W. DEATS.

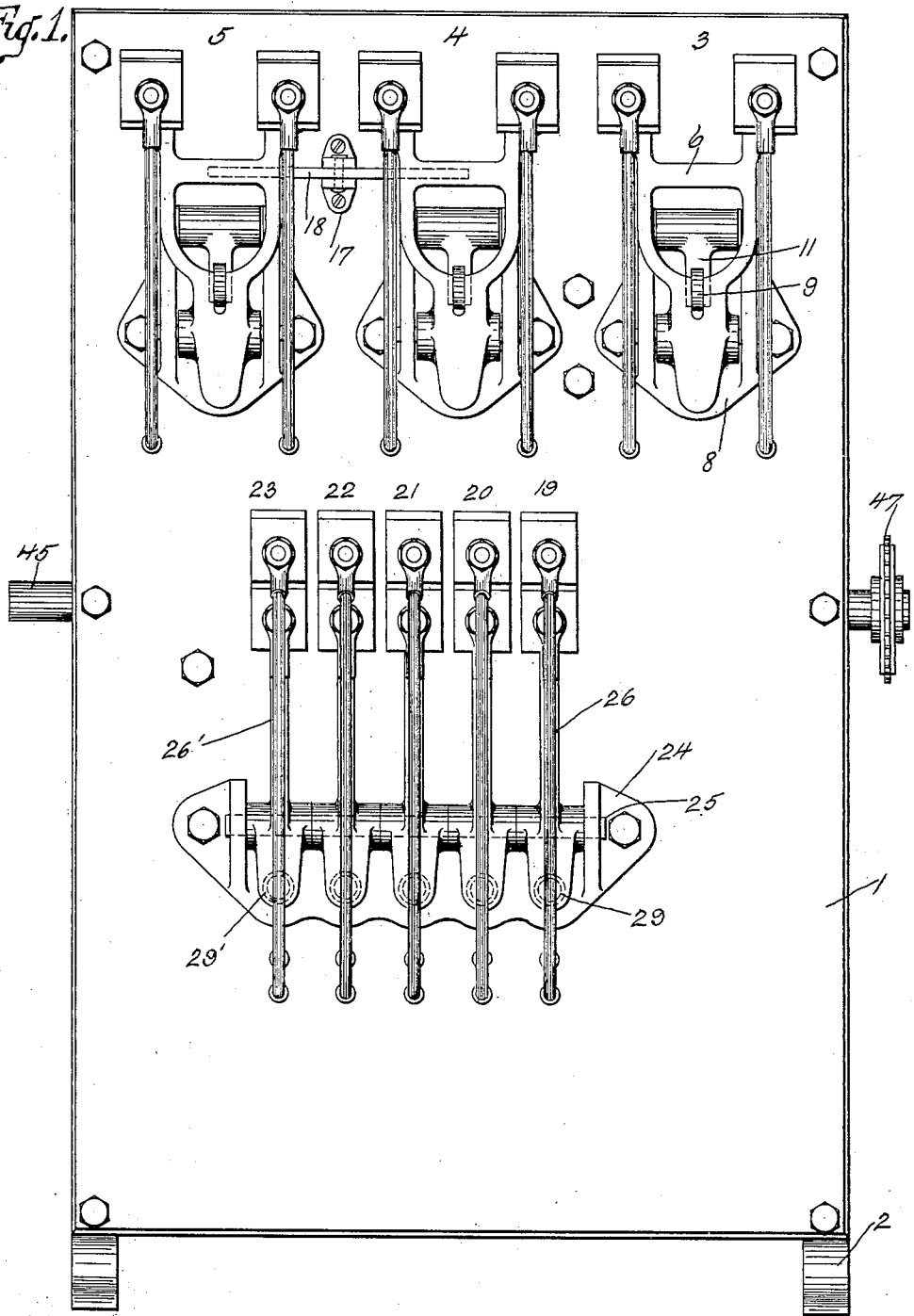
MECHANICALLY OPERATED ACCELERATING MECHANISM.

APPLICATION FILED DEC. 16, 1908.

1,077,395. **Patented Nov. 4, 1913.**

7 SHEETS—SHEET 1.

Fig. 1.



Witnesses:
Arthur C. Mason
David Larson

Inventor
William Deats
By his Attorney
J. F. Rule.

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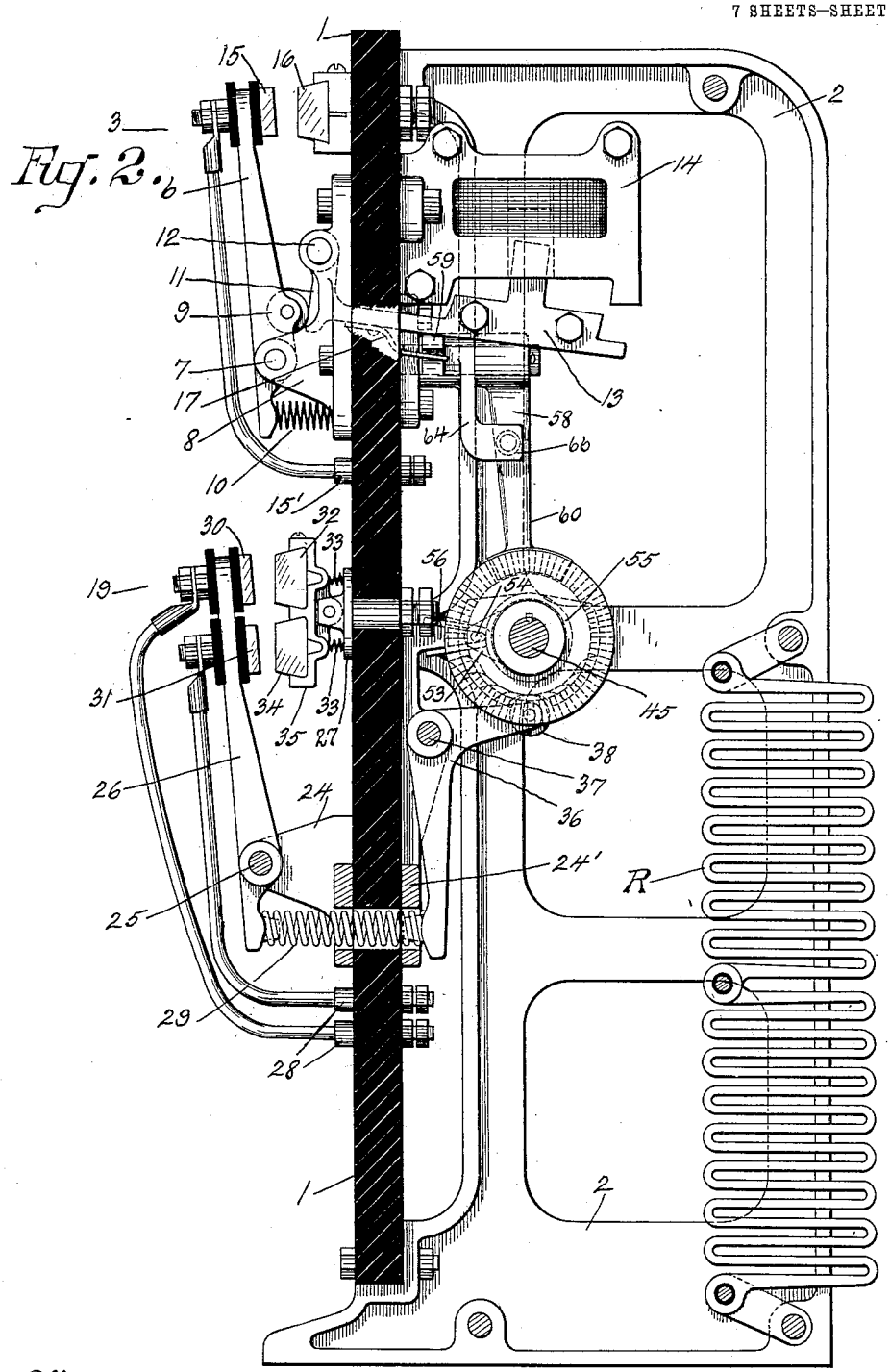
7 SHEETS—SHEET 2.

Fig. 2.



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7 SHEETS—SHEET 3.

Fig. 3.

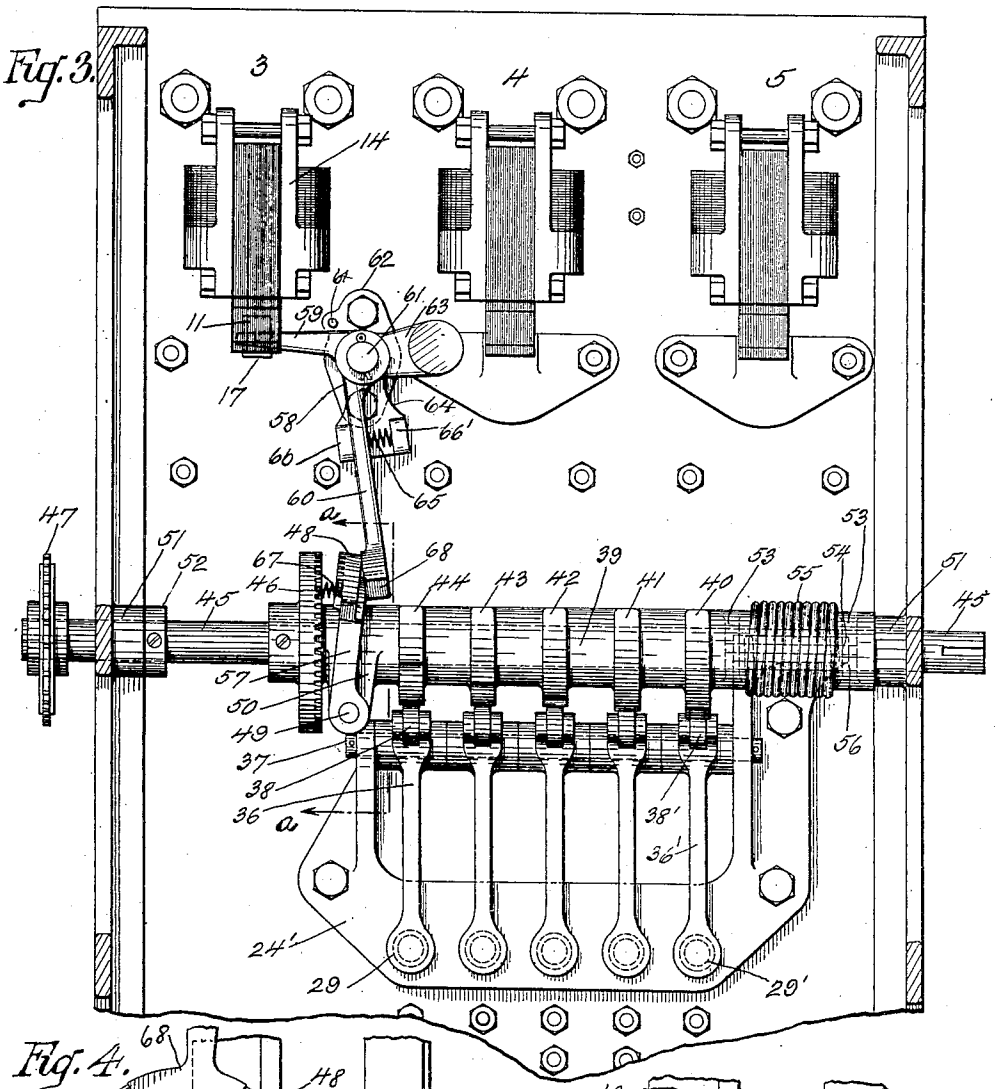


Fig. 4.

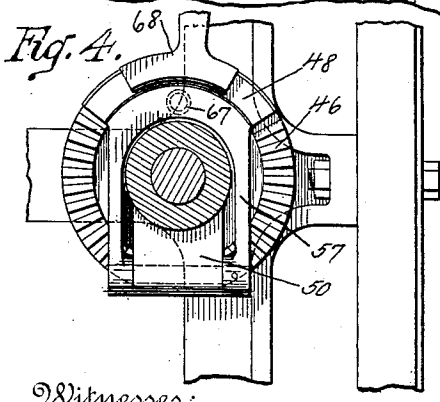
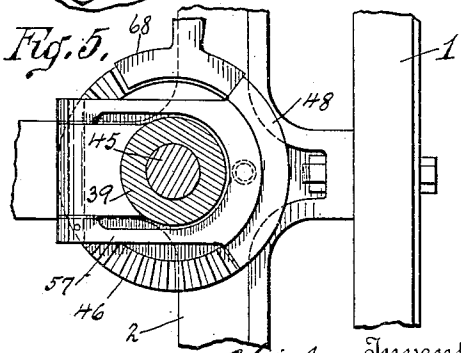


Fig. 5.



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Inventor
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J. F. Rule

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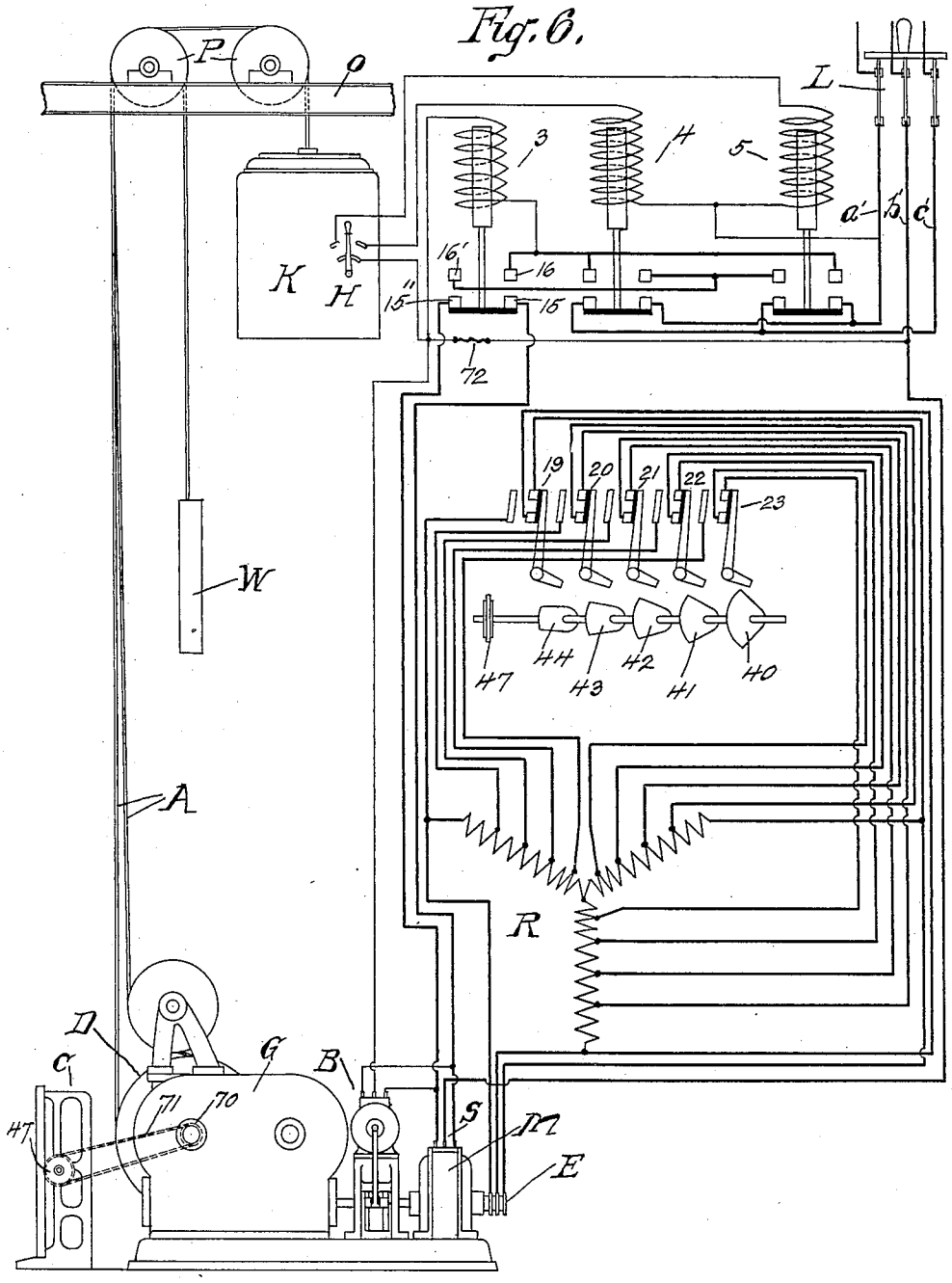
7 SHEETS—SHEET 4.

Fig. 6.



Witnesses.
Arthur C. Mason
David Larson.

Inventor
William Deats
By his Attorney J. G. Rule

W. DEATS.

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7 SHEETS—SHEET 5.

Fig. 7.

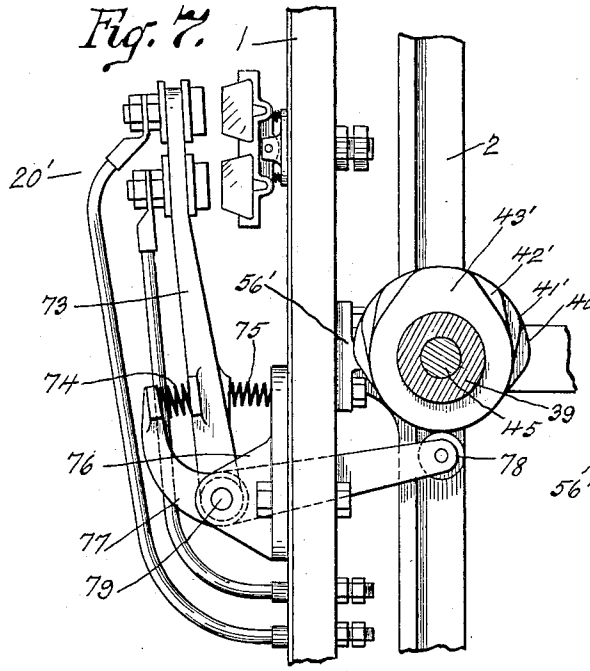


Fig. 8.

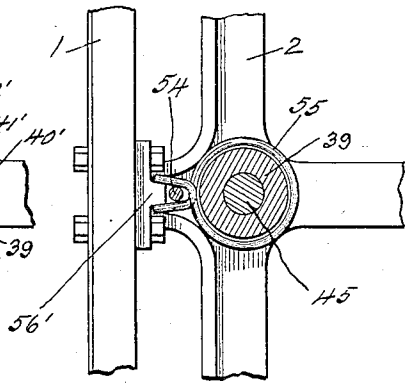


Fig. 9.

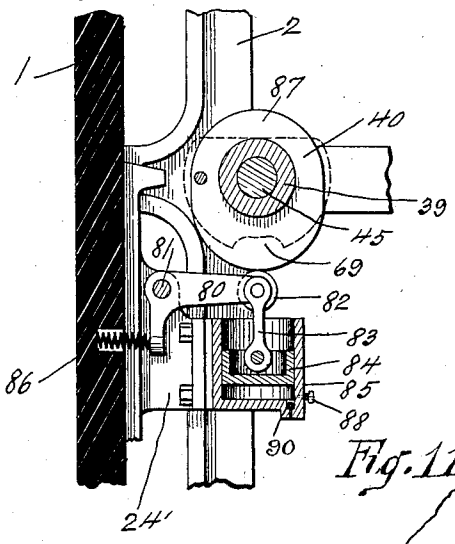


Fig. 10.

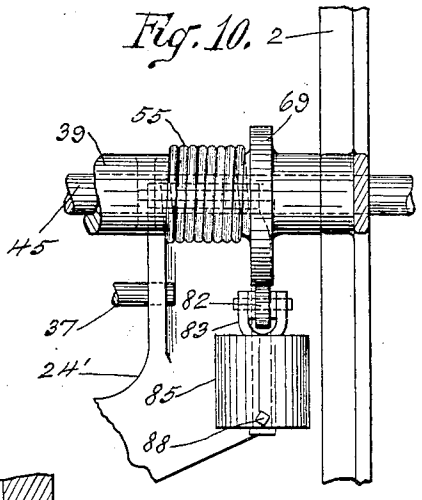
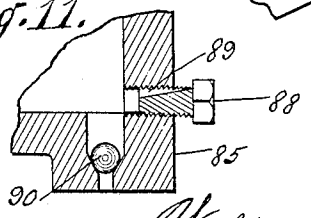


Fig. 11.



Witnesses:
Arthur C. Mason
David Larson

William Deats Inventor
By his Attorney J. F. Rule.

COLUMBIA PLANOGRAPH CO., WASHINGTON, D. C.

W. DEATS.

MECHANICALLY OPERATED ACCELERATING MECHANISM.

APPLICATION FILED DEC. 16, 1908.

1,077,395. Patented Nov. 4, 1913.

7 SHEETS—SHEET 6.

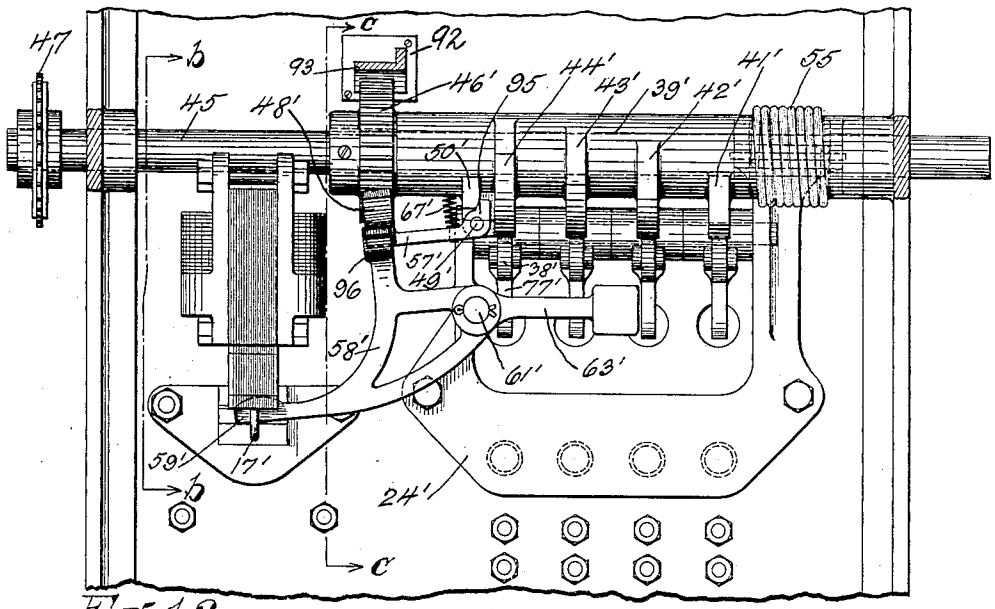


Fig. 12.

Fig. 13.

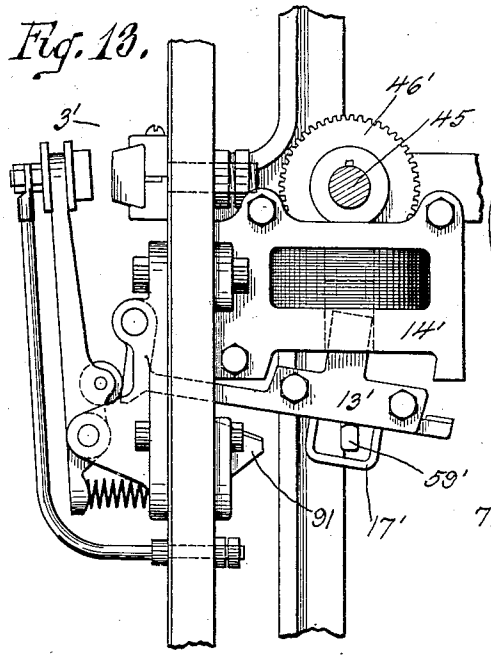
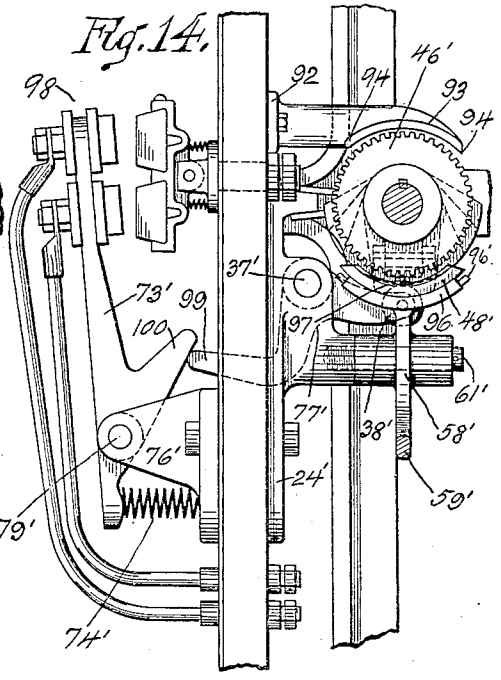


Fig. 14.



Witnesses:
Arthur C. Mason
David Larson

William Deats Inventor
By his Attorney J. T. Rule

W. DEATS.

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7 SHEETS—SHEET 7.

Fig. 15.

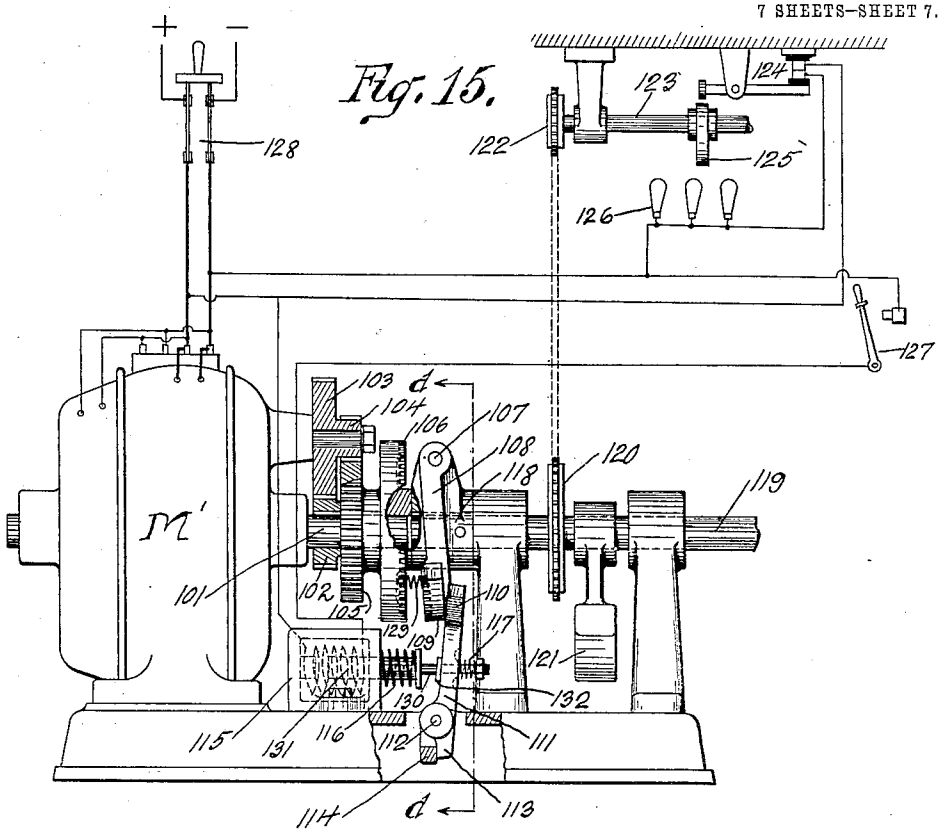
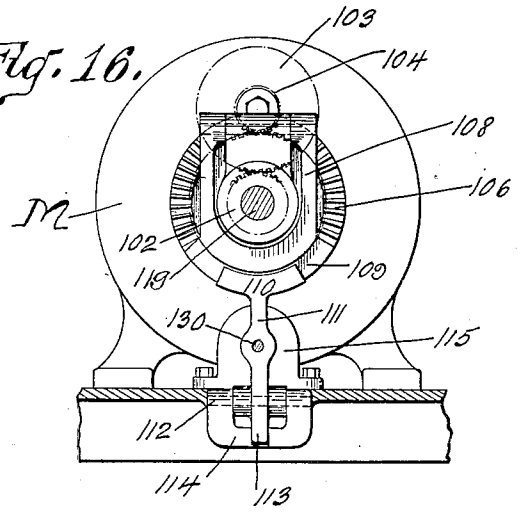


Fig. 16.



Witnesses:
Arthur C Mason
David Larson

William Deats Inventor
By his Attorney J. F. Rule

COLUMBIA PLANOGRAPH CO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

WILLIAM DEATS, OF YONKERS, NEW YORK, ASSIGNOR TO OTIS ELEVATOR COMPANY, OF JERSEY CITY, NEW JERSEY, A CORPORATION OF NEW JERSEY.

MECHANICALLY-OPERATED ACCELERATING MECHANISM.

1,077,395. Specification of Letters Patent. Patented Nov. 4, 1913.

Application filed December 16, 1908. Serial No. 467,837.

To all whom it may concern:

Be it known that I, WILLIAM DEATS, a citizen of the United States, residing at Yonkers, in the county of Westchester and State of New York, have invented a new and useful Improvement in Mechanically-Operated Accelerating Mechanism, of which the following is a specification.

My invention relates to improvements in controlling devices for electric motors and other mechanism, and has for one of its objects the provision of self-contained, practical and efficient means for controlling the operation of starting, stopping, reversing and accelerating electric motors, particularly alternating current motors used for operating elevators or for other purposes.

Generally speaking, my invention comprises means whereby a motor is started, stopped, and reversed by means of a manually controlled switch, the acceleration of the motor to full normal speed in either direction being effected by means of a series of mechanically operated switches which are controlled by the movements of the motor itself through the medium of a clutch device and intermediate mechanism.

The invention further comprises electrically controlled mechanism adapted to automatically operate an electric switch or other device, and which may therefore be used to control the operation of various forms of translating devices.

Other objects of the invention and the various features of novelty will appear hereinafter.

The combinations of elements which are considered as new are set forth in the appended claims.

In the accompanying drawings, Figure 1 illustrates in front elevation a controller constructed according to my invention; Fig. 2 is a sectional side elevation of Fig. 1; Fig. 3 is a part sectional rear view of a portion of the controller; Figs. 4 and 5 are detail views of various parts of the apparatus; Fig. 6 is a wiring diagram of electrical circuits for a typical electric elevator system with which the controller is used; Figs. 7, 8, 9, 10, 11, 12, 13 and 14 show various modifications; Fig. 15 illustrates a general application of certain features of my invention; and Fig. 16 is a section of Fig. 15 on the line *d*—*d*.

Referring to Figs. 1, 2, 3, 4 and 5, 1 designates an insulated base, preferably of slate or marble, upon which the various parts of the controller are mounted, and which is vertically supported by a metal framework 2. Upon the upper part of the base 1 are mounted three similar switches 3, 4 and 5. The switch 3 is a main line switch, while the switches 4 and 5 are motor reversing switches. Each of these switches, such as 3, comprises a swinging contact arm 6 pivoted at 7 to a stationary bracket 8. A roller 9 is carried by the switch arm 6 and is normally held in engagement with a lever 11 by means of a compression spring 10 which bears against the bracket 8 and the lower portion of the swinging arm 6. The lever 11 is pivoted at 12 to the bracket 8 and is connected to a magnet armature 13 which is adapted to be moved upwardly by an electromagnet 14 coöperating therewith when the latter is energized. The upper end of the switch arm 6 carries a number of insulated contacts, such as 15, which are connected by suitable flexible conductors to corresponding terminals 15′ secured to the base 1. The contacts carried by the switch arm 6 may be of any desired number, and are adapted to electrically engage corresponding stationary contacts, such as 16, mounted upon the insulated base 1. A rocking lever 18 is carried by a bracket 17 located between the reversing switches 4 and 5, and is for the purpose of preventing both of the reversing switches being closed at the same time. The switches 3, 4 and 5 effect the starting, stopping, and reversing of the motor. Other switches 19, 20, 21, 22 and 23 are arranged to automatically control the admission of current to the motor so as to assure an easy and gradual acceleration of the same to full normal speed. These switches are similar in construction and are pivotally mounted upon a rod 25 supported by a bracket 24 secured to the base 1. Each of these switches, such as 19, comprises a swinging arm 26, upon the upper part of which are vertically arranged insulated contacts 30 and 31. Suitable flexible conductors connect these contacts 30, 31 to corresponding terminals 28 secured to the base 1. In alinement with the contacts 30, 31 are arranged stationary contacts 32 and 34, respectively, which are supported by a metal holder 35 pivotally mounted on a bracket 27, springs 33, 33 being used in order to main-

tain the holder 35 and contacts 32, 34 in a substantially vertical position. A compression spring 29 lies between the lower end of the switch arm 26 and the depending arm of a cam lever 36 which is one of a number of similar cam levers pivotally mounted upon a rod 37 supported by a bracket 24′ upon the back of the base 1. 45 designates a horizontally arranged shaft which extends across the back of the controller and freely turns in bearings 51, 51 formed in the framework 2. A sprocket wheel 47 is keyed or otherwise securely fastened to one end of the shaft 45 by means of which the same may be rotated, provision being made for locating the sprocket wheel 47 on either end of the shaft. A cam sleeve 39 containing a number of cams 40, 41, 42, 43 and 44 is loosely carried upon the shaft 45, and under certain conditions is adapted to rotate therewith. The cams are of varying size and each cam is in contact with a cam roller, such as 38, carried upon one arm of a cam lever 36 above referred to. The sleeve 39 contains at one end an offset 50 at right angles thereto, to which is pivoted a bifurcated lever 57, the upper portion 48 of which is arc-shaped and provided with lateral gear teeth, thus forming a crown gear segment. Adjacent one end of the cam sleeve 39 is a crown wheel 46 which is rigidly mounted upon the shaft 45 and rotates therewith. This crown wheel 46 is located opposite the segmental crown gear 48 and under certain conditions is adapted to be engaged thereby, a compression spring 67 normally holding these parts out of engagement with each other. The spring 67 is not affected by the rotation of the gear 46, for the location of the spring 67, as shown in Fig. 4, is such that the end of the spring 67 bears against the smooth surface of the gear 46, which permits a sliding contact and does not affect the resilient action of the spring. The other end of the spring has a fixed connection with the clutch lever 57. The gear segment 48 is operatively connected with the main line switch 3 by means of a bell-crank lever 58 and a depending arm 60, both of which are pivoted at 61 to a stationary support 62 bolted to the base 1. The bell-crank lever 58 comprises a horizontal arm 59 which extends under the armature lever 11, a weighted arm 63 and a depending arm 64. The arm 60 extends between lugs 66 and 66′ formed on the arm 64 of the bell-crank lever, and is normally held in contact with the lug 66 by means of a compression spring 65 which bears against the lug 66′ and the depending arm 60. The lower end of this arm 60 is enlarged so as to form a segmental piece 68 conforming in shape to the gear segment 48. A stop 64′ is located a short distance above the horizontal arm 59, and is for the purpose of limiting the movement of the bell-crank lever 58. An off-set bracket 17 is connected to the armature lever 11 and extends under the horizontal arm 59, but out of contact therewith. The weighted arm 63 tends to rotate the bell-crank lever 58 about the pivot 61 in a clockwise direction, but under normal conditions is prevented from doing so by the opposing action of the weight of the armature lever 11 and connected armature 13, both of which are massive in form and have considerable weight. The cam sleeve 39 and connected parts are normally maintained in the position shown by means of a centering device comprising a coil spring 55 surrounding the cam sleeve 39, the ends of the spring being bent outwardly and engaging opposite sides of a stationary stop 56. On either side of the spring 55 are lugs 53, 53 secured to the cam sleeve 39 which carry a pin 54 lying between the ends of the spring. Any rotative movement of the cam sleeve 39 causes the pin 54 connected thereto to tighten the coils of the spring 55 which will exert a powerful tendency to return the cam sleeve to its normal position. The cams 40, 41, 42, 43 and 44 are similar in shape, the cam 40 being shown by dotted lines in Fig. 9. Each cam is formed of a circular piece flattened on top and having a cut away portion 69 in which normally rests a corresponding cam roller such as 38′, the width of the cut away portion 69 varying in size for each cam.

Referring to Fig. 6, M designates an alternating current hoisting motor with stator connections at S and rotor connections at E. The motor M is connected by the usual gearing contained in the gear case G to a hoisting drum D. B represents the ordinary spring-pressed electrically released brake apparatus. C designates the controller whose sprocket wheel 47 is connected by means of the chain 71 to a sprocket wheel 70 secured to the drum shaft and rotating therewith. The sprocket wheel 47 may be connected, if so desired, to any other moving part of the elevator apparatus, provided that it rotates in synchronism with the motor M. A designates the car and counterbalance cables which are wrapped about the hoisting drum D and pass up over suitable guide pulleys P carried upon the overhead beams O and are connected to the elevator car K and counterbalance weight W, respectively. R designates a star-connected motor starting resistance which is normally in circuit with the rotor winding of the motor M and which is arranged to be short-circuited step by step by means of the switches 23, 22, 21, 20 and 19 as the same are operated by the rotation of the cams 40, 41, 42, 43 and 44, respectively. H is a manually operated car switch which is connected to the reversing switches 4 and 5 to effect the starting, stopping and reversing

of the motor M. The switches 3, 4 and 5 are shown for the sake of simplicity as single phase solenoid and plunger switches, the plungers of each switch being connected to an insulated piece carrying contacts 15, 15'' which may be raised into electrical engagement with other contacts 16, 16', respectively, arranged directly above and in alinement therewith. The system of electrical circuits shown in Fig. 6 is connected by the conductors a', b' and c' through the switch L to a suitable source of three phase alternating current supply.

The operation of the apparatus shown and described is as follows: Upon moving the lever of the car switch H to the right, a circuit is closed from the conductor b', fuse 72, switch H, winding of reversing switch 4, to the conductor a'. The magnet winding of switch 4 now receives current and closes its contacts. The closing of switch 4 completes a circuit to the main line switch 3 from the conductor b' through fuse 72, winding of switch 3, contacts of switch 4, to the conductor c'. The switch 3 therefore receives current and closes its contacts 15, 16 and 15', 16', respectively. The switches 4 and 3 now being closed complete a circuit to the stator of the motor M and the brake B, and the motor starts to rotate at slow speed, all of the starting resistance R being in circuit with the rotor of the motor. Referring again to Figs. 1, 2 and 3, it will be seen that when the magnet 14 of the switch 3 is energized, it will lift its armature 13 and swing the lever 11 about its pivot 12 and away from the roller 9 carried upon the switch arm 6. The spring 10 is thereby enabled to swing the switch arm 6 about its pivot 7 until the contacts 15 carried thereon electrically engage the corresponding stationary contacts 16 mounted upon the insulating base 1. The operation of the switch 3 not only closes its contacts, but also by lifting the armature lever 11 out of contact with the horizontal arm 59 of the bell-crank lever 58 enables the weighted arm 63 to rotate the bell-crank lever 58 about its pivot 61. The bell-crank lever acting through the spring 65 causes the arm 60 and connected segment 68 to force the gear segment 48 into mesh with the crown wheel 46 against the action of the spring 67. The stop 64' limits the upward movement of the horizontal arm 59 so that when the magnet armature 13 has moved upward to its fullest extent, the arm 59 occupies a position intermediate the armature lever 11 and the bracket 17. Thus any vibrations set up by the magnet 3 will not be transmitted through the arm 59 to other parts of the apparatus. Owing to the spring 65, a yielding pressure is applied to the depending arm 60 whenever the magnet 3 is energized, and for this reason the magnet armature 13 may move to its fullest extent even though the teeth on the clutch members 48 and 46 do not immediately interlock. Since the motor at this time is rotating at slow speed, the shaft 45 and crown wheel 46 are also rotated, and since the crown wheel 46 is in mesh with the gear segment 48 the latter, together with the cam sleeve 39 and connected cams 40, 41, 42, 43 and 44, is rotated against the action of the centering spring 55. As the cam sleeve 39 rotates, the cam roller 38' rides up onto the circular part of the cam 40, thereby rocking the cam lever 36' about its pivot rod 37 and compressing the spring 29'. Since the switch arm 26' corresponding to the switch 23 is normally in open position, due to its weight and that of its connected parts, the compressing of the spring 29' by the cam lever 36' forces the switch closed, the contacts thereon coming into electrical engagement with the corresponding stationary contacts mounted upon the insulated base 1. The closing of the switch 23 operates to short-circuit a portion of the starting resistance R, thereby increasing the speed of the motor. As the cam sleeve 39 continues to rotate, the cam 41 next comes into operation and effects the closing of the switch 22 which short-circuits an additional portion of the starting resistance R and the motor further increases its speed. In like manner the cams 42, 43 and 44 operate to effect the closing of the corresponding switches 21, 20 and 19 in successive order to short-circuit the entire starting resistance step by step and the motor now runs at full normal speed, the rotor windings being short-circuited through the rotor terminals E and switch 19. The cam sleeve 39, together with the gear segment 48 and cams 40, 41, 42, 43 and 44, has at this time been rotated by the motor through an angle of substantially 90 degrees, the cam rollers corresponding to the various cams resting upon the circular or high part of each cam, and the switches 23, 22, 21, 20 and 19, respectively, being closed.

Referring more particularly to Figs. 4 and 5, which are sectional views of the cam sleeve 39 and connected parts taken on the line a—a of Fig. 3, it is seen that the cam sleeve will be rotated by the shaft 45 as long as the gear segment 48 is forced into engagement with the crown wheel 46 by the depending arm 60 of the bell-crank lever 58. As the sleeve rotates, the segmental end 68 of the depending arm 60 is held in sliding contact with the segment 48 by the weighted arm 63. When, however, the sleeve has rotated substantially 90 degrees the segmental crown wheel 48 is carried out of sliding engagement with the segmental end 68 of the arm 60, and is therefore no longer forced into mesh with

the crown wheel 46. The spring 67 is now able to swing the bifurcated lever 57 and connected gear segment 48 about the pivot 49, thereby carrying said segment out of mesh with the coöperating crown wheel 46. As the segment 48 swings outwardly, it moves into alinement with the end 68 of the depending arm 60, and is thus prevented from being rotated backward by the centering spring 55. This condition is clearly illustrated in Fig. 5, the crown wheel continuing to rotate with the motor without imparting any further motion to the cam sleeve 39 and connected parts.

In motor controlling apparatus it is very essential to have the starting resistance reinserted in the motor circuit every time the motor is stopped, so as to prevent an abnormal rush of current through the motor when the latter is again started. In the apparatus herein described this is accomplished as follows: Upon bringing the switch H in the car to central position, the circuit including the winding of the reversing switch 4 is broken and the switch opens its contacts. This operation opens the motor and brake circuits and also open-circuits the winding of the main line switch 3. Upon breaking the circuit for the magnet 14 of the switch 3, the armature 13 and armature lever 11 swing downwardly about the pivot 12, and in so doing depress the horizontal arm 59 of the bell-crank lever 58. The latter swings about its pivot 61, moving the depending arm 60 to the right and carrying the segment 68 back to its original position out of alinement with the segmental crown wheel 48. The centering spring 55 is now enabled to rotate the cam sleeve 39 and connected parts backward to normal position, thereby causing the switches 19, 20, 21, 22 and 23 to open in the order named, thus re-inserting the starting resistance into the rotor circuit of the motor. In order to reverse the direction of rotation of the motor M, the car switch H is moved over to the left, thereby closing a circuit through the magnet winding of the reversing switch 5 which will operate to close its contacts and effect the closing of the main line switch 3 as before. The motor will now receive current and start to rotate in the reverse direction, due to the altered connections leading to the stator terminals S. Since the motor is now reversed, the shaft 45 on the controller also rotates in a reverse direction, carrying with it the cam sleeve 39. The operation of the switches 23, 22, 21, 20 and 19 is effected as before and in the same relative order or sequence, since the cams 40, 41, 42, 43 and 44 are symmetrically arranged with respect to their coöperating parts.

Referring to Fig. 7, 20′ is a modified form of resistance controlling switch corresponding to the switches 20, etc., shown in the previous figures. It comprises a swinging contact arm 73 bifurcated at its lower end and pivoted upon a rod 79 supported by a bracket 76 fastened to the base 1. A curved cam lever 77 is also pivoted upon the rod 79 between the bifurcated ends of the swinging contact arm 73. A spring 74 bears against one end of the cam lever 77 and the switch arm 73, while another spring 75 bears against the opposite side of the switch arm 73 and the bracket 76. This latter spring normally exerts a stronger pressure than the spring 74 and thus maintains the switch arm in its outward or open position, as shown. The other end of the cam lever 77 carries a roller 78 which is at all times held in engagement with one of a series of cams 43′, 42′, 41′ and 40′ by means of the springs 74 and 75. The cams are arranged on the sleeve 39 as before, and are rotated in a manner already described, the cams being of varying size so as to produce a successive operation of the switches corresponding thereto. As each cam roller, such as 78, is moved downwardly by the cam 43′, the cam lever 77 is rocked about the rod 79, thereby compressing the spring 74 to such a degree that it overcomes the spring 75 and effects the closing of the switch contacts carried by the arm 73.

The centering device illustrated in Figs. 7 and 8 is similar to that already described in connection with the other figures, differing only in having the stop 56′ formed of a separate piece bolted to the base 1.

In order that the cam sleeve 39 and connected parts shall not be rotated back to normal position too rapidly, it is sometimes desirable to use the retarding device illustrated in Figs. 9, 10 and 11. This device comprises a dash-pot 85 and piston 84, the latter being connected by a link 83 to one arm of a bell-crank lever 80. The bell-crank lever 80 is pivoted at 81 to the bracket 24′ and carries a cam roller 82 upon one arm adapted to be held in engagement with a cam 87 secured upon the cam sleeve 39 by means of a spring 86. At the bottom of the dash-pot 85 is an adjustable screw 88 having a tapering slot 89 therein; also a ball valve 90 which opens upwardly. The operation of this retarding device is as follows: As the cam sleeve 39 is rotated in either direction to effect the closing of the resistance controlling switches operated thereby, the cam 87 rotates therewith through the same angle of substantially 90 degrees, allowing the spring 86 to carry the piston 84 upwardly as the cam roller rides onto the low portion of the cam 87. The piston 84 is not retarded in its upward movement since the valve 90 allows air to freely enter the dash-pot. As soon as the cam sleeve 39 is released and is rotated backward by the centering device, the cam 87 forces the piston of the dash-pot downwardly, thereby compressing the air in the dash-pot, which in order to escape must pass

out by way of the tapered slot 89 in the adjustable screw 88. Therefore the speed at which the cam sleeve 39 returns to normal position depends upon the rate at which the air is permitted to escape from the dash-pot 85 as the piston is forced downwardly by the cam 87, and the rate of this escaping air may be regulated by the adjustable screw 88.

Figs. 12, 13 and 14 show a further modification, Figs. 13 and 14 being sectional views taken on the lines *b*—*b* and *c*—*c* of Fig. 12, respectively. Referring to these figures, 3′ designates the main line switch which is similar in construction to the main line switch 3 already described. A U-shaped bail 17′ is connected to the bottom of the magnet armature 13′ which surrounds one arm 59′ of a bell-crank lever 58′. The latter is pivoted at 61′ to the bracket 24′ and has a weighted arm 63′ and arc-shaped segment 96 integral therewith. A bifurcated lever 57′ is pivoted at 49′ to a lug 50′ secured to the cam sleeve 39′ and is provided with a toe 95 which limits its motion in one direction. The lever 57′ carries an arc-shaped rack 48′ upon one end which contains a number of gear teeth 97 upon its inner surface adapted to engage but normally out of engagement with the gear teeth of a spur gear 46′ secured to the shaft 45. A spring 67′ bears against the lever 57′ and forces the rack 48′ into contact with the segment 96. Directly over the spur gear 46′, and a short distance therefrom, is an arc-shaped stop piece 93 which is carried by a bracket 92 secured to the base 1. This arc-shaped stop piece has beveled ends 94, 94 which are adapted to engage corresponding beveled ends of the rack 48′ when the latter is rotated into engagement therewith. The switch shown in Fig. 14 is one of four similar switches operated by means of the cam sleeve 39′ and cams thereon. Each switch comprises a spring-pressed swinging contact arm 73′ pivoted upon a rod 79′ carried by a suitable bracket. The contact arm 73′ carries a lug 100 which engages one end 99 of a cam lever 77′ which is pivoted at 37′ to the bracket 24′. The other end of the cam lever 77′ carries a cam roller 38′ which bears against a corresponding cam 44′, which latter is one of a number of cams 44′, 43′, 42′, and 41′ of varying size.

The operation of the apparatus just described is as follows: Upon the closing of the magnet switch 3′, the weighted arm 63′ is enabled to swing the bell-crank lever 58′ about its pivot 61′, since the magnet armature 13′ no longer bears downwardly upon the arm 59′ of the bell-crank lever, and the arc-shaped end 96 moves upwardly carrying with it the rack 48′ and causing the gear teeth 97 on the latter to engage the teeth of the gear wheel 46′. Since the gear 46′ is at this time rotating in one direction or the other, a rotary motion is imparted to the cam sleeve 39′ and the cams thereon operate to successively close the corresponding resistance controlling switches, such as 98, by rotating the cam 44′ out of engagement with the cam roller 38′ and allowing the spring 74′ to close the switch 98. When the rack 48′ has rotated for substantially 90 degrees, it passes out of engagement with the concave surface of the arc-shaped piece 96 on the bell-crank lever, and by so doing enables the spring 67′ to force the piece 48′ out of engagement with the gear wheel 46′ and into alinement with the arc-shaped piece 96. Stops 96′ formed on the ends of the segment 96 engage the ends of the rack 48′ which is pressed out of engagement with the gear wheel 46′ by the spring 67′, and limit the upward movement of the arm 59′ so that the latter is held out of contact with the armature 13′ and bail 17′ after the clutch has been released. The cam sleeve is prevented from being rotated backward by the centering spring 55, since the part 96 now acts as a stop. Should the spring 67′ for any reason fail to disengage the rack 48′ from the gear 46′ after the cam sleeve 39′ has rotated in either direction for substantially 90 degrees, any further rotation of the cam sleeve will cause the beveled edge of the rack 48′ to engage one of the corresponding beveled ends 94, 94 of the arc-shaped stop piece 93 and the rack will be positively disengaged from the gear and any further rotation absolutely prevented. Upon deënergizing the magnet 14′ of the switch 3′, the armature 13′ will drop, carrying with it the lever arm 59′ and causing the arc-shaped piece 96 to move out of alinement with the rack 48′ and thereby enabling the centering spring 55 to rotate the cam sleeve 39′ and connected cams back to normal position, the cams effecting the opening of the corresponding switches.

Referring to Figs. 15 and 16 which illustrate a general application of certain features of my invention, M′ designates an electric motor of the direct current type which is adapted to be set in motion by closing a main line switch 128 connected by conductors designated + and — to a suitable source of electrical supply. A small gear wheel 102 is keyed to the motor shaft 101 and rotates therewith. In mesh with the gear wheel 102 is a gear wheel 103 which is connected to a gear pinion 104 meshing with a gear wheel 105. The gear wheel 105 and a crown wheel 106 secured thereto or integral therewith are free to rotate upon the motor shaft 101. A separate shaft 119 is arranged in suitable bearings in alinement with the motor shaft and carries upon one end a boss 118 which is placed adjacent the crown wheel 106. A bifurcated lever 108 is pivoted at 107 to the boss 118 and carries upon its lower end a crown segment 109

arranged to coöperate with the crown wheel 106 under certain conditions, but normally held out of engagement therewith by a spring 129. A swinging lever 111 is pivoted at 112 to the base of the apparatus and carries upon its upper end an arc-shaped stop 110 which is normally held in contact with the segmental crown wheel 109 by a spring 117 carried by a rod 130. This rod 130 is connected to the core 131 of a solenoid magnet 115, the core being maintained in its outward position by means of a spring 116, 132 being a fixed collar on the rod 130 adjacent the pivoted arm 111. The shaft 119 carries a sprocket wheel 120 and centering weight 121, the former being connected by a sprocket chain to a sprocket wheel 122. This sprocket wheel 122 is connected to a shaft 123, carrying upon it a cam 125 which is adapted to rotate and thereby effect the opening of a switch 124. This switch 124 is connected through the lamps 126 to the positive and negative mains. The winding of the magnet 115 is also connected through the hand switch 127 with the positive and negative mains. The operation of this apparatus is as follows: Assuming the switch 127 to be in open position, as shown, and the switch 128 closed, the motor will rotate and the crown wheel 106 will be driven in the same direction at a slower speed due to the intermediate gearing 102, 103, 104 and 105. The lamps 126 at this time are lighted, their circuit being completed through the contacts of the normally closed switch 124. Upon closing the hand switch 127, a circuit is completed through the winding of the magnet 115 whose magnet core 131 is at once energized and is pulled in against the action of the spring 116. As the core 131 and connected rod 130 are moved by the magnet 115, the spring 117 swings the pivoted lever arm 111 to the left, causing the crown segment 109 to engage the crown wheel 106 against the action of the spring 129. The shaft 119 is now operatively connected to the motor shaft and rotates, carrying with it the sprocket wheel 120 and centering weight 121. The sprocket wheel 122 being driven by the sprocket wheel 120, causes the shaft 123, and cam 125 to rotate, the latter finally opening the switch 124, thereby breaking the circuit of the lamps 126. The shaft 119 and gear segment 109 have by this time been rotated about 90 degrees, or until the rear surface of the gear segment 109 has rotated out of engagement with the segment 110 carried by the lever 111. The spring 129 is now free to swing the gear segment 109 out of mesh with the crown wheel and into alinement with the segment 110, the latter acting as a stop to prevent the centering weight 121 from returning the shaft 119 and connected parts back to normal position. The motor may continue to rotate indefinitely without producing further rotation of the shaft 119. Upon opening the switch 127, the circuit to the magnet 115 is broken and the spring 116 forces the core 131 outwardly, the collar 132 on the rod 130 swinging the pivoted lever 111 back to normal position limited by the stop 114 and out of alinement with the gear segment 109. The centering weight 121 is now free to rotate the shaft 119 and connected mechanism backward, thereby closing the switch 124 and again lighting the lamps 126.

From the description of the apparatus illustrated in Figs. 15 and 16, it is readily seen that by the application of my invention to any motor a circuit containing any desired translating device, such as lamps, may be controlled in a positive and practical manner by merely operating a small hand switch which may be located at any convenient point or distance from the motor or other part of the apparatus.

While I have shown and described my invention as embodied in an electric elevator system and in a circuit controlling device, the same may have a wide application; furthermore, it is obvious that various modifications could readily be made in the apparatus herein shown and described without departing from the spirit and scope of my invention, and for this reason I desire not to be limited to the precise constructions and arrangements of parts disclosed.

What I claim as new and desire to have protected by Letters Patent of the United States is:—

1. The combination with an electric motor, of controlling mechanism therefor comprising a switch, a clutch having one member operatively connected to the motor, a connection between the other clutch member and the said switch for effecting the engagement of the clutch members, and means for automatically disengaging said members when they have operated through a predetermined distance.

2. The combination with an electric motor, of accelerating mechanism, gearing comprising a clutch between the motor and accelerating mechanism, means for connecting the clutch members when current is supplied to the motor, and positively operated mechanism for automatically disconnecting said members when said mechanism has operated and permitting the continued operation of the motor.

3. The combination with an electric motor, of a plurality of accelerating switches, a cam member for successively operating said switches, a shaft on which said cam member is mounted, mechanical connections between the motor and cam member including clutch members connected to said shaft and cam member respectively, means for

effecting an engagement of the clutch upon closing a circuit to the motor, and means for effecting a disengagement of the clutch after the cam member has been moved a predetermined amount.

4. The combination with an electric motor, of accelerating switches therefor, a cam device for operating the switches in a predetermined order, a clutch having one member geared to the motor and the other member operatively connected to the cam device, an electromagnetic device for effecting an engagement of the clutch members upon closing a circuit to said motor, and automatic means for effecting the disengagement of the clutch members after the operation of the accelerating switches and while said electromagnetic device remains energized.

5. The combination with an electric motor, of a plurality of mechanically operated accelerating switches, a cam member for effecting the operation of said switches in successive order, a clutch geared to said motor and connected to said cam member, means for effecting an engagement of the clutch members, and positive means for effecting a disengagement of said clutch members independently of the condition of said clutch-engaging means after the cam member has made a predetermined movement.

6. The combination with an electric motor, of a sectional resistance, a series of mechanically operated switches for controlling the resistance, a rotary cam member adapted to successively open or close said switches, a shaft geared to the motor, a gear clutch arranged to operatively connect said shaft to the rotary cam member upon the closing of a circuit to the motor, means for disengaging the clutch after the cam member has been rotated a predetermined amount, and means for returning the cam member to its original position upon opening the motor circuit.

7. The combination with an electric motor, of a plurality of accelerating switches, a cam member for operating said switches, power-transmitting mechanism comprising a clutch between the motor and said cam member, a switch for closing a circuit to the motor, an electromagnet for operating said switch, means controlled by said magnet for effecting an engagement of the clutch members, and means for positively effecting a disengagement of said clutch members after the cam member has effected the operation of the accelerating switches.

8. The combination with an electric motor, of a shaft connected for rotation by said motor, a clutch device between the motor and said shaft, magnetic means controlled from a distance for effecting the engagement of the clutch members and holding them in engagement, and means operable positively to disengage the clutch members after the shaft has rotated a determined amount.

9. The combination with a drive element and a driven element, of a clutch having its members secured respectively to said elements, a device operable to connect the clutch members and cause the driven element to be operated through a given distance and then to lock the driven element against backward movement, and electro-responsive devices controlled by said driven element.

10. The combination with a shaft, of a sleeve mounted thereon, a driving clutch member secured to one of said parts, a driven clutch member carried by the other part, an arm in contact with the driven clutch member, and means for moving the arm into position to effect an engagement of the clutch members, said arm and driven clutch member being relatively movable into position to prevent a backward movement of the said shaft and sleeve after the same have rotated a predetermined distance.

11. The combination with a drive shaft, of a clutch member secured thereto, a sleeve mounted on said shaft, a segmental clutch member carried by the sleeve, a lever in engagement with the segmental clutch member, and an electromagnet operatively connected to the lever to effect the engagement of the clutch members, said lever and segmental clutch member being relatively movable into position to bring the lever into the path of rotation of the segmental clutch member after the latter has rotated a predetermined distance.

12. The combination with a drive shaft, of a sleeve mounted thereon, cams carried by the sleeve, electric switches operated by the cams, clutch members secured to the drive shaft and sleeve, respectively, a lever operable to connect the clutch members, and an electromagnet for operating the lever, the lever and a clutch member being relatively movable to bring the lever into the path of movement of said clutch member when the said member is moved beyond the lever.

13. The combination with an electromagnet, of a clutch operated by the electromagnet, and a yielding mechanical connection between the electromagnet and clutch preventing the positive operation of the clutch.

14. The combination of an electromagnet having an armature, a clutch, and operating mechanism between the armature of the electromagnet and one of the clutch members for bringing the clutch members together when the armature is moved to attracted position, said mechanism comprising means for permitting said operation of the armature independently of the clutch.

15. The combination with an electromagnet and its armature, of a clutch, a clutch

operating member, a member operatively associated with said armature, and a yielding connection between said members.

16. The combination with an electromagnet and its armature, of a clutch, a bell-crank lever having one arm connected to the armature, a clutch operating member pivoted co-axially with said lever, and a spring forming an operating connection between the other arm of said lever and said member.

17. The combination of an electromagnet comprising an armature, a bell crank lever having a depending arm and a horizontal arm, said horizontal arm being connected to the armature lever, a stop in position to limit the movement of the bell crank lever when the armature is moved toward attracted position, a clutch, a pivoted member in position to operate the clutch, and a spring forming a yielding connection between said pivoted arm and the depending arm of the bell crank.

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

WILLIAM DEATS.

Witnesses:

EDWARD H. STEELE,

H. R. MARSDEN.