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ELECTROMAGNETIC DEVICES FOR CONVERTING A MOVEMENT OF AN ELECTRIC VALUE

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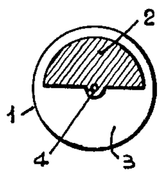

Fig. 1

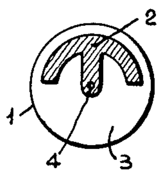

Fig. 2

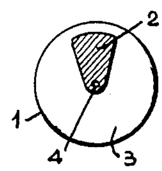

Fig. 3

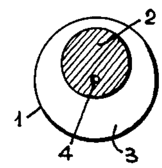

Fig. 4

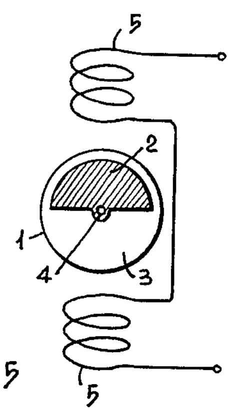

Fig. 5

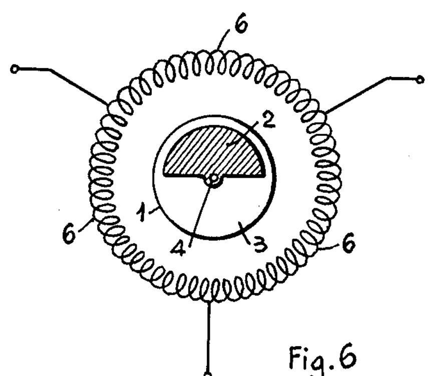

Fig. 6

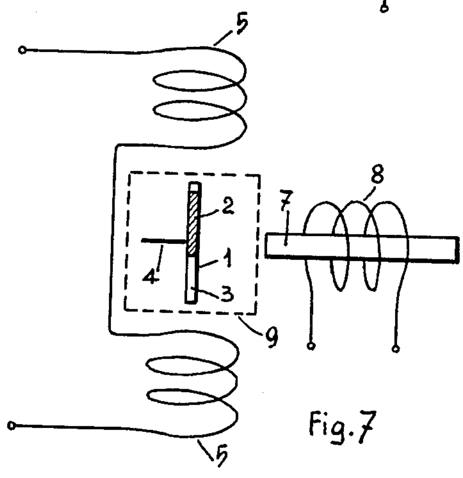

Fig. 7

3,045,227

ELECTROMAGNETIC DEVICES FOR CONVERTING A MOVEMENT OF AN ELECTRIC VALUE

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One of the most important functions of modern instruments is the immediate correction or control of the course of a variable function. To obtain prompt corrections and positive control, the changes occurring in the operation have to be made recoginzable by converting them into a value which may be easily measured, transmitted or modified. The present progress of electronic technology and the various possibilities this technology may offer, since very many operations which have to be controlled are generated, directly or indirectly, by the movement of a solid, a fluid, or gaseous bodies, has required development of and investigation of devices by means of which the task of converting this motion into an electrical value can be performed.

A considerable amount of phenomena is at present transformed into motion for practical reasons, and devices have been manufactured for this purpose and later improved by experience and world-wide use for their efficiency.

For example, temperatures are transformed into the movement of a mercury column or of a bimetal body; barometric pressures into the movement of flexible diaphragms; the magnetic phenomena into movement of magnetic needles; the time into the movement of clock hands, and so on, and the electrical signals for practical purposes are converted into the movement of an indicator needle or the like. The majority of these instruments execute their movement by utilizing the motion of a torsion couple. The action decreasing down to a minimum value at the points of equilibrium.

A principal object of the present invention is to determine with certainty various movement phenomena without substantially interfering with them by corresponding reaction phenomena.

The method and apparatus for converting a movement into an electrical value according to the present invention, is characterized in that in an alternating magnetic flux, suitably generated, there is placed, so as to be capable of moving in dependence of the movement to be converted into electrical value, an organ mechanically independent of the other portions of the group. The magnetic resistance of the organ is variable according to its position within the flux, and is characterized in that an electromagnetic receiving group, separated therefrom, is capable of being influenced by the variable flux derived from the said organ due to its movements. The method and apparatus for carrying out the invention is also characterized in that the variability in the magnetic resistance of the movable organ is produced in the alternating magnetic flux by the shape of the magnetic mass of this organ or a magnetic component connected to it or forming a part of it.

The device to realize the above method is characterized by an organ or rotor rotatable within a revolving magnetic flux or field generated in a suitable manner the rotor has different magnetic resistance values in its various directions or angular positions.

The above device is also characterized in that the organ rotatable within a revolving magnetic flux is of a laminated construction and comprises two parts, one of which is made of magnetic material and is irregular with respect to an axis perpendicular to the magnetic surface.

The device is still further characterized in that the design of the magnetic part constituting the movable organ or rotor is selected such that each position which said organ assumes, corresponds to a specific and well defined electrical value obtained by conversion.

The device is also characterized in that the rotor rotated within a magnetic flux rotates in the flux and is statically and dynamically balanced with respect to the rotation axis.

A feature of the device is that the magnetic flux, within which the movable organ or rotor moves is a unilaterally directed and linear alternating flux.

Another feature of the device is that the magnetic flux, within which the movable organ is displaced is an alternating rotary flux.

Another feature is that the electromagnetic unit or pick-off means develop a signal with variable value according to the positions assumed by the rotor and the pick-off means does not enclose the rotor but is arranged laterally to the latter in a perpendicular direction to the linear or rotary alternating flux, in which the rotor is displaced.

The device is likewise characterized in that the movable organ or rotor is enclosed in a casing, container or box of any shape. The said organ constitutes a unit by itself and independent of the mechanical construction of the magnetic circuit, and not necessarily attached to external mechanical elements.

The device in one of its embodiments is finally characterized in that the movable organ enclosed in a casing, container or box of its own, is immersed in a gas or liquid capable of attenuating the oscillations of the organ.

Some embodiments of the present invention will be shown diagrammatically and by only way of example in the annexed drawings.

FIGS. 1, 2, 3 and 4, elevation views of magnetic organs or rotors of laminar-type, discoidal in shape and comprising magnetic materials of different shapes;

FIG. 5 is a diagrammatic view of one of the organs or discoidal rotors of FIGS. 1–4 disposed in a single-phase electromagnetic flux;

FIG. 6 is a diagrammatic view of one of the organs or discoidal rotors illustrated as surrounded by a multi-phase electromagnetic flux according to the invention;

FIG. 7 is a diagram of the elements in FIG. 5 with the organ or magnetic discoidal rotor shown in section in conjunction with stationary pick-off means arranged laterally to the rotor.

Referring to the drawings and more particularly to FIG. 1 in which is illustrated a laminar-type organ or discoidal rotor **1** having a pole-piece of magnetic material **2**, suitably shaped according to a desired type of signal to be developed as hereafter described, and made of non-magnetic material **3** of sufficient thickness to statically and dynamically balance the pole-piece of magnetic material which is not a regular and symmetrical shape with respect to the axis **4** of rotation about which rotor **1** rotates. The function of this axis is primarily to mechanically support the rotor. It is not necessary for this axis to be connected to other instruments, for the motion may be transmitted to the discoidal rotor **1** through a magnetic field, fluid, thermal and similar forces. Thus the rotor **1** is rotated through 360 in response to a physical phenomenon and driven variably in response to variations of the physical phenomenon. Perpendicular to the rotation axis **4**, and thus perpendicular to the rotating circular surface of element **1**, there is induced, through a stator electrical single-phase winding **5** comprising a pair of stator coils disposed angularly spaced radially of the rotor **1** or through a three-phase winding **6** or multi-phase windings of a stator a unilaterally directed linear or rotary magnetic flux which strikes the magnetic portion **2** of the rotor **1**, and is thus guided and conveyed towards stationary pick-off means comprising central elongated core **7** of magnetic permeable material, about which is wound an electrical conductor or secondary winding **8**. The axis of the pick-off means is arranged on the ideal projection of the rotation axis **4** of discoidal rotor **1**, with suitable separation or air gap therebetween and without any mechanical connection with the rotor **1**. A casing, container or box **9** illustrated diagrammatically by broken lines containing a gas or liquid houses the rotor and damps its rotary movement and oscillations.

The arrangement above described comprises an improved transducer which operates as follows: Alternating current is applied to the electrical windings **5**, **6** to induce a unilaterally directed linear or rotary or revolving magnetic flux field which impinges on the magnetic portion or sector pole-piece **2** of the rotor **1** which, according to its angular position with respect to the magnetic portion or sector pole-piece sends out towards the stationary pick-off means, a variable or modulated magnetic flux which is picked up by the conductor **8** of the pick-off means and converted into a sinusoidal signal which is an amplitude or phase or frequency modulated electric signal. The amplitude of the electric signals is determined by the shape of the magnetic portion **2** of rotor **1** according to its position, and the modulation of the electric signals is dependent on the angle formed by discoidal element or rotor **1** on the plane orthogonal to the rotation axis **4**.

It is to be understood that the winding of the stator or the secondary winding may be energized with alternating current alternatively to induce in the other of the windings on a deenergized condition a sinusoidal signal having a phase angle representative of the variations of the physical phenomenon.

The present invention has been shown with respect to several embodiments. Many modifications and variations may be made in embodying the invention, for example either the shape and profile of the magnetic portion of the rotor or the pick-off means may be changed.

What I claim is:

1. A transducer comprising, a rotor rotatably driven in operation about an axis through 360° in response to a physical phenomenon and driven variably in response to variations of the physical phenomenon, a stator having at least a pair of electrically connected angular spaced coils disposed radially of said rotor forming a primary winding having an axis normal to said rotor axis and energizable in operation for producing a revolving flux field in which said rotor revolves, stationary pick-off means spaced from said rotor for developing a sinusoidal signal comprising a secondary winding disposed perpendicular to the axis of said primary winding in which said sinusoidal signal is developed and having a

permeable elongated core disposed coaxial with the rotor and axially spaced therefrom, said rotor having means for modulating the flux lines in said revolving field and inducing said sinusoidal signal in said secondary winding through said permeable core comprising a magnetic sector pole piece disposed for rotation coaxially with said secondary winding and said core and having a configuration assymetrical with the axis of said secondary winding for applying modulated flux to said permeable core thereby to induce in said secondary winding said sinusoidal signal at a constant amplitude.

2. A transducer comprising, a rotor rotatably driven in operation about an axis through 360° in response to a physical phenomenon and driven variably in response to variations of the physical phenomenon, a stator having at least a pair of electrically connected angularly spaced coils disposed radially of said rotor forming a first winding having an axis normal to said rotor axis, stationary pick-off means spaced from said rotor for developing a sinusoidal signal comprising a second winding disposed perpendicular to the axis of said first winding, and having a permeable elongated core disposed coaxial with the rotor and axially spaced therefrom, said rotor having a magnetic sector pole piece disposed for rotation coaxially with said second winding and said core and having a configuration assymetrical with the axis of said second winding and said permeable core, and connections on said first winding and connections on said second winding for alternatively energizing either of said windings with alternating current thereby to induce in the other of said windings in a de-energized condition a sinusoidal signal having a phase angle representative of the variations of said physical phenomenon.

References Cited in the file of this patent

UNITED STATES PATENTS

1,128,088	Kramer et al.	Feb. 9, 1915
1,171,480	Troll	Feb. 15, 1916
1,743,853	Harrison	Jan. 14, 1930
2,052,382	Dallmann	Aug. 25, 1936
2,185,767	Jefferies	Jan. 2, 1940
2,365,430	Navl	Dec. 19, 1944
2,452,862	Neff	Nov. 2, 1948
2,484,022	Esval	Oct. 11, 1949
2,486,641	Gilbert	Nov. 1, 1949
2,494,493	Schaevitz	Jan. 10, 1950
2,536,805	Hansen	Jan. 2, 1951
2,564,018	Malmqvist	Aug. 14, 1951
2,621,314	Wendt	Dec. 9, 1952
2,692,357	Nilson	Oct. 19, 1954
2,774,057	Jones	Dec. 11, 1956

FOREIGN PATENTS

888,663	Germany	Sept. 3, 1953
879,311	France	Feb. 19, 1943