No. 819,195. PATENTED MAY 1, 1906.

P. WRIGHT.

ELECTRIC ELEVATOR.

APPLICATION FILED JAN. 19, 1905.

4 SHEETS—SHEET 1.

Fig. 1

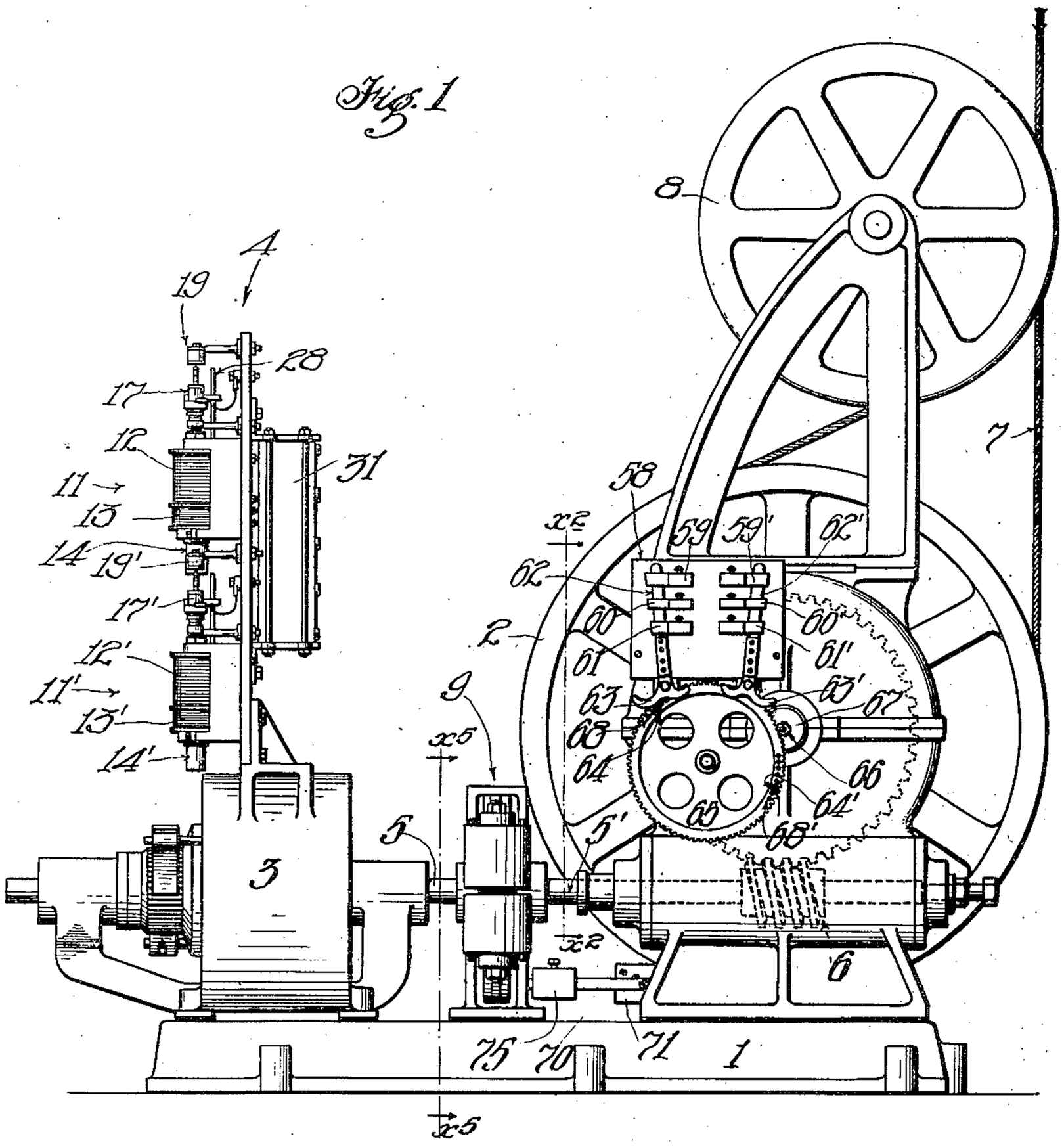
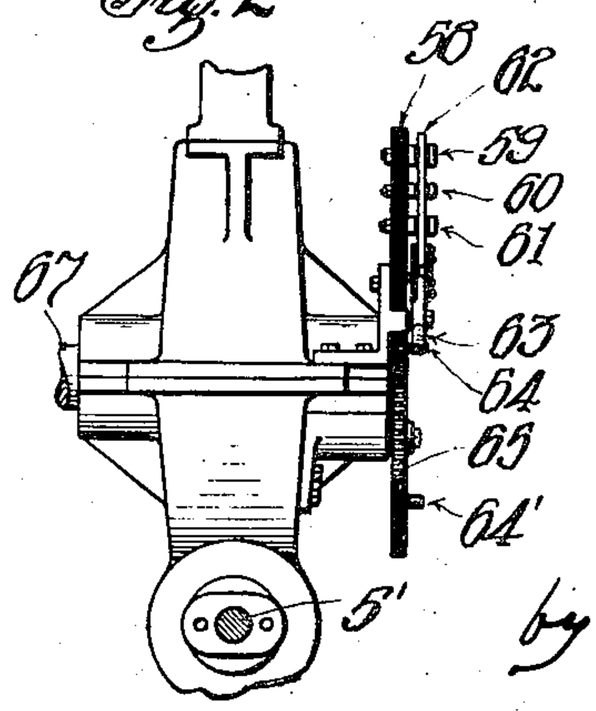


Fig. 2



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4 SHEETS—SHEET 2.

Fig. 4

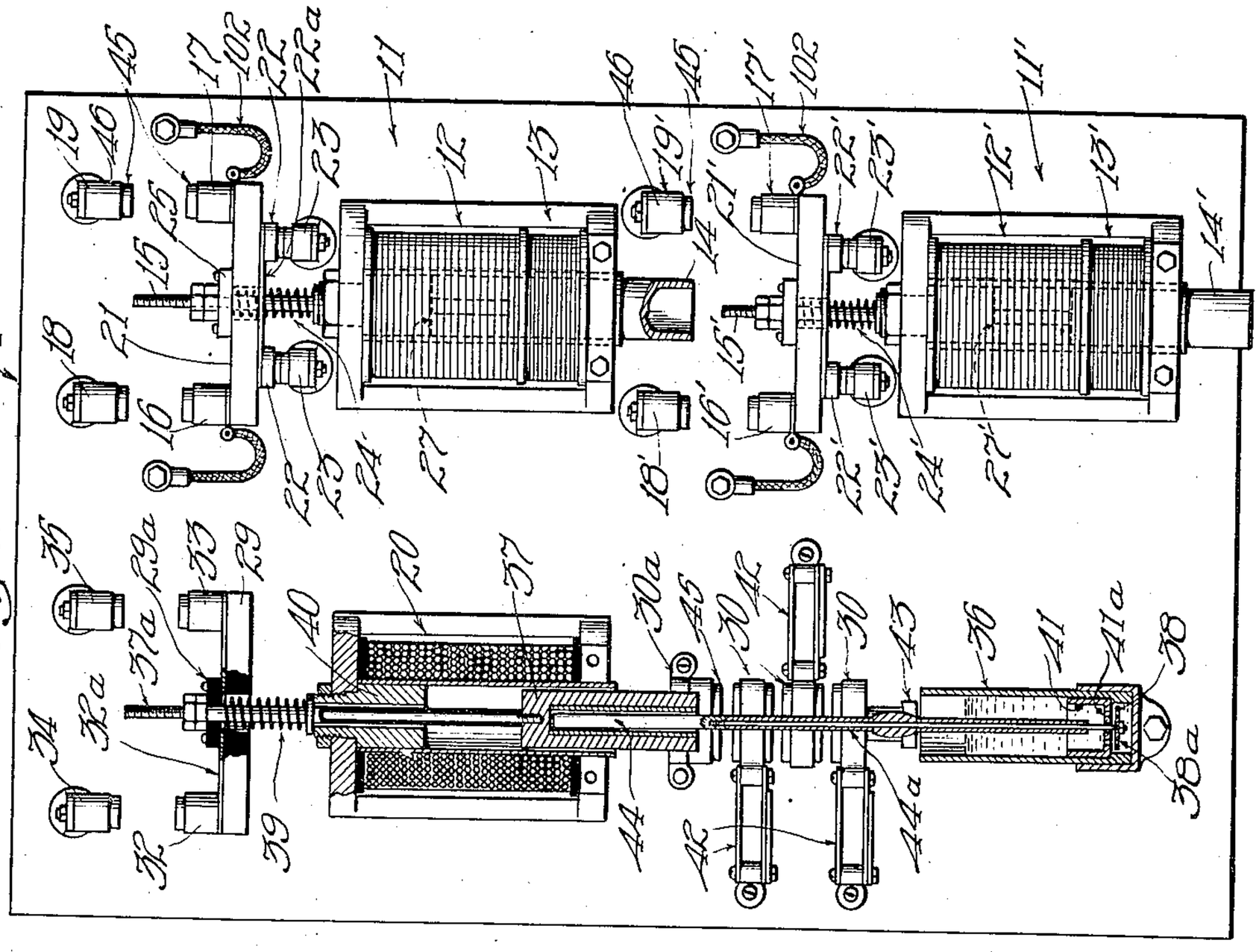
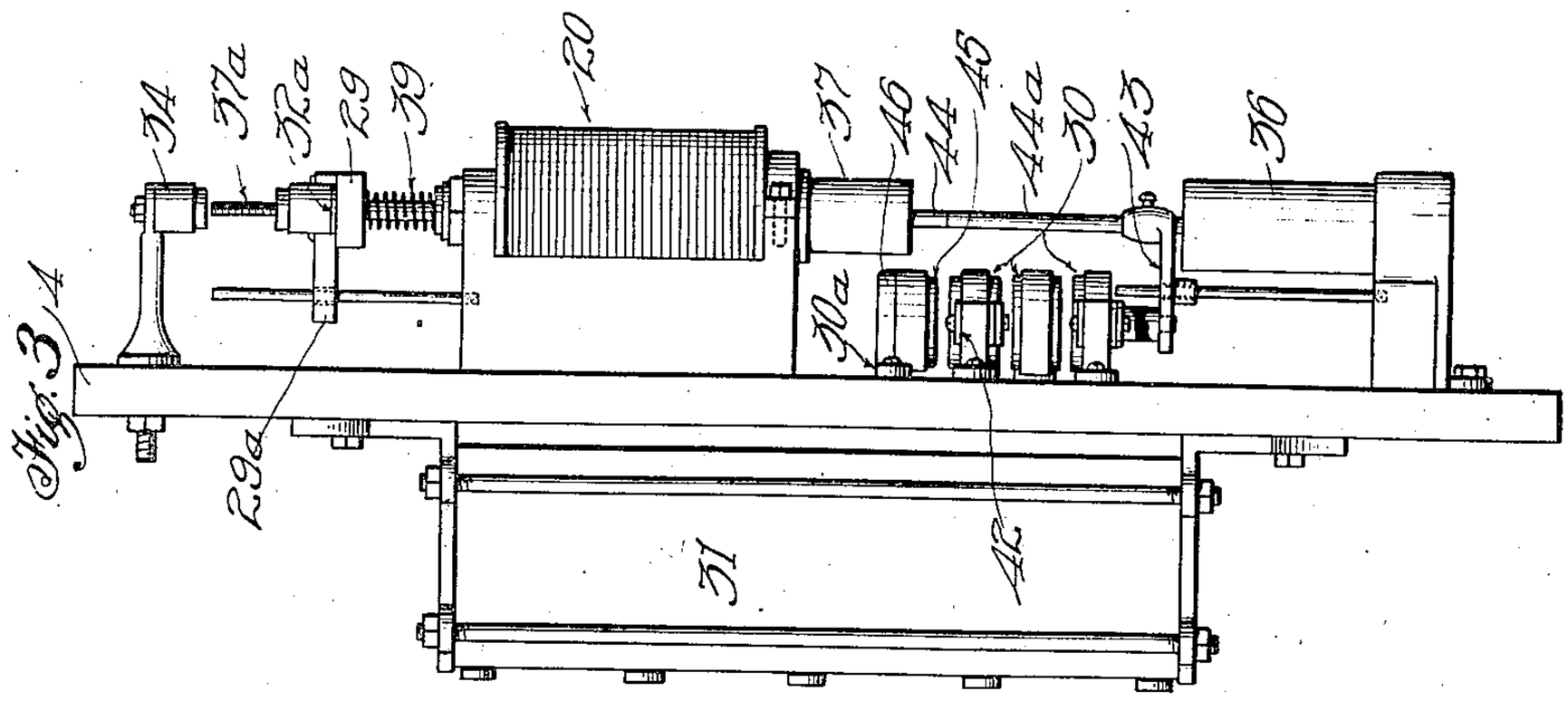


Fig. 3



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4 SHEETS—SHEET 3.

Fig. 5

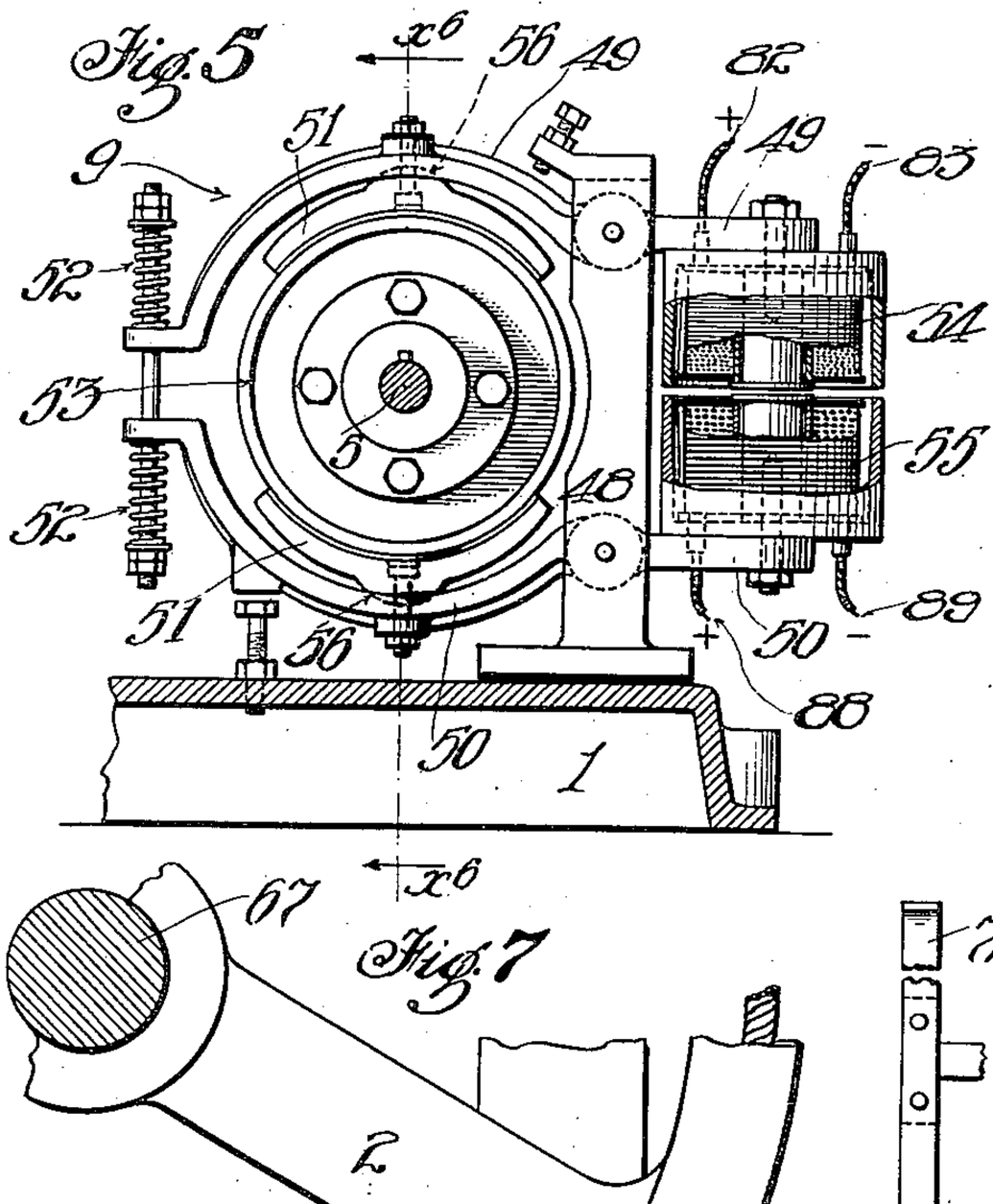

Fig. 6

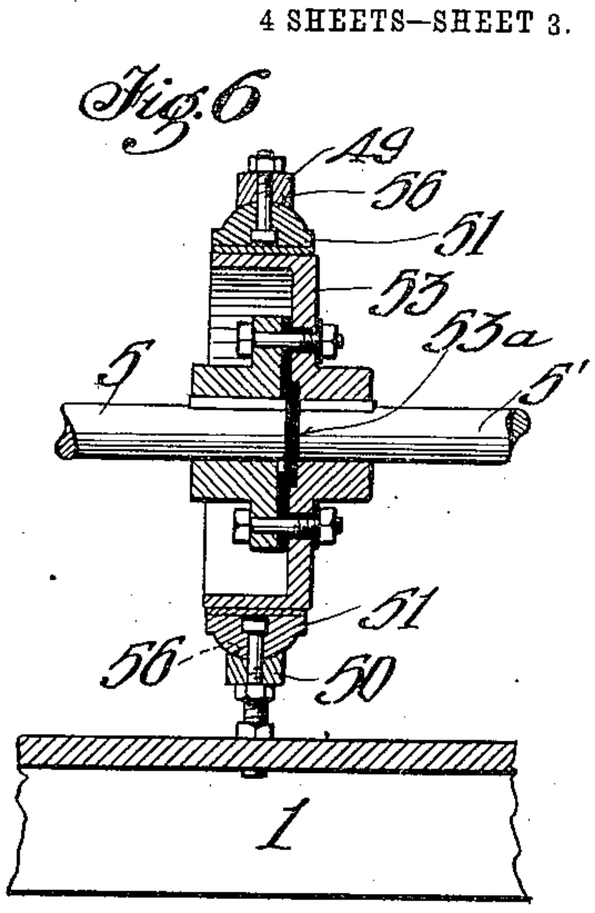

Fig. 7

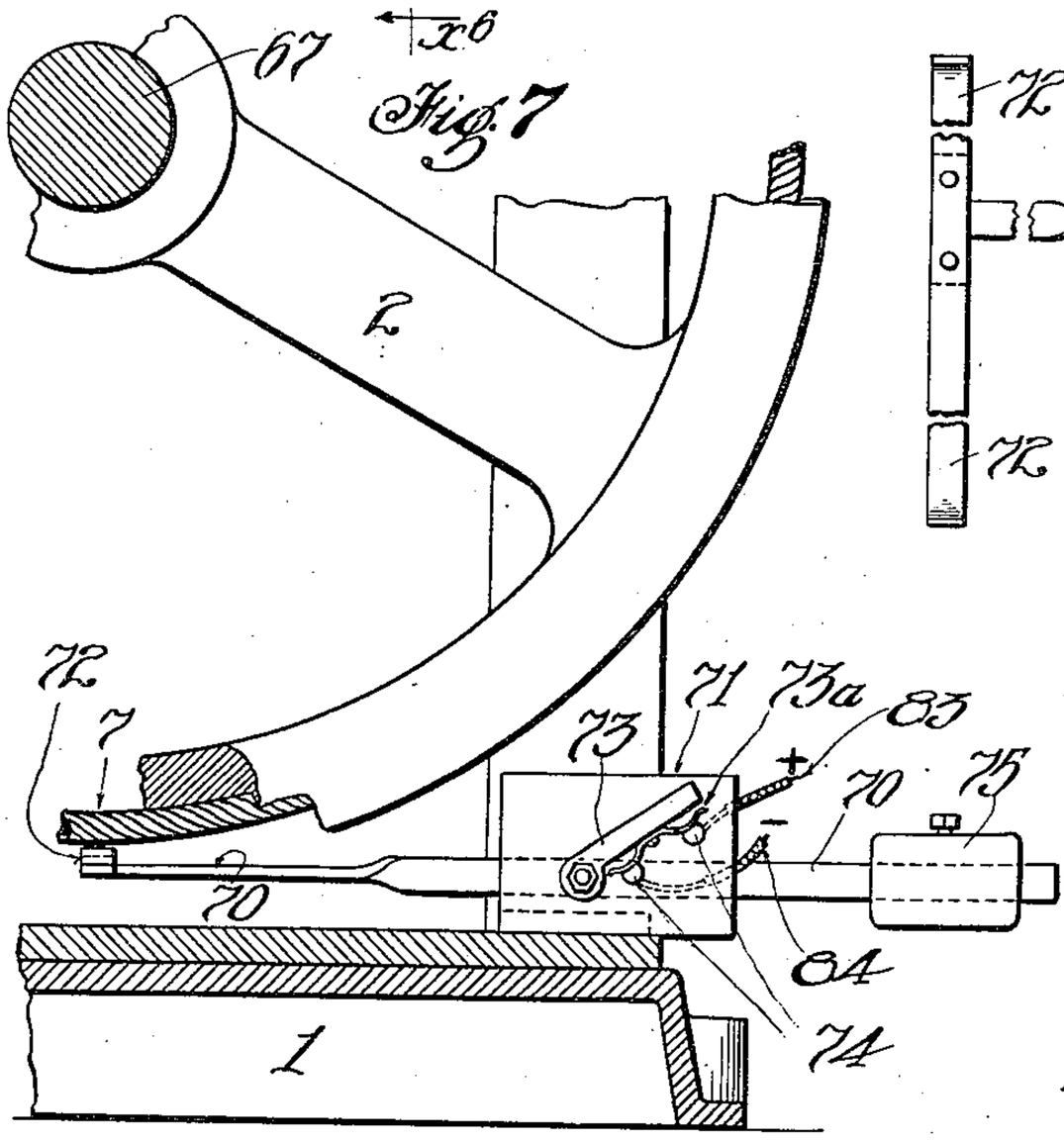

Fig. 8

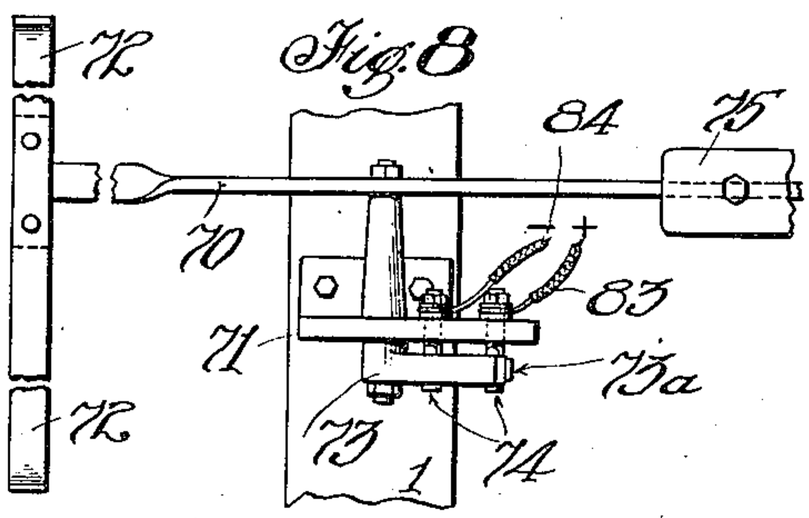

Fig. 9

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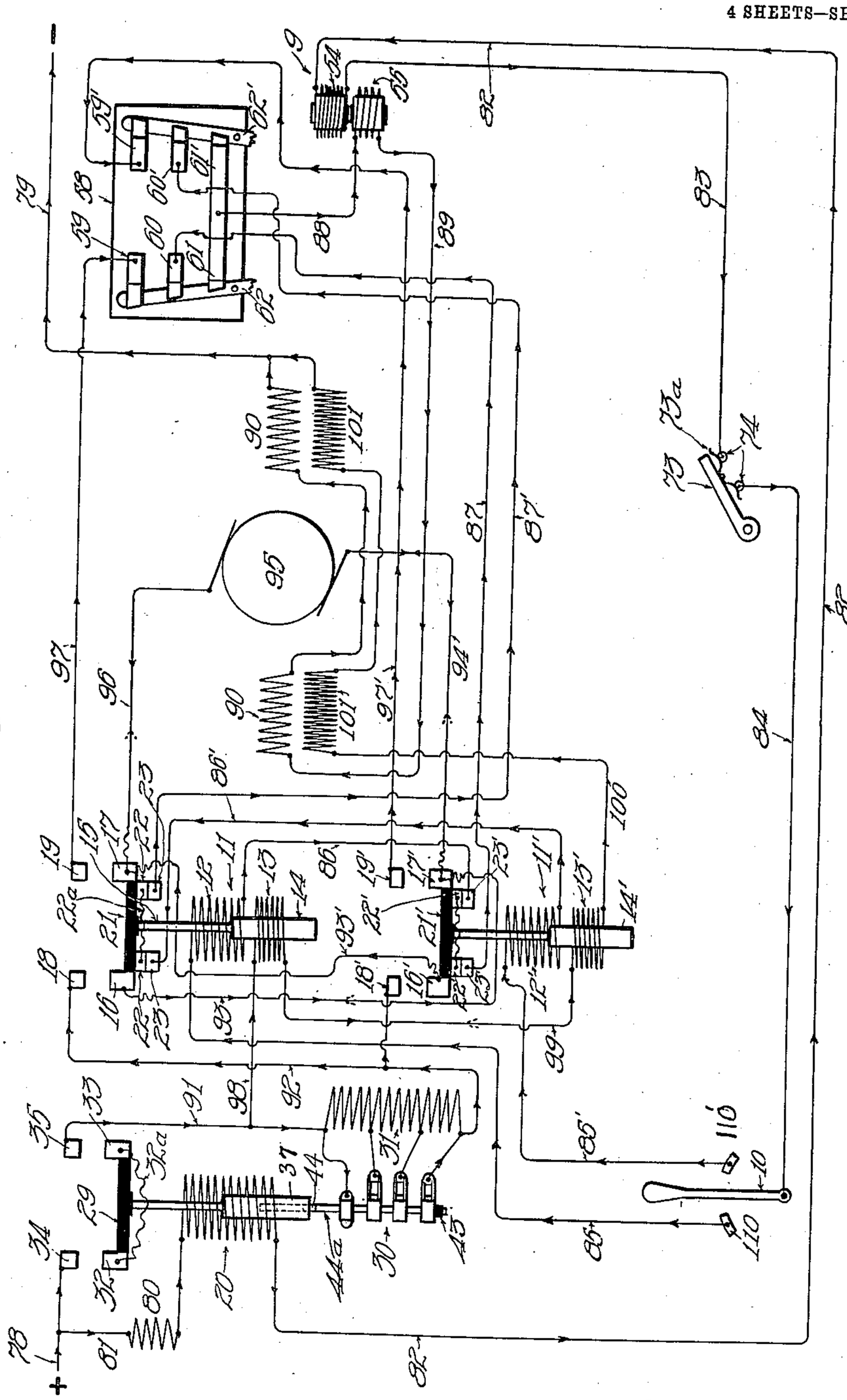
4 SHEETS—SHEET 4.

Fig. 10



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UNITED STATES PATENT OFFICE.

PARVIN WRIGHT, OF LOS ANGELES, CALIFORNIA.

ELECTRIC ELEVATOR.

No. 819,195. Specification of Letters Patent. Patented May 1, 1906.

Application filed January 19, 1905. Serial No. 241,742.

To all hom it may concern:

Be it known that I, PARVIN WRIGHT, a citizen of the United States, residing at Los Angeles, in the county of Los Angeles and State of California, have invented new and useful Improvements in Electric Elevators, of which the following is a specification.

The main object of this invention is to provide an electric-elevator system of great economy and efficiency in operation.

A further object of the invention is to provide for convenient and effective control of the operation of the elevator.

Another object of the invention is to provide means for safeguarding the system against any possibility of injury thereto by sudden reversal of the controller or reversing-switch.

Another object of this invention is to provide in an elevator system of this character improved means for automatically arresting the movement of the elevator when it reaches the limit of its travel in either direction.

Another object of the invention is to provide in an elevator system of this character means for arresting the movement of the elevator and generally for throwing the system out of operation upon occurrence of a slack cable by the sticking of the elevator in its descent.

Another object of the invention is to provide means for the gradual and smooth starting of the elevator in operation.

Another object of the invention is to provide in an elevator system of this character improved braking means for the elevator.

An additional object of the invention is to provide for gradual deënergization of the motor-field, thereby avoiding possibility of injury to the insulation by the self-induction discharge from the field-magnet.

The elevator-operating system herein shown comprises the following elements: cable mechanism connected to operate the elevator, an electric motor connected to operate said cable mechanism, operating-circuit connections for said motor, controlling means on the elevator cab or cage, and electromagnetically-operated controlling devices adjacent to the motor and controlling its operation and responsive to and controlled by the controller in the elevator-cage. Said electromagnetic controlling devices comprise a main switch operated electromagnetically to close the main circuit of the motor, a rheostatic device operated electromagnetically to gradually cut out resistance in the motor-circuit, and reversing-switches operated electromagnetically to reverse the circuit connections of the motor.

The present invention relates in part to the special construction of these electromagnetic controlling devices with a view to their more effective operation, simplicity of construction, and freedom from liability to injury by arcing.

The system is so arranged that when the motor is cut off from the main circuit the motor is connected in a closed circuit, including an electromagnetic brake, the motor acting as a generator to partially hold off the brake or retard the braking action.

The invention comprises safeguarding means for the electromagnetic reversing devices, preventing the motor from being connected to the line for reverse operation until the braking action is completed and the elevator is brought substantially to a full stop, thus preventing any liability of burning out the motor or injuring the system by throwing the line-current on an armature generating electromotive force in the same direction and also preventing the possibility of the violent reverse start that would result from such an operation.

The system further comprises certain improvements in the braking devices.

The system also comprises circuit-controlling means, herein termed "limit-switches," for disconnecting the system when the elevator reaches its upper or lower limit or movement.

The system also comprises a switch controlled by the elevator-cable and operated on slacking of the cable to disconnect the controlling system from the line.

The accompanying drawings illustrate the invention.

Figure 1 is a side elevation of the cable-drum and motor and the electromagnetic controlling devices therefor. Fig. 2 is a detail section on the line X^2 X^2 in Fig. 1. Fig. 3 is a side view of the electromagnetic controlling devices. Fig. 4 is a partly-sectional front view thereof. Fig. 5 is a side elevation, partly in section, of the electromagnetic brake, this view being taken on the line X^5 X^5 in Fig. 1. Fig. 6 is a section on the line X^6

X⁶ in Fig. 5. Fig. 7 is an inside elevation, partly in section, of part of the cable-drum, showing the slack cable circuit-controllers. Fig. 8 is a plan of said circuit-controller. Fig. 9 is a side elevation of the upper part of the electromagnetic controlling devices for the motor on the opposite side from Fig. 3. Fig. 10 is a diagram of the circuit connections.

1 designates a suitable base or frame on which are mounted the cable-winding drum 2, the electric motor 3, and the electromagnetic controlling devices mounted on a case or board 4.

The cable-drum 2 is operated from the shaft 5 of the motor 3 in any suitable manner—for example, by worm-gearing—(indicated at 6,) and the cable 7 passes over and around said drum and under the guide-sheave 8 in the usual manner.

9 designates a brake device operating on the drum-shaft 5′, said brake device operating automatically to arrest the movement of the elevator when the motor is not in operation.

The motor 3 may be of any usual or suitable type, but is preferably compound-wound. Said motor is controlled to start and stop the elevator by means of a controller or reversing switch in the elevator-cab, said controller-switch (indicated at 10 in Fig. 10) being a double-throw or two-way switch, acting through the controlling-circuits on the electromagnetic controlling means. Said electromagnetic means comprises electromagnetic switch-operating devices 11 11′, preferably solenoids, adapted to respond, respectively, to the reverse operations of the controller-switch aforesaid to close the motor-circuit for revolution in one or the other direction, the device 11 controlling the upward movement of the elevator and the device 11′ controlling the downward movement thereof.

The electromagnetic controlling means further comprises an electromagnetic device 20, preferably a solenoid, for the starting main and rheostatic switch devices to establish and control or regulate the current to the motor, so as to prevent excessive flow of current in starting and to give an easy starting movement.

The electromagnetic reverse-controllers are substantially duplicates of each other, the "up" controller comprising a solenoid with a main or operating coil 12 and an auxiliary retaining-coil 13, said coils acting conjointly on a core 14, connected by its stem or rod 15 to operate the switch 21, said switch consisting of a bar on said stem carrying insulated contacts 16 17, adapted when the bar is raised to engage fixed contacts 18 19, connected in the motor-circuit, as hereinafter set forth.

The "down" controller similarly comprises a solenoid with main and auxiliary coils 12′ 13′ and core 14′, with stem 15′, carrying switch-bar 21′ and insulated contacts 16′ 17′ thereon, adapted to engage fixed contacts 18′ 19′, also connected to the motor-circuit.

Main coils 12 and 12′ are connected in the main controlling-circuits and are sufficiently powerful to lift the respective cores on closure of the corresponding circuit. The auxiliary coils 13 13′ are connected in shunt-circuit with the motor-armature and are responsive to the electromotive condition of the armature or practically to the rotary movement of the armature, said coils acting to retain the switches in operated condition, as hereinafter set forth. Means are provided whereby when one switch is so retained in operative position the electromagnetic controlling means for the other switch is open-circuited or otherwise rendered incapable of response to the elevator-controller switch. For this purpose the switches 21 and 21′ may carry or control switch-contacts 22 22′, connected by strip 22ª and engaging fixed contacts 23 23′ to close the circuit leading to the coil 12′ or 12 of the other controlling device.

The switch-contacts 22 and 23 are connected in circuit with the solenoid-coil 12′, and when switch-bar 21 is down or in inoperative or open position its contacts 22 rest on the contacts 23 and keep the circuit of coil 12′ closed. Similarly, switch 11′ when down or open keeps the circuit of coil 12 closed.

The switch-bar 21 and arm 25 thereof may be of insulating material, so as to insulate the various contacts carried and operated thereby. Switch 21′ and switch-contacts 22′ are of similar construction to switch 21 and contact 22, respectively.

24 24′ designate buffer-springs surrounding stems 15 15′ and engaging between arms 25 on bars 21 21′ and core members 27 27′, fixed in the upper ends of the solenoids, these springs serving to give an easy cushion-stop to the switch as it drops. Arms 25 also engage and slide on guide-rods 28 to hold the switch-bars 21 21′ in alinement with the fixed contacts.

The starting-rheostat device comprises a solenoid 20, operating a main switch 29 and also operating rheostat-contacts 30, said rheostat-contacts being preferably a series of resiliently-supported contacts respectively connected to resistance-sections 31, and said contacts being movable to bring two or more of them into electric connection to short-circuit one, two, or more sections of the resistance.

The main switch may consist of a bar carrying contacts 32 33, adapted to engage when raised with fixed contacts 34 35 on the board 4. Contacts 32 33 are electrically connected by connection 32ª. Said main switch-bar is operated and carried by the stem or rod 37ª of a core 37 for solenoid 20, and a buffer-

spring 39 is desirably provided, preferably in the form of a spiral spring, surrounding rod 37ª and engaging between the cross-piece 29ª on switch-bar 29 and the top of a fixed core portion 40 of the solenoid. Members 29 38 of the switch may be of insulating material.

Each of the rheostat-contacts may be carried by a pair of parallel leaf-springs or spring-arms 42, which normally hold the contacts in extended or separated position and which will yield by a parallel linear movement to allow the contacts to be pressed together. Such operation of the contacts is effected by an arm 43, extending from the stem or rod 44ª on the core 44 of solenoid 20. The two cores 37 and 44 are preferably concentric, the core 44 telescoping within the core 37. This movement of the contacts is arrested and retarded by suitable retarding means, preferably a dash-pot 36, whose piston 41 is perforated, as at 41ª, a dasher-plate 38 on the rod 44ª being also perforated with perforations 38ª smaller than the perforations 41ª. The top contact 30 is fixed on a bracket 30ª. Normally piston 41 rests at the bottom of the dash-pot, and when the rod 44ª starts to rise it will move freely a small distance until the plate 38 strikes the piston and moves up with it.

All of the contacts of the switches 21 and 21′, main switch 27, and rheostat-contact means 25 are desirably provided with carbon terminals 45, which may be supported in suitable sockets or holders 46.

The brake device, Figs. 5 and 6, comprises a standard 48 on base 1, lever 49 50, pivoted on said standard and carrying the brake-shoes 51, spring means 52 engaging said levers to press the shoes on a wheel 53 on drum-shaft 5′, and electromagnets 54 55, mounted on the respective levers 49 50 in position to mutually attract each other when either or both are energized, as hereinafter set forth, such attraction causing the shoe-carrying arms of levers 49 50 to be moved further apart and releasing the braking-grip of the shoes on wheel 53, according to the strength of the magnet energization. Magnet 54 is connected in the controlling-circuit and magnet 55 in the motor-shunt circuit. Brake-shoes 51 are preferably mounted on levers 49 50 by a ball-and-socket bearing 56. 53ª designates an insulating-coupling between the motor and cable-drum shafts.

The limit-switches, Figs. 1 and 2, are mounted on an insulating-board 58 adjacent to the cable-drum, the upper limit-switch comprising a series of contacts 59 60 61 and a pivoted switch-lever 62 to engage simultaneously therewith and the lower limit-switch comprising corresponding members 59′ 60′ 61′ 62′. Levers 62 and 62′ have toes 63 63′ extending in the path of pins 64 64′, carried by gear-wheel 65, which is engaged by a pinion 66, fast on the cable-drum shaft 5′. Pins 64 64′ are circumferentially adjustable on wheel 65, said pins, for example, being mounted in any one of two series of holes 68 68′ on said wheel. When the elevator approaches or reaches the upper end of the elevator-shaft, pin 64 will engage toe 63 to open switch-lever 62, and when the elevator is at or near its lowermost position the pin 64′ similarly opens switch 62′, these switches being connected to open the respective circuits controlling the motor-circuits for downward and upward operation, respectively.

The slack-cable circuit-controller (see Figs. 7 and 8) consists of a lever 70, pivoted on a support 71, so that the cross arm or bar 72 on the end of said lever extends under the several rounds or layers of the cable in the drum, and a contact-arm 73, rigidly connected to lever 70 and carrying a contact-spring bridge 73ª, engaging fixed contacts 74, to normally close the controlling-circuit, a counterweight 75 on lever 70, tending to hold the circuit closed, but yielding on the springing out of the cable due to the slackening thereof, so as to cause the circuit to be broken.

The electric connections lead from the line or supply-circuit wires (indicated at 78 79) as follows: From line 78 through a wire 81, including a resistance 80, to starting and main switch solenoid 20, thence by wire 82 to brake-coil 54, wire 83 to contacts 74 73ª, wire 84 to switch 10; from one of the contacts 110 of the switch by wire 85 to coil 12, from which wire 86 leads to contact 60 of the "up" limit-switch, and from contact 61 thereof wire 88 leads to brake-coil 55, connected by wire 89 to series field-coil 90 of the motor, which is connected to wire 79. A connection 86′ leads from coil 12′ to switch-contact 23. Main switch-contact 34 is connected to line-wire 78, and contact 35 is connected by wire 91 with the series of resistance-sections 31, from which wire 92 leads to reversing-switch contact 18. From contact 16 wire 93 leads to contact 17′ of switch 21′, and wire 94 leads therefrom to one side of the motor-armature 95. Wire 96 leads from the other side of the armature to contact 17 of switch 21. From corresponding contact 19 wire 97 leads to contact 59 of the up limit-switch. A connection leads from wire 91 by wire 98 to coil 13 of solenoid 11, thence by wire 99 to coil 13′, and thence by wire 100 to one end of shunt field-coil 101 of the motor, connected at the other end to line-wire 79. Wire 92 is also connected to switch-contact 18′ of the other reversing-switch, and the connections of said switch are completed by wires 93′ 97′ in such manner as to lead the current in a reverse direction through the motor-armature. The connections to moving-contacts 16 17 16′ 17′ may be made by flexible conductors 102.

The operation of the system is as follows: Normally or when the elevator is at rest the

circuits are open, controller-circuit being open at switch 29, as well as switch 21 21′. Both upper and lower limit-switches 62 62′ will normally be closed, as will also slack-cable switch 73, leaving the controlling-circuit in condition to respond to the operation of the elevator-cab switch 10. All of the electromagnetic controlling devices will be deënergized and the motor will be inoperative; but the brake will be in action, due to deënergization of the releasing-magnets thereof, so that the elevator-cab will be held in fixed position. To start the elevator up, the switch 10 is thrown over to contact 110, thus establishing the up controlling-circuit as follows: from line-wire 78, through wire 81, resistance 80, solenoid 20, wire 82, brake-coil 54, wire 83, slack-cable switch-contacts 74 73, wire 84, switch 10, contact 110, wire 85, up solenoid 12, wire 86, switch-contacts 23′ 22′, wire 87, contact 60 of the up limit-switch, switch-blade 62, contact 61, bar 88, brake-coil 55, wire 89, series field-coil 90 of the motor to the other side of the line at 79. The current flowing in this circuit will energize the solenoid 20, drawing up the core 38 and closing switch 29, and the coil 12 of the reversing-solenoid 11 will draw up its core 14, closing the switch 21. The closure of these two switches 29 and 21 establishes the motor-circuit as follows: from wire 78 to contact 34, thence by contacts 32 33 of switch 29 to contact 35, wire 91, resistance 31, wire 92, contacts 18 16 of switch 21, wires 93 94, armature 95, wire 96, contacts 17 19 of switch 21, wire 97, contact 59, blade 62, and contact 61 of the up limit-switch, wire 88, brake-coil 55, wire 89, series field-coil 90 to the other side of the line at 79. The current flowing in this circuit energizes and sets in operation the motor, the entire resistance 26 being at first included in this circuit, but is gradually cut out by the elevation of internal core 44 of solenoid 20, the lowermost contact 30 being first brought against the second contact and on further movement the second contact being raised to engage the third, and so on, each closure between adjacent contacts cutting out one section of resistance, its movement being retarded by the dash-pot means 36 38 41, so as to give a gradual acceleration to the motor and prevent undue flow of current therein in starting. The field-magnet of the motor is energized by the series field-coil 90 in the circuit above traced and also by shunt field-coil 101, the circuit of which is traced as follows: from line-wire 78, as above, to wire 91, thence by wire 98 to coil 13 and solenoid 11, wire 99, coil 13′, wire 100, shunt field-coil 101 of the motor to the other side of the line 79.

It will be noted that the controlling-circuit at this time energizes brake-magnet 54, while the motor-circuit energizes brake-magnet 55, so that the mutual attraction of these magnets will fully release the brake. The motor will then propel the elevator upwardly until the controller-switch 10 is moved to open position, as shown in Fig. 10, thereby breaking the controller-circuit and deënergizing solenoid 20, allowing the switch 29 to fall in open position. This will break the line connection to the motor; but the armature thereof will still be on closed circuit and will act as a generator sending a current backwardly through the closed local circuit.

The operated switch 21 will not fall or open, for the reason that it is held up by the shunt-coil 13, which is energized first by a connection from the line and then when the line connection is broken by this regenerative current from the motor-armature, said current passing from the armature through wires 94 93, switch-contacts 16 18, wire 92, resistance 31, wire 98, solenoid-coil 13, wire 99, solenoid-coil 13′, wire 100, shunt field-coil 101, series field-coil 90, wire 89, brake-coil 55, contact 61, switch-arm 62, contact 59, wire 97, and switch-contacts 19 17, and wire 96 to the other side of the armature. The energization of the brake-magnet 55 will cause partial continuance of the release of the brake, so that the braking action will be gradually exerted, it being understood that the releasing action due to said coil 55 alone is much less than when the coils 55 and 54 are acting conjointly. As a result the motor will gradually slow down, and as its speed diminishes the energization of the magnet 55 will decrease, with a resulting increase in the braking action, until the motor is brought to a standstill and the elevator is stopped. The regenerative current will at this time cease to flow, and the solenoid-coil 13 will then be deenergized, allowing the core 14 to drop to open switch 21. The system is thus restored to a normal condition and is ready for operation to again start the elevator either up or down, as may be desired. If while the elevator is moving in one direction—for example, upwardly—the attendant should throw the controller-switch 10 clear over to establish a connection for moving the motor downwardly, such connection will not be immediately operated in, but the motor will first be brought to a standstill, and the safety devices for reversing switch for such connection will then be operated to establish the connection. If we assume the elevator to be moving upwardly, switch 21 will be in raised position and contact 22, controlled thereby, will be out of engagement with the contact 23, thereby opening or disconnecting the controlling-circuit for the "down" solenoid 12′. If then the attendant moves the switch-lever 10 over to the down contact 110′, the first effect will be simply that due to breaking the connection with the contact 110, which acts, as above explained, to cause the main switch 29 to open, putting the motor on closed cir

and gradually slowing up and stopping the motor, whereupon the switch 21 will drop and open the local circuit of the motor and closing contact 22 on the contact 23, thus establishing a connection through down controlling-magnet coil 12′ and to the controller-circuit 112′, so that connection established at the latter contact by the attendant will then become operative to effect reverse movement of the motor and down movement of the elevator.

The invention is not confined to the specific apparatus and connections shown, as the same may be varied considerably to meet different requirements. Thus the energizing connections for the retaining-coils 13 13′ may be connected to receive current from the armature in any suitable manner.

What I claim is—

1. In combination with an electric elevator-motor, a brake therefor, a controlling-circuit for the motor, means operated by said controlling-circuit to control the brake, a circuit for the motor independent of the controlling-circuit, and means operated by said independent circuit to control the brake.

2. In combination with an electric elevator-motor, a brake therefor, a controlling-circuit, a switch operated thereby to control the motor, connections for establishing a closed circuit for the motor independent of said switch, electromagnetic means operated by the controlling-circuit for releasing the brake, and electromagnetic means operated by said independent circuit for releasing the brake.

3. In combination with an electric elevator-motor, a brake therefor, an energizing-circuit, a main switch in said circuit and switches and reversing connections establishing reversely-operating circuits from the energizing-circuit to the motor, a controlling-circuit comprising means for operating said switches, means controlled by the operation of the reversing-switches to establish a closed circuit for the motor independent of the energizing-circuit, electromagnetic means in said closed circuit operating on the reversing means to hold the same in operated position and electromagnetic means in said closed circuit operating to release the brake.

4. In combination with an electric motor, a brake therefor, an energizing-circuit, a main switch in said circuit and switches and reversing connections establishing reversely-operating circuits from the energizing-circuit to the motor, a controlling-circuit comprising means for operating said switches, means controlled by the operation of the reversing-switches to establish a closed circuit for the motor independent of the energizing-circuit, electromagnetic means in said closed circuit operating on the reversing means to hold the same in operated position, electromagnetic means in said closed circuit operating to release the brake and a switch in the controlling connection of each reversing-switch and engaged by the other reversing-switch to close said connection when said other reversing-switch is open, and to open said connection when said other reversing-switch is closed.

5. In combination with an electric motor and its operating-circuit, a switch controlling said circuit, electromagnetic operating means for said switch comprising a coil for operating the switch and a coil for retaining the switch in operative position, a controlling-circuit including said operating-coil, and a closed circuit including the armature of the electric motor and the said retaining-coil.

6. In combination with an electric motor and its operating-circuit, a switch controlling said circuit, electromagnet operating means for said switch comprising a coil for operating the switch and a coil for retaining the switch in operative position, a controlling-circuit including said operating-coil, and a closed circuit including the armature of the electric motor and the said retaining-coil, said last-named circuit being independent of the motor-operating circuit.

7. In combination with an electric elevator-motor, a brake therefor, an energizing-circuit, a main switch in said circuit and switches and reversing connections establishing reversely-operating circuits from the energizing-circuit to the motor, a controlling-circuit comprising means for operating said switches, means controlled by the operation of the reversing-switches to establish a closed circuit for the motor independent of the energizing-circuit, electromagnetic means in said closed circuit operating on the reversing means to hold the same in operated position, electromagnetic means in said closed circuit operating to release the brake, and electromagnetic means in the controlling-circuit also operating to release the brake.

8. In combination with an electric elevator-motor, a brake therefor, an energizing-circuit, a main switch in said circuit and switches and reversing connections establishing reversely-operating circuits from the energizing-circuit to the motor, a controlling-circuit comprising means for operating said switches, means controlled by the operation of the reversing-switches to establish a closed circuit for the motor independent of the energizing-circuit, electromagnetic means in said closed circuit operating on the reversing means to hold the same in operated position, electromagnetic means in said closed circuit operating to release the brake, and limit-switches controlled by the movement of the elevator to break the respective controlling-circuit connections when the elevator reaches its limit of movement in either direction.

9. In combination with an electric eleva-

tor-motor, a brake therefor, an energizing-circuit, a main switch in said circuit and switches and reversing connections establishing reversely-operating circuits from the energizing-circuit to the motor, a controlling-circuit comprising means for operating said switches, means controlled by the operation of the reversing-switches to establish a closed circuit for the motor independent of the energizing-circuit, electromagnetic means in said closed circuit operating on the reversing means to hold the same in operated position, electromagnetic means in said closed circuit operating to release the brake, and limit-switches controlled by the movement of the elevator to break the respective controlling and brake circuit connections when the elevator reaches its limit of movement in either direction.

10. In combination with an electric elevator-motor, a cable-winding drum and a cable thereon, a brake for the motor, an energizing-circuit, a main switch in said circuit and switches and reversing connections establishing reversely-operating circuits from the energizing-circuit to the motor, a controlling-circuit comprising means for operating said switches, means controlled by the operation of the reversing-switches to establish a closed circuit for the motor independent of the energizing-circuit, electromagnetic means in said closed circuit operating on the reversing means to hold the same in operated position, electromagnetic means in said closed circuit operating to release the brake, and a switch controlled by the cable to open the controlling-circuit on occurrence of a slack cable.

11. In combination with an electric elevator-motor, a cable-winding drum and a cable thereon, a brake for the motor, an energizing-circuit, a main switch in said circuit and switches and reversing connections establishing reversely-operating circuits from the energizing-circuit to the motor, a controlling-circuit comprising means for operating said switches, means controlled by the operation of the reversing-switches to establish a closed circuit for the motor independent of the energizing-circuit, electromagnetic means in said closed circuit operating on the reversing means to hold the same in operated position, electromagnetic means in said closed circuit operating to release the brake, and a switch controlled by the cable to open the controlling and brake circuits on occurrence of a slack cable.

12. In an electric elevator system, a rheostatic device comprising a plurality of spring-contact devices arranged side by side and mounted to have a parallel linear movement toward and from one another, resistances connected to said contacts, an operating-solenoid, a core therefor, an arm connected to said core and engaging one of said contacts to press the contacts together, each of said contact devices comprising two parallel springs fixed at one end and carrying the contact means at their other end.

13. In combination with an electric motor and its operating-circuit, switches controlling said operating-circuit to operate the motor in reverse directions, retaining means for each switch to hold same in operative position, and means responsive to, and operated by, the movement of the motor to control said switch-retaining means.

14. In combination with an electric motor and its operating-circuit, switches controlling said operating-circuit to operate the motor in reverse directions, electromagnetic devices holding said switches in operative position, and a controlling connection with said operating devices to the armature of the motor to retain the switches in operated position while the motor is in motion.

15. In combination with an electric motor and its operating-circuit, switches connected to said circuit to control the operation of the motor in reverse directions, means controlled by the operation of each of said switches to prevent operation of the other switch, and means for retaining the switches in operated position, said means being responsive to, and operated by the movement of the motor.

16. In combination with an electric motor and its operating-circuit, and electric operating rheostatic switch devices controlling the resistance of said circuit, electromagnetically-operated switch devices for reversing the connections of the motor to said circuit, means retaining said reversing-switches in operated position independently of the operation of the electromagnetic device, and switch means controlled by each of the reversing-switches to render inoperative the operative connections for the other reversing-switch.

17. In an electric elevator system, an electric operating-motor, a starting-switch for the motor comprising main and rheostatic switches and a solenoid having a core connected to operate the main switch and a supplemental core connected to operate the rheostatic switch, said cores extending into the solenoid from the same end thereof and subject to attraction by the solenoid in the same direction.

18. In an electric elevator system, an electric operating-motor, a starting-switch for the motor comprising main and rheostatic switches and a solenoid having a core connected to operate the main switch, and a supplemental core connected to operate the rheostatic switch, one of said cores telescoping within the other, said cores extending into the solenoid from the same end thereof and subject to attraction by the solenoid in the same direction.

19. In an electrical elevator system, the combination with a motor of a rheostatic switch therefor comprising a plurality of

spring-supported contacts normally held in separate positions, resistance connections to the contacts, a solenoid having a removable core and an arm connected to said core to engage with one of the contacts to press the contacts successively into conducting connections, said cores extending into the solenoid from the same end thereof and subject to attraction by the solenoid in the same direction.

20. In an electric elevator system, the combination with a motor, a rheostatic switch for the motor comprising a plurality of spring-supported contacts normally held in separate positions, resistance connections to the contacts, a solenoid having a movable core and an arm connected to said core to engage with one of the contacts to press the contacts successively into conducting connection, and a dash-pot connected to said arm.

21. In an electric elevator system, the combination with a motor, of a rheostatic switch for the motor comprising a plurality of spring-supported contacts normally held in separate positions, resistance connections to the contacts, a solenoid having a movable core and an arm connected to said core to engage with one of the contacts to press the contacts successively into conducting connection, a dash-pot connected to said arm, provided with a piston-valve movable to allow free movement of the arm in one direction to allow the contacts to separate and to retard the movement in the opposite direction.

22. In combination with an electric motor, a brake therefor, and two electromagnets operating conjointly on the brake and on one another, and a controlling-circuit for the motor including both of said electromagnets.

23. In combination with an electric motor, a brake therefor, mutually-attractive electromagnetic devices acting conjointly on said brake to release the same, an operating-circuit for the motor including both of said electromagnetic devices, and a closed circuit including the armature of the motor and one of said electromagnetic brake-releasing devices.

24. In combination with an electric motor, a brake therefor, a circuit for the motor having an operating line connection, electromagnetic means acting on the brake to release the same, and a closed circuit including the armature of the electric motor and said electromagnetic releasing means, said closed circuit being independent of the operating line connection for the motor.

25. In combination with an electric motor and its operating-circuit, an electromagnetic operating-switch controlling said operating-circuit, the controlling-circuit including the electromagnetic operating means for said switch, and a field-coil of the motor.

26. In combination with an electric motor, a brake therefor, electromagnetic releasing means for the brake, an operating-circuit for the motor, an electromagnetically-operated switch in said circuit, a controlling-circuit including the electromagnetic operating means for said switch and a field-coil of the motor, and electromagnetic releasing means for the brake having an energizing-coil included in said controlling-circuit, and an energizing-coil included in the motor-operating circuit.

27. In combination with an electric motor, a brake therefor, electromagnetic releasing means for the brake, an operating-circuit for the motor, an electromagnetically-operated switch in said circuit, a controlling-circuit including the electromagnetic operating means for said switch and a field-coil of the motor, and electromagnetic releasing means for the brake having an energizing-coil included in said controlling-circuit, and an energizing-coil included in the operating-circuit and also in the controlling-circuit.

In testimony whereof I have hereunto set my hand, at Los Angeles, California, this 27th day of December, 1904.

PARVIN WRIGHT.

In presence of—
A. P. KNIGHT,
JULIA TOWNSEND.