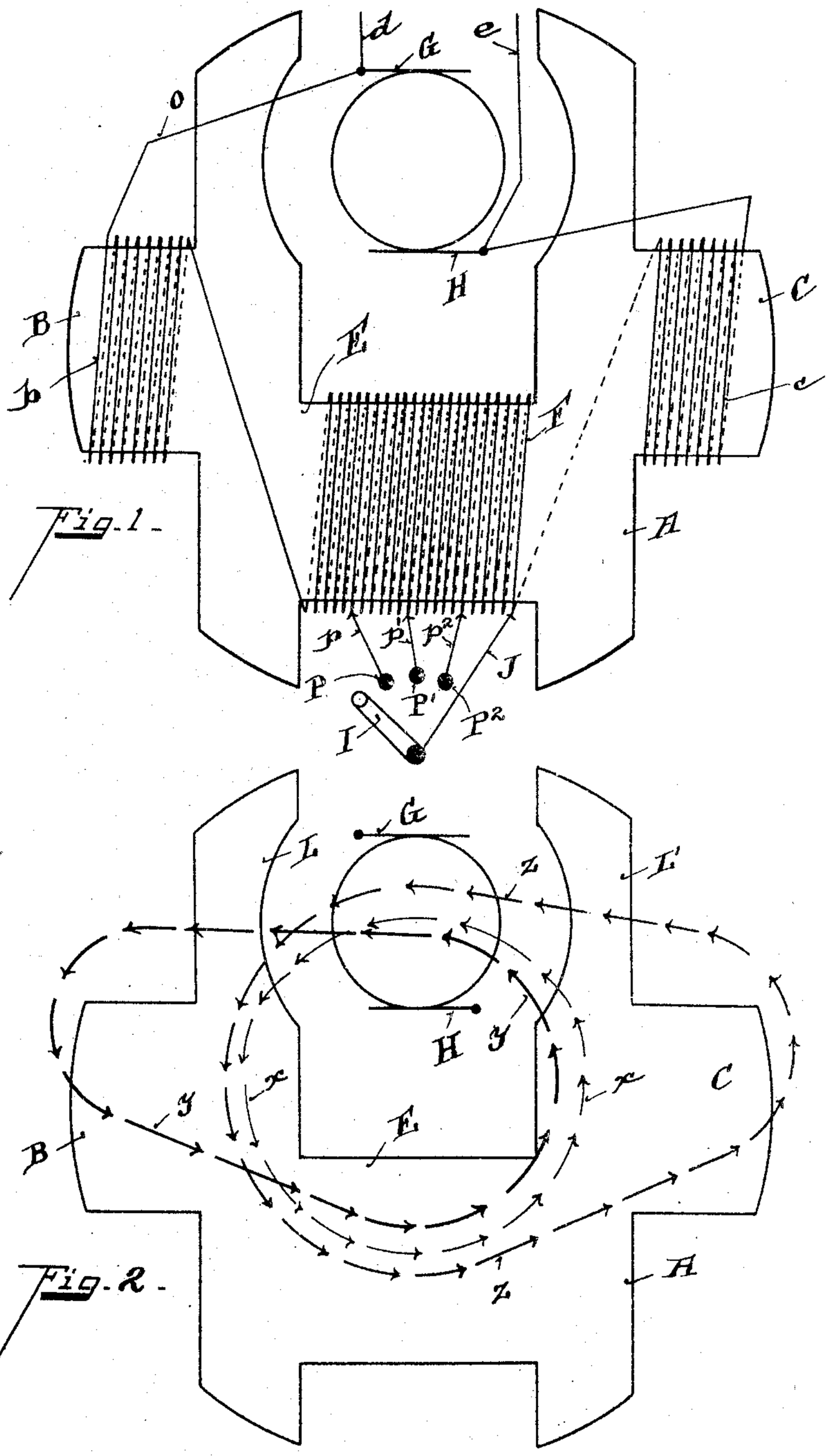
No. 814,740. PATENTED MAR. 13, 1906.

J. A. SMITH.

ELECTRIC MOTOR.

APPLICATION FILED NOV. 28, 1904.

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# UNITED STATES PATENT OFFICE.

JOHN A. SMITH, OF DAYTON, KENTUCKY, ASSIGNOR TO UNITED STATES ELECTRIC TOOL COMPANY, OF CINCINNATI, OHIO, A CORPORATION.

## ELECTRIC MOTOR.

No. 814,740. Specification of Letters Patent. Patented March 13, 1906.

Application filed November 28, 1904. Serial No. 234,454.

*To all whom it may concern:*

Be it known that I, JOHN A. SMITH, a citizen of the United States, residing at Dayton, in the county of Campbell and State of Kentucky, have invented certain new and useful Improvements in Electric Motors, of which the following is a specification.

The object of my invention is to provide means for varying the speed of the armature of a shunt-wound motor of constant potential by simply varying the active length of the exciting-coil.

In carrying out this invention I employ a core-blank of a shape permitting of the winding of the exciting-coil in several sections, so disposed relative to one another and to the armature as to form a plurality of magnetic circuits of different permeability, whereby when the active length of one of the sections of the coil is varied the shifting of the magnetic density in the exiting-field of varying permeability will change the speed of the armature irrespective of the load within the limits of the motor.

The features of the invention are more fully set forth in the description of the accompanying drawings, forming a part of this specification, in which—

Figure 1 is a diagrammatic view of my motor. Fig. 2 is a diagram of the core with the exciting-coil removed, indicating in dotted lines the magnetic circuits.

A represents the core, which is preferably constructed of laminated blanks of the shape shown, although the shape is not of the essence of the invention.

*d* represents one of the line-wires connected with one of the armature-brushes G. From brush G the wire *o* of the entire energizing-coil runs to and is wound around the side extension B, forming the coil-section *b*, thence the wire runs to and is wound around the base E, forming the main coil-section F, thence the wire runs to and is wound around the opposite side extension C, forming the coil-section *c*, thence the wire is connected to the other brush H of the armature, which brush connects with the other line-wire *e*. This is the ordinary shunt-winding. The coil-section F has three shunt-wires $p$ $p'$ $p^2$ successively leading therefrom and having their respective contact-posts P P′ P² suitably disposed on the casing of the motor.

I represents the switch-bar, adapted to make successive contacts with said posts for varying the active length of the coil-section F.

J represents a wire connecting switch-bar I with the wire J′, which latter wire connects the rear end of the coil-section F with the initial end of coil-section *c*. As shown in Fig. 1, the entire exciting-coil is in circuit.

In Fig. 2, $x\,x$ represent the magnetic circuit through all of the cores and the armature, thereby making a substantially complete metallic circuit of high permeability. The dotted lines $y\,y$ represent a second magnetic circuit formed through the cores B E and through the armature. It will be noted that this circuit has to bridge the air-gap formed between the outer end of the core B and the outside edge of the limb L. The lines $z\,z$ represent a similar counterbalancing magnetic circuit formed through the cores E C and the armature and including the air-gap formed between the pole C and the other limb L′ of the core-blank. It is obvious that these magnetic circuits $y\,y$ and $z\,z$ are of considerable less permeability than the circuit $x\,x$. These three magnetic circuits of at least two permeabilities are energized by a single shunt-wound coil disposed in three sections, and it is obvious that by varying the active length of the main section of the coil the magnetic density of the entire influencing field is correspondingly altered, which affects variations in the armature speed irrespective of the load, but of course within the given capacity of a particular motor.

In practice I provide a shunt-field divided into two sets. One-half of the wire is wound in coil F upon the field-core E and one-fourth in coil *b* and one-fourth on coil *c* on the extensions B C, respectively. This forms a plurality of magnetic circuits with one set shunt-winding.

The one magnetic circuit is complete entirely through the iron except the small air-gap left to permit the armature to revolve. The second and third magnetic circuits are completed partly through the air. The ends of the field cores or extensions are not provided with a yoke of iron to complete the magnetic circuit. The effect of this arrangement is such that if the electrical resistance of the entire circuit is varied or the electromotive force varied the number of turns of wire

remain the same. Then the influence exerted by coil F is very much greater than that of the other two coils, owing to the greater permeability which the circuit through iron has over the magnetic circuits through the air.

I find in practice that by varying the number of turns in coil-section F about fifteen per cent. I can change the speed of the armature fifty per cent. Thus I provide a simple and practical means of obtaining a great variation in speed without causing the motor to spark at the brushes.

The power of the armature is substantially the same at the different speeds. In such a motor portions of the proportion of the field F are cut out by the first and successive step movements of the switch-bar.

Thus it will be seen that varying the relative number of turns of wire of the exciting shunt-wound coil disposed to produce two or more magnetic circuits, one of which is of large and the other of small permeability, produces an effect similar to that produced by greatly varying the exciting-current in a simple field without the tendency to cause the sparking of the brushes and makes it possible to obtain predetermined armature-speed variations with the simplest form of a controlling device.

Having described my invention, I claim—

1. A shunt-wound motor having a plurality of fields of different permeability, and means for varying the active length of the exciting-coil, substantially as described.

2. A shunt-wound motor, having the exciting-coil disposed in plurality of sections, forming a plurality of magnetic circuits of different permeability, and means for varying the active length of the exciting-coil, substantially as described.

3. A shunt-wound motor, having the exciting-coil wound in sections upon different cores disposed to create two or more magnetic circuits, and means for varying the active length of one of said coil-sections, substantially as described.

4. A shunt-wound motor, having the exciting-coil wound in sections upon cores disposed to create two or more magnetic circuits, of different permeability, and means for varying the active length of one of said sections, substantially as described.

5. A shunt-wound motor, having the exciting-coil wound in one or more sections disposed on cores to form one substantially complete metallic magnetic circuit, and a second magnetic circuit, having an air-gap for lowering the permeability of the second relative to the first circuit, and means for varying the active length of the exciting-coil, substantially as described.

6. In a shunt-wound motor, an exciting-coil wound in three sections disposed around the armature to form one substantially complete metallic magnetic circuit, the core of one or more of said sections being exposed outside of the line of said metallic circuit, forming an additional circuit or circuits of lower permeability, and means for varying the active length of one of said sections, substantially as described.

7. In a shunt-wound motor, an exciting-coil wound in sections upon three different cores, said coil-sections disposed around one side of the armature to form one substantially complete metallic magnetic circuit, the cores of two of said sections being exteriorly presented upon opposite sides of the armature, and outside of the first-named circuit to form two balanced magnetic circuits of lower permeability than the first-named circuit, and means for varying the active length of the wire in the intermediate section, substantially as described.

8. In a shunt-wound motor, an exciting-coil wound in sections upon three different cores disposed around one side of the armature, the axis of the intermediate core being disposed substantially parallel with the axes of the outside cores, whereby a substantially complete metallic circuit is formed and two balanced magnetic circuits of lower permeability, and means for varying the active length of the intermediate coil-section, substantially as described.

9. In a shunt-wound motor, an exciting-coil wound upon two or more cores disposed in planes substantially parallel, and means for varying the active length of the coil on one of said cores, substantially as described.

10. In a shunt-wound motor, an exciting-coil wound upon different cores, one of which cores is disposed to form a substantially complete metallic magnetic circuit through the armature, and one of the cores being disposed to present a pole outside of the first-named circuit to form a second magnetic circuit, having an air-gap between the armature and said outside pole, and means for varying the active length of the coil, substantially as described.

11. In a shunt-wound motor, an exciting-coil wound upon three different cores, disposed around the armature, one of said cores being substantially concentric and the other two substantially radial relative to the armature forming three magnetic circuits, one of which is a substantially complete metallic circuit through the armature, and the other two of which are substantially balanced circuits, each having an air-gap between its outside pole and the armature, and means for varving the active length of the coil, substantially as described.

12. In a shunt-wound motor, a metallic blank, having two limbs between it upon which the armature revolves, an exciting-coil having a section wound upon said blank to form a substantially complete metallic circuit through said blank and armature, said

coil having one or more additional sections wound upon said blank to form one or more magnetic circuits, each having an air-gap between its pole and armature, forming through the said blank and armature two or more magnetic circuits of substantially different permeability, and means for varying the active length of the coil-section creating the complete metallic circuit, substantially as described.

13. A field-core having two parallel limbs united by a transverse base-piece, the inner opposite faces of said parallel limbs being hollowed out to receive the armature, the parallel limbs having field extensions projected outwardly substantially at right angles to said limbs respectively at points opposite the armature, a shunt-wound coil upon said lateral extensions and the said base-piece, and means for varying the active length of said exciting-coil, substantially as described.

14. A field-core having two parallel limbs united by a transverse base-piece, the inner opposite faces of said limbs being hollowed out to receive the armature, the said limbs having field extensions on their outer sides projected substantially at right angles to said limbs opposite the armature, the coil being wound in shunt-circuit on said base-piece and said side extensions, and means for varying the active length of the section of the coil disposed on said base-piece, substantially as described.

In testimony whereof I have hereunto set my hand.

JOHN A. SMITH.

Witnesses:
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