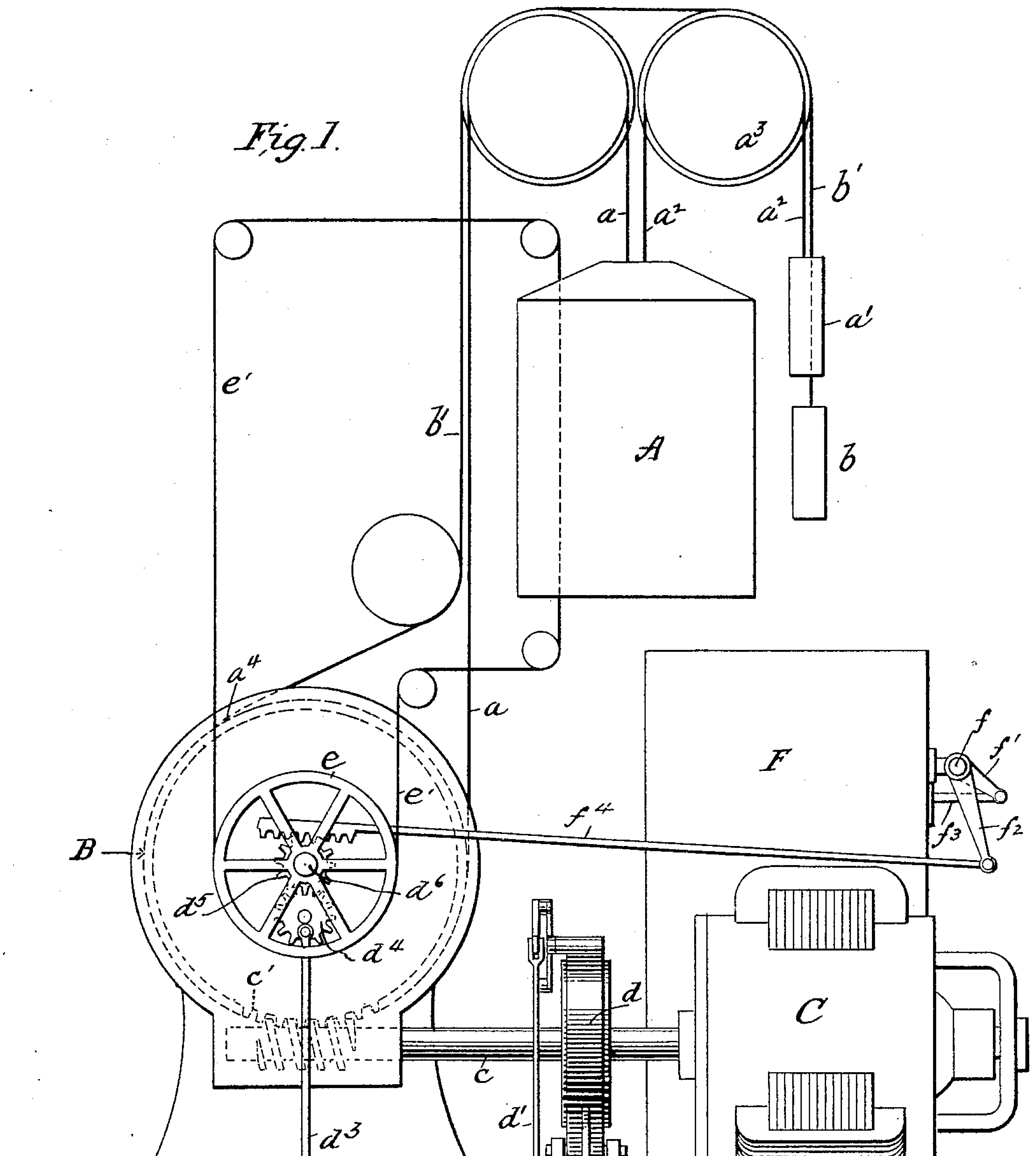
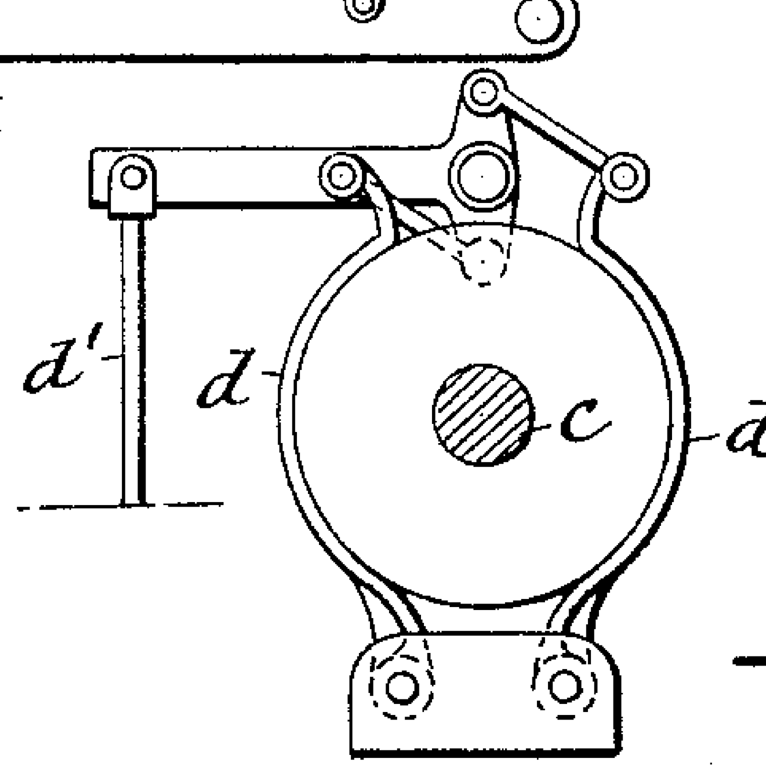
(No Model.) 2 Sheets—Sheet 1.

R. WILSON.
ELECTRIC ELEVATOR.

No. 571,502. Patented Nov. 17, 1896.

Fig. 1.





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(No Model.) 2 Sheets—Sheet 2.

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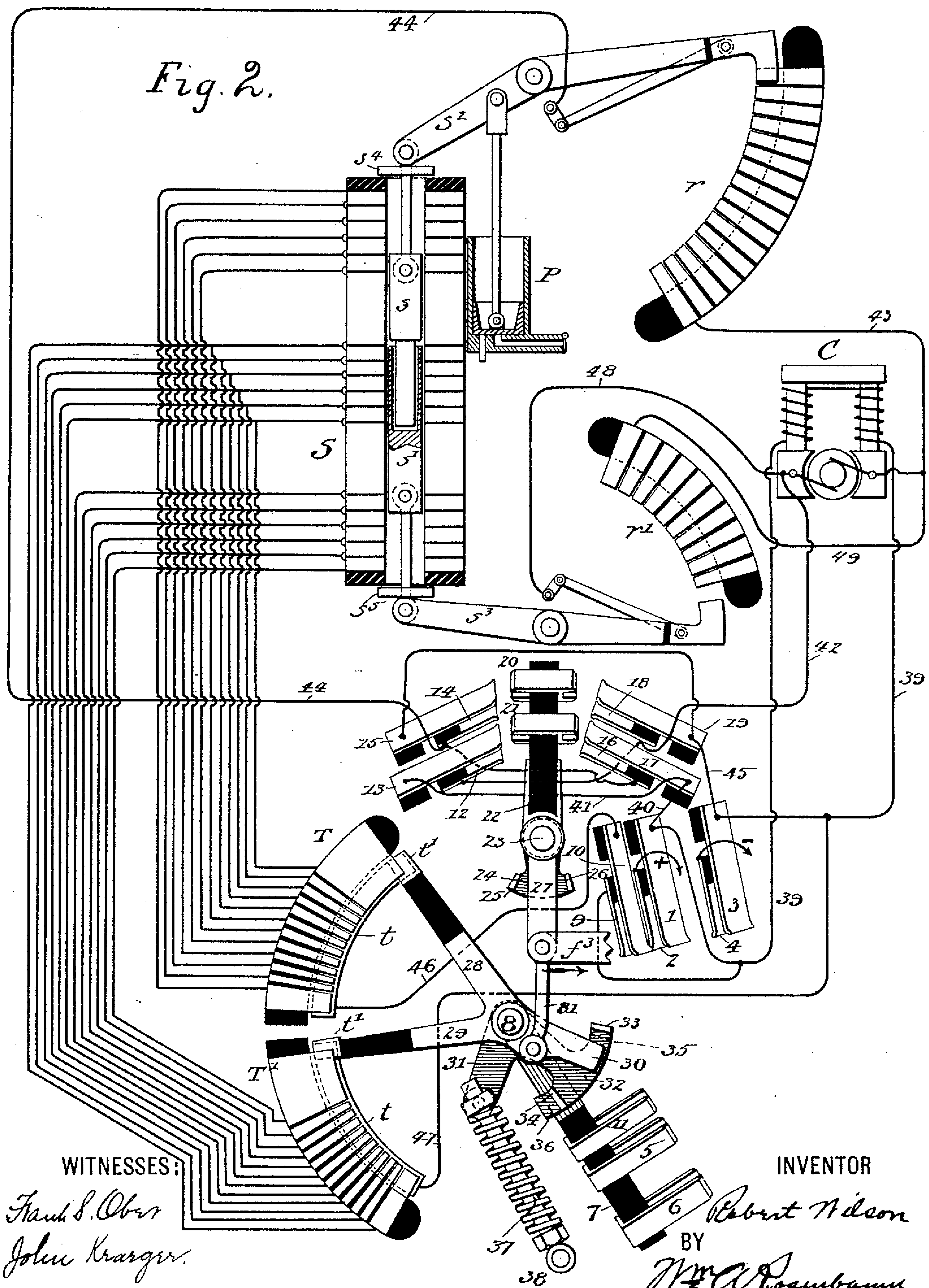
Fig. 2.



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UNITED STATES PATENT OFFICE.

ROBERT WILSON, OF LOUISVILLE, KENTUCKY.

ELECTRIC ELEVATOR.

SPECIFICATION forming part of Letters Patent No. 571,502, dated November 17, 1896.

Application filed July 8, 1895. Renewed April 16, 1896. Serial No. 587,874. (No model.)

To all whom it may concern:

Be it known that I, ROBERT WILSON, a citizen of the United States, residing at Louisville, in the county of Jefferson and State of Kentucky, have invented certain new and useful Improvements in Electric Elevators, of which the following is a full, clear, and exact description.

This invention relates to electric elevators, the object being to provide means for readily controlling the rate of travel of high-speed machines adapted especially for passenger-service.

The invention has particular reference to that class of elevators in which the motor is connected to the winding or lifting drum by worm-gear. In operating such machines it is customary to balance the car by a counterweight suspended at one end of a cord, the other end of which is attached to the car, and, in addition, to use an "overweight," which is also suspended at one end of a cord, the other end of which is attached to the back side of the winding or lifting drum. The object of the overweight is to balance as near as possible the load carried by the car, and to this end its weight is made about equal to the average load carried by the car. In this way whenever there is an exact balance between the car and load on the one side and the weights on the other the motor has merely to overcome the friction of the machinery to move the car in either direction. When, however, the load is above the average, the motor exerts power and consumes the corresponding amount of current to lift the extra load. When the load is below the average, the weights being then the heavier, the motor becomes a driven element instead of a driving element. Likewise if the car is descending with an extra load the motor is operating as a driven element, and if the car is descending with a light load the motor exerts power and consumes the corresponding amount of current to lift the overbalancing weights. The motor therefore runs positively at all times when the car moves, and whether it operates as a driving or a driven element depends upon the load in the car.

The object of my invention is to control the speed of the motor whether it be operating as a driving or a driven element. It is obvious that the operator in the car cannot tell at all times whether the load on the car is above or below the average, and consequently automatic devices must be provided whereby the speed will be controlled when desired under whichever of the two conditions the machine may happen to be operating.

In carrying out my invention I control the speed of the motor when it is acting as a driving element by introducing more or less resistance into the armature-circuit, and when it is acting as a driven element I control its speed by short-circuiting the armature and introducing more or less resistance into the short circuit. In this way the motor when being driven becomes a generator, and the less resistance that is included in the short circuit around the armature the slower will be the speed of the elevator. I am aware that it is not new to control the speed of an electric elevator when the car is descending by gravity by short-circuiting the armature through a fixed resistance and thereby permitting it to act as a generator and so retard the movement of the car. So far as known to me, however, it has never been proposed to operate the motor as a generator in connection with an overweight, whereby, whether the car be going up or down, its speed may be regulated at will.

My invention also comprehends the combination, with the last-described idea, of the control of the machine when acting as a motor and consuming current whether the car be going up or down.

My invention will now be described in detail with reference to the accompanying drawings, in which—

Figure 1 represents conventionally an elevator-car and its hoisting apparatus, and Fig. 2 is a diagrammatical view of portions of the apparatus and the circuits.

A represents the elevator-car, supported as ordinarily in a shaft at the end of a flexible rope *a*, which leads over suitable guide-sheaves to a winding-drum B. The car when empty is counterbalanced by a weight a', which is suspended from a cord a^2, passing over a suitable guide-sheaf a^3, and attached to the car, as shown. As a counterpoise for the load which the car is supposed to carry I use a weight *b*, suspended at the end of a cord b', and passing over suitable guide-sheaves to the back side of the winding-drum, where it is attached, as shown at a^4.

The winding-drum B is geared to an electric motor C through a worm-shaft c and gear c'. On the worm-shaft is a disk to which a strap-brake d is applied and operated by means of a link d' and weighted lever d^2, the latter being lifted and lowered by a link d^3, connected eccentrically to a small gear-wheel d^4, which engages with another gear-wheel d^5 on a shaft d^6. Shaft d^6 carries a wheel e, the periphery of which is grooved to receive an endless rope e'. This rope passes through the elevator-shaft and through the car and is to be manipulated by pulling it either upward or downward to start, stop, and vary the speed of the elevator-car. The rotation of the wheel e causes the brake to be either applied or released by reason of the engagement of the gears d^4 and d^5. The casing F contains the electric-motor-controlling apparatus, to be referred to hereinafter.

f is a rock-shaft, carrying at each end cranks f' and f^2. To the crank f' is connected a thrust-rod f^3, which enters the casing F and serves as the controlling element or lever for the apparatus therein contained. To the crank f^2 is attached a rod f^4, having a rack at one end engaging with the gear-wheel d^5, so that the rotation of the wheel in either direction causes thrust-rod f^3 to move in a corresponding direction by reason of the intermediate connections.

Referring now to Fig. 2, C is the motor, and the remaining apparatus constitutes the motor-controlling devices. The contacts of the main switch are represented by 1, 2, 3, and 4. The bridging-clips of the main switch are represented by 5 and 6, and are carried on the end of an arm 7, pivoted to a stud 8. Adjacent to the main contacts is another pair of contacts 9 and 10, which are adapted to be bridged by a clip 11 on the arm 7. The contacts of the reversing-switch are represented by 12, 13, 14, 15, 16, 17, 18, and 19. They are arranged in pairs, two pairs being located on each side of a center line. The bridging-clips 20 and 21 for these contacts are carried upon an arm 22, pivoted upon a stud 23, and adapted to swing in either direction and to close the circuit between the members of the two pairs of contacts on either side. Arm 22 is extended beyond its pivot in the form of an arc-shaped bracket 24, provided with two lugs 25 and 26, between which plays a lever 27, also pivoted to the stud 23. The free end of lever 27 is connected to the end of the thrust-rod f^3. Upon the stud 8 is also pivoted a three-armed lever 28, 29, and 30, which is connected to thrust-rod f^3 by a link 81. The stud also carries a two-armed lever 31 and 32, the portion 32 being in the form of a segment and having limiting-stops 33 and 34 on one face and 35 and 36 on the opposite face. The portion 31 has swiveled to it a rod and spring 37, the rod being also pivoted at the fixed point 38 and passing loosely through an eye at the swiveled end. The arm 30 plays between stops 33 and 34 and the arm 7 plays between stops 35 and 36.

S is a solenoid, the winding of which is divided into five main sections arranged successively on the axis of the solenoid. The two end sections and the middle section are each divided into five subsections. This solenoid has two movable cores s and s', the former telescoping through about one-half the length of the latter, and each core being about the length of two main sections of the solenoid. Core s is attached to the cut-out lever s^2 of a rheostat r. Core s' is attached to the cut-out lever s^3 of a rheostat r'. Each of the cores is provided with a stop s^4 and s^5, respectively, limiting the inward movement of the core. Lever s^2 is provided with a dash-pot P, preventing quick movements.

The sections of the solenoid are connected with the contacts of a two-part commutator T and T'. The contacts of the commutator T are connected, respectively, with the three upper sections of the solenoid, the topmost subsection being connected with the last contact and the lowest subsection of the upper three sections being connected with the first contact. The lowest subsection of the lower three sections is connected with the first contact of commutator T', while the topmost subsection of the lower three sections is connected with the last contact of commutator T'. The intermediate sections of both groups are successively connected with the contacts in the manner shown. Beneath the contacts of each commutator is a continuous plate t of conducting material.

The arms 28 and 29, pivoted to stud 8, carry at their extremities metallic bridging-clips t', which are adapted to slide, respectively, between the plate t and contacts of each commutator. The arms move in unison and occupy corresponding positions on the two commutators at all times. Thus when arm 28 is in connection with the first contact of commutator T, arm 29 is in connection with the first contact of commutator T'. In the connections shown and described it will be observed that when both arms are on the first contact of each commutator the lower two-fifths of the solenoid is in circuit between the two plates t t, and as the arms move toward the last contacts of each commutator the zone of the solenoid included in the circuit between the two plates, or what may be called the "magnetic center" of the solenoid, rises until when the arms are upon the last contacts of the two commutators the upper two-fifths of the solenoid is in circuit between the plates.

The circuits are as follows: The supply-mains are connected to the main switch at + and −. From the switch a branch circuit 39 leads to the field-magnet of the motor. Another branch leads by wire 40 to the reversing-switch at 17, thence by wire 41, contact

13, contact 12, contact 18, wire 42, armature of motor, wire 43, resistance r, wire 44, contact 14, contact 15, contact 19, and wire 45 to the main switch. A branch from one side of the field-circuit 39 leads to contact 9 and a wire 46 leads from contact 10 to one of the plates t of the commutator. From the other plate t a wire 47 leads to the other side of the field-circuit 39. From one of the brushes of the motor a wire 48 is led to the contact-finger on arm s^3, and from the other brush of the motor a wire 49 is led to the last contact of rheostat r'.

The operation is as follows: As above mentioned, the thrust-rod f^3 may be moved in either direction. If it is moved in the direction of the arrow, Fig. 2, arm 22 on the reversing-switch will be thrown to the left, and when the rod is moved in the opposite direction arm 22 will be thrown to the right. This determines the direction of movement of the car. When the car is stationary the parts are in the position shown in Fig. 2, except the reversing-switch, which always remains in contact with the clips on one side or the other until the direction of movement of the car is to be changed. In this normal position of the parts, then, the links 27 and 31 are in line with each other, and whichever way the rod f^3 is moved the arm 30 will be swung upward and arms 28 and 29 downward.

We will assume that the car is ready to ascend with a load requiring the motor to do work. The operator pulls his handle-rope in the direction to throw the rod f^3, say, to the right. With the first movement of the rod arms 28 and 29 travel downward over the commutators, and shortly thereafter the reversing-switch is thrust to the left by reason of link 27 striking one of the lugs on the segment 24. At the same time the arm 30, by reason of its engagement with lug 33 on the piece 32, swings the switch-lever 7 toward the main-switch contacts, the lever having meantime been struck by the lug 36 on the opposite side of piece 32. As piece 32 is thus lifted its other portion 31 is carrying the end of the spring 37 past the line of centers 8 to 38. The spring in making this movement is put under tension, and when past the center exerts its power and throws the switch-lever clips quickly into connection with the contacts of the main switch. The parts are so constructed that when this takes place the arms 28 and 29 have traveled over about three-fourths of their respective commutators, thus putting the upper portion of the solenoid into circuit between the plates t t, although not the extreme upper portion. The main switch and the contacts 9 and 10 then being bridged the upper portion of the solenoid is energized and the core s is lifted, thus cutting out resistance r and permitting the motor to start. The rod f^3 continues its motion until arms 28 and 29 are on the last contact of the commutators and the rheostat-arm s^2 has made its full stroke. The motor is then running at full speed and lifting the car, the amount of work being the weight of the load in the car above the average or above that of the overweight. To reduce the speed of the car when running in this way, push-rod f^3 is moved in the opposite direction, and this lifts the arms 28 and 29 without affecting the main switch. As said arms lift, the energized zone of the solenoid moves downward and core s follows it, thus throwing resistance into the armature-circuit and correspondingly retarding the car. The car is supposed to come to a stop when the entire resistance r is in circuit; but if the momentum of the car is such that it does not stop at that time the thrust-rod f^3, continuing to move, will lower the energized zone of the solenoid to such an extent as to cause the core s' to close the circuit 48 and 49 through more or less resistance, and thus the motor, which is then being driven by the momentum of the car, becomes a generator with its armature short-circuited. The heavy current so generated rapidly builds up the magnetism of the fields, and the car is brought to a stop very quickly. If the car is descending with a load below the average, thereby doing work in lifting the overweight b, the speed is controlled in exactly the same way. If the car is ascending with a load below the average, and is being lifted by the overweight b, the motor will be driven as a generator. Under these conditions the car is started with the same manipulation on the part of the operator in the car as above; but the car does not start necessarily when the resistance r is cut out, but only when the brake is released, which in all cases takes place at just about the time the main switch is closed. The car thus being lifted by the overweight cannot be controlled by the resistance r, and so the speed is regulated by the circuit 48 and 49 and resistance r'. When the car is descending with a heavy load, the motor is also driven as a generator and the speed is regulated, as last above described.

To stop the car under any condition, the rod f^3 is gradually moved back to the position shown in the drawings. This will reverse arms 28 and 29, which compresses spring 37, and when arms 28 and 29 have reached the first contact-points on the commutator the switch is quickly opened by the spring and the brake is applied. The object of the contacts 9 and 10 in the solenoid-circuit is to prevent the induced current of the field-magnet, which is generated when the current is broken, from entering the solenoid.

It will be observed that when resistance r' is in operation resistance r is entirely in circuit, and therefore keeps the main current out of the motor. The cut-out arm of the resistance r may open the circuit entirely when in this position, as this will be substantially the equivalent of a large resistance. It is also noted that the core s must return to its last position, as shown in the drawings, before core s' moves downward. Likewise core s'

moves upward to the position shown before s begins to move upward. The inward movement of both cores is limited to the normal position shown by the respective stops s^4 and s^5. As soon as the main switch is opened the end of rheostat-arm s^3 drops out of contact with the rheostat-points by its own weight.

It is clear that with this apparatus the speed of the elevator may be varied from the highest to the lowest with great delicacy, regardless of whether the motor is lifting the load in the car, lifting the overweight, or being driven as a dynamo by the load in the car or by the overweight.

Having described my invention, I claim—

1. In an electric elevator, the combination of an electric machine adapted to act either as a motor or as a dynamo, a controlling resistance for said machine when operating as a motor, a controlling resistance for the machine when operating as a dynamo, and an electromotive device actuating or controlling both of said resistances and means whereby said electromotive device may be operated at will from the car, substantially as described.

2. In an electric elevator, the combination of a car, an electric motor, two speed-controlling rheostats and a solenoid having two independent cores respectively operating said rheostats, substantially as described.

3. In an electric elevator, the combination of a car, an electric motor, two speed-controlling rheostats, a solenoid the center of magnetism in which may be shifted, and two independent cores in said solenoid respectively operating said rheostats.

4. In an electric elevator, the combination of a car, an electric motor, two speed-controlling rheostats, a solenoid the center of magnetism in which may be shifted, and two independent cores in said solenoid respectively operating said rheostats, each core provided with a stop limiting its movement, substantially as described.

5. In an electric motor, the combination of a car, an electric motor, two speed-controlling rheostats, a solenoid the center of magnetism in which may be shifted, and two independent cores in said solenoid respectively operating said rheostats, and mechanism operated from the car to shift the center of magnetism of the solenoid.

6. In an electric elevator, the combination of the car, an electric motor adapted to act either as a motor or a dynamo, a resistance for the armature when operating as a motor, a short circuit including a resistance, for the armature when operating as a dynamo, a solenoid whose center of magnetism may be shifted, two cores for the solenoid connected respectively with and operating the said resistances, mechanism for shifting the center of magnetism in the solenoid and means whereby said mechanism may be operated at will from the car, substantially as described.

7. In an electric elevator, the combination of a car, an actuating electric motor, two sets of resistances for controlling the speed of the car, a solenoid, a commutating-switch by which the center of magnetism of the solenoid may be shifted, two cores for said solenoid acting successively to vary the respective resistances and means whereby the commutating device may be operated from the car, substantially as described.

8. In an electric elevator, the combination of an element having a to-and-fro movement imparted by mechanism under control of the operator in the car, a main switch connected with and operated by said element, a solenoid whose center of magnetism may be shifted, a commutating-switch adapted to shift the magnetism of the solenoid, and also connected to and operated by said element, an actuating-motor and two sets of resistances located each in separate circuits and controlled respectively by two movable cores of the solenoid, substantially as described.

9. A means for controlling the speed of electrically-propelled vehicles, consisting of two rheostats, one in the main armature-supply circuit of the motor, and the other in a short circuit around the armature, a solenoid whose center of magnetism may be shifted, two cores for said solenoid one attached to and operating each rheostat, and a switching device by which the magnetism of the solenoid may be shifted, substantially as described.

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

ROBERT WILSON.

Witnesses:

ED MEYLENNY,

JAS. D. BOHON.