(No Model.) 3 Sheets—Sheet 1.

F. E. HERDMAN.

AUTOMATIC WORKING RHEOSTAT FOR STARTING ELECTRIC MOTORS.

No. 541,542. Patented June 25, 1895.

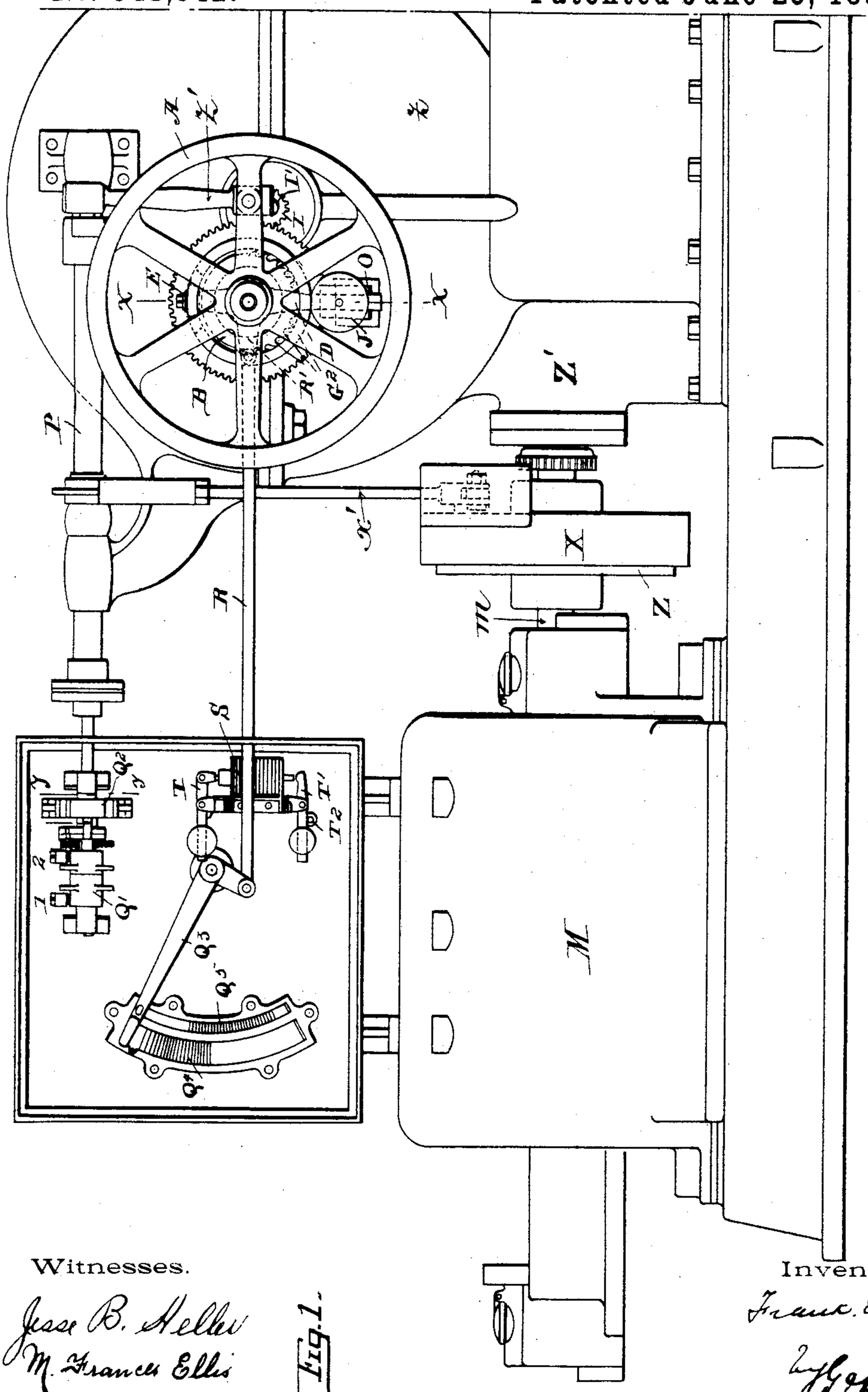

Fig. 1.

Witnesses.

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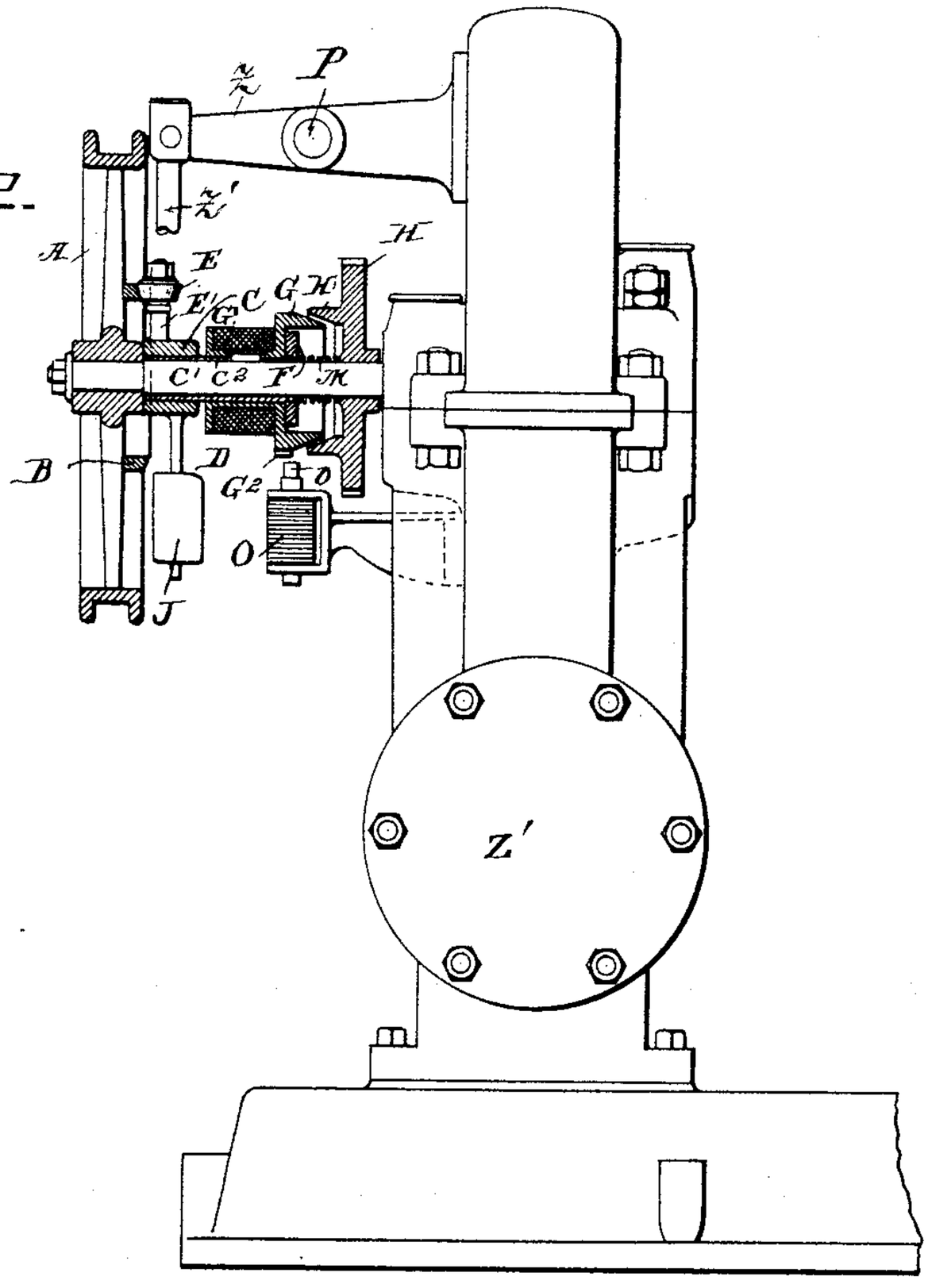
Fig. 2.



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(No Model.) 3 Sheets—Sheet 3.

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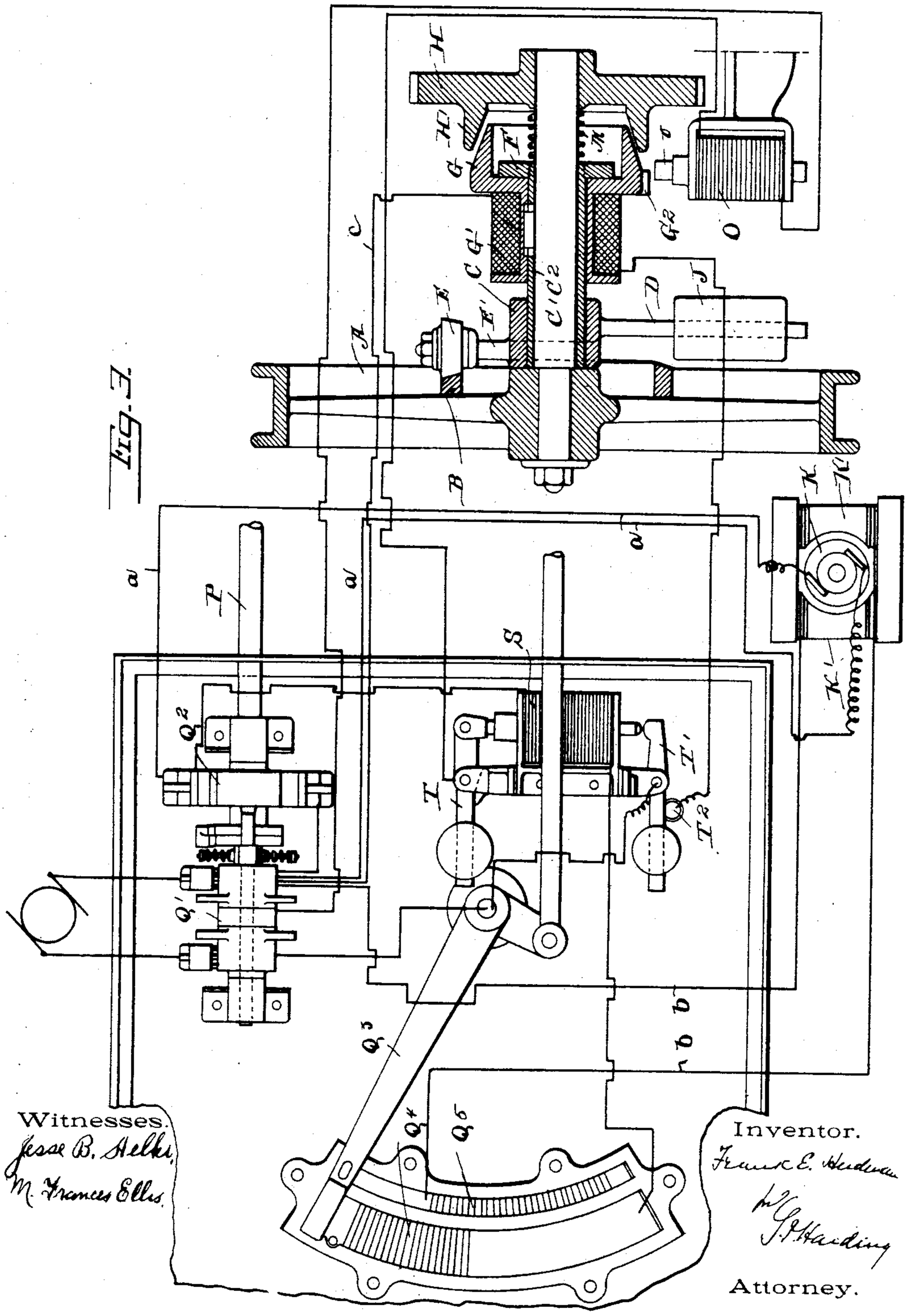
Fig. 3.



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UNITED STATES PATENT OFFICE.

FRANK E. HERDMAN, OF WINNETKA, ILLINOIS.

AUTOMATIC-WORKING RHEOSTAT FOR STARTING ELECTRIC MOTORS.

SPECIFICATION forming part of Letters Patent No. 541,542, dated June 25, 1895.

Application filed November 24, 1894. Serial No. 529,793. (No model.)

To all whom it may concern:

Be it known that I, FRANK E. HERDMAN, a citizen of the United States, residing at Winnetka, county of Cook, and State of Illinois, have invented a new and useful Improvement in Automatic-Working Rheostats for Use in Starting Electric Motors, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, which form a part of this specification.

This invention consists in certain improved mechanism and electrical connections in connection with a motor in which the current is initially admitted to the armature through resistances and which are to automatically cause a contact arm to travel over the resistances when the motor starts; to prevent throwing out the resistances more rapidly than the motor is able to take the increased current; and to increase the resistance in the armature circuit when an amount of current in excess of that which the motor can take tends to pass to the armature.

I will first describe an embodiment of my invention as illustrated in the accompanying drawings, in which the motor is combined with and operates an elevator mechanism.

Figure 1 is a side elevation. Fig. 2 is a partial section on line $x\,x$, Fig. 1. Fig. 3 is a diagram showing wiring.

A is the operating sheave controlled by the operator through the medium of a cable or other mechanism in the well known manner. On the inner side of this sheave is a ring B provided with a notch. (See Figs. 1 and 2.) This notch is so placed in the ring that when the sheave is in the central position shown in Fig. 2, the notch is in the position shown in said figure. Adjacent to this ring and adapted to rest in the notch in said ring, is the roller E having an inclined face, as shown in Fig. 2. This roller E is secured to a hub, C, by means of arm, E′, on the opposite side of the hub to that of the roller E and secured to the hub is the weighted arm D. A sleeve C^2 loose upon the shaft C′ is connected at one end to hub C and at the other end to plate F. On the sleeve C^2 is the friction wheel G, having the hub G′ wrapped with wire coils forming a magnet. On the shaft C′ is placed the gear H driven by a pinion I, on the drum shaft I′, the drum being revolved by the motor M in any well known manner. Upon the gear H is the friction disk H′. Connected with the friction wheel G are a series of teeth G^2, and directly beneath these teeth is the electro-magnet O, the core *o* of which, when the magnet is energized, meshes with the teeth G^2. The teeth G^2 are so cut, see Fig. 1, that when the core *o* meshes with these teeth, the wheel G is held from revolution in one direction, but can revolve in the other direction. On the shaft C′ and between the plate F and wheel H is placed the spring, M. This spring holds the plate F away from gear H and the roller E against the ring, B, and tends to hold friction A′ away from friction G.

P is the operating bar moved by the sheave A. The end of this operating bar is connected to a snap switch, Q′, and a reversing switch, Q^2, sections of which are shown in Figs. 3 and 4, respectively.

K is the armature of the motor, and K′ the field magnets.

Q^4 shows the resistance contacts for the armature circuit, and Q^5 the resistance contacts for the field circuit; and Q^3 is the resistance arm for controlling the resistances in the armature and field circuit. This arm Q^3 is connected by means of rod, R, with a lever R′, on the hub C. The main circuit is connected to the brushes 1, 2, of the snap switch, and from one side of the switch the current is carried to arm Q^3. The other pole of the main circuit passes to one brush of the reversing switch.

The armature circuit is denoted by the letter *a*, and terminates in brushes, a', a^2, of the reversing switch.

The field circuit is denoted by letter *b*.

S is an electro-magnet in series with the armature circuit. The core of this magnet is connected with the weighted lever, T. Beneath the magnet is placed a weighted lever, T′.

From the arm Q^3 is run a wire directly to the lever T′, and from the contact pin, T^2, in line of movement of lever T′ is run a wire to magnet G′, and from magnet G′, a wire is run to the snap switch. This circuit is marked, *c*. From lever T a wire is run to magnet O, and from magnet O a wire is run to snap switch. These various circuits above described are all lettered as above, and where more than

one circuit has a common wire for any portion of the circuit both letters are placed at that point.

The contact arm Q^3, when the machine is at rest, is on the point of greatest resistance for armature circuit, and no resistance for field circuit. The roller E rests in the notch of the surface of ring, B. When the operating sheave is thrown in the direction desired, the operating bar P is moved and the reversing switch thrown in the direction in which the motor is desired to move, and at the same time, the snap switch Q′ is closed. This closes the circuit to the armature and field, and the motor shaft revolves, revolving the drum, there being the greatest resistance of the circuit in the armature circuit and greatest strength of fields. The movement of the sheave forces the roller, E, out of the notch in the ring, B on the level surface, and throws the sleeve C^2 and plate F to the right, and the magnet G′, being in the circuit, is energized, and with it friction disk or wheel, G, is drawn to and against the friction G, and revolves with it, revolving the hub C, and through the lever R′ and rod R, the arm Q^3 is carried over the armature resistances, gradually cutting them out. Under ordinary conditions this movement of the hub C, will continue until the roller E reaches the notch in ring B, when it drops in and releases the frictions. Thus, at this point, there is no further movement of the arm, Q^3, and it is held in whatever position it may be thrown when the roller drops in the notch. When the operator moves the sheave to stop the motor the roller E, by means of the weight D, follows the sheave, and by the time the sheave has reached the center, the arm Q^3 has been brought back over the resistances, until, at the time the circuit is broken, the greatest resistance is in the armature circuit. By this arrangement, the movement of the arm, Q^3, is governed entirely by the readiness with which the motor takes its speed and by the notch and the roller. The position on the rheostat face is under full control of the operator, thereby governing the speed as he may desire.

The magnet G′ is for the following purpose: As before described, when the circuit to armature is closed, the circuit is also closed to the magnet G′. Now, if for any reason the main circuit is broken, the circuit to the magnet G′ is also broken, the frictions released, and the weight J carries the arm Q^3 to the greatest armature resistance, so that, if when this occurs, the operator has thrown the lever to either extreme positions and the current again thrown on the machine, there will be no burning of the fuse, but the machine will take its speed in the proper manner.

The magnet S is for the following purpose: This magnet is adjusted by means of the weight on the lever, T, for the greater amount of current it is desired for the motor to take. When the current exceeds this, the magnet is so energized as to overcome the weight of lever T, and its overcoming this weight, the pin on the core of the solenoid is drawn in contact with lever T′, and a circuit formed, in which circuit is the magnet O. As soon as this magnet is energized its core meshes with the teeth on the friction disk or wheel, G preventing its further revolution in a direction which will throw out further resistances, but allow it to move in the opposite direction to place more resistance in the circuit if the operating mechanism be thrown to a central position, the construction of the teeth before described enabling this to be done. If the current passing the magnet S be still further increased, and sufficient for the core to overcome the weight upon lever T′, this weight is lifted, and the connection between lever T′ and contact T^2 is broken, and the circuit to magnet, G′, broken, and the friction G released from friction H′, and the operating arm brought to its initial position, as hereinbefore described. The purpose of this is in case the current passing through the armature is above the safe limit, the resistance will immediately be thrown into the circuit. This would occur if, through any cause, the car is stopped in its descent, or the counterweight is stopped in its descent, thus throwing excessive work on the motor. Then, through the medium of magnet S, current is cut from magnet G′ and all the resistances thrown into the circuit.

I have in the foregoing specification described the parts illustrated which refer or relate to my invention. The parts illustrated and not described are as follows:

M is the motor, this letter in Fig. 1 being placed upon the motor covering; *m*, the motor shaft; Z, a brake wheel on the motor shaft; X, a brake; *x′*, the rod for operating the brake; Z′, a casing covering the connection between motor shaft and winding drum.

z is a crank projecting from the end of the operating bar P and connected to the rod or lever *z′* which is connected to the operating sheave.

Having now fully described my invention, what I claim, and desire to protect by Letters Patent, is—

1. In combination with an electric motor, resistances in the armature circuit, an arm for controlling said resistances a driving device adapted to be driven by the motor, a device adapted to be rotated by the driving device, connection between said last mentioned device and the resistance arm, the connection being such that when said device rotates said arm is moved over the resistances, a switch operating mechanism to operate the electric motor switch and connection between said switch operating mechanism and said rotatable device whereby in the throwing of said mechanism the rotatable device is thrown in and out of connection with its driving device.

2. In combination with an electric motor, resistances in the armature circuit, an arm for controlling said resistances, a driving device

adapted to be driven by the motor, a device adapted to be rotated by the driving device, connection between said last mentioned device and the resistance arm, the connection being such that when said device rotates said arm is moved over the resistances, and means to throw the rotatable device in and out of connection with the driving device, a weight or spring connected to said rotatable device adapted when said device is free from said driving device to rotate said rotatable device.

3. In combination with an electric motor, resistances in the armature circuit, an arm for controlling said resistances a driving device adapted to be driven by the motor, a device adapted to be rotated by the driving device, connection between said last mentioned device and the resistance arm, the connection being such that when said device rotates said arm is moved over the resistances, a switch operating mechanism to operate the electric motor switch, and connection between said switch operating mechanism and said rotatable device whereby in the throwing of said mechanism the rotatable device is thrown in and out of connection with its driving device, a weight or spring connected to said rotatable device adapted, when said device is free from said driving device, to rotate said rotatable device.

4. The combination with an electric motor, of resistances in the armature circuit, an arm for controlling said resistances, a driving device adapted to be driven by the motor, a device adapted to be rotated by the driving device, connection between said last mentioned device, and the resistance arm, the connection being such that when said device rotates said arm is moved over the resistances, and means to throw the rotatable device in and out of connection with the driving device, and mechanism to limit the extent of rotation of said device.

5. In combination with an electric motor, resistances in the armature circuit, an arm for controlling said resistances, a driving device adapted to be driven by the motor, a device adapted to be rotated by the driving device, connection between said last mentioned device and the resistance arm, the connection being such that when said device rotates said arm is moved over the resistances, a switch operating mechanism to operate the electric motor switch, and connection between said switch operating mechanism and said rotatable device whereby in the throwing of said mechanism the rotatable device is thrown in and out of connection with its driving device, and mechanism to limit the extent of rotation of said device.

6. In combination with an electric motor, resistances in the armature circuit, an arm for controlling said resistances a driving device adapted to be driven by the motor, a device adapted to be rotated by the driving device, connection between said last mentioned device and the resistance arm, the connection being such that when said device rotates said arm is moved over the resistances, and means to throw the rotatable device in and out of connection with the driving device, a weight or spring connected to said rotatable device adapted when said device is free from said driving device to rotate said rotatable device, and mechanism to limit the extent of rotation of said device in either direction.

7. In combination with an electric motor, resistances in the armature circuit, an arm for controlling said resistances, a driving device adapted to be driven by the motor, a device adapted to be rotated by the driving device, connection between said last mentioned device and the resistance arm, the connection being such that when said device rotates said arm is moved over the resistances, a switch operating mechanism to operate the electric motor switch, and connection between said switch operating mechanism and said rotatable device whereby in the throwing of said mechanism the rotatable device is thrown in and out of connection with its driving device, a weight or spring connected to said rotatable device, adapted, when said device is free from said driving device, to rotate said rotatable device, and mechanism to limit the extent of rotation of said device in either direction.

8. In combination with an electric motor, resistances in the armature circuit, an arm for controlling said resistances, a driving device adapted to be driven by the motor, a device adapted to be rotated by the driving device, connection between said last mentioned device and the resistance arm, the connection being such that when said device rotates said arm is moved over the resistances, an electric clutch device adapted when energized to connect the rotatable and driving device and when de-energized to sever said connection, said clutch device being in electrical connection with current supply, a solenoid in the armature circuit, a switch in the circuit to the clutch magnet, the arm of which is in line of movement of solenoid core, and which said core is moved and opens the circuit to the clutch magnet.

9. In combination with an electric motor, resistances in the armature circuit, an arm for controlling said resistances, a driving device adapted to be driven by the motor, a device adapted to be rotated by the driving device, connection between said last mentioned device and the resistance arm, the connection being such that when said device rotates said arm is moved over the resistances, and means to throw the rotatable device in and out of connection with the driving device, a weight or spring connected to said rotatable device adapted when said device is free from said driving device to rotate said rotatable device, a clutch device adapted when energized to connect the rotatable and driving device, and when de-energized to sever said connection, said clutch device being in electric connection with current supply, a solenoid in the arma-

ture circuit, a switch in the circuit to the clutch magnet the arm of which is in line of movement of solenoid core, and which said core is moved and opens the circuit to the clutch magnet.

10. In combination with an electric motor, resistances in the armature circuit, an arm for controlling said resistances, a driving device adapted to be driven by the motor, a device adapted to be rotated by the driving device, connection between said last mentioned device and the resistance arm, the connection being such that when said device rotates said arm is moved over the resistances, and means to throw the rotatable device in and out of connection with the driving device, teeth upon the rotatable device, a solenoid the core of which when energized is adapted to mesh with said teeth and stop the rotation of said device in one direction, a normally open circuit to said solenoid, a solenoid in the armature circuit and in the circuit to the first mentioned solenoid, the core of the armature solenoid being adjusted to the desired current to the armature, and adapted when said current is exceeded to close the circuit to the first mentioned solenoid.

11. In combination with an electric motor, resistances in the armature circuit, an arm for controlling said resistances, a driving device adapted to be driven by the motor, a device adapted to be rotated by the driving device, connection between said last mentioned device and the resistance arm, the connection being such that when said device rotates, said arm is moved over the resistances, and means to throw the rotatable device in and out of connection with the driving device, a weight or spring connected to said rotatable device adapted when said device is free from said driving device to rotate said rotatable device, teeth upon the rotatable device, a solenoid the core of which when energized is adapted to mesh with said teeth and stop the rotation of said device in one direction, a normally open circuit to said solenoid, a solenoid in the armature circuit and in the circuit to the first mentioned solenoid, the core of the armature solenoid being adjusted to the desired current to the armature and adapted when said current is exceeded to close the circuit to the first mentioned solenoid.

12. In combination with an electric motor, resistances in the armature circuit, an arm for controlling said resistances a driving device adapted to be driven by the motor, a device adapted to be rotated by the driving device, an operating sheave a ring, B, having a notch secured or adapted to be secured to the sheave, a hub having arms one of which has a roller the other a weight, means to hold said roller against the face of the disk, a rotatable device, a sleeve connecting said rotatable device and hub, and connection between said resistance arm and hub whereby the arm is moved over the resistances when the hub is rotated.

13. In combination with an electric motor, resistances in the armature circuit, an arm for controlling said resistances a driving device adapted to be driven by the motor, a device adapted to be rotated by the driving device, an operating sheave, a ring B, having a notch secured or adapted to be secured to the sheave, a hub having arms one of which has a roller the other a weight, means to hold said roller against the face of the disk, a rotatable device, a sleeve connecting said rotatable device and hub, and connection between said resistance arm and hub whereby the arm is moved over the resistances when the hub is rotated, an electric clutch device adapted when energized to connect the rotatable and driving device and when de-energized to sever said connection, said clutch device being in electrical connection with current supply, a solenoid in the armature circuit controlling the circuit to the clutch magnet, and when said core is moved sufficiently opens the circuit to the clutch magnet.

14. In combination with an electric motor, resistances in the armature circuit, an arm for controlling said resistances, a driving device adapted to be driven by the motor, a device adapted to be rotated by the driving device, an operating sheave, a ring B, having a notch secured or adapted to be secured to the sheave, a hub having arms one of which has a roller, the other a weight, means to hold said roller against the face of the disk, a rotatable device, a sleeve connecting said rotatable device and hub, and connection between said resistance arm and the hub whereby the arm is moved over the resistance when the hub is rotated, teeth upon the rotatable device, a solenoid the core of which when energized is adapted to mesh with said teeth and stop the rotation of said device in one direction, a normally open circuit to said solenoid, a solenoid in the armature circuit, said solenoid controlling the circuit of the first mentioned solenoid, the core of the armature solenoid being adjusted to the desired current to the armature, and adapted when said current is exceeded to close the circuit to the first mentioned solenoid.

15. In combination with an electric motor, resistances in the armature circuit, an arm for controlling said resistances, a driving device adapted to be driven by the motor, a device adapted to be rotated by the driving device, connection between said last mentioned device and the resistance arm, the connection being such that when said device rotates said arm is moved over the resistances, a weight or spring connected to said rotatable device adapted when said device is free from said driving device to rotate said rotatable device, a clutch device adapted when energized to connect the rotatable and driving device, and when de-energized to sever said connection, said clutch device being in electrical connection with current supply and means inde-

pendent of the clutch device to throw the rotatable device in and out of connection with the driving device.

16. In combination with an electric motor, resistances in the armature circuit, an arm for controlling said resistances, a driving device adapted to be driven by the motor, a device adapted to be rotated by the driving device, connection between said last mentioned device and the resistance arm, the connection being such that when said device rotates said arm is moved over the resistances, an electric clutch device adapted when energized to connect the rotatable and driving device, and when de-energized to sever said connection, said clutch device being in electrical connection with current supply, a solenoid in the armature circuit, a switch in the circuit to the clutch magnet adapted to break the circuit to the clutch magnet.

17. In combination with an electric motor, resistances in the armature circuit, an arm for controlling said resistances, a driving device adapted to be driven by the motor, a device adapted to be rotated by the driving device, connection between said last mentioned device and the resistance arm, the connection being such that when said device rotates said arm is moved over the resistances, and means to throw the rotatable device in and out of connection with the driving device, a weight or spring connected to said rotatable device adapted when said device is free from said driving device to rotate said rotatable device, a clutch device adapted when energized to connect the rotatable and driving device, and when de-energized to sever said connection, said clutch device being in electrical connection with current supply, a solenoid in the armature circuit, a switch in the circuit to the clutch magnet adapted to break the current to the clutch magnet.

In testimony of which invention I have hereunto set my hand.

FRANK E. HERDMAN.

Witnesses:

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JOB FISH, Jr.