(No Model.) 2 Sheets—Sheet 1.

N. P. OTIS.

ELECTRICAL ELEVATOR.

No. 356,496. Patented Jan. 25, 1887.

Fig. 1.

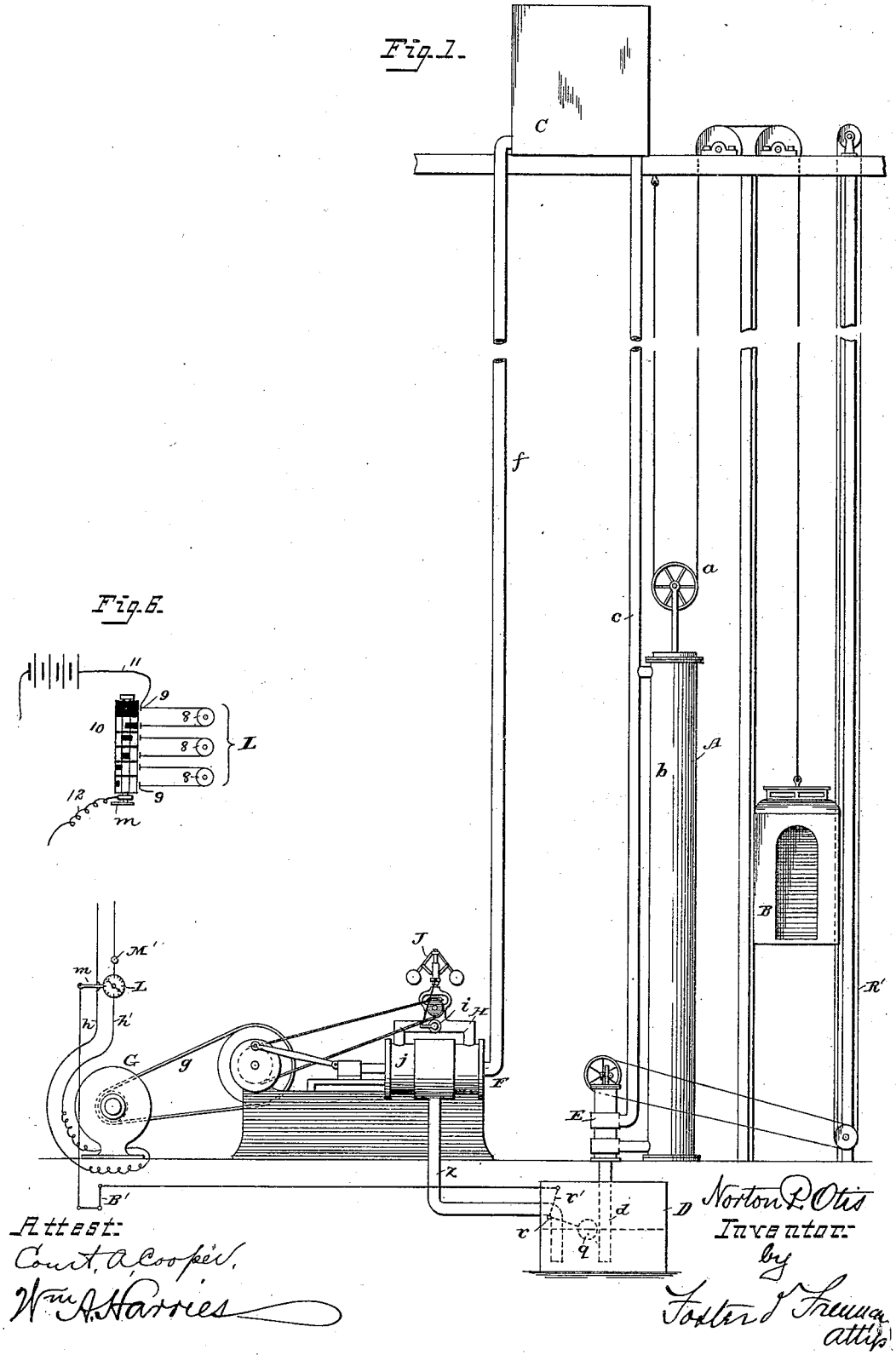

Fig. 5.

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(No Model.) 2 Sheets—Sheet 2.

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Fig. 2.

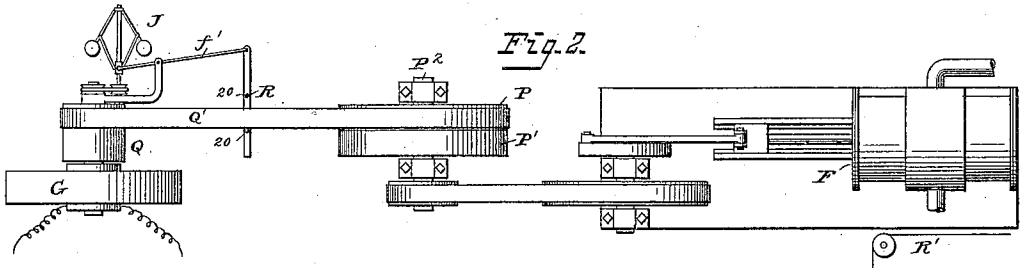


Fig. 3.

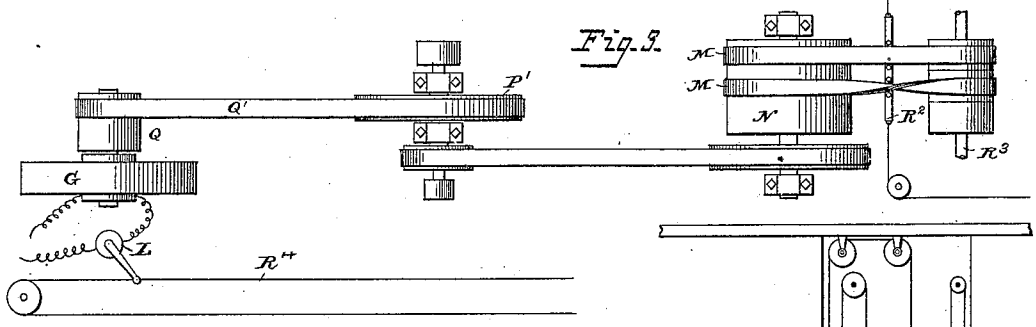
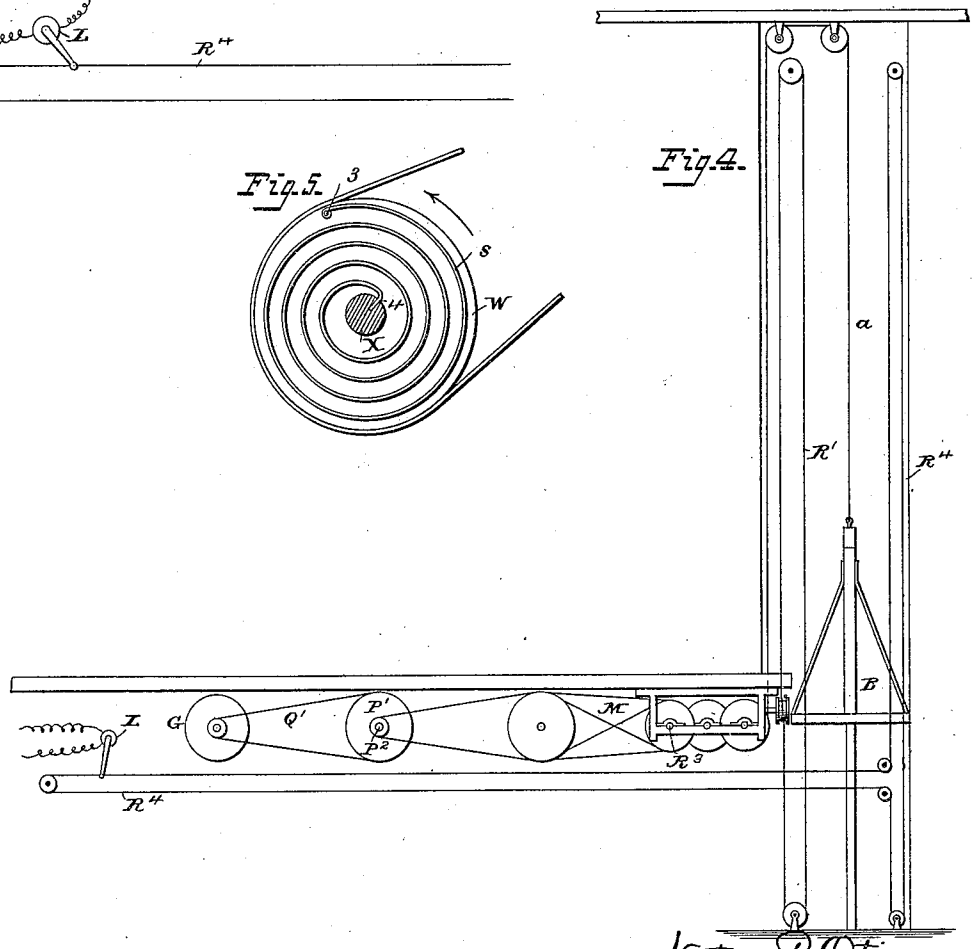


Fig. 5.

Fig. 4.



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UNITED STATES PATENT OFFICE.

NORTON P. OTIS, OF YONKERS, NEW YORK.

ELECTRICAL ELEVATOR.

SPECIFICATION forming part of Letters Patent No. 356,496, dated January 25, 1887.

Application filed June 14, 1886. Serial No. 205,115. (No model.)

To all whom it may concern:

Be it known that I, Norton P. Otis, a citizen of the United States, and a resident of Yonkers, Westchester county, New York, have invented certain new and useful Improvements in Electrical Elevators, of which the following is a specification.

In that class of hoisting and elevating apparatus in which electromotors have heretofore been employed the connections and arrangements have generally been such as to render it necessary to put the elevating engine or appliances which operate more directly upon the cage into sudden connection with the motor after the latter is in full operation, it being necessary to permit the shaft of the motor to acquire a certain speed before throwing it into connection with the other parts of the apparatus which offer any resistance to its movement. The sudden starting or connection of the motor and elevating-engine running at or approximating a maximum power results in jolts and strains, which are most objectionable and detrimental. It has also been the practice in such apparatus for the engineer or attendant stationed at the point where the switch is located to throw the current into the motor by hand, either by means of the graduating or common switch, which results in great inconvenience and loss of time. In order to avoid these objections I provide means for throwing the operating engine or mechanism, whatever may be its character, into action upon the elevating mechanism gradually and preferably automatically, and I also provide means for automatically and gradually throwing the current into the motor, and I thus throw the resistance of the engine at its full operation against the motor only after the latter has acquired or approximates its maximum power or speed, so that the preliminary movements of the motor are effected with but little resistance.

The character of the apparatus used for operating the elevator cage or platform will determine to a greater or less extent the character of the devices employed for varying the resistance and for throwing the hoisting mechanism gradually into action, and for varying the strength of the current. I will therefore, for the purpose of fully setting forth my invention, describe it in its different applications to both hydraulic elevators and elevators driven directly from electric motors, the latter being directly or indirectly the prime mover in all cases.

In the accompanying drawings, Figure 1 shows sufficient of a hydraulic elevator, pump, and electromotor driving the pump to illustrate my invention in connection with this class of machines. Figs. 2 and 3 are plan views illustrating my invention in connection with other forms of machines. Fig. 4 is an elevation of Fig. 3. Fig. 5 is a view illustrating a modification; Fig. 6, a plan illustrating a form of switch to cut out or increase the resistance to the current from the generator.

In Fig. 1 A represents a hydraulic elevating-engine, which, as shown, may be similar to what is known as the "vertical" engine, or it may be of any other well-known construction, so as to operate upon the cage either directly or through the medium of flexible suspensories *a*, so as to raise and lower the cage within the well.

In the construction of engine shown in Fig. 1, the piston in the cylinder *b* of the engine is moved by the pressure of water from an elevated tank, C, conducted to the cylinder through a pipe, *c*, and discharged from the cylinder through a pipe, *d*, into the tank D, a valve device, E, regulating the flow of the water in a manner too well known to require further description. A pump, F, exhausts the water from the tank D through a pipe, *z*, and forces it through a pipe, *f*, into the upper tank, C. The pump is suitably connected to an electromotor, G, so as to be driven thereby. For instance, a belt, *g*, extends round a small pulley upon the shaft of the motor to a larger pulley upon the crank-shaft of the pump.

The motor G is of any suitable construction, and receives through conductors *h h'* the current that imparts movement to the armature-shaft.

A pump of the ordinary construction, made as shown in Fig. 1, would start into full operation immediately upon the starting of the motor, and the full power of the pump would thus be opposed to the power of the motor, either preventing the starting of the motor altogether in some instances or throwing great strains upon the various parts of the machine. To prevent such a result, I provide means

whereby the power of the pump is applied to raising water only as the parts of the pump acquire their maximum speed. One means of effecting this is through the medium of a channel, permitting the water to circulate from one side of the piston to the other until the motor has acquired the requisite speed, when the size of the channel will be obstructed gradually until it ceases to offer a passage for the water.

In the construction shown the circulating-passage is in a pipe, H, connecting the opposite ends of the cylinder *j* and containing a valve at *i*, connected with the governor J, deriving its motion from any moving part of the pump or motor, the connections being such that when the balls of the governor are down the channel in the passage H will be opened; but as the speed of the pump and governor increases the circulating-channel will be gradually closed.

When the motor is first put in operation and the engine moves slowly, the passage of water back and forth through the circulating-channel offers but little resistance to the movements of the parts of the pump; but as the speed increases the channel is obstructed until it is entirely closed, when the pump will work effectively to lift the water to the upper tank.

By the arrangement described I not only effectually prevent the strains which result from the sudden starting of the pump in case it is thrown into quick connection with an electric motor operating at full speed, but I am also able to start the motor while it is in connection with the pump, as the shaft of the motor can turn readily and with little resistance until it acquires or approximates its maximum speed and is capable of working effectively.

The electrical motor is gradually started by the use of a variable resistance controlled by a switch, L, or any similar device, whereby the resistance to the current may be gradually reduced, or whereby the strength of the current may be gradually increased, by the adjustment of the operating handle or lever *m*, or other movable device; and in order to prevent the passage of a destructive current to the motor I place a safety-catch or fusible plug, M', in the conductor.

One form of resistance-switch is shown in Fig. 6, in which 8 8 8 represent resistance-coils having separate terminals 9 9 in line, and 10 a cylinder having a series of insulated contact-pieces arranged to increase or decrease the resistance in circuit from the battery 11 to the conductor 12 through additional coils as the cylinder is turned.

The switch L may be connected to be operated by the attendant within the cage, and in some instances it may be moved automatically through the medium of appliances operated by variations of the water-level in the upper or lower tank, or by variations in the air-pressure when air is used as the motor-fluid or in connection with water.

In the drawings the operating device is a float, *q*, arranged within the lower tank, D, upon an arm connected to the shaft *r*, carrying a second arm, *r'*, connected through the medium of rods and a bell-crank lever, B', with the operating-arm of the switch L. When the water accumulates in the upper tank and sinks in the lower tank, so that there is a sufficiency or surplus of power, the descent of the float will move the handle of the switch so as to cut off the current and stop the motor. When, on the contrary, the water decreases in the upper tank and increases in the lower tank, the float will be lifted and the motor will be set in operation.

It will be seen that the movement of the float gradually stops or starts the motor, and that by means of the regulating devices described the motor is allowed to acquire its full speed before it is brought to operate against the full resistance of the pump, and that such resistance is thrown in so gradually that there is no sudden strain or jarring of the parts of the machine.

The governor may be used for gradually bringing the pump into operation after the motor acquires its full speed, or after it has begun to move with such rapidity as to operate effectively by other means than those above described. For instance, in connection with another form of hydraulic machine, the governor may be arranged, as shown in Fig. 2, to operate a lever, *f'*, connected to a shifting-bar, R, which, when the balls of the governor are thrown out, transfers the driving-belt Q' from the loose pulley P to the tight pulley P' of the counter-shaft P^2, from which the driving-shaft of the pump F is driven. The governor J is driven from the motor, and is so constructed and adjusted that it will not shift the belt until the motor acquires or approximates its maximum speed, and as the belt is gradually transferred to the fast pulley P' there is sufficient friction and slip to prevent the too sudden starting of the pump.

I have termed the device J a "governor," under which term I include any of the various appliances which may be employed to regulate the position of the valve, shifting-bar, or equivalent device according to the speed at which the governor is driven, and I therefore do not limit myself to any particular form of governor.

Other means than those described may also be used for permitting the shaft of the motor to acquire a certain degree of speed before throwing it into operative or effective connection with the engine or devices that operate directly or indirectly to move the cage. In some instances this is secured by interposing between the armature and its shaft a spring, which upon the sudden revolution of the armature is wound without imparting immediate movement to the shaft. Such an arrangement is shown in Fig. 5, where the spring *s* is connected to the armature W at 3 and to the shaft

X at 4, and the armature moves loosely upon the shaft, so that it may make a number of revolutions and acquire a certain speed before it is called upon to put the shaft into working operation, the spring being gradually compressed and the shaft gradually started in operation, but moving fully with the armature only after the spring has been wound to its greatest tension. A like device may be interposed at any point between the motor and the pump or lifting-engine.

When the motor is used to operate a belt-elevator and it is desirable to stop and start the motor by hand, as is frequently the case where the elevator is not used continuously, greater facility and convenience can be secured by the use of such an arrangement as is shown in Figs. 3 and 4, in which N is a counter-shaft having a wide pulley for receiving the shifting belts M M, which give motion to the lifting power. The switch L' is operated by an independent hand-rope, R^4, which lead to the car or platform of the elevator, in the same manner as the main hand-rope R', which is used to start and stop the elevator during the movement of the engine, by moving the shifting-bar R^2, which carries the belts M M, to and from the center or fast pulley of the lifting-power shaft R^3.

By interposing a spring, as shown in Fig. 5, between the pulley P' and its shaft in Fig. 3, the elevating-engine may be thrown into operation more gradually than when the pulley P' is secured fixedly to the shaft.

Without limiting myself to the precise construction and arrangement of parts shown, I claim—

1. In an electric elevator apparatus, a cage, mechanism for raising and lowering the cage, an electromotor for driving such mechanism, and automatic power-transferring devices, substantially as described, whereby the motor is thrown automatically into operation upon the said mechanism only as it acquires or approximates its full power, substantially as described.

2. The combination, with a cage and cage-elevating engine and with an electromotor for operating said engine, of a governor and connections, substantially as set forth, whereby the elevating-engine is put gradually into effective operation by said governor as the electromotor acquires or approximates its maximum power, substantially as described.

3. The combination, with an elevating-engine and cage operated thereby, of an electromotor connected with the engine, a governor, and connections, substantially as set forth, whereby the engine is maintained out of effective working condition until the motor has attained a predetermined speed, substantially as described.

4. The combination, with the electromotor and an elevating-engine, of an automatic circuit-controlling device, whereby the gradual starting of the motor is automatically effected, and mechanism whereby the engine is gradually and automatically put into working operation as the speed increases, substantially as described.

5. The combination of an elevator-engine, a cage, an electromotor and a current-controlling device, and automatic mechanism independent of the cage and its connections to move the current-controlling device, substantially as described.

6. The combination, with the electric motor, variable resistance, resistance-switch, and pump and tank, of a float controlled in position by the water in the tank and connections between the float and the resistance-switch, substantially as described.

7. The combination, in an elevator, of an electrical motor, cage, elevating-engine, and power-transferring governor whereby the motor is thrown into operative effect upon the engine after the motor has begun its movements, substantially as described.

8. The combination, with the pump of an elevator-engine and with the motor-engine, of a circulating-passage between the ends of the pump-cylinder, a valve in said passage, a governor driven from the pump or motor, and connections between the governor and valve whereby the latter is closed as the speed of the pump increases, substantially as described.

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

NORTON P. OTIS.

Witnesses:
JAMES S. FITCH,
MARTIN BLAUVELT.