the operation of a mechanical recording stylus mounted adjacent to a suitable moving record blank to thereby mechanically form a record groove on said blank, the said reduced speed of said primary record being so chosen as to largely

eliminate errors in the formation of said final record due to inertia and momentum of the moving parts concerned in the formation thereof.

5. A method of making sound records, comprising, causing an acoustically-modulated electric current to vary the illumination of a luminous glow-discharge correspondingly, and causing such acoustically-modulated light to fall upon a sensitized transparent moving carrier, developing the same to form a photographic substantially undistorted sound record, thereafter progressing said record, or copy thereof, and causing light from a fixed source to pass through the record and fall on a light-sensitive cell and to thereby set up in a circuit currents which vary proportionately to the original sound, and causing such currents to control the operation of a mechanical recording stylus mounted adjacent to a suitable record blank to thereby mechanically form a record on said blank.

In testimony whereof we affix our signatures.

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