(No Model.) 2 Sheets—Sheet 1.

C. J. VAN DEPOELE.

RECIPROCATING ELECTRIC ENGINE SYSTEM.

No. 431,494. Patented July 1, 1890.

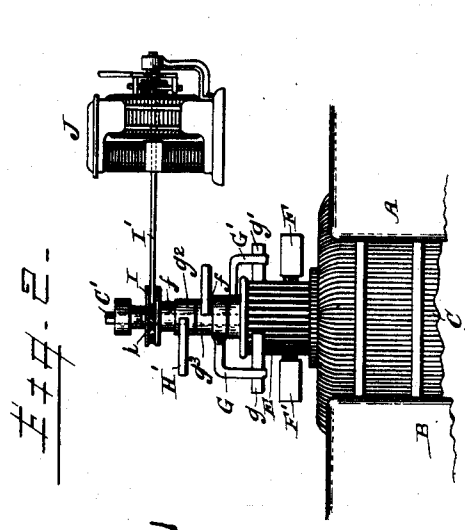

FIG. 2.

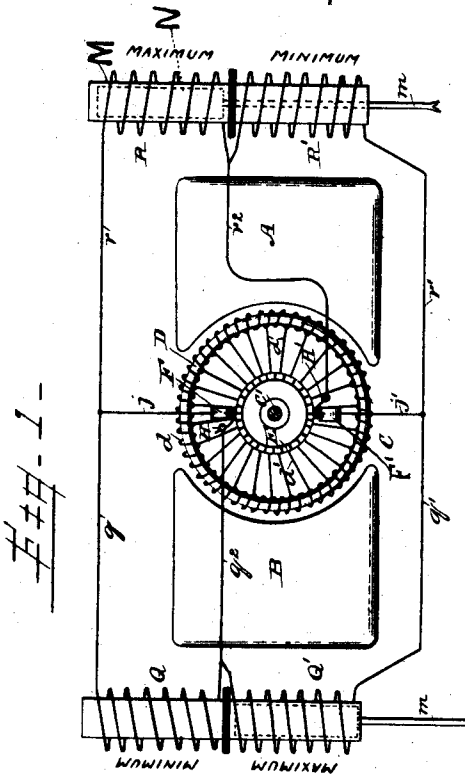

FIG. 1.

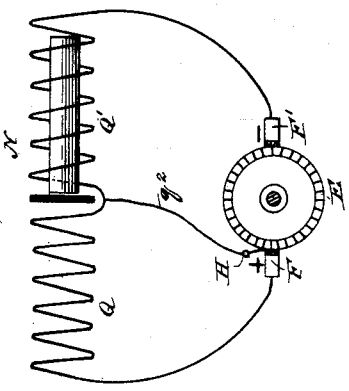

FIG. 5.

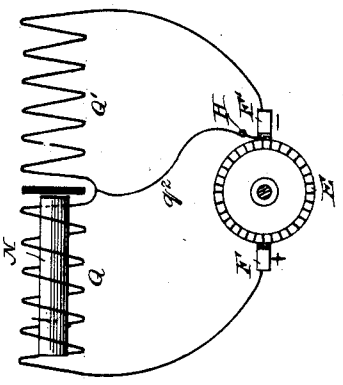

FIG. 4.

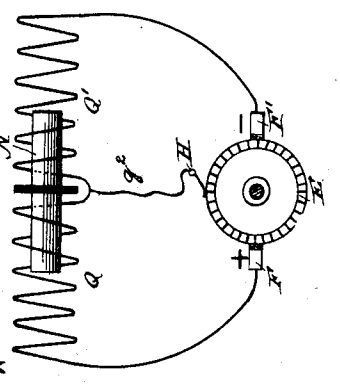

FIG. 3.

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(No Model.) 2 Sheets—Sheet 2.

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RECIPROCATING ELECTRIC ENGINE SYSTEM.

No. 431,494. Patented July 1, 1890.

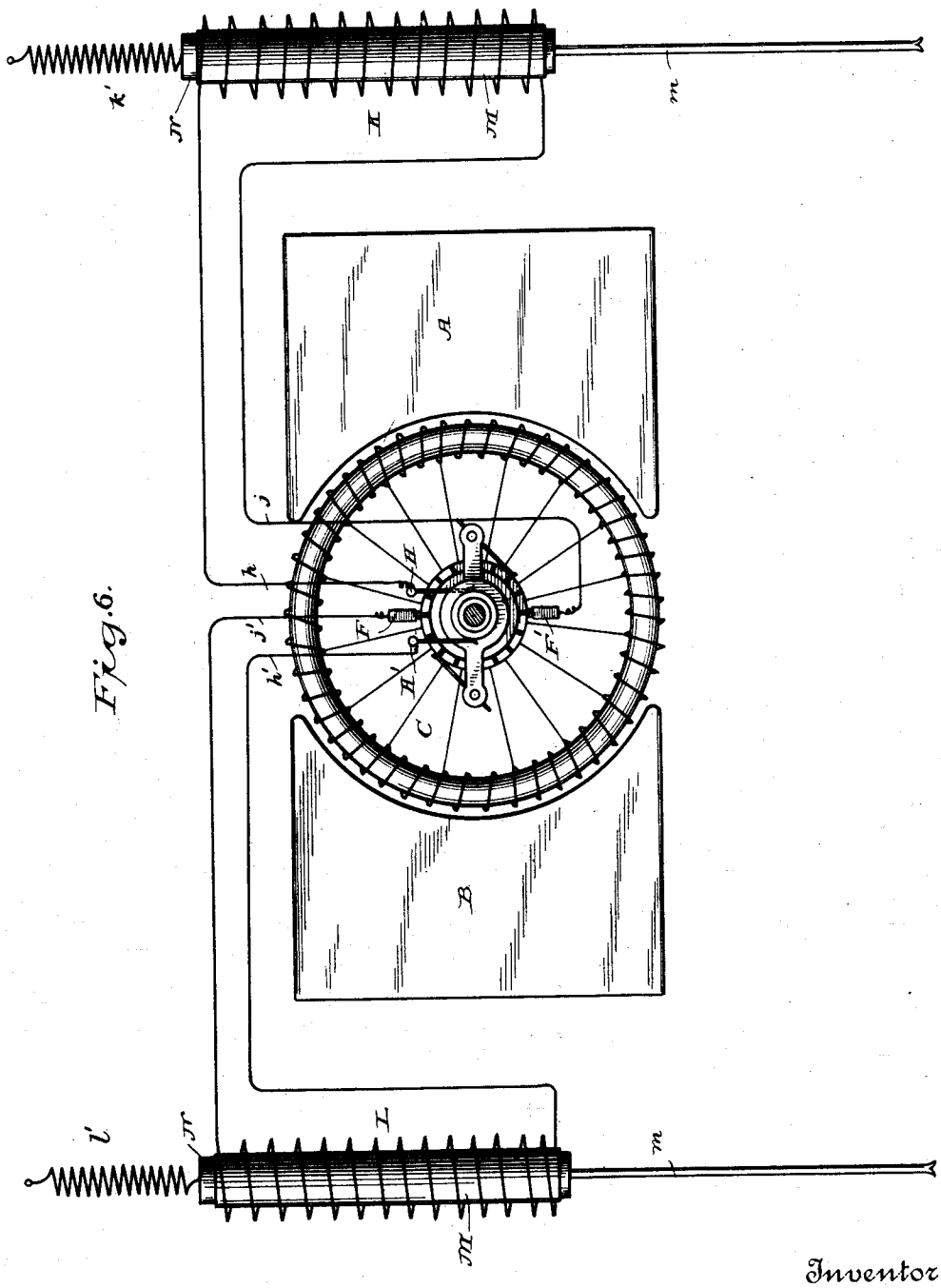

Fig. 6.

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UNITED STATES PATENT OFFICE.

CHARLES J. VAN DEPOELE, OF LYNN, MASSACHUSETTS.

RECIPROCATING ELECTRIC-ENGINE SYSTEM.

SPECIFICATION forming part of Letters Patent No. 431,494, dated July 1, 1890.

Original application filed June 26, 1889, Serial No. 315,579. Divided and this application filed April 17, 1890. Serial No. 348,376. (No model.)

To all whom it may concern:

Be it known that I, CHARLES J. VAN DEPOELE, a citizen of the United States, residing at Lynn, in the county of Essex and State of Massachusetts, have invented certain new and useful Improvements in Reciprocating Electric-Engine Systems, of which the following is a description, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

This application is a division of my divisional application, Serial No. 315,579, filed June 26, 1889.

My invention relates to an improved apparatus for and method of operating reciprocating electric engines, the engine being of the type set forth in my patent, No. 401,231, dated April 9, 1889. As set forth in the said patent, my improved electro-magnetic reciprocating engines are operated in synchronism with a generator or source of defined currents, each current impulse, phase, or wave energizing one of the motor-coils of the engine, the source of current and the motor-coils being so arranged relatively to each other that the phases of current will occur in the motor-coils in alternation, whereby each phase will produce movement of the magnetic piston of the engine. As indicated in said patent, the current impulses sent to the motor-coils will be alternately reversed and the polarity of the piston changed accordingly. By my present invention the current flowing in the respective motor-coils is always of the same polarity, and the connections between the source and the said motor-coils are so made that when the engine is at rest the supply-current may flow through both motor-coils in series, thereby automatically positioning the magnetic piston at the center of the combined coils, from which point it will readily start when the current begins to alternately rise in one coil and fall in the other, and vice versa, as occurs during the operation of the engine. With such an arrangement it will be apparent that the moving magnetic piston is constantly magnetized, and therefore no time whatever is lost in remagnetizing the piston upon the change of current from one motor-coil to the other, or in reversing the magnetism of the piston in response to a motor-coil in which the poles were oppositely located.

The invention is embodied in an electric machine having an armature of any desired continuous-current type, and a commutator for straightening the currents therein. Adjustable commutator-brushes are provided upon the normal line of commutation, and said stationary brushes are connected, respectively, with the outside terminals of a two-coil reciprocating engine, so that when interrupted the current would flow from one stationary brush through the combined motor-coils and back to the machine through the other stationary brush. The energizing-current is caused to rise in one coil while falling in the other, and vice versa, by means of an auxiliary commutator-brush, which is connected to the inner terminals of both motor-coils and arranged to be moved around or upon the commutator toward and away from the stationary brushes, whereby the said supply-current is alternately fed to one of the motor-coils through the moving brush, and then permitted to return to the machine therethrough and through the other coil, producing rise of current in one coil and a corresponding fall in the other coil without breaking either of the circuits, and also without changing the direction of the flow of the supply-current, so that while the machine is in operation there is a continuous flow of current through some parts of its coils, and it follows that a magnetic piston placed within the motor-coils will follow the rise and fall of current, being always under the influence thereof. Furthermore, it is not necessary to provide any means for arresting the motion of the magnetic piston at the extremities of its movement, for the reason that said piston, being always magnetized and always under the influence of a live coil, cannot escape therefrom, and its momentum is arrested at each end of its stroke by what I have termed the "magnetic" cushion.

Further details of the invention, together with the arrangements of the parts shown by way of illustration, will be hereinafter fully described, and referred to in the appended claims.

In the drawings, Figure 1 is an elevation, partly in diagram, showing a generator embodying my invention and two working-circuits extending therefrom, each circuit including a reciprocating electro-magnetic engine. Fig. 2 is a top plan view of a portion of the generator seen in Fig. 1, and showing also a motor and connections therefrom for operating the rotating brushes upon the commutator of the generator. Figs. 3, 4, and 5 are diagrammatic views illustrating the operation of the invention. Fig. 6 is a view in elevation, partly in diagram, showing a generator embodying the invention and a duplex working-circuit extending therefrom and including two reciprocating electro-dynamic engines.

As indicated, A B are the polar extensions of the field-magnet system of the generator, and between which an armature C, of the Gramme or any other suitable type, is rotatively mounted. The core D of the armature is wound with continuous conductor d, connected by terminals d' with the segments of a sectional commutator E, as in the well-known Gramme armature. The face of the commutator E is made long enough to receive two sets of brushes, one (the main) being stationary and the other movable, and by "stationary" is meant remaining in the desired position upon the line of commutation, although they will of course be adjustably sustained, and said brushes can be single or double.

F F′ are the stationary brushes, desirably of carbon. The brushes F F′ are placed upon the line of commutation and occupy that part of the commutator nearest the armature. Upon the armature-shaft C′ is placed a rotating sleeve f, insulated from the shaft and provided with a pair of metallic arms G G′, extending rearward to opposite points below and above the commutator, and at the extremities of said arms a second set of commutator-brushes $g\ g'$ are secured. The brush-holders G G′ are carefully insulated each from the others upon their common bearing f, and adjacent to the axis of each is located a collector-ring $g^2\ g^3$, one of said rings being in electrical connection with the brush g and the other with the brush g'. Collector-brushes H H′ bear upon the collector-rings $g^2\ g^3$, and from said brushes extend working-conductors $h\ h'$, as will appear.

The sleeve f, together with the brush-holders and collector-rings attached thereto, is mechanically rotated, thereby causing the commutator-brushes $g\ g'$ to travel around the commutator toward and away from the points of maximum and zero electro-motive force, and to collect or convey currents of a duration dependent upon the speed with which the said brushes are moved about the commutator. The sleeve f may be rotated in any convenient manner, the specific means being immaterial; but in Fig. 2 it is shown as provided with a worm-wheel I, which is engaged by worm i upon a driving-shaft I′. The shaft I′ may be an extension of the armature-shaft of an electric motor J, by which the shaft, worm-wheel, sleeve, and commutator-brushes may be rotated at any desired speed, suitable means being provided for regulating the motor. Where but one moving brush is required one of the brush-carriers and contact devices therefor (shown in Fig. 2) will be omitted.

In said Fig. 1, the conductor j, extending from main brush F, is bifurcated, one part q leading to one motor-coil Q and the other r to motor-coil R of separate double-coil engines comprising motor-coils Q Q′ and R R′. The conductor j' from main brush F′ likewise divides and extends by conductor q' to motor-coil Q′ and by conductor r' to motor-coil R′, returning from said coils to the moving brushes by conductors $q^2\ r^2$, connected, respectively, to brushes H H′. With the positions shown the currents are maximum in coils Q′ R, the succeeding half-rotation of the brushes H H′ reversing the conditions. With this construction and arrangement it will be understood that the rise and fall of potential in the working-circuits will, with proper circuits and connections, result in alternately reducing the power in the motor-coils of reciprocating engines, which will thereby be caused to operate in synchronism with the source of supply current and perform useful work.

Figs. 3, 4, and 5 show the different positions of the magnetic piston corresponding with different positions of the moving brushes. In Fig. 3 the moving brush is equidistant between the stationary brushes. Consequently there is no more tendency of the current to flow through the intermediate conductor q^2 in one direction than another, and the whole current flows from the positive brush through both motor-coils and back to the negative brush. The inner terminals of the motor-coils being united at the point of their connection with the intermediate conductor q^2 will with this arrangement be practically in series and form one long coil, within which the magnetic piston will take position at the point of magnetic equilibrium. As the moving brush travels toward one of the stationary brushes, the flow of current will be decreased in one coil and increased in the other until, as indicated in Fig. 4, the moving brush, having reached a position opposite to the main negative brush, all the current will flow from the positive brush through the coil Q, and thence through the intermediate conductor q^2 to the negative side of the commutator, the position of the magnetic piston N being then central within the coil Q. As the moving brush travels away from the negative and toward the positive brush, the current falls in the coil Q and rises in the coil Q′ until the said moving brush reaches a position opposite to the positive brush, as indicated in Fig. 5, when the whole current will flow through the intermediate conductor g^2 from the positive side of the commutator through the coil Q′

and back to the main negative commutator-brush. The magnetic plunger N moves through the coils Q Q′ precisely in accordance with the transfer of current from one coil to the other. This being effected as described, it follows that the magnetism of the plunger is never changed or varied to any perceptible extent, and therefore a regular, steady movement of said piston takes place, the piston following the movement of its magnetic field and being wholly unable to escape therefrom.

No particular form of generating armature or source of rising and falling current is essential so long as the principles herein set forth are followed.

The reciprocating engines here shown may be of a type seen in my patent, No. 400,809—that is to say, each having a single motor-coil for moving the piston in one direction, the reverse movement being effected by a suitable spring k' l', as indicated in Fig. 3 of said patent, or vice versa. Within the said coils K L are arranged non-magnetic casings M and magnetic pistons N, adapted to be reciprocated within the casings M, under the influence of the motor-coils and the compression of their springs k' l'. As here indicated, the motor-coils constitute two working-circuits for the generator; but the said circuits might be extended and include a plurality of reciprocating engines or other motors, according to the capacity of the engines, two only being shown by way of illustration.

The working-circuits in Fig. 6 are from main brush F of the generator by conductor j, extending therefrom to the motor-coil K of a reciprocating engine, returning by conductor h, connected to moving brush H. The second working-circuit from the said generator is from brush F′ by conductor j' to motor-coil L of a second reciprocating engine, returning through conductor h' to moving brush H′. Assuming that the armature C is capable of furnishing current of the desired constant potential, the intensity of which may vary, with the circuits and connections arranged as shown in Fig. 1, if the potential between F F′ is, for example, one hundred volts, the voltage between F and H and F′ H′ will depend upon the relative positions of the moving brushes H H′ with regard to the main brushes F F′, and currents will rise and fall simultaneously in the respective circuits and motor-coils K L, the maximum currents being given when the largest number of sections are between the brushes F H F′ H′, the said currents rising and falling in the solenoids K L with the rotation of the moving brushes.

As seen in Fig. 6, the pistons of the engines will move simultaneously. It will be obvious, however, that by changing the connections, for example, as by connecting the conductors j j' to one of the stationary brushes, substantially the same effect would be produced as though the double-coil engines (shown in Figs. 1, 3, 4, and 5) were separated to operate as single-coil engines with retracting-springs.

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

1. The herein-described method of operating reciprocating electric engines having a plurality of motor-coils and a magnetic piston adapted to be reciprocated therethrough, which consists in supplying a continuous electric current to the terminals of said motor-coils and causing the said current to rise in one coil while falling in the other, thereby transferring the magnetic field from one set of coils to the other, and vice versa, without interruption, substantially as described.

2. The herein-described method of operating reciprocating electric engines having a plurality of motor-coils included in two working-circuits, and a magnetic piston adapted to be reciprocated through the motor-coils, which consists in causing a supply-current to rise in the coil or coils included in one working-circuit while falling in the other, thereby transferring the magnetic field from one set of coils to the other, while maintaining constant magnetization of the piston, the said piston following the movements of the field of force, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

CHARLES J. VAN DEPOELE.

Witnesses:

S. G. HOPKINS,

FRANKLAND JANNUS.