March 8, 1938. J. D. DURKEE ET AL 2,110,144

MECHANICAL OSCILLATOR

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FIG. 1

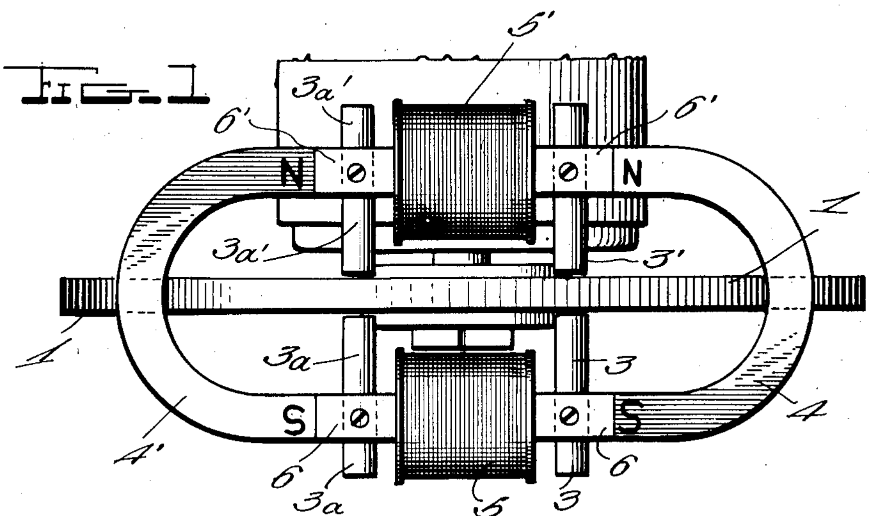
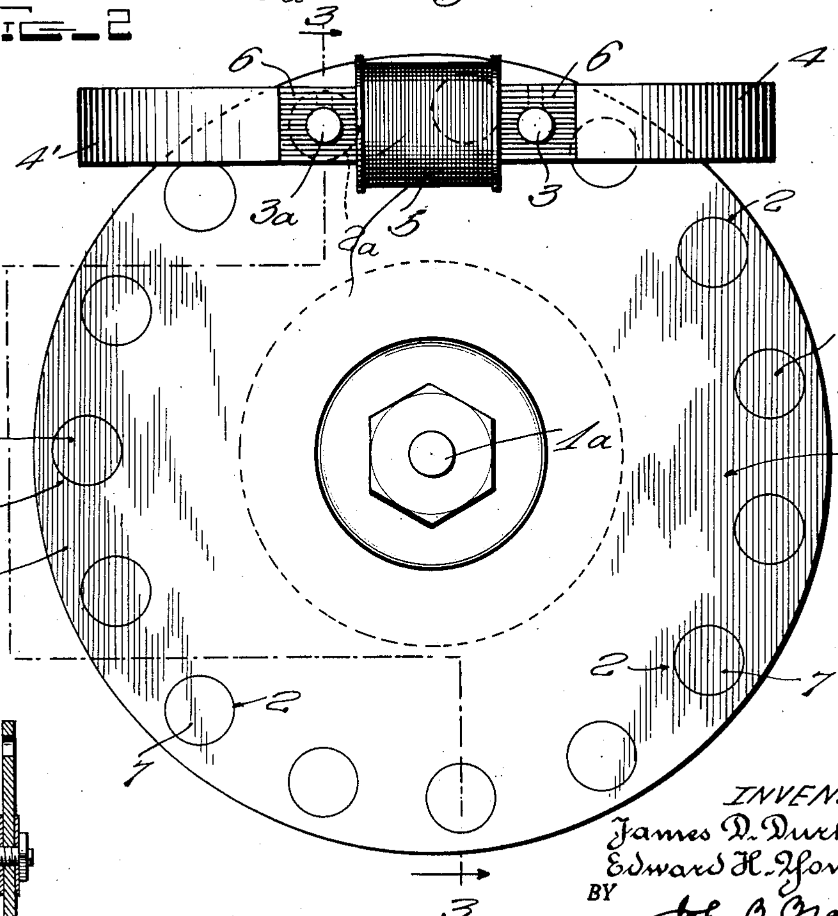


FIG. 2



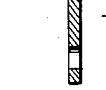


FIG. 2 A

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FIG. 3.

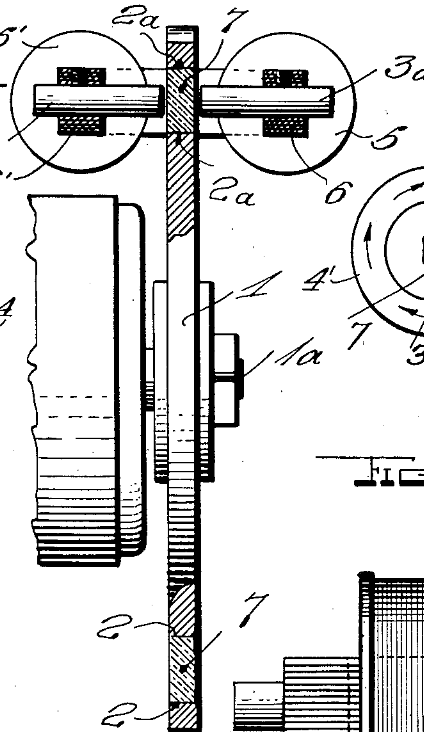


FIG. 6

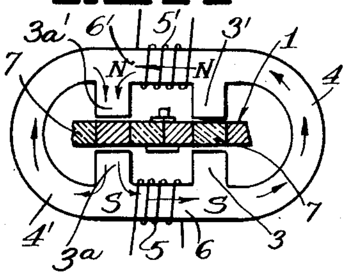


FIG. 7.

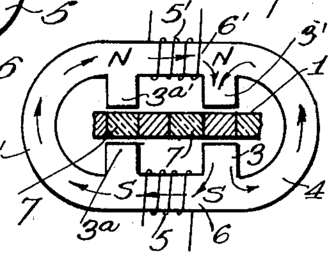


FIG. 5

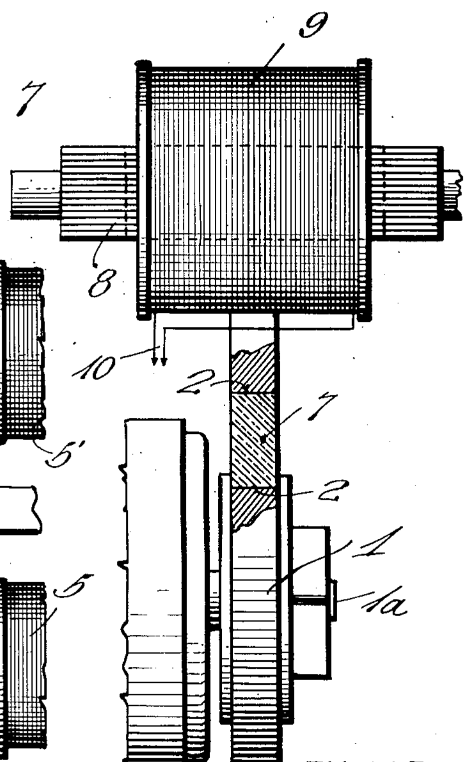
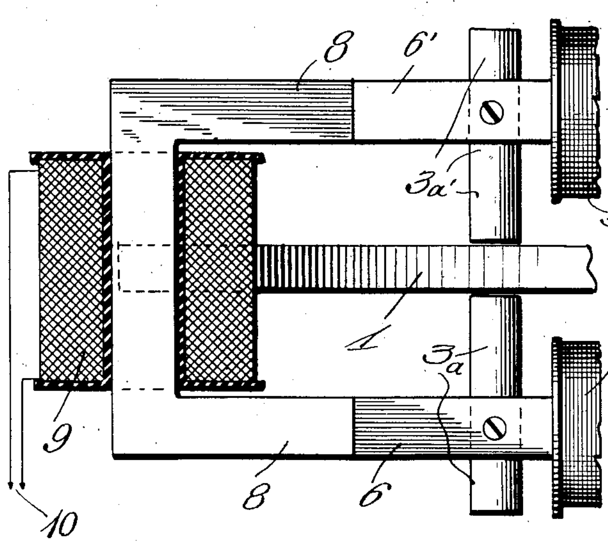


FIG. 4



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MECHANICAL OSCILLATOR

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Application July 24, 1935, Serial No. 32,952

15 Claims. (Cl. 171—252)

Our invention relates broadly to oscillation generators and more particularly to an improved form of mechanical oscillator of the type known as induction generator.

One of the objects of our invention is to provide a simple and efficient construction of induction generator for the generation of oscillations of frequencies up to 20,000 cycles per second.

Another object of our invention is to provide an arrangement of core structure in a mechanical oscillator in which the magnetic flux alternates only in position in a portion thereof, and the total amount of magnetic flux remains substantially unchanged.

A further object of our invention is to provide inductor coils mounted between pairs of pole pieces of the same polarity, the magnetic flux shifting alternately between the poles of each pair and linking the turns of the inductor coils to generate the oscillations.

A still further object of our invention is to provide a rotating disc of varying magnetic reluctance adapted to effect complementary variations in the reluctances of the magnetic paths of a pair of pole pieces of the same polarity, the total flux to both the pole pieces passing alternately through each of the pole pieces in accordance with the reluctance of the individual paths as determined by the rotating disc.

A further object of our invention is to provide means for varying the frequency of generation of the oscillations produced in the oscillator of our invention.

Still another object of our invention is to provide a structure of mechanical oscillator which will produce a substantially sinusoidal form of oscillation, even under load conditions.

A further object of our invention is to provide a construction of generator employing a constant magnetic field whereby hysteresis loss in the core of the field structure is substantially eliminated.

Another object of our invention is to provide a laminated form of field structure preferable for use when a magnetic field of varying intensity is employed.

Other and further objects of our invention reside in the structure and arrangements hereinafter more fully described with reference to the accompanying drawings, in which:

Figure 1 is a top plan view of the mechanical oscillator of our invention; Fig. 2 is a side elevation thereof; Fig. 2*a* is a sectional view through a modified form of rotatable disc; Fig. 3 is a detailed sectional view taken on line 3—3 in Fig. 2; Fig. 4 is a top plan view of a modified form of field structure adaptable to the mechanical oscillator shown in Figs. 1–3; Fig. 5 is an end elevation of the modified form of field structure shown in Fig. 4; and Figs. 6 and 7 are diagrammatic views of the magnetic system in the oscillator of our invention showing the flux in alternate sets of pole pieces.

The induction generator employs the principle of generating voltage by shifting the magnetic flux so as to link the turns in the inductor coils. The frequency of the voltage depends upon the number of times the flux links in and out of the coil each second. The embodiment of this principle in the generator of our invention provides a simple and convenient means for generating voltages of various frequencies for use in a number of ways. The generator of our invention has been applied in field measurements of soil conductivity where an instrument giving constant output, and which is light in weight and durable is required. The device of our invention has also been employed to generate carrier currents for use in telegraph and telephone communication systems.

Referring to the drawings in more detail, Fig. 1 shows as the principal components of the mechanical oscillator of our invention, a disc 1, having a series of equi-spaced perforations 2 disposed adjacent the periphery thereof. The disc 1 is composed of magnetic material, such as soft iron, which does not retain magnetism. The disc is mounted on shaft 1*a* and arranged for rotary movement between sets of pole pieces 3, 3′, and 3*a*, 3*a*′. The pole pieces 3 and 3′ of one set are of opposite polarity, as are the pole pieces 3*a* and 3*a*′ of the other set; but pole pieces 3 and 3*a*, disposed on the same side of the disc 1, are of the same polarity, as are the other pair 3′ and 3*a*′, disposed on the other side of the disc 1.

The perforations 2 in the disc 1 are arranged, as shown more particularly in Fig. 2, so that when a perforation such as 2*a* is disposed between pole pieces 3*a* and 3*a*′, a portion of the disc 1 lies between pole pieces 3 and 3′, providing a magnetic path of low reluctance for the magnetic flux between pole pieces 3 and 3′ and a path of high reluctance between pole pieces 3*a* and 3*a*′. As the disc 1 rotates, therefore, the sets of pole pieces are alternately provided with paths of low or high reluctance.

The field structure shown in Figs. 1 and 2 comprises a pair of permanent magnets 4 and 4′ of equal strength, arranged in abutment with laminated core members 6 and 6', in the relative polarity shown. Inductor coils 5 and 5' are mounted centrally on laminated core members 6 and 6' respectively. Core pieces 3 and 3*a* are adjustably mounted in core member 6 adjacent the ends thereof; and core pieces 3' and 3*a*' are similarly mounted in core member 6'. Pole pieces 3, 3', 3*a* and 3*a*' are adjusted to within a few thousandths of an inch clearance of the disc 1. The adjustable mounting of the pole pieces 3*a* and 3*a*' in the core members 6 and 6' is shown particularly in Fig. 3.

In operation, core members 6 and 6' are each abutted by poles of the magnets 4 and 4' of the same polarity. Of the paths between the members of each set of pole pieces, between 3 and 3', 3*a* and 3*a*', the one which has the lower reluctance at the moment, will conduct the flux in circuit, as shown in Fig. 6, for example. Then, as the disc rotates, to the position shown in Fig. 7, the other path becomes of lower reluctance and the first path becomes of more reluctance, and the flux shifts in the core members 6 and 6' to the other set of pole pieces, linking the coils 5 and 5' and generating therein the desired voltage. The flux in the magnets 4 and 4' is unaffected for, as the flux in the pole pieces 3 and 3' increases, that in pole pieces 3*a* and 3*a*' decreases, and vice versa, the flux merely shifting in position in the core members 6 and 6', while remaining at substantially constant intensity. Since in the shifting of the magnetic flux from one set of pole pieces to the other, the flux from magnet 4, for example, moves out of the coil 5, and the flux from magnet 4' moves into the coil 5 from the opposite direction, substantially all of the available magnetic flux is employed to link the turns of the inductor coils 5 and 5' and generate voltage.

The coils 5 and 5' may be connected either in series or in parallel, and their design may be varied widely to match the load conditions of the system to which the oscillator is applied.

The pole pieces and perforations are designed so that when the coils 5 and 5' are not connected to the load, the magnetic reluctance of the system is constant for all positions of the disc and there is, therefore, substantially no drag on the disc other than friction. When a load is applied there is some displacement of flux due to the generating action and then the force required to rotate the disc is substantially proportional to the energy output plus the frictional loss.

In order to reduce as much as possible the air friction, the perforations 2 in the disc 1 are filled with a non-magnetic material 7 such as Bakelite, which also permits closer adjustment of the pole pieces to the disc without danger of damage. But the fillings 7 need not be employed, the apertures 2 being left open as indicated in Fig. 2*a*.

Figs. 4 and 5 show a modified form of field magnet by which a flux of varying intensity may be employed as the field in the mechanical oscillator device. Reference character 8 designates a laminated core structure on which is mounted a coil 9 adapted to be energized through leads 10 by current which may be constant, or variable such as voice currents from the output of an audio frequency amplifier. The core 8 is laminated not because of flux variations in this part of the magnetic circuit caused by the flux valving disc 1, but to reduce losses incident to the flux variations as produced. The use of a field of varying intensity in a device of this character has numerous advantages and the structure shown in Figs. 4 and 5 is especially adaptable to such use. In the modified form of our invention, an electromagnetic field structure like that shown in Figs. 4 and 5 is employed in place of the permanent magnets 4 and 4' at either end of the structure shown in Figs. 1–3, the remainder thereof being the same as described in connection with Figs. 1–3.

The frequency of generation in the mechanical oscillator of our invention is directly proportional to the number of perforations and to the speed of rotation of the disc 1 and may be varied by changing one or the other, or both of these factors.

The symmetrical arrangement of the sets of pole pieces and core structure, together with pole tips and perforations of appropriate shape, results in the production of substantially sinusoidal alternating current.

While we have described our invention in certain preferred embodiments, we desire it to be understood that modifications may be made, and that no limitations upon our invention are intended other than may be imposed by the scope of the appended claims.

What we claim as new and desire to secure by Letters Patent of the United States is as follows:

1. A mechanical oscillator comprising a magnetic field core structure, a plurality of pole pieces associated with each pole of said field core structure, inductor coils mounted on said core structure between the pole pieces on the poles of said core structure, and means for causing substantially the total magnetic flux produced in said core structure to pass alternately on opposite sides of said inductor coils through pole pieces on the same side of said coils whereby said flux links said inductor coils and generates voltage therein.

2. A mechanical oscillator comprising a magnetic field core structure, a plurality of pole pieces associated with each pole of said field core structure, inductor coils mounted on said core structure between the pole pieces on the poles of said core structure, and a perforated rotatable disc member of magnetic material adapted to shift the magnetic flux produced in said core structure and cause substantially all said flux to pass alternately through sets of pole pieces on opposite sides of said inductor coils whereby said flux links said inductor coils and generates voltage therein.

3. A mechanical oscillator comprising a permanent magnet field core structure, a plurality of pole pieces associated with each pole of said field core structure, inductor coils mounted on said core structure between the pole pieces on the poles of said core structure, and means for causing substantially the total magnetic flux produced in said core structure to pass alternately on opposite sides of said inductor coils through pole pieces on the same side of said coils whereby said flux links said inductor coils and generates voltage therein.

4. A mechanical oscillator comprising a permanent magnet field core structure, a plurality of pole pieces associated with each pole of said field core structure, inductor coils mounted on said core structure between the pole pieces on the poles of said core structure, and a perforated rotatable disc member of magnetic material adapted to shift the magnetic flux produced in said core structure and cause substantially all

said flux to pass periodically through the pole pieces on one side of said inductor coils and alternately through the pole pieces on the opposite side of said inductor coils whereby said flux links said inductor coils and generates voltage therein.

5. A mechanical oscillator comprising a magnetic field core structure including a pair of U-shaped permanent magnets and a pair of laminated core members disposed between like poles of said U-shaped magnets, forming a substantially oval shaped core structure; pole pieces mounted adjacent the ends of said laminated core members and directed inwardly of said oval shaped core structure, inductor coils mounted on said laminated core members intermediate said pole pieces, and means for causing substantially the total magnetic flux produced in said core structure to pass alternately on opposite sides of said inductor coils through pole pieces on the same side of said coils whereby all said flux links said inductor coils and generates voltage therein.

6. A mechanical oscillator comprising a magnetic field core structure including a pair of U-shaped permanent magnets and a pair of laminated core members disposed between like poles of said U-shaped magnets, forming a substantially oval shaped core structure; pole pieces mounted adjacent the ends of said laminated core members and directed inwardly of said oval shaped core structure, inductor coils mounted on said laminated core members intermediate said pole pieces, and a perforated rotatable disc member of magnetic material adapted to shift the magnetic flux produced in said core structure and cause substantially all said flux to pass alternately through sets of pole pieces on opposite sides of said inductor coils whereby said flux links said inductor coils and generates voltage therein.

7. A mechanical oscillator comprising a magnetic field core structure including a pair of U-shaped permanent magnets and a pair of laminated core members disposed between like poles of said U-shaped magnets, forming a substantially oval shaped core structure; pole pieces mounted adjacent the ends of said laminated core members and directed inwardly of said oval shaped core structure, inductor coils mounted on said laminated core members intermediate said pole pieces, and a perforated rotatable disc member of magnetic material disposed between said inwardly projecting pole pieces, the perforations being disposed so as to open the magnetic path between pole pieces on one side of said inductor coils while maintaining the magnetic path between the pole pieces on the opposite side of said inductor coils as said disc is rotated.

8. A mechanical oscillator comprising an electromagnetic field core structure including laminated core members and field coils mounted thereon; a plurality of pole pieces associated with each pole of said field core structure, inductor coils mounted on said core structure between the pole pieces on the poles of said core structure, and means for causing substantially the total magnetic flux produced in said core structure to pass alternately on opposite sides of said inductor coils through pole pieces on the same side of said coil whereby said flux links said inductor coils and generates voltage therein.

9. A mechanical oscillator comprising an electromagnetic field core structure including laminated core members and field coils mounted thereon; a plurality of pole pieces associated with each pole of said field core structure, inductor coils mounted on said core structure between the pole pieces on the poles of said core structure, and a perforated rotatable disc member of magnetic material adapted to shift the magnetic flux produced in said core structure and cause substantially all said flux to pass alternately through sets of pole pieces on opposite sides of said inductor coils whereby said flux links said inductor coils and generates voltage therein.

10. A mechanical oscillator comprising an electromagnetic field core structure including a pair of U-shaped laminated core members and a pair of straight laminated core members disposed between the poles of said U-shaped members and forming a substantially rectangular shaped core structure; pole pieces mounted adjacent the ends of said straight core members and directed inwardly of said rectangular shaped core structure, field coils mounted on said U-shaped members, inductor coils mounted centrally on said straight core members intermediate said pole pieces, and means for causing substantially the total magnetic flux produced in said core structure to pass alternately on opposite sides of said inductor coils through pole pieces on the same side of said coils whereby said flux links said inductor coils and generates voltage therein.

11. A mechanical oscillator comprising an electromagnetic field core structure including a pair of U-shaped laminated core members and a pair of straight laminated core members disposed between the poles of said U-shaped members and forming a substantially rectangular shaped core structure; pole pieces mounted adjacent the ends of said straight core members and directed inwardly of said rectangular shaped core structure, field coils mounted on said U-shaped members, inductor coils mounted centrally on said straight core members intermediate said pole pieces, and a perforated rotatable disc member of magnetic material adapted to shift the magnetic flux produced in said core structure and cause substantially all said flux to pass alternately through sets of pole pieces on opposite sides of said inductor coils whereby said flux links said inductor coils and generates voltage therein.

12. A mechanical oscillator comprising an electromagnetic field core structure including a pair of U-shaped laminated core members and a pair of straight laminated core members disposed between the poles of said U-shaped members and forming a substantially rectangular shaped core structure; pole pieces mounted adjacent the ends of said straight core members and directed inwardly of said rectangular shaped core structure, field coils mounted on said U-shaped members, inductor coils mounted centrally on said straight core members intermediate said pole pieces, and a perforated rotatable disc member of magnetic material disposed between said inwardly projecting pole pieces, the perforations being disposed so as to open the magnetic path between pole pieces on one side of said inductor coils while maintaining the magnetic path between the pole pieces on the opposite side of said inductor coils as said disc is rotated.

13. In a mechanical oscillator having a perforated rotatable disc of magnetic material as set forth in claim 2, inserts of non-magnetic material supported in the perforations for effecting a reduction in air friction as said disc is rotated.

14. In a mechanical oscillator having a plurality of pole pieces disposed adjacent to a perforated rotatable disc as set forth in claim 2, ad-

justable mounting means for said pole pieces whereby said pole pieces may be fixed in operative position at the desired clearance with respect to said rotatable disc.

15. A mechanical oscillator comprising a magnetic field core structure, an inductor coil mounted on each pole of said core structure, and means for causing substantially the total magnetic flux produced in said core structure to pass through said inductor coils in unison in opposite directions, and means for causing substantially the said total flux to pass through said coils in the reverse directions, respectively.

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