No. 641,538. Patented Jan. 16, 1900.

F. DE B. PAVON.

ELECTROMAGNETIC APPARATUS.

(Application filed Nov. 4, 1899.)

(No Model.)

FIG. 1.

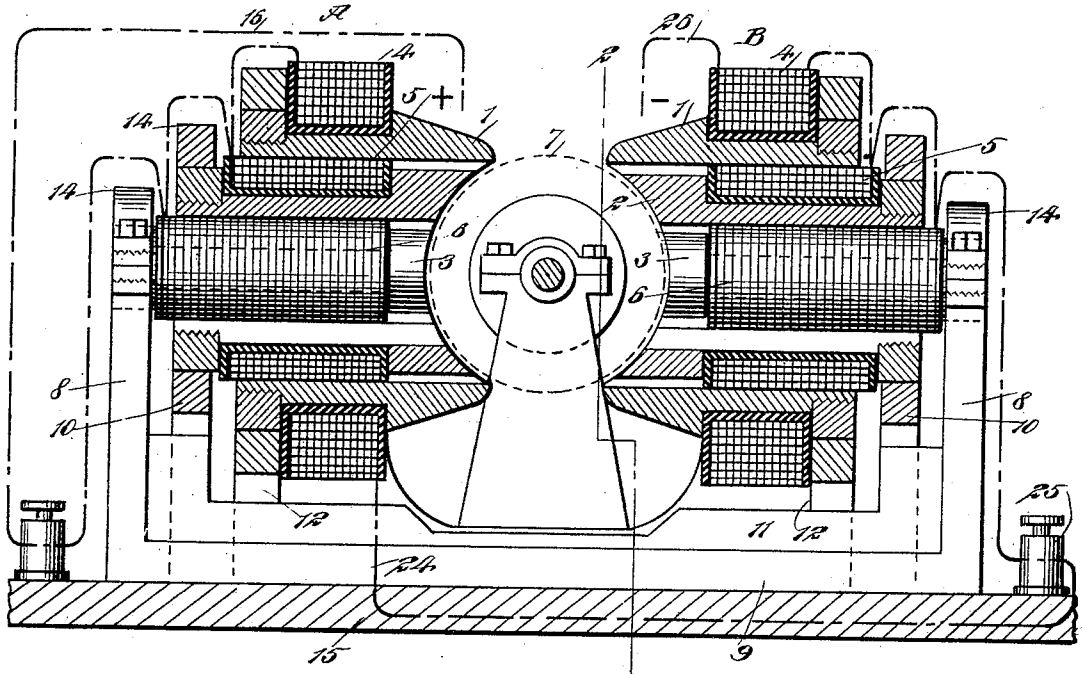


FIG. 2.

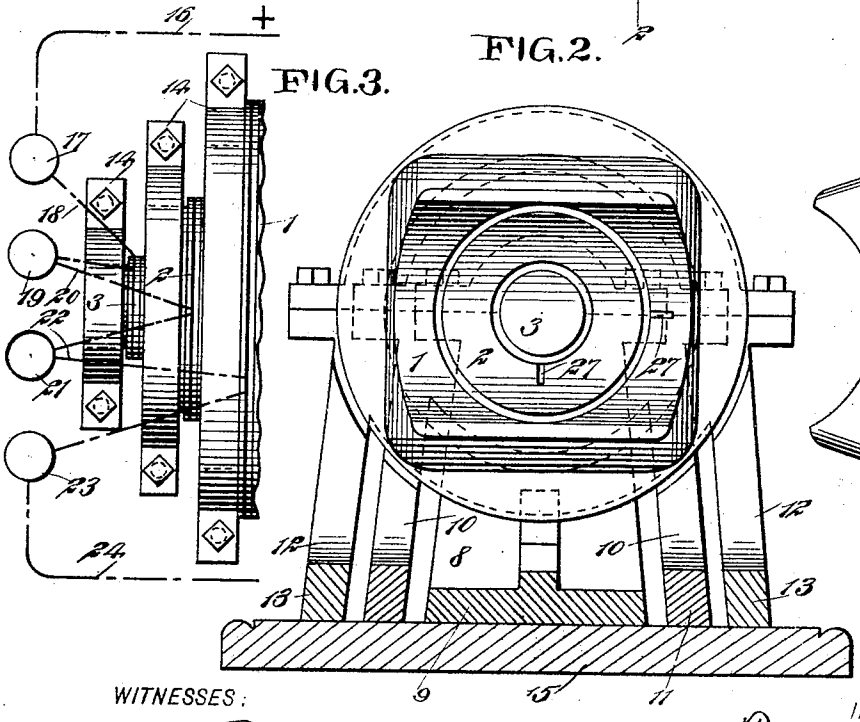
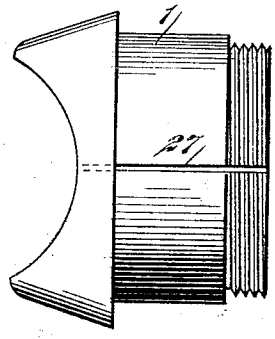


FIG. 3.

FIG. 4.



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ELECTROMAGNETIC APPARATUS.

SPECIFICATION forming part of Letters Patent No. 641,538, dated January 16, 1900.

Application filed November 4, 1899. Serial No. 735,775. (No model.)

To all whom it may concern:

Be it known that I, FRANCISCO DE BORJA PAVON, a subject of the King of Spain, and a resident of Caibarien, Island of Cuba, have invented a new and Improved Electromagnetic Apparatus, of which the following is a full, clear, and exact description.

This invention relates to improvements in electric dynamos or motors and other apparatus in which a field or electromagnet is employed; and the object is to so construct the field that the lines of magnetic force will be concentrated, thus resulting in a greater force and economy of current.

I will describe a dynamo or motor as illustrated in the drawings and embodying my invention and then point out the novel features in the appended claims.

Reference is to be had to the accompanying drawings, forming a part of this specification, in which similar characters of reference indicate corresponding parts in all the figures.

Figure 1 is a sectional elevation of the multitubular and concentric electromagnetic apparatus embodying my invention and which with their uprights and bases must be made of soft or cast iron or other magnetic metal. Fig. 2 is a section on the line 2 2 of Fig. 1. Fig. 3 is a plan view of a portion of the device, showing the system of connection of the bobbins of each of the cores with the object of facilitating the partial taking apart of each core to make repairs or for other purposes. Fig. 4 represents the polar end of one of the outer cores with the bobbin omitted.

The invention comprises in each of its polar ends a number of tubular electromagnets introduced one within another with their respective magnetizing-bobbins and so arranged that these cores together constitute the ends of the circuit for the formation of the magnetic field, being arranged or placed in such a way that although introduced into each other they have no contact one with another and their magnetism being excited by a single current circulating through the several bobbins.

Referring particularly to the drawings, A B indicate the two opposite fields. Each field or polar end consists of a tubular core 1, within which is arranged a tubular core 2, and within this tubular core 2 is a cylindrical core 3. The tubular core 1 is surrounded by a bobbin of inductive wire 4, the core 2 by another bobbin of inductive wire 5, and the core 3 by another bobbin of inductive wire 6. The bobbins are so arranged as to prevent the contact of the walls of the tubular cores one with another. The polar inner ends of the several cores, between which is situated the magnetic field, are properly shaped to the armature 7; but as the system of tubular electromagnets is applicable to all kinds of dynamos and motors they will be properly shaped whether the armature be cylindrical or of other form. Each core at its end opposite to the magnetic field is supported by upright and independent bases, forming complete magnetic circuits. As here shown, the cores 3 are supported by uprights 8, connected and forming a whole with the base-frame 9. The opposite cores 2 are supported by uprights 10, which, together with the base-frame 11, form a whole, and the opposite cores 1 are supported by uprights 12, connected with the base-frame 13. Thus the uprights and base-frames, with the cores they support, form each a horseshoe or magnetic circuit. The upper portions of the uprights are made in the form of yokes 14, connected by means of screws or otherwise to the lower portion and strongly and rigidly hold the cores, favoring or helping the contact and the magnetic communication through all the circuits or horseshoes. By this construction the sections of the polar inductors may be easily removed for repairs or other purposes.

The winding of the wire forming the bobbins of the several cores can be made continuous, because the current for all the windings is the same. In Fig. 3, however, I have illustrated each winding having its two ends connected to binding-posts on the base 15. This is merely for the purpose of easily separating the several parts; but obviously it is in practice a continuous wire. Referring to this figure, a leading-in wire 16 is shown as connected to a binding-post 17, from which one end of the wire 18 for the bobbin 6 extends, while the other end of said wire connects with a binding-post 19, from which one end of the wire 20 of the bobbin 5 extends. The other

end of said wire 20 is connected to a binding-post 21, having connection with one end of the wire 22 of the outer winding-core 4, while the other end of this wire 22 connects with a binding-post 23, from which a wire 24 leads to a binding-post 25 on the opposite end of the base, and from this binding-post 25 the wiring is carried out through the system of windings of the negative polar end in the same way as described before for the positive polar end terminating in the leading-out wire 26.

To facilitate the interior magnetization of the tubular cores each one is provided through its wall with a longitudinal slot 27, parallel to the axis of the core, and each slot cuts through the thickness of the core-wall. The magnetism therefore will not only pass over the outer surfaces of the tubular cores, but will pass to the interior surface thereof, spreading like a magnetic atmosphere.

In the construction described the several electromagnets are excited by the same current; but each one in itself constitutes, with its uprights and bases, a system and magnetic circuit independent one of another, although from the fact of the polar tubular ends being introduced into each other they aggregate their effect or action to concentrate the magnetic force toward the central core in the space comprised between the opposite polar ends, thus producing an increase of the magnetic field as a result of the mutual action of the electromagnets, which by the manner of being introduced into each other are strengthened and excited mutually, concentrating their magnetic power or force toward the central core.

In the drawings a bipolar machine is shown of a single circuit; but it is my purpose to apply the principle just as well to multipolar machines with a double circuit and with tubular cores of circular elliptical square section or other form and for all kinds of armatures—cylindrical, disk-like, ring, or spherical.

Having thus described my invention, I claim as new and desire to secure by Letters Patent—

1. A compound electromagnet consisting of a series of electromagnets arranged one within another and each supported independently.

2. The combination of a series of supports arranged one in advance of another, with a series of electromagnets arranged one within another and projecting stepwise beyond one another at one end, the projecting ends being secured to said supports.

3. In an electric apparatus, a field comprising a series of independently-supported electromagnets one arranged within another, the windings of the several magnets being connected in series, substantially as specified.

4. In an electric dynamo or motor, a field comprising tubular cores arranged one within another and a cylindrical core arranged in the inner tubular core, the cores being independently supported and out of contact one with another, and windings on the several cores, the several windings being connected, substantially as specified.

5. A field for an electric apparatus, comprising a series of magnets arranged one within another and independently supported, the windings of the several magnets being connected in series, whereby the current will successively pass through the windings, and from one field to another, substantially as specified.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

FRANCISCO DE BORJA PAVON.

Witnesses:
JNO. M. RITTER,
C. R. FERGUSON.