No. 824,687. PATENTED JUNE 26, 1906.

A. W. DARBY.

AUTOMATIC STARTER FOR MOTORS.

APPLICATION FILED NOV. 21, 1903.

4 SHEETS—SHEET 1

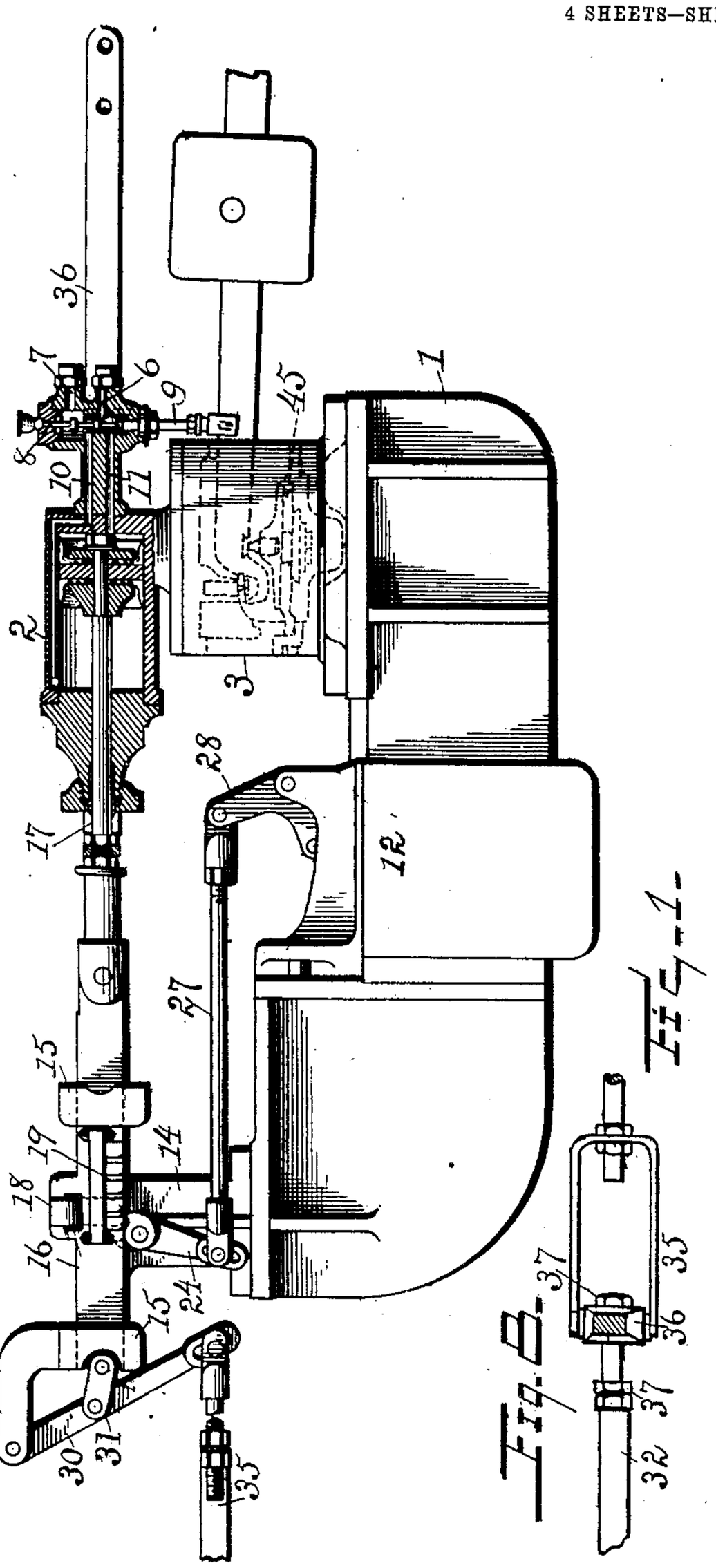


FIG. 1.

FIG. 2.

WITNESSES:

W. F. Doyle.

Leona C. Smith

INVENTOR

Arthur W. Darby.

BY

Jenkins & Barker.

Attorneys

No. 824,687. PATENTED JUNE 26, 1906.

A. W. DARBY.

AUTOMATIC STARTER FOR MOTORS.

APPLICATION FILED NOV. 21, 1903.

4 SHEETS—SHEET 2

Fig. 4.

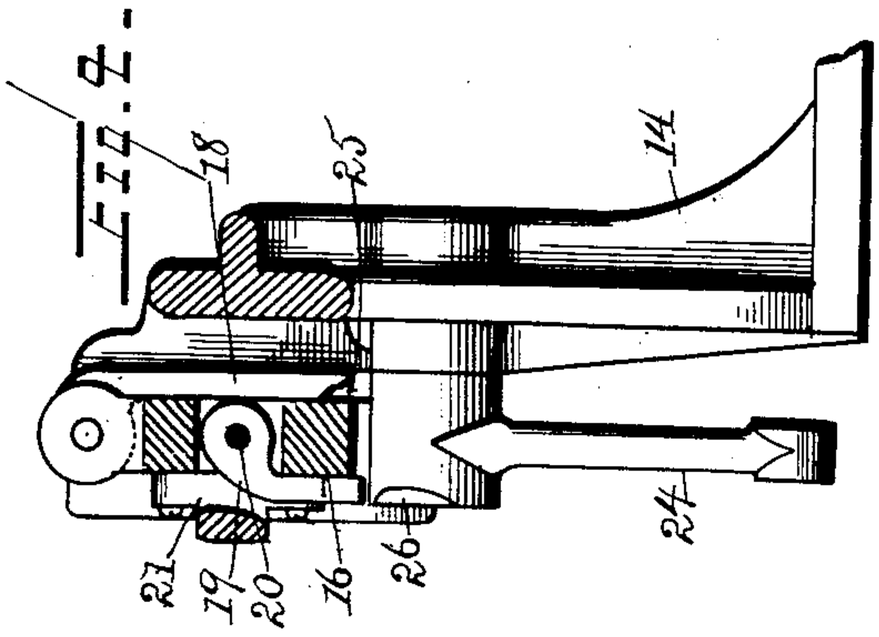


Fig. 6.

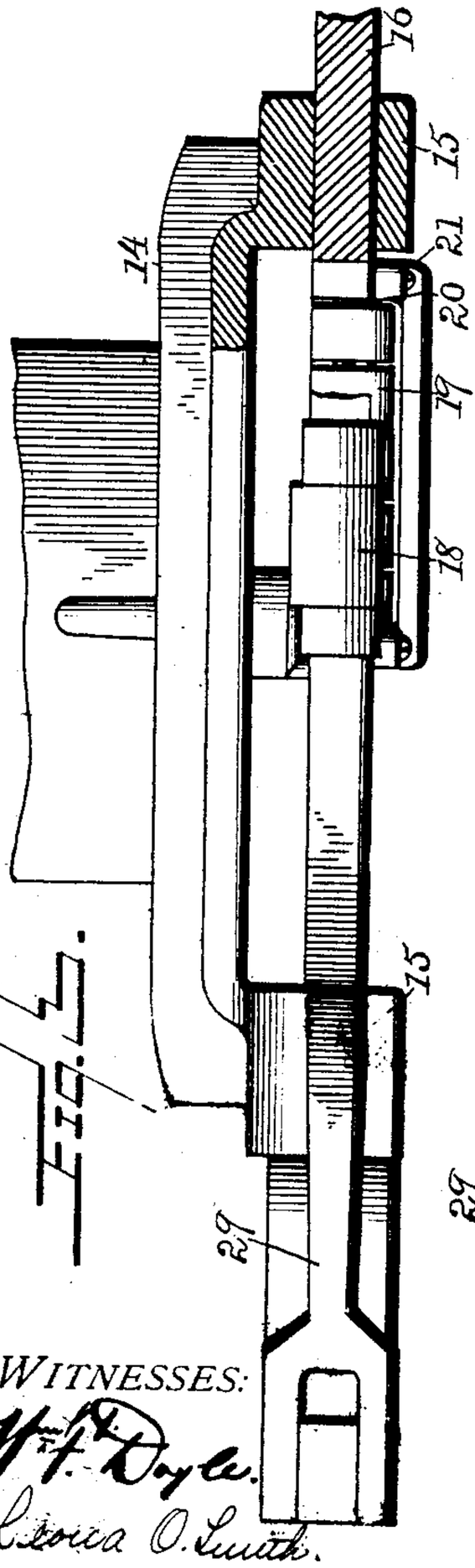


Fig. 7.

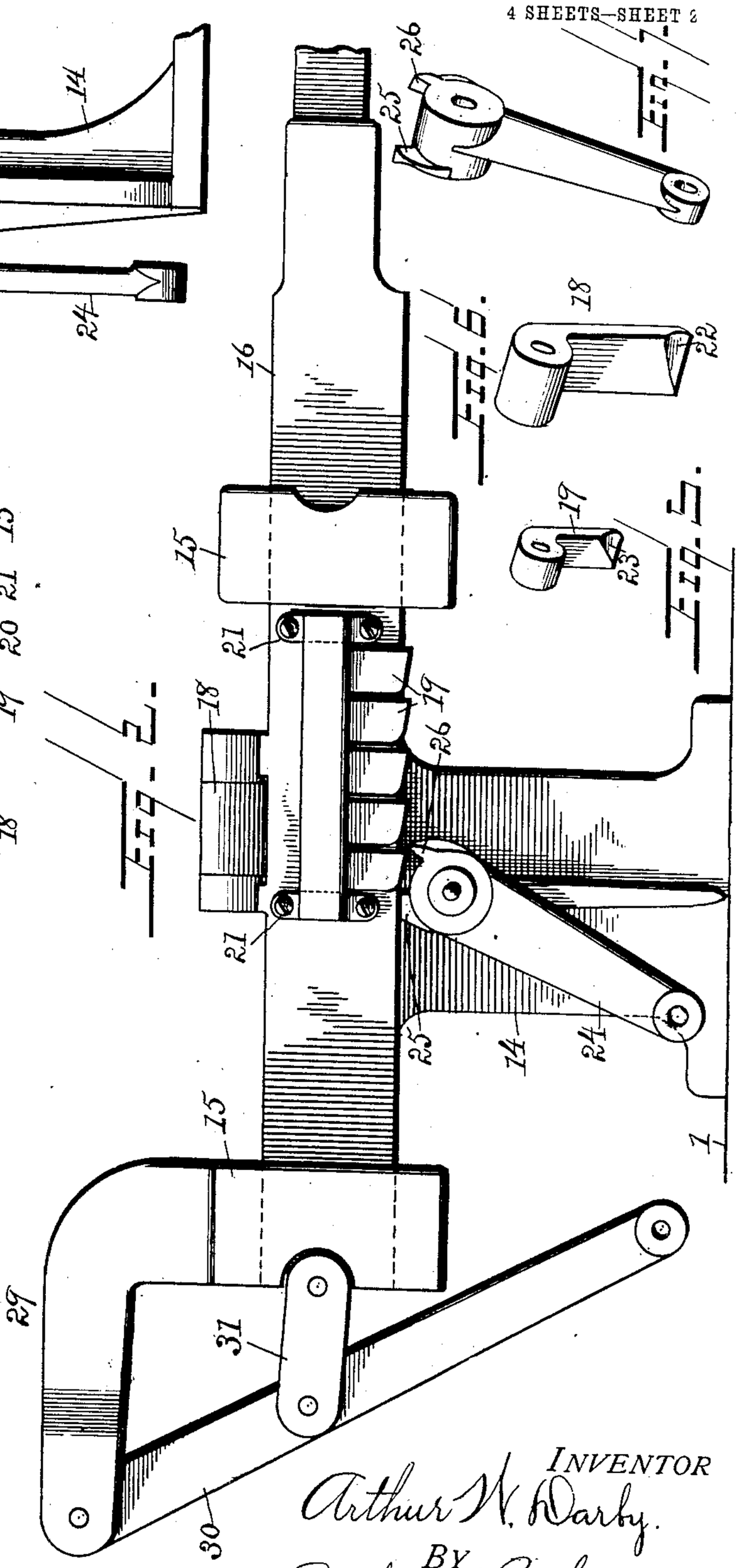


Fig. 5.

Fig. 3.

Fig. 2.

Fig. 1.

WITNESSES:

W. F. Doyle.

Leora O. Smith.

INVENTOR

Arthur W. Darby.

BY

Jenkins & Barker,

Attorneys.

No. 824,687. PATENTED JUNE 26, 1906.

A. W. DARBY.

AUTOMATIC STARTER FOR MOTORS.

APPLICATION FILED NOV. 21, 1903.

4 SHEETS—SHEET 3.

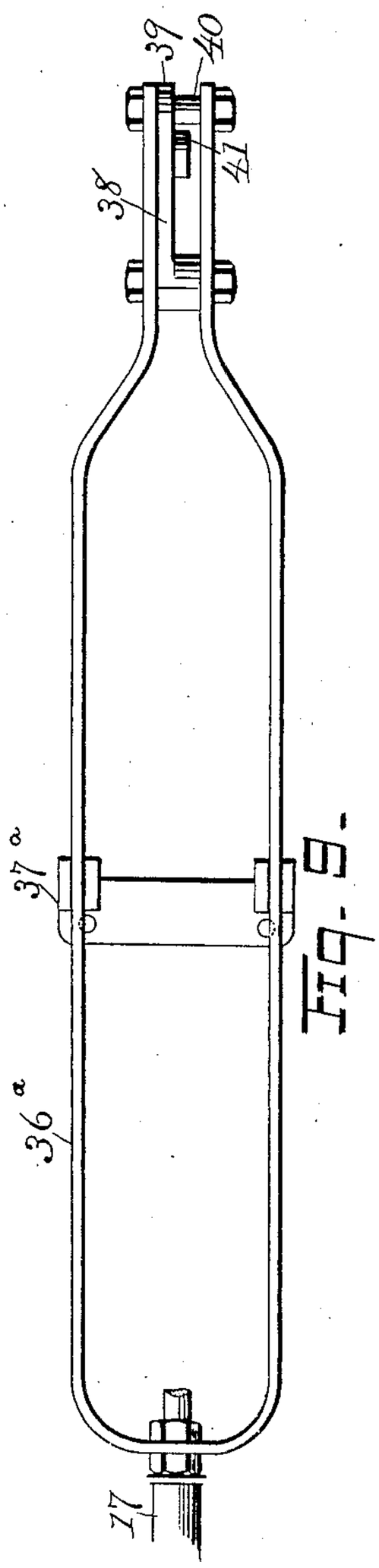


FIG. 9.

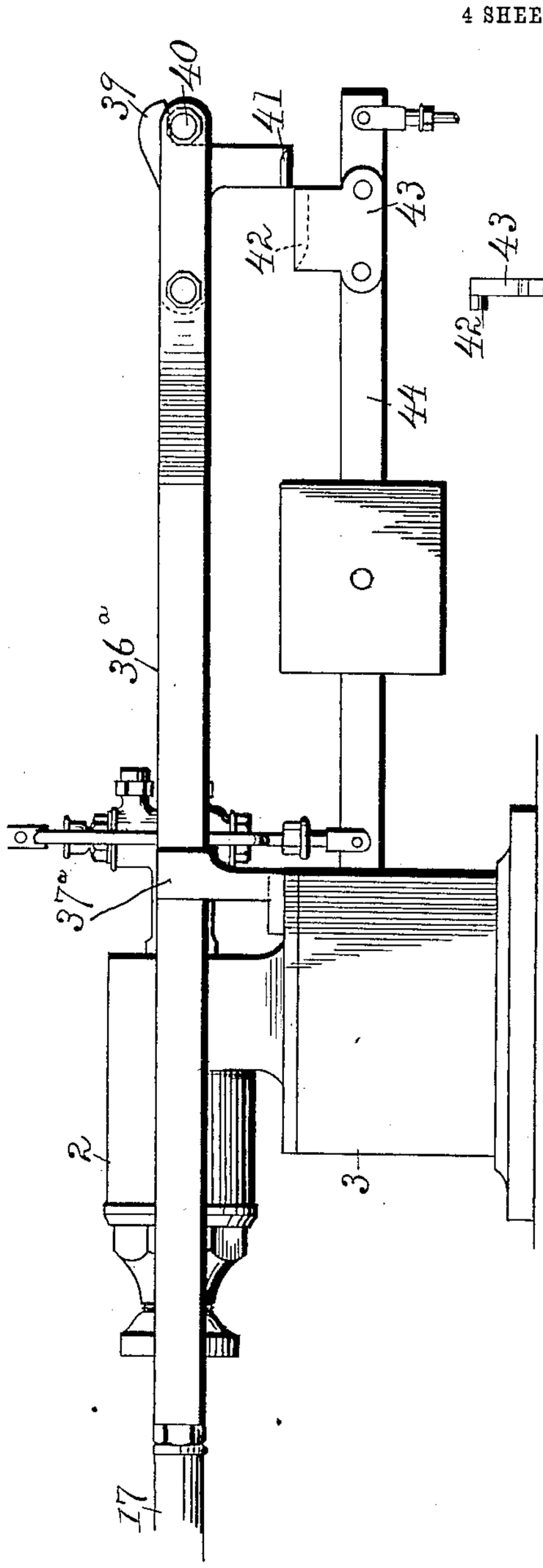


FIG. 10.

FIG. 11.

WITNESSES:

Leona O. Smith.

Clara E. Johnson

INVENTOR:

Arthur W. Darby.

by Jenkins & Barker

Attorneys.

No. 824,687.

PATENTED JUNE 26, 1906.

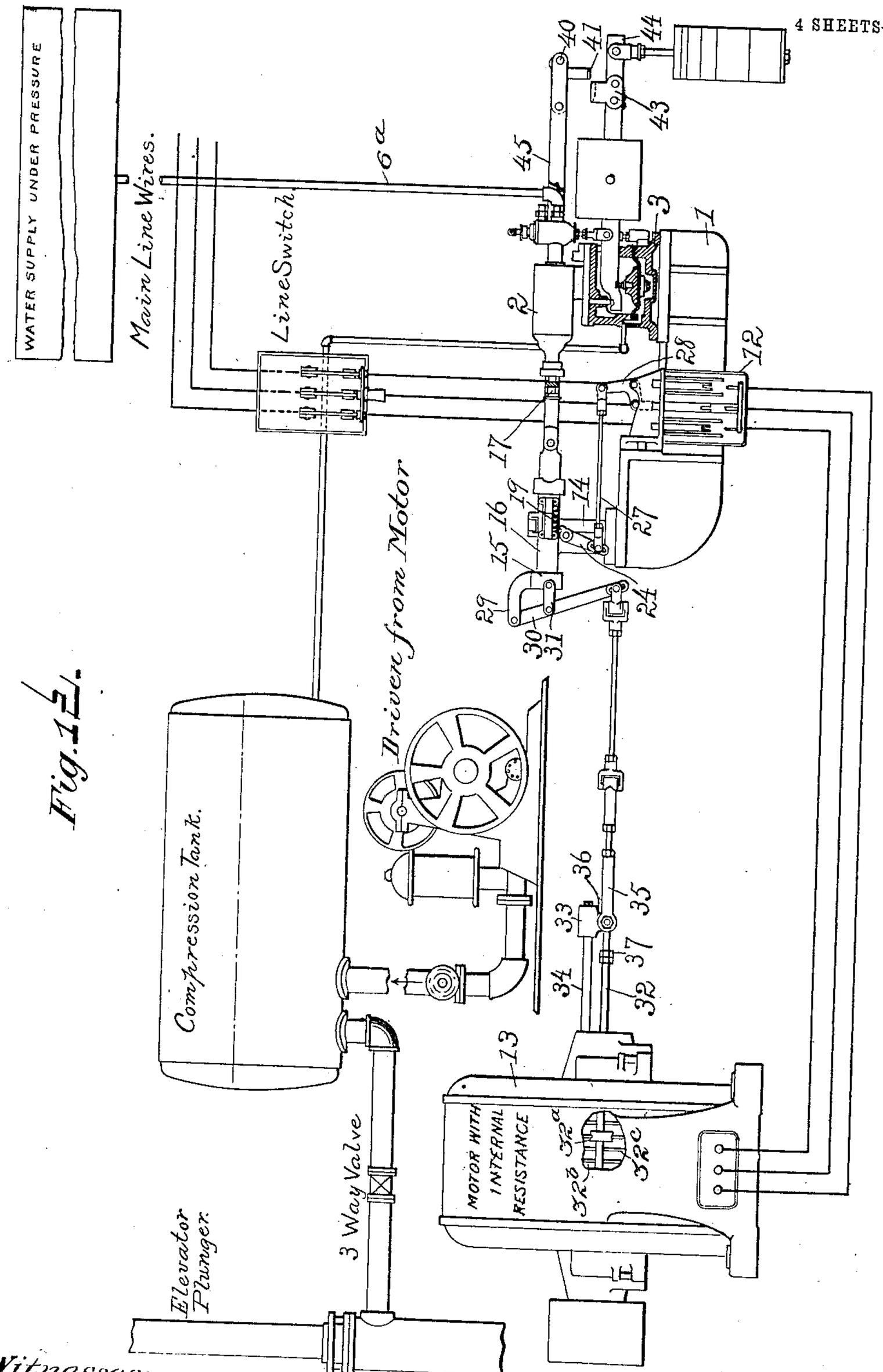
A. W. DARBY.

AUTOMATIC STARTER FOR MOTORS.

APPLICATION FILED NOV. 21, 1903.

4 SHEETS—SHEET 4.

Fig. 12.



Witnesses:
Cora M. Atwood
Lena E. Berkovitch.

Inventor:
Arthur W. Darby.
By his Attorneys
Jenkins & Barker.

UNITED STATES PATENT OFFICE.

ARTHUR W. DARBY, OF HOLYOKE, MASSACHUSETTS.

AUTOMATIC STARTER FOR MOTORS.

No. 824,687. Specification of Letters Patent. Patented June 26, 1906.

Application filed November 21, 1903. Serial No. 182,118.

To all whom it may concern:

Be it known that I, ARTHUR W. DARBY, a citizen of the United States, and a resident of Holyoke, in the county of Hampden and State of Massachusetts, have invented a certain new and useful Automatic Starter for Motors, of which the following is a specification.

My invention relates to the class of devices for starting and stopping an electric motor; and the objects of my invention are to provide a device of this class especially applicable for controlling the movements of an alternating-current motor having internal resistance, to provide a device of this class in which the "cutting in" and "cutting out" of the resistance shall be effectively controlled, and to provide a simple and effective device for controlling the flow of electric current in the starting and stopping of the motor. A device in the use of which these objects may be attained is illustrated in the accompanying drawings, in which—

Figure 1 is a view in front elevation of a portion of a device embodying my invention, with parts cut in section and with the speeding device removed. Fig. 2 is a detail view, on enlarged scale, showing the starting and stopping slide. Fig. 3 is a top view of the same with parts broken away to show construction. Fig. 4 is a view in vertical cross-section of the device shown in Fig. 2. Fig. 5 is a detail perspective view of one of the stopping-pawls. Fig. 6 is a detail perspective view of the starting-pawl. Fig. 7 is a detail perspective view of the switch-controlling lever. Fig. 8 is a detail view showing the loose connection between the resistance-core and the slide. Fig. 9 is a detail plan view showing the speeding device and its connection. Fig. 10 is a detail view in elevation of the speeding device and parts upon which it is mounted. Fig. 11 is a detail edge view of the lifting-block. Fig. 12 is a diagram view showing the relative location of the several parts of the device and illustrating the method of operation.

In the accompanying drawings the numeral 1 denotes a base or support on which the starter or controller is mounted. This controller, briefly speaking, may be said to consist of a mechanical actuator and a mechanical motor therefor, the latter including valve and valve-operating mechanism.

The numeral 2 indicates a cylinder of the mechanical motor, and 3 a valve-operating device of the kind frequently used in connection with an elevator for controlling the operations of a motor which operates a pump. This valve-operating device is governed and controlled in the usual manner by pressure from the compression-tank, the pressure in this tank being reduced during the movement of the elevator and increased by the operation of the pump connected up to the tank. The cylinder 2 may be mounted, as shown, on the casing or operating device 3. While I have shown herein one form of valve-operating mechanism, it is obvious that many different forms may be used to accomplish this purpose and to cause a reciprocating movement of the valve, and my invention is not limited to any special form of valve-operating device.

The valve mechanism is preferably located at one end of the cylinder and includes an inlet 6 and an outlet 7, each controlled by a valve 8, located in the valve-chamber. This valve is connected with a rod extending to the valve-operating mechanism 3. (See Fig. 12 of the drawings.) The valve 8 controls the ports 10 and 11, leading to the chamber in the cylinder 2, and by manipulation of the valve the water, air, or other fluid is conducted to the chamber at either end of the cylinder, creating a pressure therein, while the exhaust from the other end of the cylinder is duly regulated. The mechanism herein described may be of any well-known construction and, except in combination with parts to be hereinafter described, forms no part of my present invention.

As a means for operating the piston in the cylinder 2 I have shown herein a pipe 6^a, extending from a water-supply tank to the inlet 6; but it will be understood that in most instances in use this inlet 6 will be connected directly with a system of water-supply under pressure. An electric cut-out or switch 12 is located on the support 1, and this cut-out may be of any well-known form and construction, as shown in Fig. 12 of the drawings. This cut-out is employed for the purpose of controlling the flow of an electric current to the electric motor 13, and by the term "electric motor" as used herein I mean to include all parts included within the device herein illustrated, including the stator and all other parts.

While my invention may be applied to mo-

tors of various types, it is especially applicable to a motor of the alternating type having internal resistance, as it is absolutely essential in such a motor that the flow of electric current for operating the motor shall be absolutely controlled, as otherwise damage is sure to result, and while I do not limit my invention to use specifically with such a motor such has been employed in the drawings herein for the purpose of properly illustrating the operation of my device.

A very important feature of my invention resides in the mechanical actuator forming a part of the structure as a whole, the term "mechanical" as applied to this actuator being used for the purpose of distinguishing it from other devices used for a similar purpose and in which electricity is employed in the operation. The construction of this improved mechanical actuator is as follows: A bracket 14 is secured to the support 1, and at the upper end of this bracket is formed in projections 15 a slideway for the starting and stopping slide 16. This slide is suitably connected at one end with the piston-rod 17, by means of which the slide is reciprocated. A starting-pawl 18 is pivoted to the slide 16 and hangs at one side of the slide, as shown in Fig. 4. A series of stopping-pawls 19 is also pivoted to the slide, being preferably supported on a rod 20, extending between the supports 21. The starting-pawl 18 is beveled, as at 22, this beveling being located at the rear edge of the pawl, and this term "rear edge" is used with respect to the direction of movement of the pawl in its operation to start the device. Each of the pawls 19 is beveled at its front edge, as at 23.

A cut-out or switch-operating lever 24 is pivoted on the bracket 14, and this lever is provided with a starting-tooth 25 and a stopping-tooth 26, these teeth being arranged so that the starting-tooth 25 will operate in connection with the starting-pawl 18 to start the motor, and the stopping-tooth 26 will act in connection with the stopping-pawls 19 to stop the motor. It will be noted that these teeth are located near opposite ends of the hub of the lever. The lever is connected, as by means of a rod 27, with a bell-crank lever 28, that operates the switch or cut-out. An arm 29 extends from the bearing 15, and a resistance-lever 30 is pivoted to this arm. The lever is connected by a link 31 with the slide 16, and the lower end of the lever is connected to a resistance rod or core 32. This rod or core 32 has a loose connection with a guide 33, mounted on a guide-rod 34, supported by the motor. This loose connection is secured by means of a yoke 35, having a cross-piece 36, through which the core end or an extension from the end of the core 32 projects. Nuts 37 are located on the projection from the core 32 and at some distance apart, these nuts being located on opposite sides of the cross-piece 36, so that the yoke 35 and guide 33 may have a movement independent of the core, said movement of the guide and core being caused by a reciprocating movement of the slide 16. The core 32 bears a short-circuiting collar 32^a, that operates in connection with the conductors 32^c on a short-circuiting plate 32^b, this constituting a portion of the resistance mechanism.

In the operation of the device, the parts being in the position shown in Figs. 1 and 12 of the drawings, the starting-lever or other device of an elevator being operated to cause the elevator to move upward, the three-way valve shown in Fig. 12 is opened and pressure from the compression-tank is admitted to the elevator - cylinder, causing the plunger to move upward. This operation has caused a reduction of pressure in the compression-tank, and a like reduction in pressure is caused underneath the diaphragm in the operating device 3. This reduction in pressure under the diaphragm is caused by reason of the communication of the chamber under the diaphragm with the compression-tank through the connecting-pipe shown in Fig. 12. This reduction of pressure under the diaphragm causes the lever 44 to fall, and this downward movement of the lever carries with it the rod 9. This operation causes the valve 8 to be operated to admit fluid to the right-hand end of the cylinder 2, the piston and piston-rod 17 being moved outward, and the exhaust from the cylinder is suitably regulated to permit this movement. This movement of the piston-rod 17 causes a corresponding movement of the slide 16, which carries the working edge of the starting-pawl 18 into engagement with the tooth 25 of the lever 24. This swings the lever on its pivot, operating the bell-crank lever 28 by the connection 27 and the cut-out or switch 12 to admit current to the motor 13. The core 32 being at the outward limit of its play at this time the full resistance of the motor is exerted. In the initial movement of the slide the loose connection of the core and lever permits such movement without operating the core, thus permitting the closing of the switch without movement of the core. The core is now gradually inserted, and the resistance thus gradually cut out until the full strength of the current is in effective operation. The motor is suitably connected to a pump (the connection not being shown herein, but which may be a belt or the like common to devices of this class) for supplying pressure to the compression-tank through the pipe from the pump, as shown in Fig. 12. When the pressure in the tank, and consequently under the diaphragm in the operating device 3, has reached the required degree, the lever 44 is thereby raised and the valve 8 is operated to admit pressure to the opposite end of the cylinder 2. This causes the piston to

travel backward and imparts a reverse movement to the slide 16. The connections hereinbefore described serve to operate the cut-out or switch 12 and throw off the electric current, switch being moved while the core 32, to throw in the resistance, is at rest. After the current has been thrown off the core begins to operate to throw in the resistance. The movement of the lever 24 in stopping the motor is caused by the engagement of a pawl 19 with the tooth 26, the latter being engaged by the pawl, whose working edge is in position to next encounter the teeth. It will be seen that by this construction I have provided means whereby the lever 24 is certainly moved to operate the cut-out irrespective of the position of the slide when it shall begin its movement to stop the operation of the motor. This is of special advantage from the fact that it is essential that the switch shall be operated to cut off the electric current before the core is operated to throw in the resistance, and in case one of the pawls 19 should fail to engage the tooth 26 on the lever 24 a succeeding pawl is sure to engage it and operate the lever. It will be seen that this same result will be attained should the slide 16 not have moved its full extent to cut out the resistance before its start in the opposite direction to throw in the resistance.

In the use of an internal-resistance motor it is absolutely essential that the resistance mechanism shall be properly operated and that the supply of electric fluid to the motor shall be absolutely controlled with respect to said resistance mechanism. In addition to the advantages above described by providing a series of pawls whereby the switch is thrown in a reverse movement of the starting and stopping slide from any point which it may have reached and before the operation of the resistance mechanism, should one of the pawls in a movement of the slide fail to operate to throw the switch, there are succeeding pawls which may be depended upon to accomplish this result and that therefore the providing of a series of pawls absolutely insures the operation of the switch to control the flow of electric fluid to the motor before the resistance mechanism shall be put into operation. In some adaptations of the device while it is desirable to have the movement of the piston in a direction to start the motor comparatively slow, so that the cutting out of the resistance shall not be so rapid as to cause injury to the motor, it may also be desirable to have the movement of the piston in the reverse direction comparatively rapid in order to prevent the electric current from arcing across the switch, as well as for other reasons that may present themselves.

In order that the device may operate to these ends, I have provided a speed mechanism more particularly shown in Figs. 9 and 10 of the drawings. This speed device consists of a yoke 36^a, secured to the piston-rod 17 and clamped between nuts on the rod, as shown in the drawings. This yoke 36^a is free to move horizontally through a guide 37^a, mounted on the starting device 3. The arms of this yoke pass on opposite sides of the cylinder 2 and are brought close together at their outer ends. Between these outer ends a latch 38 is pivotally suspended. This latch has a nose 39, adapted to rest on a stop 40, which consists of a stud extending between the outer ends of the arms. The lower end of this latch is provided with a cam 41, adapted to engage a cam-lip 42 on a block 43. This block 43 is mounted on the pressure-lever 44 of the starting device 3.

In the operation of this device it will be noted that when the pressure under the diaphragm in the starting device 3 is low and the diaphragm 45 is down the valve mechanism is in a position to move the piston to start the motor. As the piston-rod 17 moves forward it carries the yoke 36 and the latch 38 rises and moves over the top of the block 43. The movement of the valve-operating mechanism caused by reduction of pressure under the diaphragm, and the consequent movement of the piston to start the motor, is slow as compared with the movement of the parts in the opposite direction under the action of my improved device. As the piston moves in a direction to stop the motor the latch 38, having dropped to its lowermost position, causes its cam 41 to engage underneath the cam-lip 42 on the block 43, thus quickly raising the lever 44, and consequently the valve-rod. This initial movement of the piston to the extent of raising the valve-rod will occur before the cut-out has operated to cut off the electric current. The valve mechanism having been thus thrown into full operation to admit full pressure to the piston the movement of the latter backward for its entire length will be comparatively quick.

It is obvious that the specific form of construction herein illustrated and described may be departed from to a considerable extent and yet come within the scope of the invention, and I do not desire to limit myself to the exact construction herein illustrated and described.

While the invention has been shown and described herein with reference to an alternating-current motor of the internal-resistance type as a device in connection with which the invention has been found to produce beneficial results, it is obvious that such results may follow from the use of the invention with motors of other types.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. In combination with an electric motor for actuating a device to supply pressure to a tank, resistance for the motor, resistance-controlling mechanism, a mechanically-oper-

ated valve-operating device, a valve connected therewith, an actuator, a piston connected with the actuator and operated by fluid admitted by the valve, means for supplying pressure to the piston through the valve mechanism, a switch connected with the actuator to be operated before movement of the resistance mechanism, and connections between the actuator and resistance-operating mechanism.

2. In combination with an electric motor for actuating a device to supply pressure to a tank, resistance for the motor, resistance-controlling mechanism, a mechanically-controlled valve-operating device, a valve connected therewith, an actuator, a piston for operating the actuator, means for supplying pressure to the piston through said valve, a switch connected with the actuator to be operated before movement of the resistance-operating mechanism, and connections between said actuator and the resistance-operating mechanism.

3. In combination with an electric motor for actuating a device for supplying pressure to a tank, resistance for the motor, resistance-controlling mechanism, the tank, a valve-operating mechanism connected with the tank, a valve connected with the operating mechanism, an actuator, a piston connected with the actuator and actuated in both directions by the same source of supply, means for supplying pressure through the valve to said piston, a switch, and connections between the resistance-operating mechanism and the switch for operating the latter before movement of the former.

4. In combination with a motor, resistance therefor, resistance-controlling mechanism, a switch for closing the circuit to the motor, a mechanical actuator, a mechanical motor therefor, connections between said actuator and resistance-operating mechanism, and connections between said actuator and the switch to operate the latter before movement of the resistance-operating mechanism.

5. In combination with an electric motor, resistance therefor, a movable member for controlling the resistance, a slide connected with the movable member, a switch, a lever connected with the switch, pawls located on the slide for throwing said lever in either direction, and means for operating the slide.

6. In combination with an electric motor, resistance therefor, a movable member for controlling the resistance, a slide connected with said movable member, a switch, a lever connected with the switch, a pawl for operating said lever in one direction, a series of pawls for operating the lever in the opposite direction, and means for operating the slide.

7. In combination with an electric motor, resistance therefor, a movable member for controlling the resistance, a slide connected with the movable member, a switch, a lever connected with the switch, and connections between the slide and switch and including a plural number of devices for insuring the throwing of the switch in one direction.

8. In combination with an electric motor, resistance therefor, a movable member to control the resistance, a slide connected with said movable member, current-controlling means, a lever connected with said controlling means, a pawl borne by the slide to operate the lever to admit current, a series of pawls borne by the slide to operate the lever to cut off the current, and means for operating the slide.

9. In combination with a mechanical device, an electric motor for driving the same, resistance for said motor, resistance-controlling mechanism, a switch for closing the circuit to the motor, an actuator to operate both the switch and resistance-controlling mechanism, and intermittently connected with the former, and means for operating said actuator to throw off the switch at any point from which the backward movement of the actuator shall begin.

10. In combination with an electric motor, resistance therefor, resistance-controlling mechanism, a switch for closing the circuit to the motor, an actuator, a mechanical motor therefor, means for operating the motor, connections between the actuator and resistance-controlling mechanism, and means for intermittently connecting the actuator with and to operate the switch.

11. In combination with a motor, resistance therefor, resistance-controlling mechanism, means for admitting current to said motor, including its resistance, and an actuator loosely connected with the resistance-controlling mechanism and with the current-admitting mechanism.

12. In combination with a motor, resistance therefor, resistance-controlling mechanism, means for admitting current to the motor, including its resistance, a slide loosely connected with the resistance-controlling mechanism and also with the current-admitting means, and means for operating the slide.

13. In combination with an electric motor, resistance therefor, resistance-controlling mechanism, a mechanical motor for imparting motion to the resistance-controlling mechanism, means for controlling the movement of the mechanical motor and including a pressure-chamber having a diaphragm and connected lever, means for actuating the diaphragm and connected lever, and means for moving said lever by force other than that exerted by the movement of the diaphragm.

14. In combination with an electric motor, resistance therefor, resistance-controlling mechanism, a mechanical motor, means for controlling the movements of the mechanical motor and including a pressure-chamber

having a diaphragm and connected lever, and additional means for actuating said lever to control the movements of the mechanical motor.

15. In combination with an electric motor, resistance therefor, resistance-controlling mechanism, means for admitting current to said motor and its resistance, a mechanical motor for operating said admission means and including a piston, means for controlling the movements of the piston, and including a pressure-chamber, a diaphragm located therein, a lever connected with the diaphragm for operating the piston-controlling means, a yoke secured to the piston-rod, and means borne by the yoke for operating said lever independently of the force exerted by the movement of the diaphragm.

16. In combination with an electric motor, resistance therefor, resistance-controlling mechanism, a mechanical motor for operating the resistance including a piston and a piston-rod, means for controlling the movement of the piston, and including a pressure-chamber, a diaphragm located in said chamber, and having a connected lever for operating the piston-controlling means, a yoke, and connections between the yoke and lever for raising the latter in the movement of the yoke in one direction.

17. A motor, resistance therefor, resistance-controlling mechanism, a motor-actuator, including a slide, means for operating the actuator, connections between said slide and the resistance-controlling mechanism, a switch for admitting current to the motor, a lever connected with the switch and provided with teeth, a series of pawls borne by the slide to engage one of the teeth on the lever, and a single pawl borne by the slide to engage another tooth on the lever.

18. A motor, resistance therefor, resistance-controlling mechanism, a motor-actuator including a slide, means for operating the actuator, a loose connection between the resistance-controlling mechanism and said slide, a switch for admitting current to the motor, a lever connected with the switch and having oppositely-disposed teeth, a series of pawls borne by the slide to engage one of the teeth borne on the lever, and a single pawl to engage another tooth on the lever.

19. A motor, resistance therefor, resistance-controlling mechanism, a motor-actuator including a slide, means for operating said actuator, a switch, a lever connected with the switch, and a series of pawls borne by the slide freely movable over said lever in one direction, one of which engages therewith in the movement of the slide in the opposite direction.

20. In combination with an electric motor, resistance therefor, resistance-controlling mechanism, means for admitting current to the motor, an actuator, means for operating the actuator and including a piston, means for controlling the movements of the piston, and including a pressure-chamber, a diaphragm located therein, a lever connected thereto for operating the piston-controlling means, a yoke secured to the piston-rod, and a latch borne by the yoke to engage the lever and lift it independent of the force exerted by pressure on the diaphragm.

ARTHUR W. DARBY.

Witnesses:
W. W. RAYNOLDS,
ETTA M. ORRELL.