(No Model.)

F. VAN RYSSELBERGHE.

ELECTRIC SPEED REGULATOR FOR REVOLVING MOTORS.

No. 370,575. Patented Sept. 27, 1887.

Fig. 1.

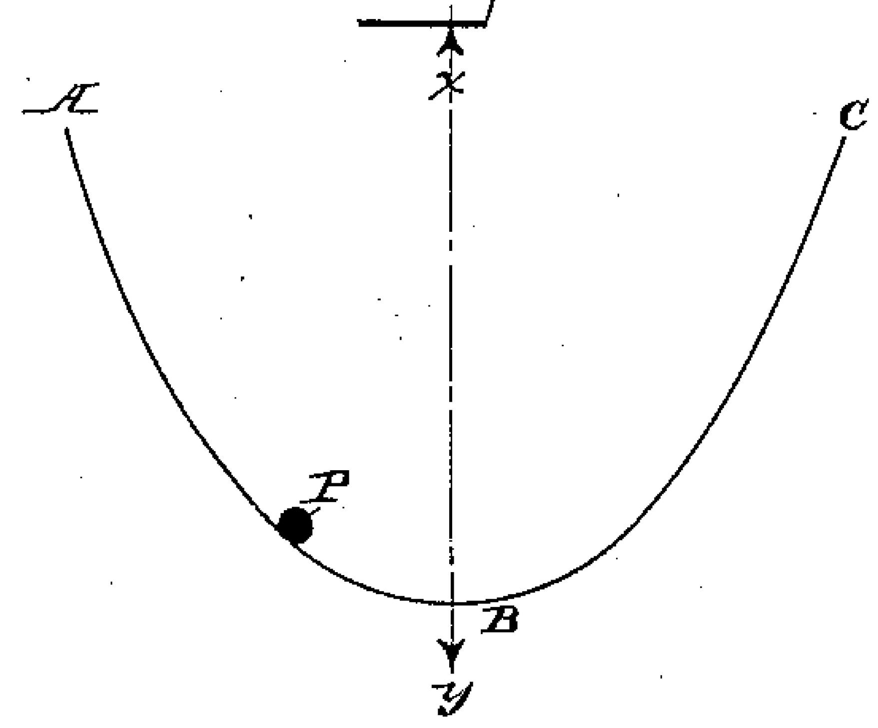


Fig. 2.

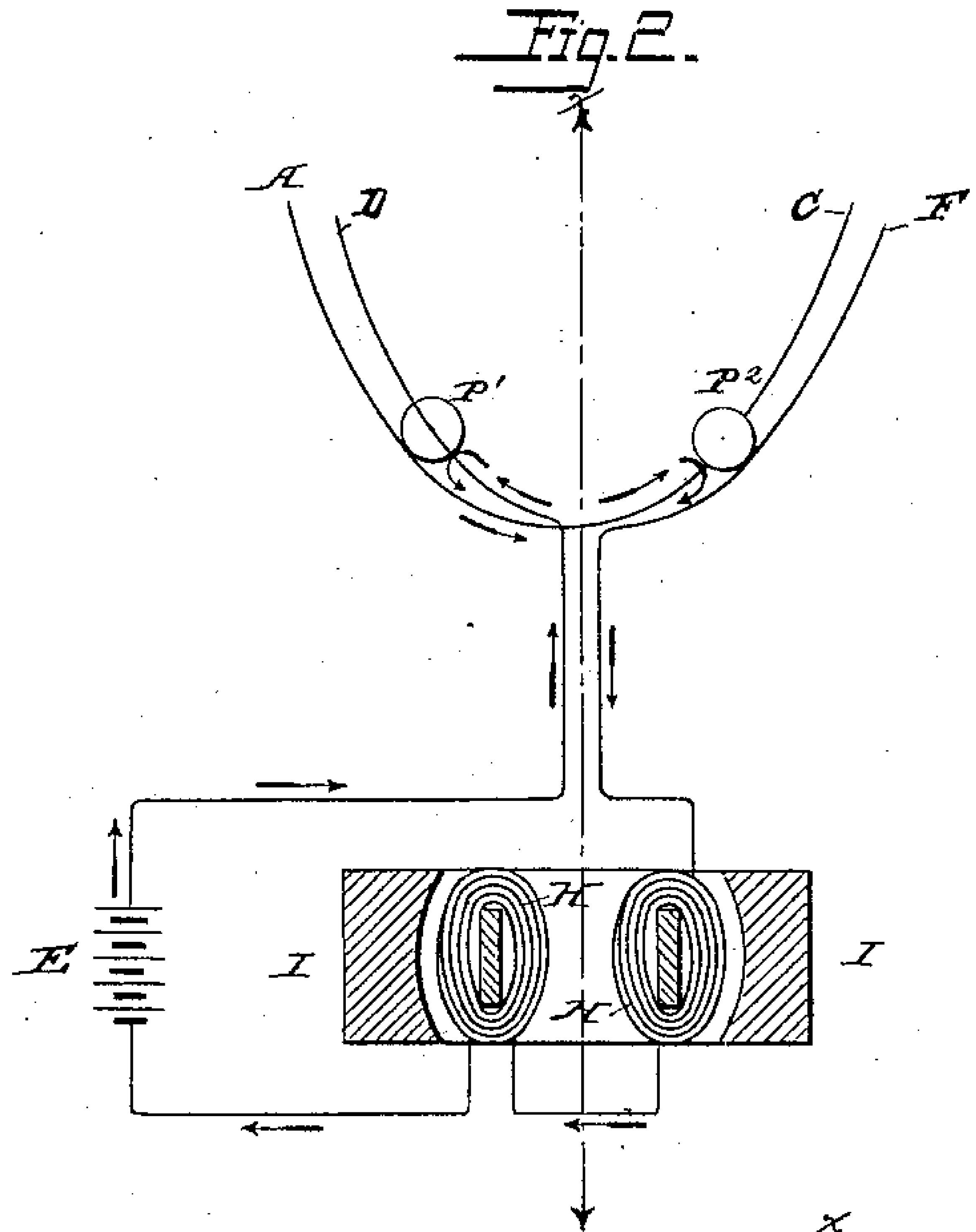
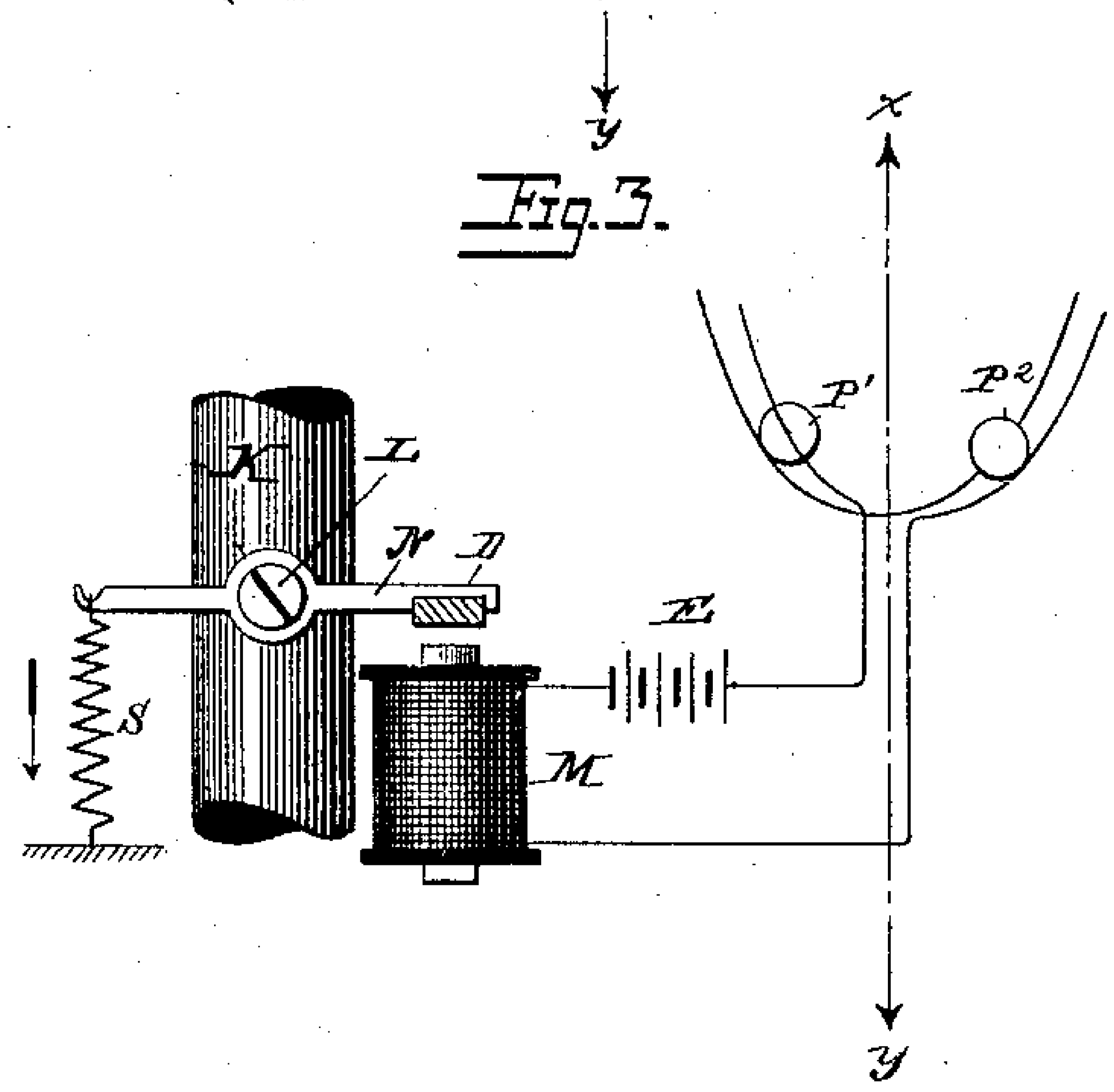


Fig. 3.



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FRANÇOIS VAN RYSSELBERGHE, OF BRUSSELS, BELGIUM.

ELECTRIC SPEED-REGULATOR FOR REVOLVING MOTORS.

SPECIFICATION forming part of Letters Patent No. 370,575, dated September 27, 1887.

Application filed September 8, 1886. Serial No. 213,027. (No model.)

To all whom it may concern:

Be it known that I, FRANÇOIS VAN RYSSELBERGHE, a citizen of Belgium, residing at Brussels, Belgium, have invented certain new and useful Improvements in the Art of Governing or Regulating Revolving Machines; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to letters or figures of reference marked thereon, which form a part of this specification.

My invention has reference to an electric speed-governor for motors—such as steam-engines, electric motors, and gas or hydraulic motors; and it consists, broadly, in a method and an apparatus by which the motive power or the resistance to the motive power is controlled by the movement of a runner upon a parabolic track, and is dependent upon the position of said runner upon said track.

In carrying my invention into effect I provide in a vertical plane a parabolic track of such description that the same will maintain upon any point of its surface a body acted upon by gravity, and by the rotation of said track, to the exclusion of other forces in equilibrium when the track is rotated about its axis with a certain predetermined speed, but that upon the least change of the speed of rotation the equilibrium of forces shall be disturbed, so as to cause the body to move to a higher or lower point upon the track. I further provide arrangements to cause the body moving with and upon the parabolic track to vary the speed of the motor by its movements and to determine the speed of the motor by its position from moment to moment upon the track. In this last particular my governor differs from all others known to me, for, while the arrangement of a parabolic track with a runner upon the same has prior to my invention been suggested for use as a governor for steam-engines, the particular position of the runner upon the track had no controlling effect.

The invention will be more fully understood from the following detailed description of the same, with reference to the accompanying drawings, in which—

Figure 1 is a diagram illustrating the mechanical laws which are utilized in my invention; Fig. 2, a similar view showing the application of my invention to the regulation of electric motors; and Fig. 3 a like view illustrating the application of my invention to the regulation of fluid-motors, &c.

In Fig. 1 is shown a parabola, A B C, the axis of which is indicated by the vertical line *x y;* and a material point, P, at any desired point upon the parabola will remain in equilibrium at that point, if the parabola is rotated about its axis at a speed which has a certain relation to the parameter of the parabola and to the acceleration of gravity. This relation is expressed by the equation—

$$t^2 = \frac{4\,p\,n^2}{g},$$

where t denotes the time of a single rotation of the parabola, g the acceleration of gravity, p the parameter of the parabola, and n the known relation between the diameter and circumference of a circle. So long as the speed of rotation is equal to t, as expressed in the above formula, the material point P, resting upon the parabola, will be in equilibrium and have no tendency to change its position; but as soon as the speed of rotation increases the material point P will have a tendency to assume a higher position upon the branch of the parabola upon which it rests, and, being free to move, will run up indefinitely until stopped by a decrease of speed. If, on the other hand, the speed decreases below that of t, the material point P will fall down toward the vertex B of the parabola, from which it can only rise when the speed is again increased to be greater than t. This is a well-established mechanical law, and its utilization for the regulation of the speed of fluid-motors has been suggested by others prior to my invention. I have reiterated this law in order to render the use which I make of the same more clearly understood.

In Fig. 2, H and I designate the armature and field-of-force magnet, respectively, of an electric motor to which my regulator is applied. E designates the source of electrical energy which supplies current to the motor, and A C D F are two parabolas identical in form and arranged side by side without touching in vertical planes and parallel to each other, with their axes also arranged vertically. These parabolas are preferably constructed of a material which offers a considerable resistance to the passage of an electric current, and they are connected with the motor to be rotated by the same about an axis, $x\ y$, parallel to and between their mathematical axes. A runner, or, as shown in this instance, two runners, P' P^2, of good conducting material are placed one on each branch of the parabolic system, so as to be in contact with both parabolas, and circuit-connections are provided, as indicated, to cause the current from the generator to pass through both parabolas and runners and through the electric motor. When the motor is at rest, the two runners, which may be of any desired shape, will rest at the vertex of the parabolic system, and will thus short-circuit the parabolas. If, now, the circuit is closed, the motor will receive the whole current from the generator, and will soon attain a speed greater than the normal speed at which it is desired to operate the motor. With the speed of the motor that of the governor, which is actuated by the same, also changes, and the relation of the two is so determined that when the motor rotates with its normal speed the parabolic system rotates with the velocity t expressed by the equation given above. If, therefore, the armature attains a speed above the normal, the governor will also run at a speed above its normal, and the runners P' P^2 will run up the branches of the parabolic track, whereby the resistances of portions of the parabolas are introduced into the circuit of the motor. The speed of the motor is thereby reduced, the runner rising continuously upon the track until the resistance introduced brings the speed of the motor and the governor down each to its normal. So long as the motor continues at this speed, the runners maintain their positions, which is only changed when a change in the speed from the normal occurs, as will now be fully understood. If the speed of the motor decreases for any reason whatever, the runners will descend and will cut out a portion of the resistance of the parabolas. More current will then be supplied to the motor, which thus again attains its normal speed, and so long as it continues at such speed the runners will maintain their newly-gained positions. Thus it will be seen that by my parabolic governor the speed of the electric motor is regulated by regulating the electrical resistance of the circuit in which the motor is placed, which amounts to the same thing as regulating the motive power, which motive power in this instance is an electric current. At the same time it will be observed that the electrical resistance of the motor-circuit, and consequently the motive power of the motor, depends upon the positions of the runners upon the parabolic track. The greater the distance of the runners from the vertex of the track, the greater is the electrical resistance of the circuit and the smaller is the motive power acting upon the motor at that particular instant.

In parabolic governors made prior to my invention the movement of a runner upon the track regulated the speed by regulating the motive power of fluid-motors; but the force of the motive power was not determined by and in no manner depended upon the position at a given moment of the runner upon the track.

In a motor provided with my improved governor the motive power is at its maximum when the motor is started. The speed of the parabolic track will therefore necessarily become greater than its normal, and the runners will consequently be driven to a position above the vertex until the proper reduction of the motive power has been accomplished. From this position of the runners the regulation of the speed is sure to be effected, whether the next following variation of the motor is a decrease or an increase of speed. This object could not be accomplished with certainty if the force of the motive power did not depend upon the position of the runners upon the parabolic track, for in that case there is nothing in the governor that will insure the attainment of a speed greater than the normal when the motor is started, so that the runners remaining at the vertex of the parabolic track could not operate to regulate for decrease of speed.

In Fig. 3 my invention is shown as applied to a fluid or a spring motor. M designates an electro-magnet or solenoid or electro-magnetic motor in the circuit of the generator E, in which the parabolic governor is included. This governor is rotated by a fluid-motor or other motor; and L represents the regulating-valve of the admission-pipe K, if the motor is actuated by a fluid, or it may be a friction-brake or other mechanical-force regulator if the motor is actuated by other means. In either case, there is a connection or lever, N, connected to the mechanical-force regulator, which lever is held in a position to allow the motive power to act upon the motor with its minimum force, as by a spring, S, and is acted upon by the electro-magnet M, or its equivalent, to allow the whole force of the motive power to come into action.

The operation is now easily understood. When the motor is started, the circuit of the generator E is closed, and, the runners being at that instant at the vertex of the parabolic track, the maximum current of the generator will energize the electro-magnet M, or its equivalent, and this in turn will actuate the lever N against the force of the spring S to entirely open the valve or release the mechanical-force regulator L. The motor therefore will start with its maximum force and will soon attain a speed greater than its normal. The same will be the case with the parabolic governor, and the runners, ascending upon the branches of the parabolic track, will act to reduce the power of the magnet M, or its equivalent, which in turn will allow spring S to actuate the mechanical-force governor to reduce the power of the motor. It will be seen that in this case the force of the motive power is also dependent upon the positions of the runners upon the parabolic track at a given moment, and that said force is at its maximum when the motor is started, the same as in the arrangement shown in Fig. 2.

Another important distinguishing feature of my invention is that the regulation is not intermittent, but absolutely continuous, since the least movement of the runners varies the force of the motive power or the resistance to the same proportionately to the extent of such movement. I therefore produce true undulations of the motive power or of the resistance to the same, and these undulations, being produced in accordance with the movements of bodies upon a parabolic track, follow the mathematical laws which govern the delineation of a parabola.

Having now described my invention, I desire it to be understood that the same is not limited to the precise details herein shown and described, since these may be indefinitely varied without departing from the broad principle which underlies the same.

I claim—

1. The method, substantially as hereinbefore described, of regulating the speed of motors, which consists in varying the motive power or the resistance to the motive power, substantially in accordance with the position of an object moving in a parabolic curve.

2. A speed-governor for motors, having a moving body in continuous operative connection with the motor moving in the path of a parabola and changing its position in accordance with the speed of the motor, substantially as described.

3. A speed-governor consisting, essentially, of a rotating parabolic track, a freely-moving runner upon the track, and a source of power for the motor under the continuous control of the runners, substantially as described.

4. In a speed-governor for motors, the combination of a parabolic track actuated by the motor to rotate about its vertical axis with a freely-moving runner upon the track and a source of electrical energy controlling the operation of the motor and under the continuous control of the runner, substantially as described.

5. In a speed-governor for motors, the combination of a parabolic track actuated by the motor to rotate about its vertical axis with a freely-moving runner upon the track, a source of electrical energy controlling the operation of the motor, and an electric circuit of variable resistance, composed in part of the track charged by the source of electrical energy and under the continuous control of the runner, substantially as described.

6. In a speed-governor for electric motors, the combination of a parabolic track constituting a continuous resistance in the circuit of the motor and rotated by the latter about a vertical axis with freely-movable runners upon the track, for completing and maintaining the circuit, whereby the resistance of the motor-circuit and the speed of the motor are under the continuous control of the runners, substantially as described.

7. In a speed-governor for electric motors, the combination of a parabolic track composed of two parallel parabolas of relatively poor conducting material rotated about a vertical axis by the motor and included in the circuit of the latter with free metallic runners, one upon each branch of the track and each in contact with the two parabolas, substantially as described.

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Witnesses:

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