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G. F. HARPELL

3,185,866

MAGNETIC FUNCTION GENERATOR

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FIG. 2

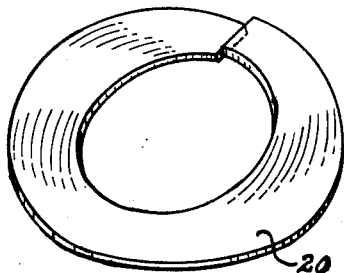
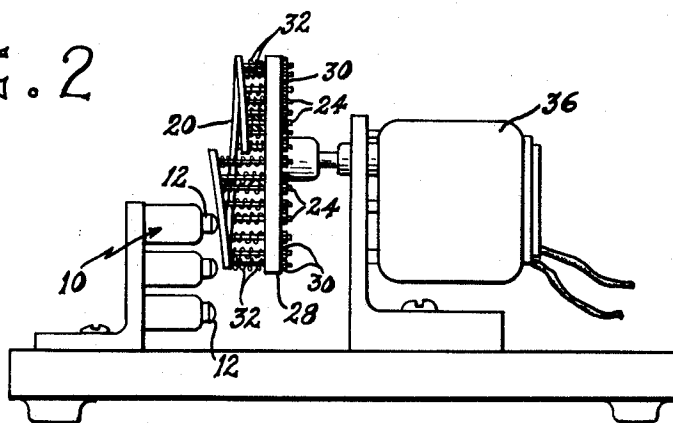


FIG. 3

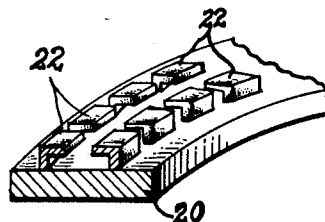


FIG. 4

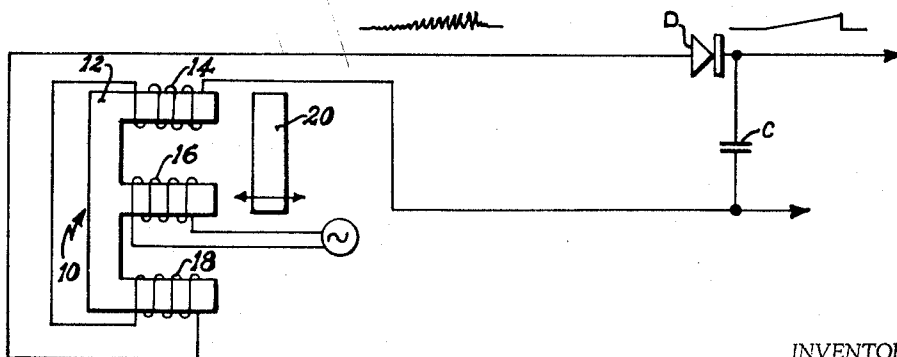


FIG. 1

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3,185,866

MAGNETIC FUNCTION GENERATOR

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8 Claims. (Cl. 307-107)

(Granted under Title 35, U.S. Code (1952), sec. 266)

The invention described herein may be manufactured and used by or for the United States Government for governmental purposes without payment to me of any royalty thereon.

This invention relates generally to function generators, and more particularly to a magnetic function generator which utilizes the variation of the output voltage of a function coil by means of movement of a bar of permeable material in relation to the E laminations.

The magnetic function generator of this invention comprises E transformer laminations with a coil wound on each of the three legs. One of the windings is the function or output winding while a second is a primary or inner coil and the third is utilized as a bucking coil. With the function and primary coils adjacent each other on the E laminations, the voltage produced in the function coil is determined by spacing of a bar of permeable material in relation to the E laminations. Once a function is established in relation to this spacing, a piece of metal, varying in its distance from the E laminations in accordance with the desired function, may be rotated by means of a small motor.

Previously, function generators were either mechanical linkages which are subject to wear, or were in the form of potentiometers which also were subject to wear and required unwieldy changes of its taps to vary a function. The instant invention allows for a long life of the function generator while maintaining a high degree of flexibility for changing the function.

Accordingly, it is an object of this invention to provide a novel magnetic function generator.

It is another object of this invention to provide a magnetic function generator having only one moving part with a long life determined only by the life of a motor bearing.

It is still another object of this invention to provide a function generator which is facile of adjustment for various desired functions.

It is a further object of this invention to provide a function generator which has provision for cancelling out residual voltage generated in the function coil.

It is a still further object of this invention to provide a magnetic function generator which is easy and economical to produce and utilizes standard components which lend themselves to mass production manufacturing techniques.

Another object of this invention is to provide a function generator wherein a variable D.C. output is a function of the shape of a rotating iron ring.

These and other advantages, features and objects of the invention will become more apparent from the following description taken in connection with the illustrative embodiments in the accompanying drawings, wherein:

FIG. 1 is a schematic representation of the system for generating a function;

FIG. 2 is a side view of the E transformer with the means for varying the voltage of the function coil;

FIG. 3 is a pictorial view of the one side of the permeable ring; and

FIG. 4 is a sectional view illustrating the means for securing the ring of permeable material.

Referring to FIG. 1, 10 represents a three-legged or E-type transformer having laminations 12 with a coil

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wound on each of the three legs. As shown in FIG. 1, the top coil 14 is the function coil or output winding. The middle coil 16 is the primary coil which provides the input for the transformer, while the lowermost coil 18 functions as a bucking coil, as will be explained infra.

In order to provide a D.C. output, a diode D and filter capacitor C are utilized to rectify and filter the output from the E transformer. The primary coil 16 is connected to a suitable source of alternating current. The bucking coil 18 has one end connected with one side of the function coil 14 while its other end is connected to diode D. The filter capacitor C is connected with the output of diode D on one side and the remaining end of function coil 14 on the other.

When the primary coil is energized with alternating current, a voltage is produced in the function coil 14 and a permeable bar 20, for example of soft iron, depending upon its spacing in relation to the E laminations 12, is used to vary the voltage produced in the function coil. As the bar 20 is moved closer to the upper part of the E laminations the output voltage is increased in the function coil. The bucking coil 18, by being connected in series opposition, cancels out the residual voltage generated in the function coil with the maximum spacing of iron bar 20, thereby eliminating the need for a D.C. power supply to establish a zero level.

FIG. 2 shows a preferred means for producing variations in spacing between the iron bar 20 and the E lamination 12. Once a function to be generated is chosen, the spacings of the permeable material are correlated with the speed of a motor in order to produce the desired function.

The permeable material 20 is generally ring-shaped (FIG. 3) and has a channel formed on the rear side thereof by means of elements 22 (FIG. 4) within which the heads of bolts or machine screws 24 are slidable. The spacing between adjacent elements 22 allows for flexing of the ring 20. A lock nut (not shown) may be provided to bind the head of bolt 24 against the channel 22. The bolts 24 extend from the channel in ring 20 through holes formed in a hub 28 and are secured by means of nuts 30. Springs 32 bias ring 20 away from hub 28 with nuts 30 providing a stop. This arrangement allows for easy adjustment of the ring for various functions. It is, however, contemplated that an additional lock nut on the other side of hub 28 from that on which 30 is secured may be used to replace the spring elements or alternatively the holes in hub 28 could be internally threaded.

A motor 36, which may be of the synchro type, has a shaft in driving engagement with the hub 28. Thus, rotation of motor 36 by its rotation of ring 20 varies the spacing between it and the E laminations 12 in order to produce the desired function.

Although the invention has been described with reference to a particular embodiment, it will be understood to those skilled in the art that the invention is capable of a variety of alternative embodiments. For example, the bolts 24 could be brazed or otherwise secured permanently to the iron bar 20, provided the iron bar were very thin and capable of being stretched, or, alternatively, bolt 24 could be fixed to sections of ring 20 which would be somewhat wider than the spacing between adjacent sections. This would allow for an overlapping of the sections such that, when the bolts are attached for the desired distance from the E laminations, the separate sections may be formed to provide a relatively smooth contour. In addition, a number of rings could be ganged adjacent separate transformers to provide a number of functions simultaneously.

I intend to be limited only by the spirit and scope of the appended claims.

I claim:

1. A magnetic function generator comprising a transformer including an E-type core having a primary winding on the center leg, a function winding on one of the outer legs and a bucking winding on the other of said outer legs, said function winding and said bucking winding being connected in series opposition, permeable means overlying only said center leg and said outer leg with said function winding, and means for varying the distance of said permeable means above said center and said outer leg.

2. A magnetic function generator as defined in claim 1 wherein said last-mentioned means comprises a motor having its axis parallel with the axis of said windings and said permeable means comprises a ring mounted for rotation with said motor, said ring having variations in its distance from said transformer in accordance with the parameter of a function to be generated.

3. A magnetic function generator as defined in claim 2 including means for adjusting said variations for different functions.

4. A function generator comprising a three-legged transformer having coils on each of the three legs, an alternating current source connected with the center coil, the outer coils of said transformer being connected in electrical opposition, and permeable means rotatable relative to said transformer, said permeable means comprising a ring having a portion thereof overlying only said center leg and one of said outer legs of said transformer, said ring having convolutions in its axial direction in accordance with a function to be generated.

5. A function generator as defined in claim 4 wherein said convolutions of said ring are adjustable.

6. Means for producing a signal in response to the relative displacement between two objects, said means comprising an E-type transformer having coils wound on each of its legs, the outer two of said coils being connected in electrical opposition, the center coil being connected with a source of alternating current, permeable means having a portion overlying only said center coil and one of said outer coils of said transformer, and means for adjusting the shape of said permeable means such that rotation thereof varies the displacement between said permeable means and the coils which it overlies.

7. Means as defined in claim 6 wherein said permeable means is ring shaped and including a motor for rotating said permeable means, a hub on the shaft of said motor, adjustable means connecting said hub with said ring whereby portions of said ring are axially displaced with respect to said hub in accordance with a predetermined signal output.

8. Means as defined in claim 7 including a means for rectifying and filtering the output from said coils on said outer legs of said transformer.

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30 LLOYD McCOLLUM, *Primary Examiner*.