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POLARIZED ELECTROMAGNETIC OPERATOR
WITH DAMPED COIL ARMATUREJoseph Lukacs, Astoria, N. Y., assignor, by mesne
assignments, to Technicon Cardiograph Corpo-
ration, New York, N. Y.Original application December 4, 1946, Serial No.
714,084. Divided and this application January
14, 1947, Serial No. 721,971

5 Claims. (Cl. 175—339)

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This invention relates to a magneto-motive device intended primarily for actuating the pen or stylus of a direct-writing cardiograph.

The primary object of the invention is to provide a magneto-motive device which is highly efficient and well adapted to actuate a pen or stylus of a direct-writing electrocardiograph.

Another object is to provide a magneto-motive device which includes movable means, including a movable coil, for actuating the stylus or pen, and which is provided with means to flatten the response of said movable means for correction of amplitude variations thereof as mechanical resonance is approached.

The above and other objects of the invention will be fully understood from the following description in connection with the accompanying drawings which are to be considered as illustrative of the invention but not in limitation thereof.

In the drawings:

Fig. 1 is a perspective view of a magneto-motive device embodying the present invention;

Fig. 2 is a sectional view thereof on the line 2—2 of Fig. 1;

Fig. 3 is a perspective view of the movable coil;

Fig. 4 is a perspective view of the diaphragm on which the coil bobbin is mounted and which is connected to the pen-operating rod.

Referring now to the drawings in detail, the magneto-motive device embodying the present invention comprises a magnet structure having a permanent annular magnet 10, the end plates 12 and 14, and the center-pole core 16, forming a magnetic circuit. As here shown, the magnet 10 and the plates 12 and 14 are held together, mechanically and in magnetic-circuit relation, by a plurality of circumferentially spaced screws 18 of brass or other non-magnetic metal. The center-pole core 16 is secured in plate 12 preferably by a press fitting in the opening 20 of said plate. Said core 16 is of circular cross section and has an end part 22 which together with the central circular part 24 forms an annular axially-extending air gap in which the coil 26 is movable.

The center-pole core 16 is of circular cross section and has an axially-extending conical portion 28 between the end cylindrical part 22 and the opposite end cylindrical portion 30 which is secured to plate 12, said portion 28 tapering toward said part 22. The air gap-defining part 22 of core 16 has an axial recess 32 which is conical or tapers inwardly, thereby providing the core

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part 22 with an annular wall which is of decreasing radial thickness in a direction extending axially of the core toward the outer end of plate 14. Also, as shown plate 14 is of varying axial thickness, the thickness of said plate increasing to a maximum in the central or gap-defining part 24 thereof. By virtue of this construction of core 16 and of plate 14, magnetic leakage, which would otherwise occur, is greatly reduced, and the magnetic flux is caused to pass across the air gap between parts 22 and 24 along substantially parallel lines radially of the central longitudinal axis of the magnet. Further it will be observed that the plate 12 is provided with a chamfered outer edge 34 which aids in reducing magnetic leakage. Preferably the magnet 10 is formed of Alnico, and the plates 12 and 14 and the core 16 are preferably formed of hot rolled ingot iron or SAE 10-10 annealed steel.

The winding of the movable coil 26 is carried by a bobbin 36 which is strong and of light weight. Said bobbin 36 is preferably formed by molding the same of nylon, but can be formed of "bakelite" or of any other suitable material. As shown, said bobbin is provided with a flange 38 by which it is secured to the central ring 40 of the flexible diaphragm 42. The outer ring 44 of said diaphragm is clamped between a spacer ring 46 and a retaining ring 48. As here shown, a plurality of screws 50 are utilized for securing diaphragm 42 between rings 46 and 48 and for securing the assembly of said rings and diaphragms and the coil which is carried by said diaphragm to plate 14. Rings 46 and 48 are formed of aluminum or other non-magnetic material. Diaphragm 42 is formed of thin flexible sheet metal such as bronze, and has a plurality of webs 52 which extend between the outer clamped ring 44 and the inner ring 40 to which the bobbin is secured. Thus, said diaphragm is secured in fixed relation to the magnet structure and is mounted for vibratory movement normal to the plane of the diaphragm and axially of the air gap of the magnet. A cap 54 of bronze or other suitable material is secured to the inner ring 40 of diaphragm 42, and a rod 56 is connected to said cap at the center point thereof so as to project axially of the winding of the coil 26. Rod 56 may be connected in any suitable way for example, as shown in my application Ser. No. 714,084, filed December 4, 1946, to a pen or stylus for actuating the latter to record the oscillations of coil 26 on a paper web, for example, the paper web or chart of a direct writing electrocardiograph, thus the cap 54 and the rod 56 together constitute the actuat-

ing or operating mechanism for the stylus. It will be understood that the coil 26 is connected to the output circuit of an amplifier of small voltages, such as those involved for example in the operation of an electrocardiograph.

The device of the present invention is provided with means for flattening the response of the movable unit of the device for correction of amplitude variations thereof as mechanical resonance of said movable unit or assembly is approached. For this purpose an endless metal ring 58, preferably of copper, is mounted on bobbin 36 in position centrally of the coil winding in insulated relation thereto. Said ring 58 provides short-circuited current-conductive means for damping vibrations or oscillations of the movable coil unit for providing correction for the natural change in amplitude of oscillations of the movable coil unit as mechanical resonance is approached, thus flattening the response and preventing over excursion of the pen or stylus in the operation of the latter for forming the trace on the paper web.

This application is a division of my application for Electrical Recording Instruments for Electrocardiographs, filed on or about December 4, 1946, Ser. No. 714,084.

It will be understood that various changes in the details of construction and in the arrangement of parts may be made without departing from the underlying idea or principles of this invention within the scope of the appended claims.

Having thus described my invention, what I claim and desire to secure by Letters Patent is:

1. In combination with a magnetic circuit comprising an annular magnet, an annular magnetic member coaxially disposed at one end of said magnet in magnetic-circuit relation therewith, and a center-pole core for said magnet coaxially disposed within said magnet and said member, said core being provided with an annular wall of decreasing radial thickness in a direction extending axially of said core, said wall being spaced from said member to define an air gap across which magnetic leakage is substantially reduced; a flexible diaphragm, a coil disposed for rectilinear oscillatory movement within said gap for driving said diaphragm, coil mounting means carried at one side of said diaphragm and actuating means carried at the other side of said diaphragm and driven thereby in response to said movement of the coil, said diaphragm constituting the sole support for said coil and said actuating means, said coil being provided with a short-circuit current conductive means mounted thereon for bodily movement thereby and electrically insulated from said coil, said means being free of engagement with said diaphragm and being disposed in coaxial relation about said annular wall whereby it is disposed within an area of maximum flux linkage for damping the movement of said coil as mechanical resonance thereof is approached.

2. In combination with a magnetic circuit comprising an annular magnet, an annular magnetic member coaxially disposed at one end of said magnet in magnetic-circuit relation therewith, said member varying in axial thickness from a minimum at its perimeter to a maximum in the central part thereof, and a center-pole core for said magnet coaxially disposed within said magnet and said member, said core being provided with an annular wall of decreasing radial thickness in a direction extending axially of said core, said wall being spaced from the central part of said

member to define an air gap across which magnetic leakage is substantially reduced; a flexible diaphragm, a coil disposed for rectilinear oscillatory movement within said gap for driving said diaphragm, coil mounting means carried at one side of said diaphragm and actuating means carried at the other side of said diaphragm and driven thereby in response to said movement of the coil, said diaphragm constituting the sole support for said coil and said actuating means, said coil being provided with a short-circuit current conductive means mounted between adjacent windings thereof for bodily movement thereby and electrically insulated from said coil, said means being free of engagement with said diaphragm and being in coaxial disposition between said annular wall and the central part of said member whereby it is disposed within an area of maximum flux linkage for damping the movement of said coil as mechanical resonance thereof is approached.

3. In combination with a magnetic circuit comprising an annular magnet, an annular magnetic member coaxially disposed at one end of said magnet in magnetic-circuit relation therewith, and a center-pole core for said magnet coaxially disposed within said magnet and said member, said core being provided with an annular wall of decreasing radial thickness in a direction extending axially of said core, said wall being spaced from said member to define an air gap across which magnetic leakage is substantially reduced; a flexible diaphragm, a coil disposed for rectilinear oscillatory movement within said gap for driving said diaphragm, coil mounting means carried at one side of said diaphragm and actuating means carried at the other side of said diaphragm and driven thereby in response to said movement of the coil, said diaphragm constituting the sole support for said coil and said actuating means, said coil being provided with a short-circuit current conductive means carried between adjacent windings thereof and electrically insulated from said coil, said means being free of engagement with said diaphragm and being disposed in coaxial relation about said annular wall whereby it is disposed within an area of maximum flux linkage for damping the movement of said coil as mechanical resonance thereof is approached, said flexible diaphragm being mounted in fixed relation to said magnet.

4. In combination with a magnetic circuit comprising an annular magnet, an annular magnetic member coaxially disposed at one end of said magnet in magnetic-circuit relation therewith, said member varying in axial thickness from a minimum at its perimeter to a maximum in the central part thereof, and a center-pole core for said magnet coaxially disposed within said magnet and said member, said core being provided with an annular wall of decreasing radial thickness in a direction extending axially of said core, said wall being spaced from the central part of said member to define an air gap across which magnetic leakage is substantially reduced; a non-conductive member mounted for rectilinear movement in said gap, a flexible diaphragm having one side thereof in engagement with said member, a coil carried by said non-conductive member for effecting said rectilinear movement thereof to drive said diaphragm, actuating means carried at the other side of said diaphragm and driven thereby in response to said movement of the non-conductive member, said diaphragm constituting the sole support for said non-con-

ductive member and said actuating means, and a short-circuit current-conductive means carried by said non-conductive member for bodily movement therewith in said gap for damping the oscillations of said diaphragm, said means being electrically insulated from said coil and being in coaxial disposition between said annular wall and the central part of said magnetic member whereby it is disposed within an area of maximum flux linkage for damping the movement of said coil as mechanical resonance thereof is approached, said flexible diaphragm being mounted in fixed relation to said magnet.

5. A magneto-motive device comprising an annular magnet, end plates and a center-pole core forming a magnetic circuit having an annular air gap, a flexible diaphragm mounted in fixed relation to said magnet for vibratory movement normal to the plane of the diaphragm and axially of said magnet, a coil carried at one side of said diaphragm for vibrating the latter, said coil being mounted for rectilinear oscillatory movement in said gap, and actuating means carried at the other side of said diaphragm and driven thereby in response to said movement of the coil, said diaphragm constituting the sole support for said coil and said actuating means short-circuited current-conductive means carried by said coil for bodily movement thereby in said gap for damping the vibrations of said diaphragm and coil assembly as mechanical resonance thereof is approached, said short-circuited means being elec-

trically insulated from said coil and free of engagement with said diaphragm, said core having a wall portion spaced from one of said end plates for defining said air gap therewith, said wall portion being of decreasing radial thickness in a direction extending axially of said core for substantially reducing magnetic leakage across said gap whereby said short-circuited current conductive means is disposed within a maximum flux linkage area of said device for providing optimum damping of said vibrations as said mechanical resonance is approached.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
149,797	Siemens	Apr. 14, 1874
1,734,944	Green	Nov. 5, 1929
1,763,846	Fay	June 17, 1930
1,828,284	Hanna	Oct. 20, 1931
1,868,607	Kolster	July 26, 1932
1,906,066	Holst et al.	Apr. 25, 1933
1,921,924	Hunter	Aug. 8, 1933
1,934,099	Sollie	Nov. 7, 1933
2,064,621	McNairy	Dec. 15, 1936
2,164,374	Barker	July 4, 1939
2,252,846	Giannini et al.	Aug. 19, 1941
2,318,308	Harris	May 4, 1943