A. RUCKGABER.

SPEED REGULATOR FOR PHONOGRAPHS.

APPLICATION FILED AUG. 7, 1914.

1,212,693.

Patented Jan. 16, 1917.

2 SHEETS—SHEET 1.

Fig. 1.

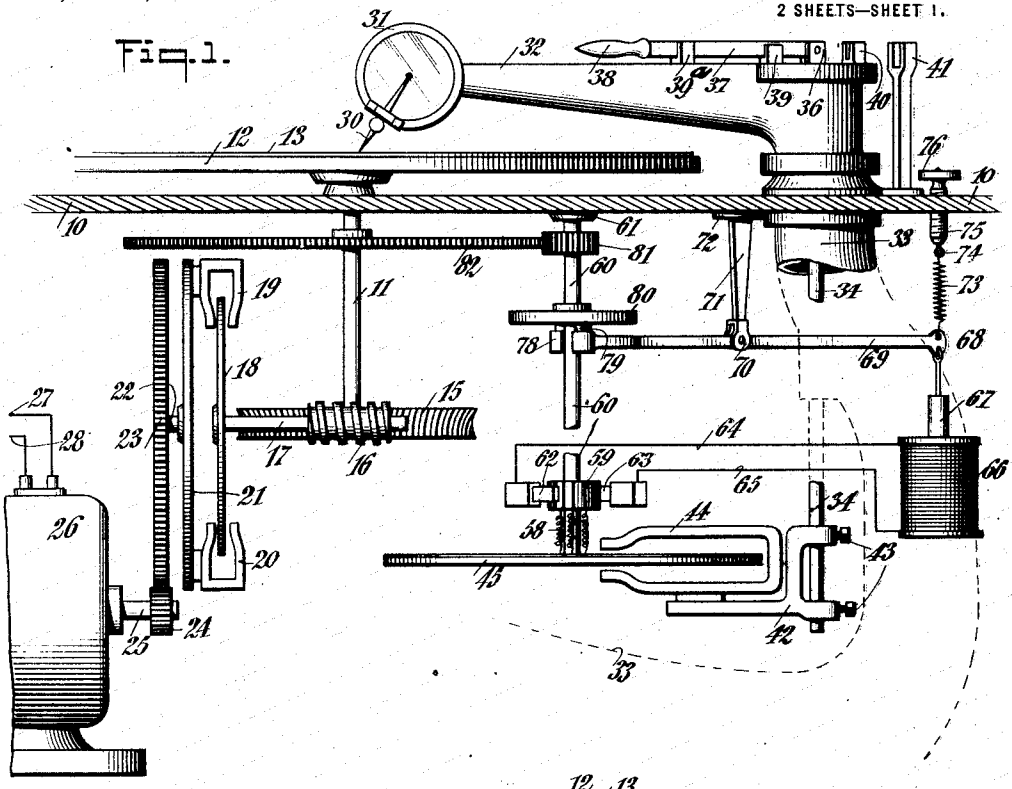
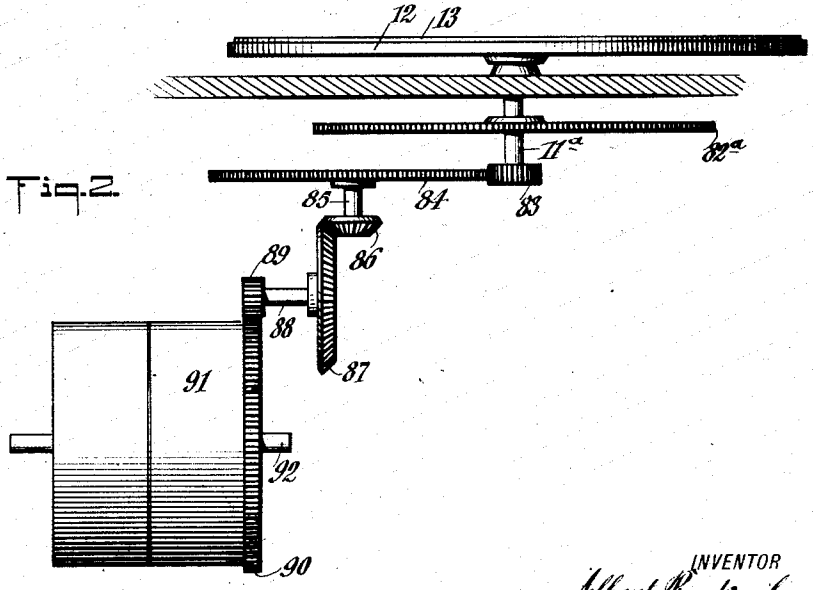


Fig. 2.



WITNESSES

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2 SHEETS—SHEET 2.

Fig. 3.

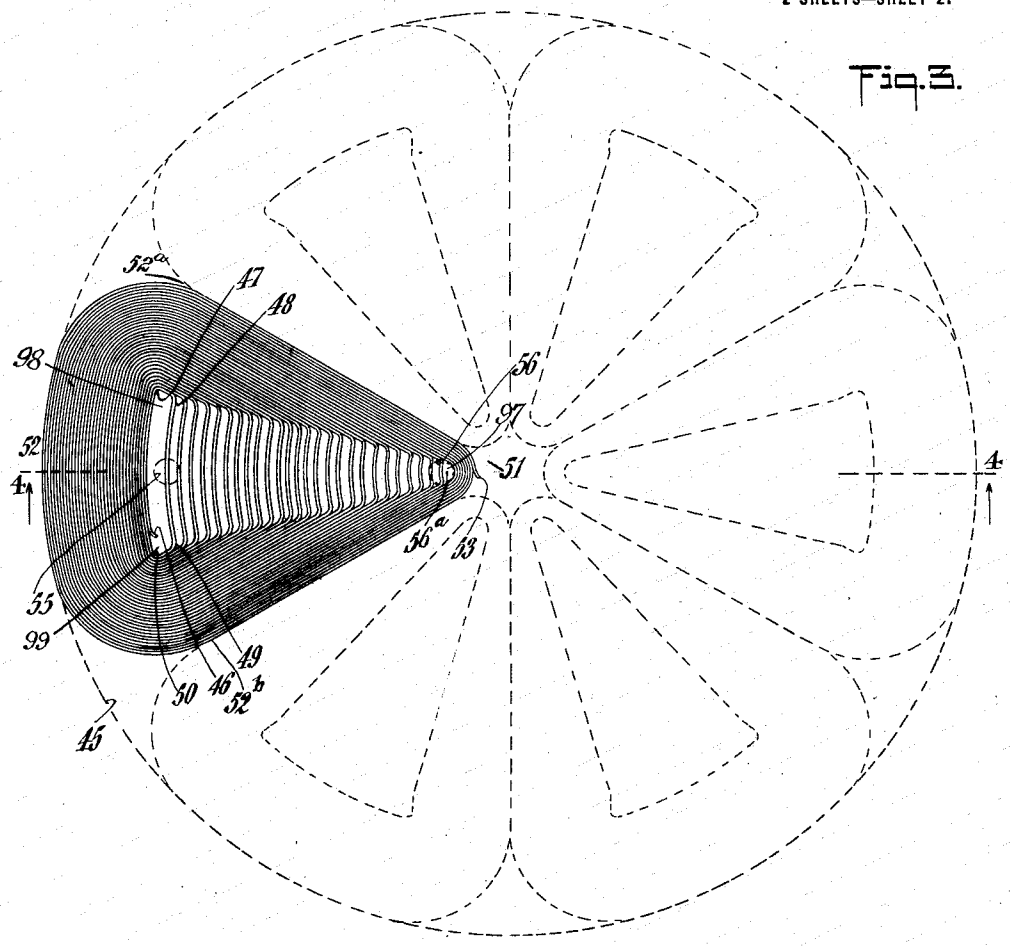
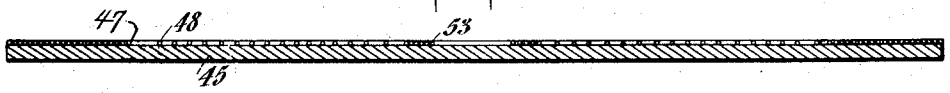


Fig. 4.



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UNITED STATES PATENT OFFICE.

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SPEED-REGULATOR FOR PHONOGRAPHS.

1,212,693. Specification of Letters Patent. Patented Jan. 16, 1917.

Application filed August 7, 1914. Serial No. 855,618.

To all whom it may concern:

Be it known that I, ALBERT RUCKGABER, a citizen of the United States, and a resident of Brooklyn, county of Kings, and State of New York, have invented certain new and useful Improvements in Speed-Regulators for Phonographs, of which the following is a specification.

This invention relates to phonographs, and more particularly to improvements therein, and to the invention described in my copending application filed by me on March 6, 1914, under Serial No. 822,933.

The invention of the present application has particularly for its object to utilize the currents generated by the rotation of coils of wire passing between the jaws of a permanent magnet so as to create friction, and thereby regulate the speed of the record disk.

The invention will be more fully described hereinafter and finally pointed out in the claims.

In the accompanying drawings, Figure 1 is a side view, partly in section, of the essential parts of the phonograph necessary for the carrying out of my invention, and showing the invention applied thereto, the operating parts being driven by an electric motor, Fig. 2 is a side view partly in section of the operating parts driven by a spring motor, Fig. 3 is a plan view of the disk showing the method of winding the coils thereon, and Fig. 4 is a vertical transverse section taken on line 4—4 of Fig. 3.

Similar reference numerals indicate corresponding parts throughout the various views.

Referring to the drawings, and more particularly to Fig. 1, the frame 10 of the machine supports the rotary shaft 11 having the record support 12 thereon, on which is seated the record disk 13. The support 12 and record disk 13 are rotated by means of the gear wheel 15 secured to the shaft 11 which gear wheel 15 meshes with the worm 16 secured to the shaft 17, which in turn is secured to the metal disk 18. The metal disk 18 is rotated by means of the attraction afforded by the magnets 19 and 20, which are supported by the rotary member 21 and embrace the peripheral portions of the member 18. This support 21 is secured to the shaft 22 which in turn is secured to the gear wheel 23, which meshes with a pinion 24 on the shaft 25 of the electric motor 26. The electric motor has conductors 27 and 28, serving to supply the motor 26 with electric current, whereby the shaft 25 is rotated and sets into operation the train just described. The stylus 30 is supported as usual by the sound-producing member 31 on the tone arm 32, which extends downwardly through the base 10 into the horn portion 33 shown in dotted lines in Fig. 1. Passing through the tone arm is arranged a shaft 34 which has its upper end 36 pivotally secured to the locking member 37 which is provided with the handle 38, and which, in the position shown in Fig. 1, rests on supports 39 and 39ª. When the locking member 37 is in the position shown in Fig. 1, it moves with the tone arm 32, and consequently the shaft 34 is moved correspondingly. When, however, the locking member is moved so as to be engaged by the support 40, and by the stationary support 41 on the base 10, then the shaft 34 is locked in position and prevented from moving with the tone arm. Secured to the shaft 34 is a support 42 which is secured thereto by the locking members 43, and which support 42 has a permanent magnet 44 thereon. When the locking member 37 is engaged by the supports 39 and 39ª, the magnet 44 moves with the tone-arm 32, but when the locking member 37 is engaged by the supports 40 and 41, then the magnet 44 is stationary. This magnet 44 is movable in respect to a disk 45 as the vertical shaft 34 is moved during the movement of the tone arm 32, when as stated the locking member 37 is engaged by the supports 39 and 39ª. The disk 45 is provided with a plurality of coils wound in the special manner shown in Fig. 3, six coils being shown on the disk 45. Each of these coils is wound in the manner shown in full lines at the left of Fig. 3, in which the end 46 of the coil which is a beginning of the coil, extends in the direction 46, 47, where the wire is bent and then extends parallel to the radius 51—52ª of the disk a short distance to the point 48 where it is again bent, and carried in a circular direction to the point 49, where it is again bent, and then extends parallel to the radius 51—52ᵇ outwardly to the point 50, where it is again bent and caused to be placed in a position adjacent to and substantially concentric with that part of the coil between the points 46 and 47. Thereafter, it is again bent at a point adjacent the point 47, and is carried

parallel to the radius 51—52ª inwardly adjacent to and parallel with the portion of the first convolution between 47 and 48, and thereafter it follows the outline of the first convolution 46, 47, 48, 49 and 50. It will be noted that the outermost lateral wires of the coil extend in a radial direction, and the wires adjacent to them run parallel to each other and to the outermost wires, while those two circular portions that extend substantially at right angles to the radial line 51, 52, are also concentric with each other, until the coil has its other end 53 in close proximity to the center of the disk. The extreme positions of the points of the permanent magnet are shown in dotted lines and are indicated by the characters 55 and 56. The ends of each of the coils arranged on the disk 45 are connected by the connecting wires 58 with commutator bars of the commutator 59 shown in Fig. 1. This commutator is arranged on the shaft 60 secured to the disk 45 and extending upwardly to a bearing 61 in the base 10. Brushes 62 and 63 and connecting wires 64 and 65 serve to take off the current produced by the movement of the coils past the magnet terminals, and cause the same to flow through the coil 66 surrounding the core 67 and having a solenoid action therewith. The core 67 is hingedly connected with one end 68 of a lever 69, which is hinged at 70 to a supporting bar 71, which is secured at 72 to the base 10. This end 68 has also hingedly connected therewith a spring 73 which is connected at 74 with a screw 75 which enables the spring 73 to be adjusted depending upon the rotation of the screw 75. For convenience, the screw 75 is provided with a manipulating knob 76. The other end 78 of the lever 69 supports pads 79 of leather or other material, which press against the rotating friction disk 80 which is secured to the shaft 60, whereby a varying friction can be obtained. Thus, by the downward movement of the end 78 away from the disk 80, less friction is obtained than when the end 78 is moved toward the disk 80, and pressed thereagainst. To the shaft 60 is secured a pinion 81 which meshes with the gear 82 secured to the shaft 11.

In Fig. 2, the train for operating the disk support 12 and record disk 13 is shown, and in this the electric motor shown in Fig. 1 is replaced by the usual spring motor. For this purpose, the shaft 11ª has secured thereto a gear 82ª, and a pinion 83, which meshes with a gear 84, which has secured thereto a shaft 85 having the bevel gear 86 meshing with the bevel gear 87 which is secured to the shaft 88. To the shaft 88 a pinion 89 is secured, meshing with the gear 90 which is secured to the casing 91 which surrounds a spring, and which has a shaft 92. Thus, by the operation of this train by the gradual unwinding of the spring which is not shown but which is contained in the casing 91, the support 12 with the record disk 13 thereon is operated.

It will thus be seen that in the embodiment shown in the drawings and described, a disk carrying coils of wires revolves between the jaws of the permanent magnet which is mounted similarly to previous embodiments in my copending application, and moving in conjunction with the tone-arm.

In variable speed phonographs, the linear velocity of the record line with respect to the stylus is constant, and in the arrangement herein described, each portion of the disk with the coils, as it passes between the jaws of the magnet, has an equivalent constant linear velocity. In the case of the structure shown in the copending application referred to, the disk is composed of metal, having cut-out portions. But for the purpose of explaining the present invention, it is assumed that the disk is solid, that is, without cut-out portions. On this assumption, then, the magnitude of the eddy currents generated in its structure by the rotation of the disk between the jaws of the magnet, is constant. This is because the electromotive force generated in the disk and causing these currents to flow, depends on the strength of the magnetic field, and upon the length of the portion of the disk between the jaws of the magnet, and upon the linear velocity with which the portion of the disk between the jaws of the magnet cuts the lines of force, and as these are constant, as also the resistance of the disk is constant, the eddy currents flowing in the disk are constant, for all positions of the magnet. These currents flow radially and could be taken off through contacts located at the center and at the periphery. While the currents generated under these conditions may be of some magnitude, the electromotive force will be small, and difficulty will be experienced in constructing the contacts to give a low resistance. In the structure herein described, however, coils of wire are utilized in order to provide a higher electromotive force than can be obtained from the metal disk. In this case, we again have a constant strength of magnetic field, a constant length of each wire under the magnetic pole at one time, a constant resistance of each coil and of the solenoid, and therefore the current flowing will be a constant, provided a constant linear velocity of each portion of the coil as it passes between the jaws of the magnet is maintained. Conversely, if the current taken from the windings of the coil is maintained constant, a constant linear velocity of each porton of the coil as it passes between the jaws of the magnet will be maintained, and therefore a constant linear velocity of

each portion of the record line as it passes underneath the stylus, will be maintained.

In order to maintain the current taken from the coil at a constant value, the current is conducted to a solenoid which operates on an iron core, and acting through a lever, presses the friction pads against a friction disk, the spring 73 resisting the pull of the solenoid with a practically constant tension. Should the speed be too high, the current will exceed the average value, and the friction pad 79 will be pressed against the friction disk 80, whereby the speed will be lowered and consequently the value of the current taken from the commutator 59 and flowing through the solenoid 66 is in turn reduced, which in turn will reduce the friction on the friction disk. Should the speed be too low, the current passing through the solenoid 66 will be reduced, and consequently the core 67 will be drawn up slightly by the spring 73, which will pull up the lever 69, and the drag on the friction disk by the end 78 will be reduced, thus allowing the speed to increase to the proper amount. For this reason it is advantageous that the friction pad 78 should normally bear against the friction disk 80, allowing the solenoid to increase or decrease the friction in accordance with the requirements.

The adjustment of the spring 73 will control the constant linear velocity which will be maintained throughout the playing of the record, and can be adjusted similarly to the arrangement in the machine heretofore used.

The machine described is suitable for playing constant speed records by simply fixing the position of the magnet at the proper point to give the proper constant speed.

In order to clearly appreciate the difference between the present invention and the constant speed phonographs, it must be remembered that in the case of the present constant speed phonographs with a ball governor, the arrangement of the springs and weights on the governor is such that they maintain a constant angular velocity by varying the drag on the system or by increasing or decreasing the friction in the system. The arrangement of weights and springs in the governor is essentially adapted only for a constant speed, and any attempt to regulate the speed by having the tone arm vary the point in space where friction takes place between the friction disk and the friction pad, to obtain the desired variable rotative speed of the record table, as in a prior patent to Mr. Taintor, No. 730,986, will lead to unsatisfactory results on account of the unsatisfactory control it is possible to exert over friction.

Whereas in the case of the present constant speed phonograph, the angular velocity with which the record disk revolves is a constant and therefore supplies us with a convenient and simple means of controlling the speed by aid of the ball governor, in the case of the variable speed phonograph, however, the angular velocity is continuously varying and although the need of some simple device for measuring and controlling the variable speed is felt, yet there seems to be great difficulty in devising a purely mechanical device to achieve this result. In the case of the present invention, I utilize the principle of the generation of an electromotive force in a moving conductor, cutting the lines of force of a magnetic field, the magnitude of such an electromotive force being proportional among other things, to the linear velocity with which the lines of force are cut. Hence this principle as embodied in the present arrangement, furnishes us with the required device for measuring and at the same time controlling the speed in the manner described elsewhere in this specification.

The action of the winding shown in Fig. 3 is as follows: In the case of that part of the coil running in a radial direction, the electromotive force generated in it when cutting the lines of force emanating from the magnet, will be proportional to the distance of the magnet from the center, if the angular velocity of the coil is constant. If, however, the coil revolves so that each portion of the same as it passes between the jaws of the magnet, cuts the lines of force with a constant linear velocity, then the electromotive force generated in the conductor will be a constant. A plurality or multiplicity of parts so arranged will give an electromotive force proportionately greater if connected in series. As shown in Fig. 3, only the outermost lateral wires of the coil run truly radial, and the adjacent wires run parallel to the outermost wires and to each other, which is done in order to have the same number of wires under the magnet at one instant, irrespective of the location of the magnet. In order to avoid generating opposing electromotive forces in the two legs of the coil at the same instant when the magnet is in one of the extreme positions 56, Fig. 3, a space 56^a is left, which becomes proportionately greater as the magnet is nearer the periphery of the coil. During the time that the magnet is in the space 97, 98 and 99, no electromotive force is generated.

In the embodiment shown in Fig. 3, when the magnet is in one extreme position, near the center, as indicated by 56, the least number of turns of each coil cut the lines of force of the magnet, and when it is in the other extreme position, namely near the periphery, as indicated by 55, the largest num-

ber of turns of each coil cut the lines of force. Any intermediate position of the magnet has a different number of conductors of each coil cut the lines of force of the magnet. If, however, each coil should be wound as to have the same number of turns cut the lines of force of the magnet irrespective of the position of the magnet, then the maximum value of the electromotive force and the duration of each pulsation would be the same for all positions of the magnet as it moved inward from position 55 to 56, but the time interval between these pulsations would become proportionately less as the magnet moved inward. The flow of energy to the solenoid on account of the increased number of pulsations in a given unit of time would, therefore, increase as the magnet moves inward. But in order to make the proper correction, more conductors are provided near the periphery than near the center and return from one side of the coil to the other side, as in the case of the coil shown in Fig. 3. By this means, the pull of the solenoid acting on its core, will practically remain constant if the linear velocity of each portion of the coil as it passes the jaws of the magnet is constant. It will be noted that throughout the coil, the portions of the turns passing from one lateral part of the coil to the other, between the extreme positions of the magnet, are curved or circularly arranged, so as not to produce any electromotive force in those parts by the rotation of the coil.

The winding as shown in Fig. 3 can undoubtedly be changed to meet certain conditions, as for instance, in order to provide a continuous flow of energy to the solenoid.

In the embodiment shown in the drawings, the use of a solenoid operated by the electric current produced by the cutting of the lines of force of the magnet by the coil or coils has been shown and this has been described herein, but other means may be substituted therefor which work in a way to accomplish the same result, and which may suggest themselves to one skilled in the art.

The electric motor 26, shown in Fig. 1, can be either shunt or series wound. In case it is shunt wound, the action of the solenoid can be made to maintain the proper speed irrespective of any voltage fluctuations in the supply circuit, by having some slip in the magnetic coupling 18—19—20 at the average electromotive force of the supply circuit, thus allowing the solenoid to maintain the speed desired by diminishing or increasing the friction load. With a series wound motor, the action of the magnetic coupling 18—19—20 and of the disk 45, which in this case would be of metal, will be similar to the mechanism described in my copending application, except that in the present invention, the effect of fluctuations in the voltage of the supply circuit will be corrected by the solenoid varying the friction.

The disk supporting the coils of wire may be made of either a metallic or a non-metallic material. In the case of a non-metallic material, the necessary regulation of the speed would be performed entirely by the current acting through the solenoid on the friction disk. While in my opinion, a metallic disk is not necessary for the successful operation of the machine, I recommend its use, since the retarding effect of the eddy currents generated in the disk, as described in my copending application, may be made to act in such a manner as to assist the action of the current generated in the windings. This may be done, for instance, by providing the supporting disk with suitable cut-out portions. As the magnitude of the counter torque due to the friction of the stylus on the record, and that due to the reaction between the magnet and the coils of wire, depends upon the position of the tone arm, the metallic disk supporting the coils may be provided with suitable cut-out portions to be determined by experiment, thus allowing the counter torque due to the eddy currents generated in the disk for various positions of the magnet, to balance the changes in the counter torque enumerated above. In this case, therefore, the sole function of the solenoid acting on the friction disk, would be to supply a frictional counter torque to compensate for the varying strength of the spring. The exact configuration of these cut-out portions would be determined by experiment.

I have shown an embodiment of my invention, but it is clear that changes may be made therein without departing from the spirit of the invention as defined in the appended claims.

I claim:

1. In a phonograph having a record disk, a stylus, and means for rotating the record disk, means actuated by said first named means for producing an electromotive force by electromagnetic induction, and means acted upon by the electric energy corresponding to the produced electromotive force, said means operating to vary the speed of rotation of the record disk on the variation of the induced electromotive force.

2. In a phonograph having a record disk, a stylus, and means for rotating the record disk at a constant linear velocity relatively to the stylus, means actuated by said first named means for producing an electromotive force by electromagnetic induction, and means acted upon by the electric energy corresponding to the produced electromotive force, said means operating to vary the speed of rotation of the record disk on the variation of the induced electromotive force

from that electromotive force produced corresponding to a constant linear velocity of the record line and stylus relatively to each other.

3. In a phonograph, the combination of a record medium, a medium coacting therewith, and members coacting with each other and in magnetic relationship with each other, with means for changing the position of one of said members relatively to the other, upon the change of the position of the coacting medium upon the record medium, means capable of changing the linear velocity of the record medium and the coacting medium relatively to each other, on the change of position of one of said members relatively to the other, and means on one of the members for inducing therein when in magnetic relationship with the other member an electromotive force, for controlling said last-named means.

4. In a phonograph having a record disk, a movable tone-arm, means for moving the record disk, a rotary member rotated with the record disk, means movable by the tone-arm, the last-named means and rotary member being movable with respect to each other and being in magnetic relationship to each other for the purpose of regulating the speed of the record disk, means moved by the rotary member for inducing therein, when in magnetic relationship with the other member, an electromotive force, and means for utilizing the electric energy generated, for controlling the movement of the rotary member and record disk.

5. In a phonograph having a record disk, means for actuating the record disk, and a movable tone-arm, a magnet movable with the tone-arm, a coil of wire movable to cut the lines of force of the magnet for generating an electric current, means actuated by said current, and means actuated by said last-named means and operating on the means for rotating the record disk.

6. In a phonograph having a record disk, means for actuating the record disk, and a movable tone-arm, a magnet movable with the tone-arm, a coil of wire for cutting the lines of force of the magnet for generating an electric current, means for moving the coil of wire, means actuated by said current, and means actuated by said last-named means and operating on the means for moving the coil of wire.

7. In a phonograph, having a record disk and a stylus, means for rotating the record disk, a magnet, means rotating between the poles of the magnet and cutting the lines of force of said magnet, the linear velocity of said portion of said means between the poles bearing a constant relationship to that of the record line and stylus for inducing an electromotive force therein proportionate to a constant linear velocity of each portion of the record line as it passes underneath the stylus, and means acted upon by said electromotive force and operated by any variation of the electromotive force above or below that corresponding to the said constant linear velocity, for regulating the record disk rotating means to modify the operation thereof to obtain the said constant linear velocity.

8. In a phonograph having a record disk, and means for moving the same, a support movable with the record disk, a magnet movable in respect to the support during its rotation, coils arranged on the support, movable between the poles of the magnet, a commutator connected with the ends of the coils, means operated by the current taken from the commutator, and a friction device operated by said means.

9. In a phonograph having a record disk, and means for moving the same, a support movable with the record disk, a magnet movable in respect to the support during its rotation, coils arranged on the support, movable between the poles of the magnet, a commutator connected with the ends of the coils, a solenoid, conductors connected with the commutator and with the solenoid, a core in the solenoid, a lever pivotally supported, having one end connected with the core of the solenoid, and connected with an adjusting spring, a friction disk rotatable with the support, and friction pads on the other end of the lever from that to which the adjusting spring and core is connected, for exerting a varying pressure on the friction disk.

10. In a phonograph, the combination of a record medium having a record line, a medium coacting with said record medium, the said mediums being relatively movable to each other, a member capable of having an electromotive force induced therein, a second member in magnetic relationship with the first member, the said members being relatively movable to each other for producing an electromotive force in the first member by electromagnetic induction, and means transmitting the relative movement of the mediums in respect to each other to said members, so that the said members correspond in their relative movement to the relative movement of said mediums, whereby the electromotive force induced bears approximately the relationship to a constant linear velocity of each portion of the record line and said coacting medium relatively to each other.

11. In a phonograph, the combination of a record medium having a record line, a medium coacting with said record line, the said mediums being relatively movable to each other, members coacting with each other and in magnetic relationship with each other, means on one of said members

for inducing therein an electromotive force, means acted upon by the resulting electric energy, and operated by any variation therein and means operated by said last-named means for regulating the angular velocity of the record medium on the variation of the induced electromotive force from constancy.

12. In a phonograph, the combination of a record medium having a record line, a medium coacting with said record line, the said mediums being relatively movable to each other, members coacting with each other and in magnetic relationship with each other, means on one of said members for inducing therein an electromotive force, means operated by the resulting electric energy, and means operated by said last-named means for regulating the relative linear velocity of the record and coacting mediums at their coacting point, on the variation of the electromotive force induced from that electromotive force which bears an approximately constant relationship to the constant linear velocity of each portion of the record line and coacting medium, relatively to each other.

In testimony, that I claim the foregoing as my invention, I have signed my name in presence of two subscribing witnesses.

ALBERT RUCKGABER.

Witnesses:
C. P. GOEPEL,
G. LOWE.