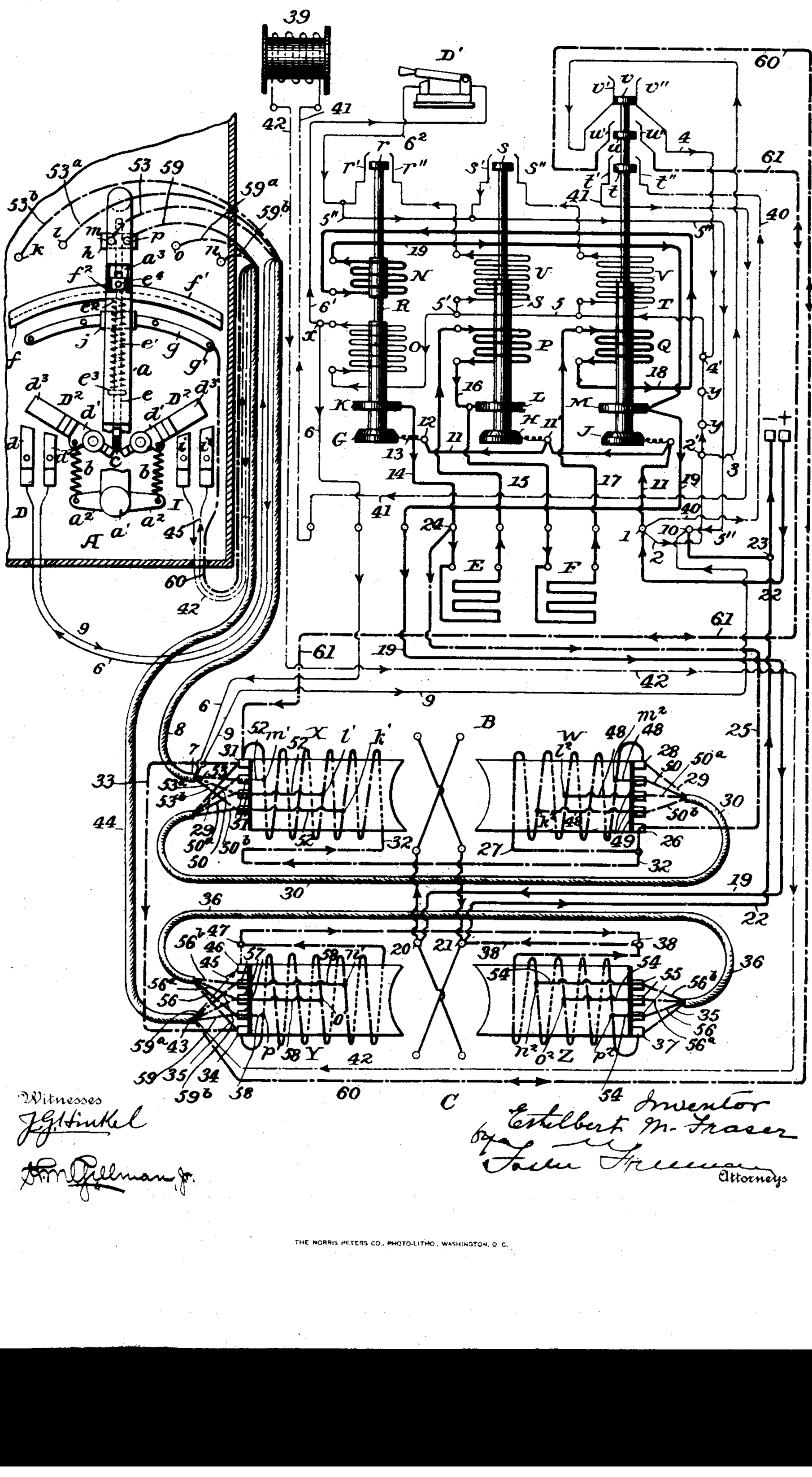
No. 683,924. Patented Oct. 8, 1901.

# E. M. FRASER.

## ELECTRIC ELEVATOR SYSTEM.

(Application filed July 20, 1899.)

(No Model.)



Witnesses
J. J. Hinkel
H. M. Pillman, Jr.

Inventor
Estelbert M. Fraser
by Fulton Freeman
Attorneys

# UNITED STATES PATENT OFFICE.

ETHELBERT M. FRASER, OF SAN FRANCISCO, CALIFORNIA, ASSIGNOR, BY MESNE ASSIGNMENTS, TO THE OTIS ELEVATOR COMPANY, OF NEW JERSEY.

## ELECTRIC-ELEVATOR SYSTEM.

SPECIFICATION forming part of Letters Patent No. 683,924, dated October 8, 1901.

Application filed July 20, 1899. Serial No. 724,542. (No model.)

*To all whom it may concern:*

Be it known that I, ETHELBERT M. FRASER, of the city and county of San Francisco, State of California, have invented certain new and useful Improvements in Electric-Elevator Systems, of which the following is a specification.

My invention has reference in general to the operation of machinery by electric power, but relates more particularly to an elevator system in which the car is operated by means of two electric motors that are capable of being driven at the same and also at relatively different rates of speed, the construction and arrangement of parts being such that the car remains stationary when the motors are both running at the same speed, but moves either upward or downward when the relative rates of speed of the motors are changed, so that one of them runs either faster or slower than the other. Such a system is exemplified in United States Patent No. 610,481, granted to me September 6, 1898, for an improvement in elevators. In addition to the car and the two motors and their necessary equipment of cables, sheaves, driving-pulleys, and other parts illustrated in said patent the elevator system herein shown and described includes a starting apparatus, such as illustrated in United States Patent No. 655,355, granted to me August 7, 1900, whereby automatic means are provided for gradually and smoothly starting and stopping the elevator-motors, an automatic brake, which may be applied to the hoisting-sheave and electrical means for withdrawing the same, and electrical means controlled from the car for varying or restoring as required the normal speed of either motor. The starting and stopping apparatus is controlled either from a switch on the car or from a switch in the building in which the elevator is placed, the latter switch being merely auxiliary and designed for use when the motors are run without running the car for the purpose of inspecting or testing machinery, &c. The starting and stopping switch on the car is so arranged with reference to a switch controlling the action of the brake that both are operated together, while an automatic switch controlled by the starting apparatus prevents the removal of the brake until the motors are started, the brake being allowed to return before the motors are stopped. The arrangement of apparatus and circuits in my system is such that the relative speeds of the motors cannot be varied until they have attained normal speed, nor can they be stopped after the speed of either one has been varied until they have been brought back to normal speed and are both running at the same number of revolutions per minute. While the speed of either motor is maintained constant the speed of the other may be varied by varying its field magnetization, one or more field-coils being short-circuited or again thrown into circuit, as desired, and controlling means are provided upon the car for varying the strength of the fields in this manner or for restoring normal conditions of running.

The accompanying drawing is a diagrammatic representation of the preferred form of my invention, showing the two motors with their armatures in parallel, the motor field-circuits, the arrangement of circuits for the starting and stopping apparatus, the brake-circuit, a car, a controller on the car for varying the number of coils in the respective field-windings, and also a simultaneously-operated starting and stopping switch and brake-switch on the car.

In the drawing A represents the elevator-car, which may be a passenger-car of any approved design and construction or a hoisting cage or platform of any kind, my invention being applicable to all forms of hoisting mechanism.

B and C are two electric motors of any suitable construction employed to operate the elevator-car, I having shown bipolar shunt-wound motors. The armatures are connected in parallel, while the two field-windings of each motor are connected in parallel with each other; but the entire field of one motor is connected in series with that of the other.

X W and Y Z represent the field-windings of the motors B and C, respectively, X being in parallel with W and Y with Z, but X W in series with Y Z.

The automatic starting and stopping ap-

paratus, as described in the patent hereinbefore referred to, consists, essentially, of the comparatively low resistance solenoids N P Q in series with the armature-circuit, the rheostats E F, also in series, the movable cores R, S, and T, carrying the cone-shaped contacts G, H, and J, adapted to make contact with the fixed contact-pieces K, L, and M, respectively, and in multiple shunt with the series coils of the high-resistance solenoids O, U, and V. The solenoids N and O are so wound that when energized they both tend to attract the core R upward; but solenoids P U and Q V are so wound and the current passes through them in such direction that when energized P and Q always tend to hold their respective cores S and T downward, while U and V tend to attract the cores upward, the solenoids P and Q upon first starting being stronger in attractive force than U and V. On the tops of the cores R, S, and T are contact-pieces *r s t u v*, adapted to make contact with the spring-contacts between which each is placed, respectively, when the cores are raised. Pieces *r*, *s*, *t*, and *u* are normally out of contact with their respective springs; but *v* is normally in contact with springs *v' v''* and is moved out of contact therewith when core T rises. The armature-circuit, including the series solenoids and rheostats, is indicated in heavy black lines, and current is supplied thereto from the mains indicated at + and — on the right of the diagram. The starting apparatus is controlled from the elevator-car by means of a switch D or from an auxiliary switch D' outside of the car. Presuming D to be open, should switch D' be closed a circuit would be completed from the positive main at 1 by wire 2 to the point 2' and from there by a shunt 3 around the lamps *y y* or other high resistance to spring *v'* through contact-piece *v* to spring *v''*, from thence by wire 4 to the point 4', by wire 5 to the high-resistance solenoid O, and by wire 6' to switch D', through the switch and by wire $6^2$ to wire 5'', and thence to the negative lead at binding-post 10. Solenoid O being energized attracts its core R upward and closes the armature-circuit between G and K as follows: Current entering from the positive lead at 1 passes by the wire 11 to binding-post 12 and through a flexible connection 13 to contact-piece G, thence through fixed contact K and by wire 14 to rheostat E, from thence by wire 15 to solenoid P, by wire 16 to rheostat F, by wire 17 to solenoid Q, by wire 18 to solenoid N, by wire 19 to binding-post 20, connecting with one brush of motor C, thence through the armatures of the motors B and C in parallel to binding-post 21, and back by wire 22 to the negative lead at 23, thus completing the armature-circuit. A circuit is simultaneously completed through the field-windings, starting from the point 24 on wire 14 just above rheostat E. The field-circuits are shown in heavy dotted and dashed lines. From 24 the current passes by wire 25 to a suitably-insulated binding-post 26 on motor B, from whence it divides, part passing by wire 27 through coil W to binding-post 28 and by wire 29 through the cable 30 to binding-post 31, and part passing by wire 32 through coil X, also to binding-post 31. Wire 33 connects binding-post 31 with binding-post 34 on motor C, where the current again divides, part passing by wire 35 through cable 36 to binding-post 37, and thence through winding Z to binding-post 21 in the armature-circuit and out to the negative lead, and part passing from the post 34 directly through winding Y and by wire 38 to post 21. A part of the field-current also passes through a shunt-circuit, including a field-controlling switch, on the car. This shunt-circuit will be hereinafter described in connection with the system of field-control, it being sufficient to state here that it in no way affects the relative speeds of the motors. The armature and field circuits being energized, the motors will start, with the rheostats E and F in series with the armatures, and will tend to speed up, both running at the same number of revolutions per minute. The core R having been attracted upward by the joint action of solenoids O and N causes contact-piece *r* to bridge springs *r' r''*, and therefore coil U is energized, the current entering the solenoid at the point 5' on wire 5 and returning to the negative lead at post 10 by wire 5''. The attractive force of solenoid P having been somewhat weakened by the counter electromotive force produced by the motors is now overcome by solenoid U acting in opposition, and core S is attracted upward, bridging the springs *s' s''* and causing contact H to close on contact-piece L, thus short-circuiting rheostat E and solenoid P, the current now passing directly from wire 11 at 11' to contact H and to the armatures as before. The bridging of springs *s' s''* throws solenoid V into circuit, which attracts core T upward, solenoid Q having become weakened, so that contact J makes contact with contact-piece M. The springs *t' t''* and *u' u''* are then bridged and contact across the springs *v' v''* is broken. Rheostat F and solenoids N and Q are now short-circuited and the armatures take current directly from the mains. Solenoids O, U, and V in multiple-shunt arrangement maintain their respective cores in a raised position, which they will continue to do until the controlling-switch D' is broken. Upon contact-piece *v* passing out of contact with springs *v' v''* the current is shunted through the lamps *y y*, thus reducing the current in the multiple-shunt circuit. As before stated, switch D' is not used in the ordinary operation of the elevator and is normally open. Should the motors be started from the switch D in the car, this switch being opened and closed in a manner hereinafter to be described, a circuit would be completed as follows: Starting from the positive lead at 1 the current will follow the same course be-

fore described, passing through solenoid O to the point *x*. From thence the current continues by wire 6 to the end 7 of flexible cable 8, through the cable to the elevator-car and contact *d* of switch D, through the switch, and back by wire 9 through cable 8 to the cable end 7, and still by wire 9 to the negative lead at post 10. The course of the armature and field currents and the operation of the starting apparatus is then as before described when switch D′ was closed, and the motors attain normal speed, both running at the same number of revolutions per minute.

39 represents a brake-solenoid adapted to remove the brake from that part of the elevator apparatus to which it may be applied, while I is a switch in the car adapted to control the action of the brake. The starting-switch D and brake-switch I are so arranged that one may not be opened or closed without opening or closing the other, while since the circuit of the brake-solenoid includes the contact-piece *t* and springs *t′ t″*, through which circuit is not completed until the last core T is attracted upward and the motors have about attained normal speed, it follows that the brake cannot be removed until the motors have started and is also returned before the motors have stopped. The brake-circuit may be traced as follows: Leaving the positive lead at post 1 by wire 40, the current passes through spring *t″*, contact *t* to spring *t′*, thence by wire 41 to solenoid 39, thence by wire 42 to the end 43 of cable 44, through the cable by wire 42 to contact *i* of switch I on the car, and then returns by wire 45 through the cable to cable end 43 and to binding-post 46, tapping onto the field at 47, and returning thence to the negative main.

In order that the switches D and I may be simultaneously operated, any suitable form of switch-lever may be used; but I prefer to use that form patented by me in United States Patent No. 655,336, granted August 7, 1900, for a "Controller," which device serves the function also of allowing the switch-arms of D and I to be thrown only when the operating-lever is in a central or neutral position, as fully shown and described in that patent. I have therefore shown upon the car A a diagrammatic representation of this form of controller, the essential features only of which will be again described.

The controller comprises a lever *a*, pivoted at *a′*, from which point extend arms $a^2$, rigidly connected to the lever, to which arms are connected springs *b*. These springs are also connected to the pivoted switch-arms $D^2$, upon which they exert a downward pull, causing them to bridge the contact-pieces $d\,d^2$ and $i\,i^2$, respectively, when a lug *c* is withdrawn from contact with the inner ends of the switch-arms. The pieces *d′* are insulated from the pieces $d^3$, so that there may be no electrical connection between the switches D and I. The lug *c* is fastened upon the end of a vertically-sliding rod *e*, carried by the lever *a*, this rod being forced downward by a suitable spring *e′*, fastened at $e^2$ to the lever and at $e^3$ to the rod. Upon the upper part of the rod is another lug $e^4$, working in a slot $a^3$ in the lever *a*, and behind the lever extends a grooved arc-shaped piece *f*, (which may be part of the frame of the controller,) with flanges *f′*, having a central opening $f^2$, in which lug $e^4$ may enter when the lever *a* is opposite the center of the arc. When lug $e^4$ enters the opening $f^2$, spring *e′* forces rod *e* down and causes lug *c* to impinge upon the inner ends of switch-arms $D^2$, forcing the arms out of contact with their respective contacts. By pulling the rod upward the arms $D^2$ are released and close their respective switches. When lug $e^4$ is removed from the opening $f^2$, the lever *a* may be moved to the right or left, lug $e^4$ sliding upon the top of flange *f′*, and thus the lug *c* is prevented from actuating switch-arms $D^2$ unless the lever *a* is in a central or neutral position. Contact-pieces *h* and *j* on the back of lever *a* are adapted to sweep over contacts *k l m n o p* and a conducting-arc *g*, respectively, when the lever is moved to the right or left, the pieces *h* and *j* being electrically connected, preferably by flat springs, in the manner described in my Patent No. 655,336, above referred to. Piece *h* is adapted to make contact with the contacts *k l m n o p* separately, except as to the two central contacts *m* and *p*, with both of which it makes contact at the same time, and when the lever *a* is in a central or neutral position, for reasons which will hereinafter appear, the motors are both running at the same speed and the car is stationary. When the lever is moved to the right or left, the speed of one or the other of the motors is varied, for the farther it is moved to the left over the contacts *k l m* the greater number of coils are short-circuited in the field-windings of motor B, and hence B speeds up, while motor C remains at normal speed, and the farther the lever is moved to the right over contacts *n o p* the greater is the number of coils short-circuited in the field-windings of motor C, so that this motor speeds up, motor B in the meantime having been returned to normal speed. Therefore the mechanical connections may be so arranged that if motor B is running at the higher speed the car will move up, while if motor C is running at the higher speed it will move down. The electrical connections for carrying into effect this system of field control consist in this instance of parallel circuits connecting various coils of the motor field-windings with the contacts *k l m n o p* on the car and a common conductor which connects a point on the field-circuit between the two motor-fields with the conducting-arc *g* in the car in order that one field may be varied while the other is left normal. This common conductor is also connected to the contact-springs *u′ u″*, so that its circuit includes the contact-piece *u* on core T, and since this contact-piece *u* is normally out

of contact with springs $u'$ $u''$ and does not bridge them until the core T has been attracted upward and the last rheostat F short-circuited it will be evident that no variation can be effected in the speed of either motor until this switch $u$ is closed and the motors have attained normal speed, both running at the same number of revolutions per minute. In other words, it is only through this common conductor that electrical connection can be made between the field-controller on the car and that field which is to be varied.

Any suitable connections may be used in carrying out my system of field-control, I having shown a method which is particularly applicable to motors whose armatures and fields are arranged in the relationship described; but without departing from the spirit of my invention other methods may be devised applicable to this arrangement of motors and their fields or methods applicable to other arrangements of other types of motors. In the accompanying diagrams connections are made from the points $k^2$ $l^2$ $m^2$ on field-winding W by wires 48 to insulated binding-posts 49, and thence through the cable 30 by wires 50, $50^a$, and $50^b$ to binding-posts 51, and connections are made from the points $k'$ $l'$ $m'$ in field-winding X by wires 52 also to the insulated posts 51. Posts 51 are connected by wires 53, $53^a$, and $53^b$ through cable 8 to contacts $k$ $l$ $m$ on the car. Connections are likewise made from the points $n^2$ $o^2$ $p^2$ on field-winding Z by wires 54 to the insulated binding-posts 55, and thence through cable 36 by wires 56 $56^a$ $56^b$ to the insulated binding-posts 57, and connections are also made from the points $p'$ $o'$ $n'$ on field-winding Y by wires 58 to the insulated binding-posts 57. Posts 57 are connected by wires 59 $59^a$ $59^b$ through cable 44 to contacts $n$ $o$ $p$ on the car.

The common conductor above referred to passes from contact-arc on the car at the point $g'$ by wire 60 through cable 44 to cable end 43 and from thence by wire 60 to contact-spring $u'$ and from contact-spring $u''$ by wire 61 to binding-post 31 on motor B, thus cutting in on the motor field-circuit at a point between the respective fields of the two motors.

It was hereinbefore stated that upon the closing of the armature-circuit part of the field-current followed a path in shunt to the field-circuit through the field-controller on the car. This is so only when the lever-arm $a$ of the field-controller is in its central or neutral position, so that both contacts $m$ and $p$ are bridged by contact-piece $h$. While all of the coils in the field-windings of both motors are energized, at the same time part of the current follows a shunt-circuit, starting from the point $m^2$ on winding W and passing from thence by wire 48 to a post 49 through cable 30 by wire 50 to a post 51, and current also passes from the point $m'$ on winding X by a wire 52 to post 51, to which wire 50 connects, and from thence there is a common path by wire 53 through cable 8 to contact $m$, through contact-piece $h$ to contact $p$, back by wire 59 through cable 44 to a post 57, where the current divides, part passing by a wire 58 and tapping the field-winding Y at $p'$, while a part passes by wire 56 through cable 36 to a post 55 and by wire 54 to the point $p^2$ on field-winding Z. It will therefore be obvious that while the lever $a$ of the field-controller is in its central or neutral position over contacts $m$ and $p$ the fields of the motors are equally energized, and they are consequently running at the same speed, and the car is standing still. Now let the lever $a$ be moved to the left, so that contact-piece $h$ rests upon contact $l$ only. Then the field-circuit may be traced as follows: The energizing-current reaches the fields at post 26 by wire 25, and since the points $l^2$ and $l'$ on the fields W and X are electrically connected with contact $l$ on the car that part of the field-coils respectively between the points $l^2$ and $l'$ and binding-post 31 will be short-circuited, and the current will pass directly from the points $l'$ and $l^2$ to contact $l$. Starting from $l^2$ in field-winding W, the current will pass by wire 48 to post 49, thence through cable 30 by wire $50^a$ to post 51, and current also passes from the point $l'$ on field-winding X to binding-post 51. From thence the current passes through cable 8 by wire $53^a$ to contact $l$, thence to arc $g$, thence by common conductor 60 through cable 44 to cable end 43 and continues by common conductor 60 to spring $u'$, to spring $u''$, by common conductor 61 to binding-post 31, thence by wire 33 to post 34, and from thence through the entire field-windings Y and Z back to the negative lead. The field magnetization of motor B has thus been reduced, while that of C has remained unaltered, and B will speed up, while C will remain at normal speed. If lever $a$ is moved to the right, so that contact-piece $h$ rests upon contact $o$, the field-current will pass through the entire field-windings of motor B to binding-post 31, from thence by common conductor 61 to spring $u''$, to spring $u'$, by common conductor 60 to the cable end 43, through the cable 44 by common conductor 60 to arc $g$ on the car and contact $o$, thence back through cable 44 by wire $59^a$ to post 57, where the current divides, part passing by wire 58 to the point $o'$ on the field-winding Y, thus short-circuiting some of the coils of this field, and part passing by wire $56^a$ through cable 36 to post 55, thence by wire 54 to the point $o^2$ on winding Z, thus short-circuiting some of the coils of this field. Hence motor C will speed up and motor B remain at normal speed.

In my system it has been shown that the controlling-lever $a$ on the car must be moved to a central position in order to operate the starting and stopping switch D and that in this position the field magnetization of each motor is the same, a variation in the field magnetization of either motor being possible only by a movement of the lever to one side

or the other of the center. It has also been shown that this variation can only be produced when the circuit through the common conductor is completed, which does not take place until the last core T is attracted upward and the motors are deriving current directly from the mains. From the foregoing considerations it therefore follows that no variation in the relative speeds of the motors can be produced until they have reached their normal speed and are running at the same number of revolutions per minute, nor can they be stopped after the speed of one has been varied until they have been brought back to normal speed. It is at once obvious to those skilled in the art that this improved method of operation is of the utmost utility in a system such as I have described, since chances of injuring the motors are greatly reduced, certainty of operation is provided and smooth consistent working obtained with the greatest economy.

Having thus described my invention, what I claim, and desire to secure by Letters Patent of the United States, is—

1. The combination of a car, two electric motors connected therewith in such a way that when they are both running at the same speed the car will remain stationary and when they are running at relatively different rates of speed the car will move either upward or downward, a source of electrical energy, and means for short-circuiting the current through a portion of the field of either one of the motors, substantially as set forth.

2. The combination of two electric motors capable of running at the same and also at relatively different rates of speed, a car operated thereby, the same remaining stationary when the said motors run at the same speed and moving either upward or downward when said motors run at relatively different rates of speed, a source of electrical energy, and means carried by the car for cutting out field-sections of either motor while the strength of the field of the other motor remains unaltered, substantially as set forth.

3. The combination of two electric motors, a circuit therefor, a car operated by said motors in the manner described, a motor-starter, and controlling mechanism dependent for its operation upon the previous working of the motor-starter, substantially as set forth.

4. The combination of two electric motors, a car operated thereby as described, a source of electrical energy, and devices for starting said motors and controlling their respective speed, the arrangement being such that the motors will be fully started before their speed can be varied and their speed must again be equalized before they can be stopped, substantially as set forth.

5. The combination of a car, two motors adapted to operate said car in connection with a brake, a source of electrical energy, a starting apparatus and circuit therefor including a switch, and a circuit including a solenoid capable of withdrawing the brake and also including a switch in parallel with the switch of said starting apparatus, said switches being worked together and operating to make and break circuit so that the brake will be withdrawn only after the motors are started and will be again applied before they are stopped, substantially as set forth.

6. The combination of two motors, a source of electrical energy, a car operated by said motors in the manner described, in connection with the brake, a circuit including a switch and means for withdrawing the brake, and a controller occupying a neutral position at the time when said switch is being closed or opened, substantially as set forth.

7. The combination of two motors, a source of electrical energy, a car operated by said motors as described, in connection with a brake, a starting apparatus, a circuit for the starting apparatus and for the brake, means for electrically removing the brake, and a controller occupying a neutral position at the time of the closing and opening of the circuit, substantially as set forth.

8. An elevator system comprising two electric motors having their fields connected in multiple severally and in series collectively, their armatures being also connected in multiple, a car operated by said motors in the manner described, in connection with a suitable brake, a motor-starter, means for electrically withdrawing the brake after the motors are started, a controller workable subsequently to the starting of the motors and withdrawal of the brake, a source of electrical energy, and circuits for the motor-armatures, fields, starter, brake, and controller, the circuit of the motor-starter including lamps and a differential solenoid with a core carrying contact-disks respectively adapted to cut in the lamps and close the field and brake circuits, substantially as set forth.

9. The combination of a car, two electric motors connected therewith in such a way that when they are both running at the same speed the car will remain stationary and when they are running at relatively different rates of speed the car will move either upward or downward, a source of electrical energy, and electrical means for varying the speed of either motor, substantially as set forth.

10. The combination of a car, two electric motors connected therewith in such a way that when they are both running at the same speed the car will remain stationary and when they are running at relatively different rates of speed the car will move either upward or downward, a source of electrical energy, and means for varying the field magnetization of either motor, substantially as set forth.

11. The combination of a car, two electric motors connected therewith in such a way that when they are both running at the same speed the car will remain stationary and when they are running at relatively different rates

of speed the car will move either upward or downward, a source of electrical energy, and electrical means controlled from the car for varying the speed of either motor, substantially as set forth.

12. The combination of a car, two electric motors connected therewith in such a way that when they are both running at the same speed the car will remain stationary and when they are running at relatively different rates of speed the car will move either upward or downward, a source of electrical energy, and means controlled from the car for varying the field magnetization of either motor, substantially as set forth.

13. The combination of a car, two electric motors connected therewith in such a way that when they are both running at the same speed the car will remain stationary and when they are running at relatively different rates of speed the car will move either upward or downward, a source of electrical energy, and means controlled from the car for short-circuiting the current through a portion of the field of either one of the motors, substantially as set forth.

14. The combination of a car, two electric motors connected therewith in such a way that when they are both running at the same speed the car will remain stationary and when they are running at relatively different rates of speed the car will move either upward or downward, a source of electrical energy, and electrical means for varying the speed of either motor, while that of the other is maintained constant, substantially as set forth.

15. The combination of a car, two electric motors connected therewith in such a way that when they are both running at the same speed the car will remain stationary and when they are running at relatively different rates of speed the car will move either upward or downward, a source of electrical energy, and means for varying the field magnetization of either motor while that of the other is maintained constant, substantially as set forth.

16. The combination of a car, two electric motors connected therewith in such a way that when they are both running at the same speed the car will remain stationary and when they are running at relatively different rates of speed the car will move either upward or downward, a source of electrical energy, and electrical means controlled from the car for varying the speed of either motor while that of the other is maintained constant, substantially as set forth.

17. The combination of a car, two electric motors connected therewith in such a way that when they are both running at the same speed the car will remain stationary and when they are running at relatively different rates of speed the car will move either upward or downward, a source of electrical energy, and means controlled from the car for varying the field magnetization of either motor while that of the other is maintained constant, substantially as set forth.

18. The combination of a car, two electric motors connected therewith in such a way that when they are both running at the same speed the car will remain stationary and when they are running at relatively different rates of speed the car will move either upward or downward, a source of electrical energy, and controlling means, operative only after the motors have attained substantially normal speed, for varying the speed of either motor, substantially as set forth.

19. The combination of a car, two electric motors connected therewith in such a way that when they are both running at the same speed the car will remain stationary and when they are running at relatively different rates of speed the car will move either upward or downward, a source of electrical energy, and means, operative only after the motors have attained substantially normal speed, for varying the field magnetization of either motor, substantially as set forth.

20. The combination of a car, two electric motors connected therewith in such a way that when they are both running at the same speed the car will remain stationary and when they are running at relatively different rates of speed the car will move either upward or downward, a source of electrical energy, and controlling means, operative only after the motors have attained substantially normal speed, for short-circuiting the current through a portion of the field of either motor, substantially as set forth.

21. The combination of a car, two electric motors connected therewith in such a way that when they are both running at the same speed the car will remain stationary and when they are running at relatively different rates of speed the car will move either upward or downward, a source of electrical energy, and controlling means controlled from the car, operative only after the motors have attained substantially normal speed, for varying the speed of either motor, substantially as set forth.

22. The combination of a car, two electric motors connected therewith in such a way that when they are both running at the same speed the car will remain stationary and when they are running at relatively different rates of speed the car will move either upward or downward, a source of electrical energy, and means controlled from the car, operative only after the motors have attained substantially normal speed, for varying the field magnetization of either motor, substantially as set forth.

23. The combination of a car, two electric motors connected therewith in such a way that when they are both running at the same speed the car will remain stationary and when they are running at relatively different rates of speed the car will move either upward or

downward, a source of electrical energy, and controlling means controlled from the car, operative only after the motors have attained substantially normal speed for short-circuiting the current through a portion of the field of either motor, substantially as set forth.

24. The combination of a car, two electric motors connected therewith in such a way that when they are both running at the same speed the car will remain stationary and when they are running at relatively different rates of speed the car will move either upward or downward, a source of electrical energy, and controlling means, operative only after the motors have attained substantially normal speed, for varying the speed of either motor while that of the other is maintained constant, substantially as set forth.

25. The combination of a car, two electric motors connected therewith in such a way that when they are both running at the same speed the car will remain stationary and when they are running at relatively different rates of speed the car will move either upward or downward, a source of electrical energy, and means, operative only after the motors have attained substantially normal speed, for varying the field magnetization of either motor while that of the other is maintained constant, substantially as set forth.

26. The combination of a car, two electric motors connected therewith in such a way that when they are both running at the same speed the car will remain stationary and when they are running at relatively different rates of speed the car will move either upward or downward, a source of electrical energy, and controlling means, operative only after the motors have attained substantially normal speed, for short-circuiting the current through a portion of the field of either motor while that of the other is maintained constant, substantially as set forth.

27. The combination of a car, two electric motors connected therewith in such a way that when they are both running at the same speed the car will remain stationary and when they are running at relatively different rates of speed the car will move either upward or downward, a source of electrical energy, and controlling means controlled from the car, operative only after the motors have attained substantially normal speed, for varying the speed of either motor while that of the other is maintained constant, substantially as set forth.

28. The combination of a car, two electric motors connected therewith in such a way that when they are both running at the same speed the car will remain stationary and when they are running at relatively different rates of speed the car will move either upward or downward, a source of electrical energy, and means controlled from the car, operative only after the motors have attained substantially normal speed, for varying the field magnetization of either motor while that of the other is maintained constant, substantially as set forth.

29. The combination of a car, two electric motors connected therewith in such a way that when they are both runnning at the same speed the car will remain stationary and when they are running at relatively different rates of speed the car will move either upward or downward, a source of electrical energy, and controlling means controlled from the car, operative only after the motors have attained substantially normal speed for short-circuiting the current through a portion of the field of either motor while that of the other is maintained constant, substantially as set forth.

30. The combination of a car, two electric motors connected therewith in such a way that when they are both running at the same speed the car will remain stationary and when they are running at relatively different rates of speed the car will move either upward or downward, a source of electrical energy, means for starting and stopping the motors, and means for varying the speed of either motor, the arrangement being such that the motors must be brought to run at normal speed before they can be stopped, substantially as set forth.

31. The combination of a car, two electric motors connected therewith in such a way that when they are both running at the same speed the car will remain stationary and when they are running at relatively different rates of speed the car will move either upward or downward, a source of electrical energy, means for starting and stopping the motors, and means for varying the field magnetization of either motor, the arrangement being such that the motors must be brought to run at normal speed before they can be stopped, substantially as set forth.

32. The combination of a car, two electric motors connected therewith in such a way that when they are both running at the same speed the car will remain stationary and when they are running at relatively different rates of speed the car will move either upward or downward, a source of electrical energy, means for starting and stopping the motors, and means for short-circuiting the current through a portion of the field of either motor, the arrangement being such that the motors must be brought to run at normal speed before they can be stopped, substantially as set forth.

33. The combination of the car, two electric motors connected therewith in such a way that when they are both running at the same speed the car will remain stationary and when they are running at relatively different rates of speed the car will move either upward or downward, a source of electrical energy, means for starting and stopping the motors, and electrical means for varying the speed of either motor while that of the other is maintained constant, the arrangement be-

ing such that the motors must be brought to run at normal speed before they can be stopped, substantially as set forth.

34. The combination of the car, two electric motors connected therewith in such a way that when they are both running at the same speed the car will remain stationary and when they are running at relatively different rates of speed the car will move either upward or downward, a source of electrical energy, means for starting and stopping the motors, and means for varying the field magnetization of either motor while that of the other is maintained constant, the arrangement being such that the motors must be brought to run at normal speed before they can be stopped, substantially as set forth.

35. The combination of the car, two electric motors connected therewith in such a way that when they are both running at the same speed the car will remain stationary and when they are running at relatively different rates of speed the car will move either upward or downward, a source of electrical energy, means for starting and stopping the motors, and means for short-circuiting the current through a portion of the field of either motor while that of the other is maintained constant, the arrangement being such that the motors must be brought to run at normal speed before they can be stopped, substantially as set forth.

36. The combination of the car, two electric motors connected therewith in such a way that when they are both running at the same speed the car will remain stationary and when they are running at relatively different rates of speed the car will move either upward or downward, a source of electrical energy, means for starting and stopping the motors, and electrical means, operative only after the motors have obtained substantially normal speed, for varying the speed of either motor, the arrangement being such that the motors must again be brought to run at normal speed before they can be stopped, substantially as set forth.

37. The combination of the car, two electric motors connected therewith in such a way that when they are both running at the same speed the car will remain stationary and when they are running at relatively different rates of speed the car will move either upward or downward, a source of electrical energy, means for starting and stopping the motors, and means, operative only after the motors have attained substantially normal speed, for varying the field magnetization of either motor, the arrangement being such that the motors must again be brought to run at normal speed before they can be stopped, substantially as set forth.

38. The combination of the car, two electric motors connected therewith in such a way that when they are both running at the same speed the car will remain stationary and when they are running at relatively different rates of speed the car will move either upward or downward, a source of electrical energy, means for starting and stopping the motors, and electrical means, operative only after the motors have attained substantially normal speed, for short-circuiting the current through a portion of the field of either motor, the arrangement being such that the motors must again be brought to run at normal speed before they can be stopped, substantially as set forth.

39. The combination of the car, two electric motors connected therewith in such a way that when they are both running at the same speed the car will remain stationary and when they are running at relatively different rates of speed the car will move either upward or downward, a source of electrical energy, means for starting and stopping the car, and controlling means, operative only after the motors have attained substantially normal speed, for varying the speed of either motor while that of the other is maintained constant, the arrangement being such that the motors must again be brought to run at normal speed before they can be stopped, substantially as set forth.

40. The combination of the car, two electric motors connected therewith in such a way that when they are both running at the same speed the car will remain stationary and when they are running at relatively different rates of speed the car will move either upward or downward, a source of electrical energy, means for starting and stopping the motors, and means, operative only after the motors have attained substantially normal speed, for varying the field magnetization of either motor while that of the other is maintained constant, the arrangement being such that the motors must again be brought to run at normal speed before they can be stopped, substantially as set forth.

41. The combination of the car, two electric motors connected therewith in such a way that when they are both running at the same speed the car will remain stationary and when they are running at relatively different rates of speed the car will move either upward or downward, a source of electrical energy, means for starting and stopping the motors, and controlling means, operative only after the motors have attained substantially normal speed, for short-circuiting the current through a portion of the field of either motor while that of the other is maintained constant, the arrangement being such that the motors must again be brought to run at normal speed before they can be stopped, substantially as set forth.

In testimony whereof I hereunto set my hand in the presence of two witnesses.

ETHELBERT M. FRASER. [L. S.]

Witnesses:
L. C. FRASER,
A. H. STE. MARIE.