Dec. 26, 1933. W. LENK 1,941,036

DEVICE FOR THE MAGNETO-ELECTRIC GENERATION OF ALTERNATING CURRENTS FOR SOUND PRODUCTION

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Fig. 1.

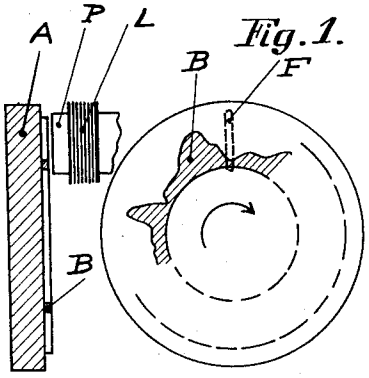


Fig. 2.

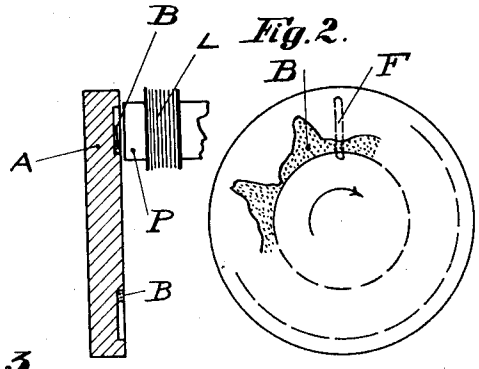


Fig. 3

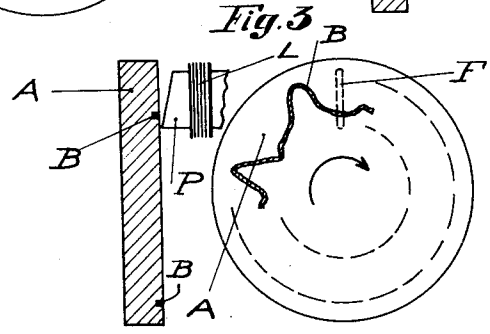
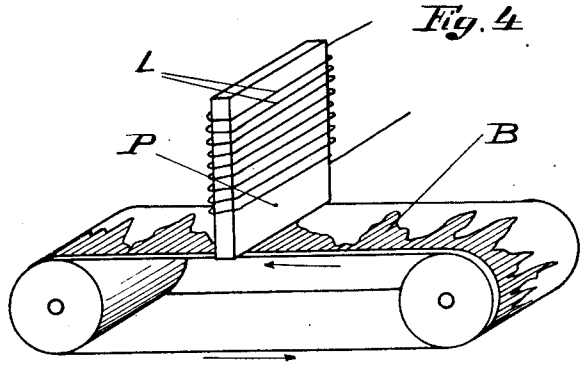


Fig. 4



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UNITED STATES PATENT OFFICE

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DEVICE FOR THE MAGNETO-ELECTRIC GENERATION OF ALTERNATING CURRENTS FOR SOUND PRODUCTION

Wilhelm Lenk, Linz-on-the-Danube, Austria

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4 Claims. (Cl. 179—100.2)

This invention relates to improvements in devices for the magneto-electric generation of alternating currents of given wave shape, in particular for sound production, of the type comprising armatures of varying magnetic permeability which are adapted to be moved past induction coils. One essential feature of the invention consists in the fact that the curve incorporating the wave shape of the desired alternating current is applied to the armature on a plane surface of the latter disposed at right angles to the bundle of lines of force of the induction coil, and is provided either in relief on the said surface or countersunk therein. Further essential features of the invention are the manner in which these curves are obtained and plotted on the surface of the armature, the precise manner of their formation and incorporation with the armature, and special means for ensuring the appropriate cooperation between the armatures provided by the invention and the nduction coils and magnet cores associated therewith. The invention further provides for the varied shaping of the armatures to suit different needs.

Devices are already known, more particularly for electric sound production, in which the required alternating currents are induced in conductor coils by the appropriate temporal variation of magnetic fluxes, and in which movable, in particular cases rotating, armatures of varying magnetic conductivity are employed which are adapted to effect the temporal variation of the magnetic flux traversing the conductor coils. For this purpose there have hitherto been used, for example, discs of sheet iron provided with peripheral excisions of different shapes or with teeth evenly distributed round the circumference. The induction coils associated with armatures of this type are generally so placed that their axes lie in the plane of the disc armature, so that when the disc is moved relatively to the coil the varying magnetic conductivity of the edge of the disc causes alternating currents to be induced in the coil.

In the manufacturing of disc armatures of this order and of apparatus based thereon, however, very great difficulties are met with. In the first place the cutting out of the complicated curves required for sound production from the edge of an iron disc is a laborious and costly proceeding, and can not in fact be carried out with accuracy. Secondly, when the coils are placed with their axes in the plane of the disc armature, in the manner described, the alternating currents produced by the curve of the periphery of the disc do not conform sufficiently to the shape of the curve, since the peripheral excisions or teeth can only produce variations in the current induced in the coil by virtue of increasing and decreasing the air gap, and the effect of this alteration is dependent upon the absolute extent of the air gap, that is to say a given alteration in the air gap on the crests of the curve has a different effect on the induced current than the same alteration in the valleys of the curve. Further, it is very difficult to distribute the successive period lengths over the circumference of the disc without remainder, and if, as is generally the case, the distribution is not perfect sub-tones are produced, when the disc is rotated, which are determined by the speed of rotation. In accordance with the present invention these drawbacks in the known types of similar apparatus are obviated, and at the same time a graphic, preferably photographic, method of plotting the curve on the surface of the armature is employed which enables the finest differentiations in the configurations of such curves to be rendered magnetically effective.

In the process for transferring the curve to the surface of the armature in accordance with the invention, the curve to be reproduced, e. g. an experimentally determined sound wave curve, is first drawn on as large a scale as possible, for instance with the help of a scale device and a stencil for the configuration of the curve. This large scale drawing can then, say after the taking of an oscillographic exposure of the desired tone, be retraced into a suitable coordinate system. The curve taken can also be replaced by the curve of which the differential curve is the desired curve (integral curve), for the purpose of producing thereby induction which is accurately in phase, and which therefore reproduces the desired tone faultlessly. Known errors in the recording or reproducing apparatus can be taken into account by this method and corrected or compensated for. Such curves can also be obtained synthetically on the basis of analyses, and can be corrected empirically, or even be built-up or constructed empirically. The drawing thus obtained is reduced photographically, and then transferred to magnetic material, such as iron, or to non-magnetic material, such as zinc, and deeply recessed or etched therein. In the latter case the depressions obtained are filled out with magnetic material, e. g. fine iron filings, mixed with a hardening binding material, such as solutions of resin, lacquer, or the like, and smoothed

off. This process can also be applied in such a manner that a metal plate prepared and negatively etched in the above-described manner, is used as a matrix for the purpose of producing the same shapes in plastic, hardening, non-magnetic material by stamping or casting, which can then be filled out in the above-described manner. Instead of etching or hollowing-out the surface of the armature, the shape of the curve can also be cut out in relief or applied to the surface of the armature.

Several examples of the carrying out of the invention are illustrated in the accompanying drawing, in which:—

Fig. 1 shows in side elevation and in end elevation the relative positions of the armature and an induction coil in a form of construction in which the armature is of disc shape and the sound curve is applied thereto in raised relief.

Fig. 2 shows, likewise in the two elevations, a modified form in which the curve is etched into a non-magnetic disc-shaped armature body and filled out with magnetic material.

Fig. 3 shows, likewise in the two elevations, a modified form of a similar type of apparatus in which the sound curve is linear and countersunk in the non-magnetic material of the body of the armature, and in which the pole of the induction coil is provided with an oblique end facing the armature.

Fig. 4 shows in perspective a form of construction in which the armature is in the form of an endless band.

Referring to Fig. 1, a non-magnetic armature body A is provided with a coating B of magnetic material which covers annularly the outer portion of the one plane surface of the armature disc. This coating is then etched through so that its remaining outer edge follows the required sound curve, while its inner edge remains circular and unaltered. This relief of the sound curve to be reproduced is adapted to move past the end of a narrow quadrilateral pole shoe P embraced by the conductor coil L, so that the curve is felt by a narrow bundle of lines of force which is indicated in transverse section by the dotted lines F. The induction in the coil is thus varied by the width of the magnetic relief passing beneath the pole shoe. The circuit is closed through the magnetic relief B itself, either through a second pole shoe or through the air.

The form of construction shown in Fig. 2 differs from that of Fig. 1 only in that the non-magnetic armature body A is depressed in the shape of the curve by etching, recessing, stamping, or the like, and that the depressed area is filled out with magnetically conducting material in the manner indicated.

In the form shown in Fig. 3 the curve tracing is linear and is countersunk in the non-magnetic armature body A, and with this curve there is associated an oblique pole shoe P of rectangular cross-section, so that the magnetic resistance between the countersunk curve B and the pole shoe depends directly upon the configuration of the curve.

The highest frequency capable of being reproduced satisfactorily with such armatures is determined by the breadth of the bundle of lines of force in association with the period length of the frequency concerned in terms of the speed adopted.

The armature of the form of construction shown in Fig. 4 is in the form of an endless band adapted to travel over rollers. As in the previous examples the sound curve is disposed on the surface of the armature and passes beneath the end of a pole shoe.

The armatures produced in accordance with the described process have the advantage over those hitherto employed for the same purpose that the errors in distribution can be kept down to a minimum, while at the same time the photographic reduction employed increases the degree of accuracy of the plotted curves. Moreover, through the employment of magnetic material in the state of the finest subdivision in conjunction with an insulating binding material, eddy current formation is likewise reduced to a minimum. The photo-mechanical method of production permits of great freedom in the shapes of the curves which it is possible to reproduce, as also in the disposition of these curves on the armature and in the construction and functioning of the feeling system.

The armatures made in accordance with the process provided by the invention can be employed for a great variety of purposes: in scientific measurement, for example, for obtaining alternating currents of given precise wave shape, e. g. absolutely accurately sinusoidal currents. It is also possible in an armature of this type to incorporate a plurality of alternating currents of different frequency and of different shapes of curve with adjustable relative phase displacement and adjustable voltages. In the production of musical tones, these armatures permit of the reproduction of any desired sound quality or timbre, such as those of the different musical instruments.

The preferred disc shape of the described armatures can naturally be replaced, to suit certain requirements, by continuous band or other shape with any desired type of movement, provided only that the essential features described and claimed herein are observed and embodied therein.

I claim:—

1. The method of producing an armature cooperable with an electrical induction coil to electrically reproduce a wave form on said armature of varying magnetic permeability which comprises photographing the outline of the wave form on the armature of non-magnetic material, recessing the armature in accordance with the pattern of said wave form, and filling the formed recess level with the plane of the armature with a material of different magnetic permeability.

2. In a device of the type described, a plane armature of non-magnetic material having a substantially linear sound record thereon consisting of magnetic material countersunk in said armature having a contour corresponding to the sound waves, an induction coil adapted to have induced therein currents of varying strength disposed perpendicularly to the plane of said armature, a core within said coil, a pole shoe of narrow quadrilateral cross-section on the side of said core facing said armature, means whereby the density of the bundle of lines passing from said pole shoe to said armature is variable, the lines of force emanating from said pole shoe adapted to be influenced by the contour of said sound record.

3. In a device of the type described, a plane armature of non-magnetic material having a substantially linear sound record thereon consisting of magnetic material countersunk in said armature having a contour corresponding to the sound

waves, an induction coil adapted to have induced therein currents of varying strength disposed perpendicularly to the plane of said armature, a core within said coil, and a pole shoe of narrow quadrilateral cross-section on the side of said core facing said armature, the outer end of the said pole shoe inclined at an angle to the surface of the said armature whereby the density of the bundle of lines of force passing from the said pole shoe to the said armature is variable, the lines of force emanating from said pole shoe adapted to be influenced by the contour of said sound record.

4. In a device of the type described, a plane armature of non-magnetic material having a substantially linear wave form of a varying outline thereon consisting of magnetic material countersunk in said armature having a contour corresponding to the sound waves, an induction coil adapted to have induced therein currents of varying strength disposed perpendicularly to the plane of said armature, a core within said coil, and a pole shoe of narrow quadrilateral cross-section on the side of said core facing said armature, the outer end of the said pole shoe inclined at an angle to the surface of the said armature whereby the density of the bundle of lines of force passing from the said pole shoe to the said armature is variable, the lines of force emanating from said pole shoe adapted to be influenced by the outline of said wave form.

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