No. 622,430. Patented Apr. 4, 1899.

T. W. HEERMANS & N. WHICHELLO.

ELECTRIC ELEVATOR.

(Application filed Jan. 29, 1898.)

(No Model.) 7 Sheets—Sheet 1.

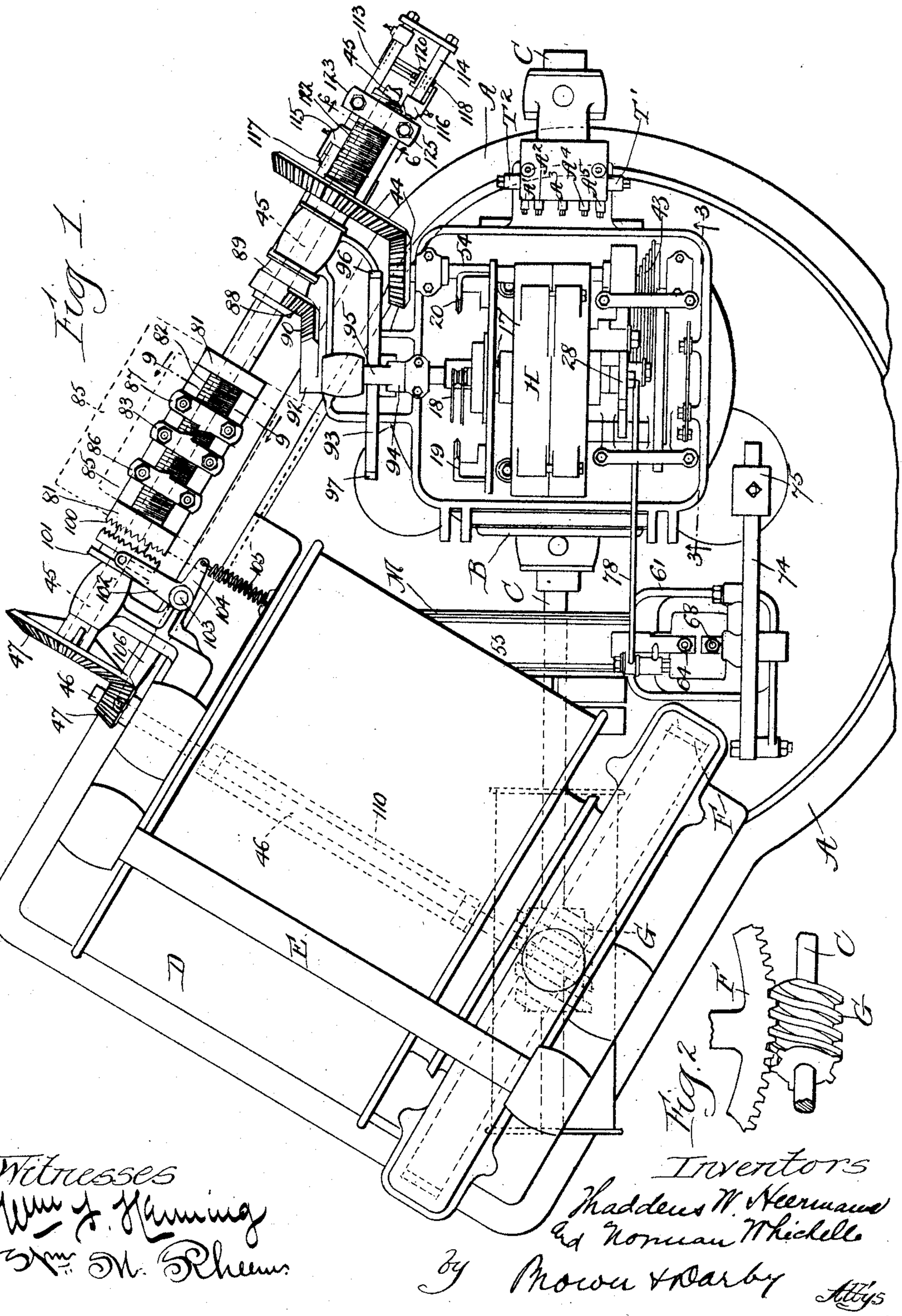

Fig. 1.

Fig. 2.

Witnesses
Wm. F. Fleming
Wm. N. Rheem.

Inventors
Thaddeus W. Heermans
and Norman Whichello
by Brown & Darby Atty's

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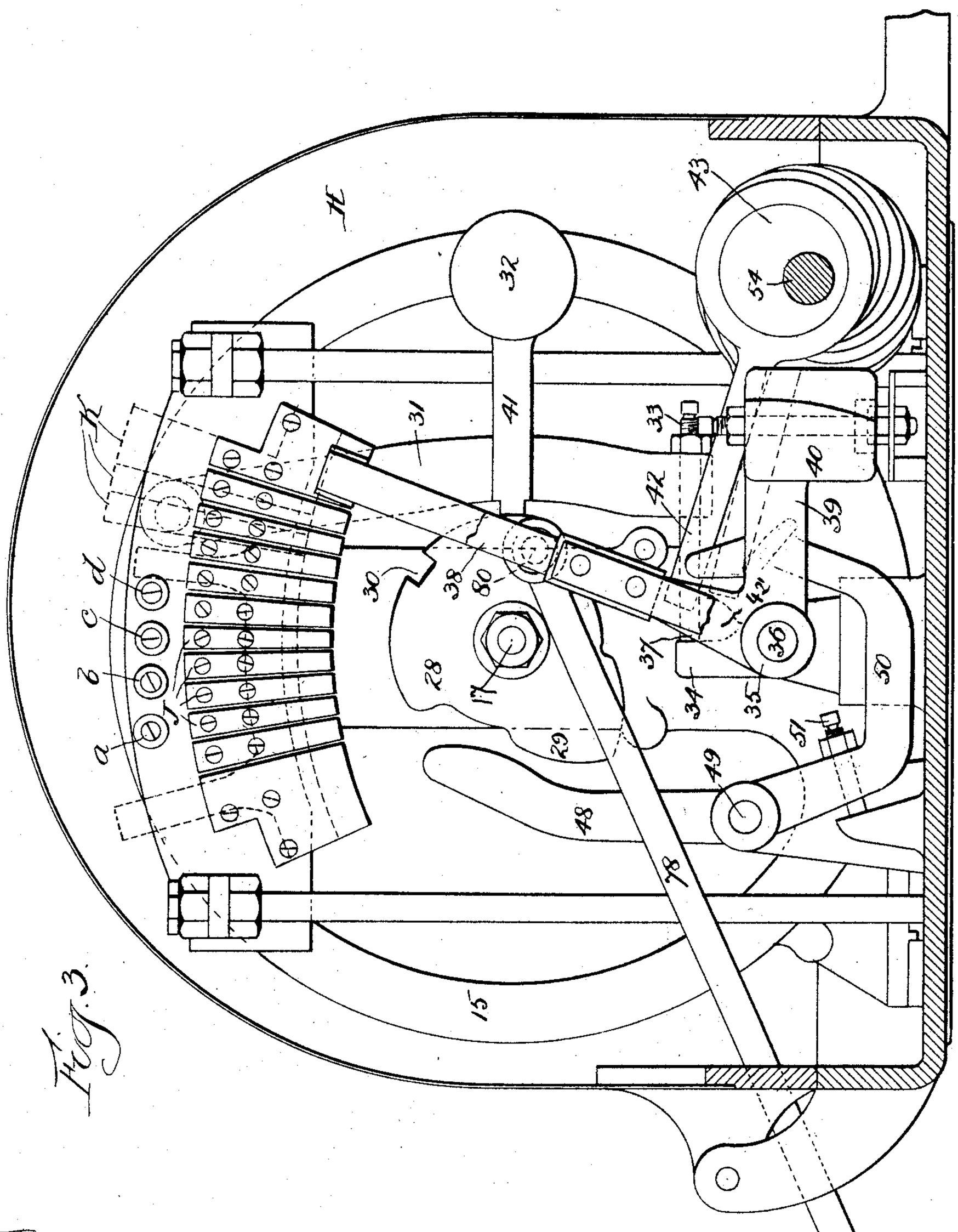

Fig. 3.

Witnesses
Wm. F. Fleming
Wm. N. Rheem.

Inventors
Thaddeus W. Heermans
Ed Norman Whichello
By Brown & Darby
Attys

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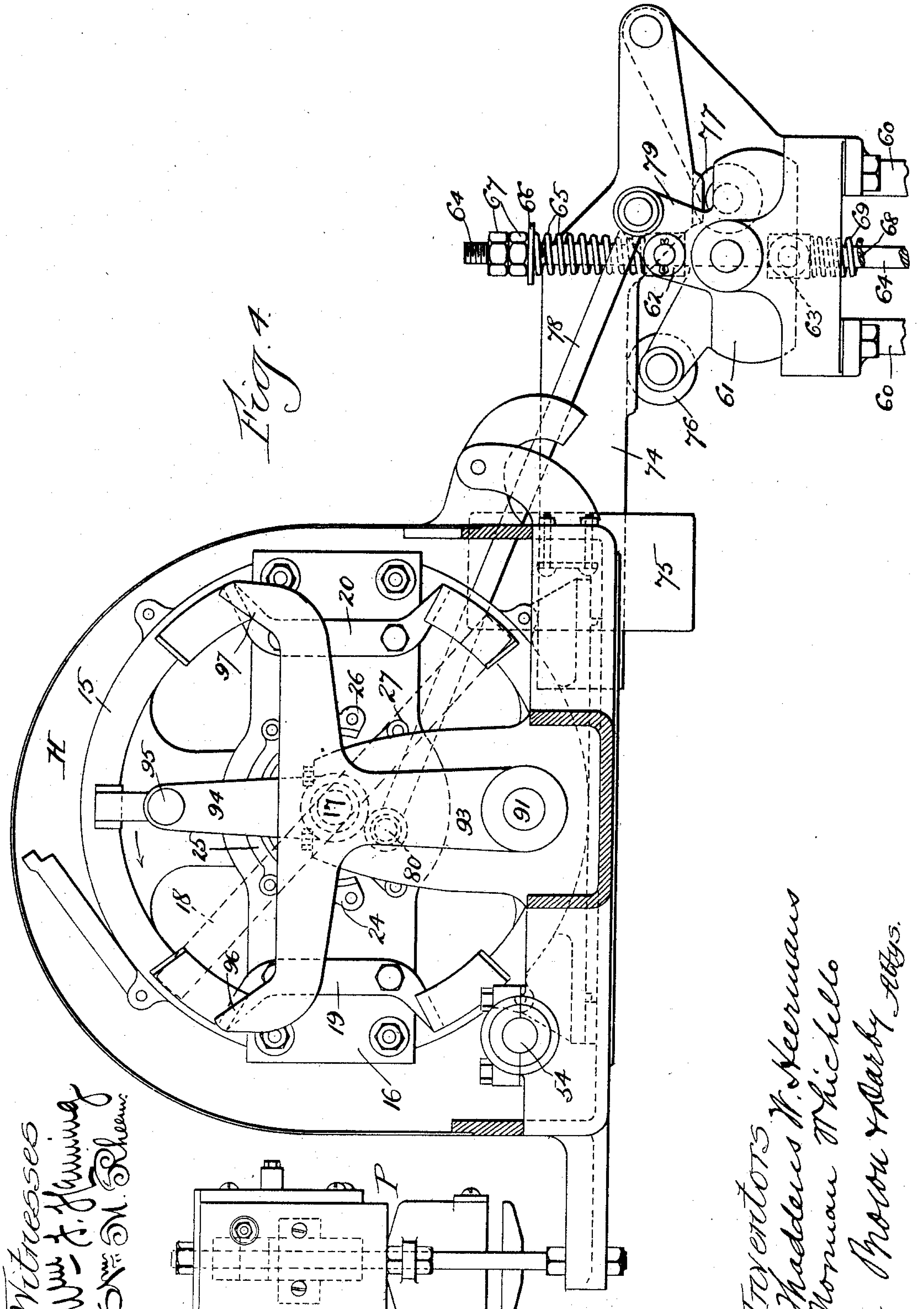
Fig. 4.



Witnesses
Wm. F. Hunning
Jno. M. Rheem

Inventors
Thaddeus W. Heermans
Norman Whichello
by Brown & Darby Attys.

No. 622,430. Patented Apr. 4, 1899.

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(No Model.) 7 Sheets—Sheet 4.

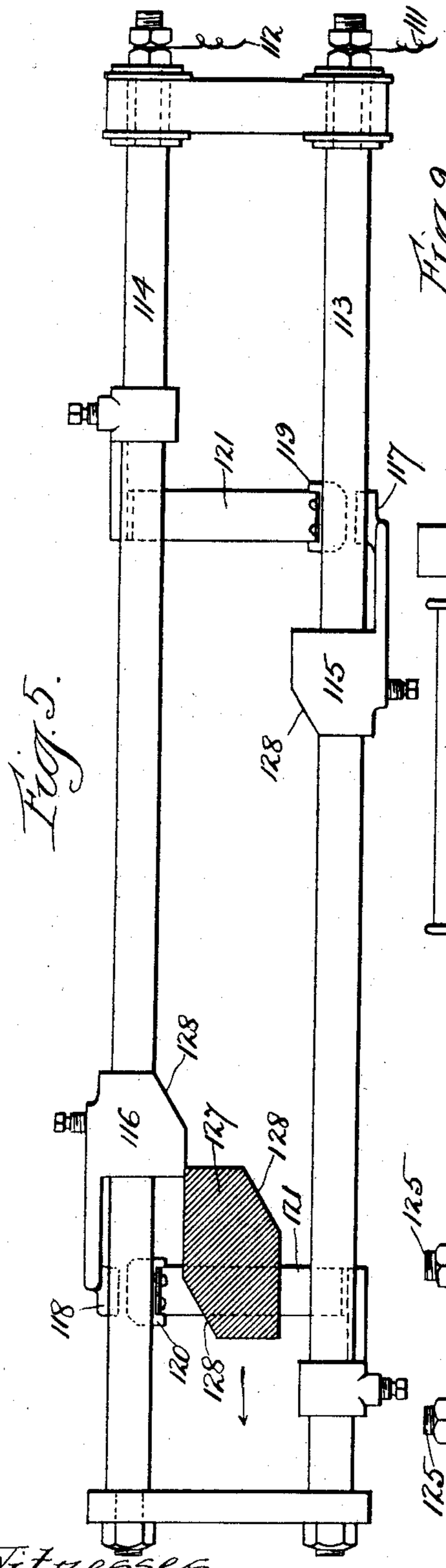


Fig. 5.

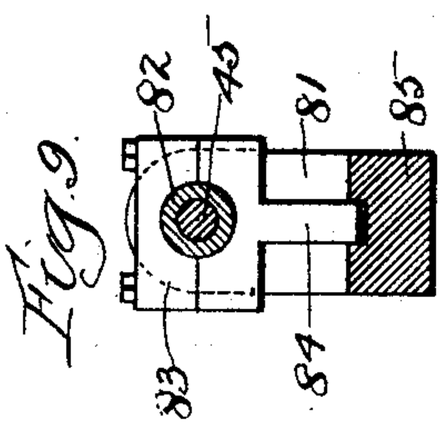


Fig. 9.

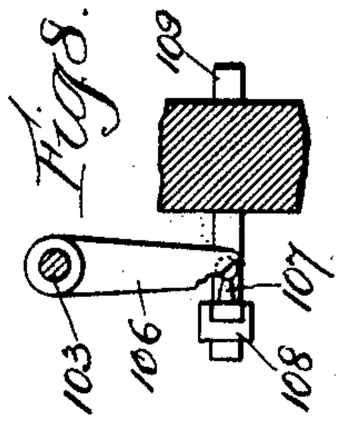


Fig. 8.

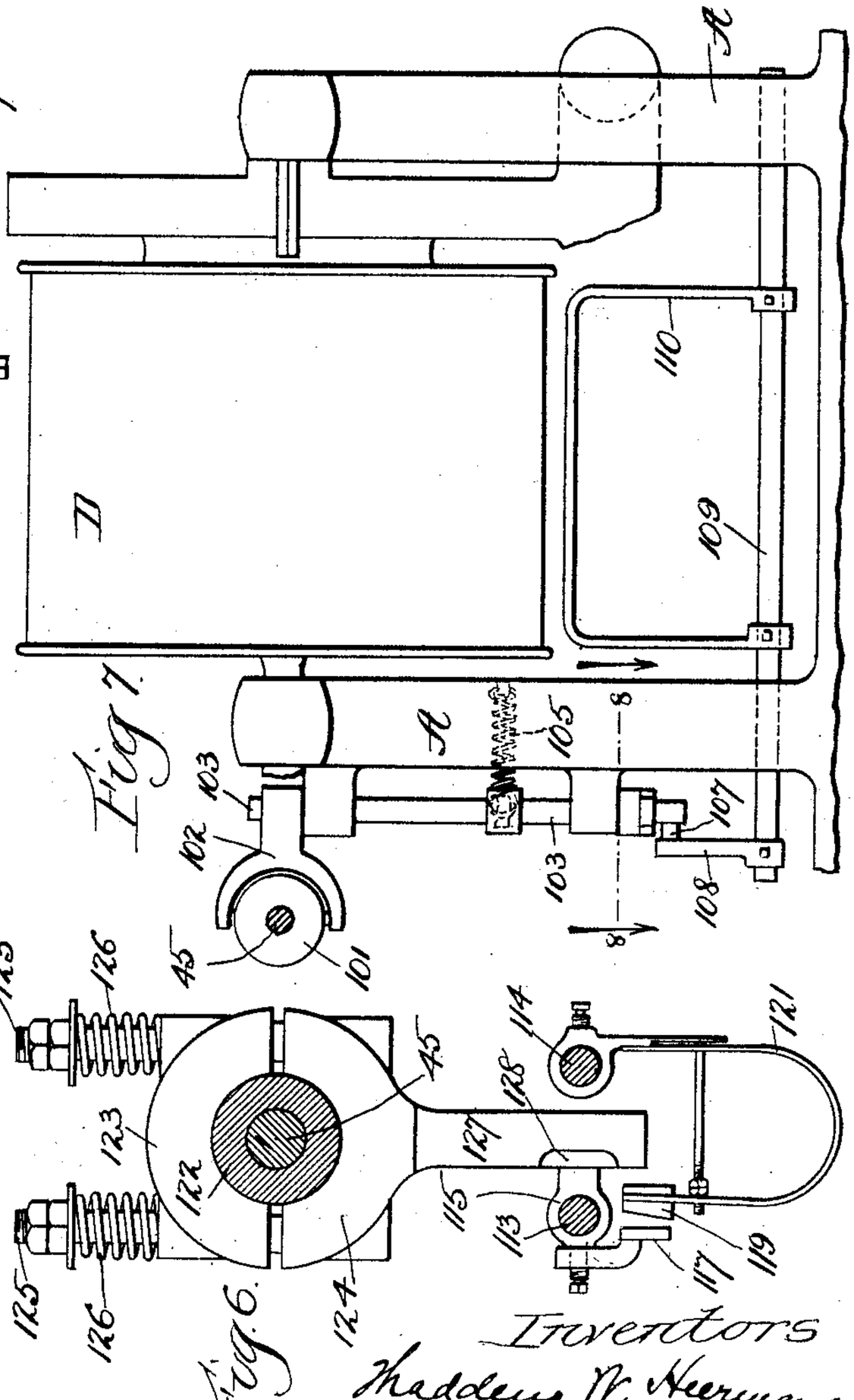


Fig. 7.

Fig. 6.

Witnesses.
Wm. F. Fleming
Wm. M. Rheems.

Inventors
Haddeus W. Heermans
and Norman Whichello
by Moore & Darby Attys

No. 622,430. Patented Apr. 4, 1899.

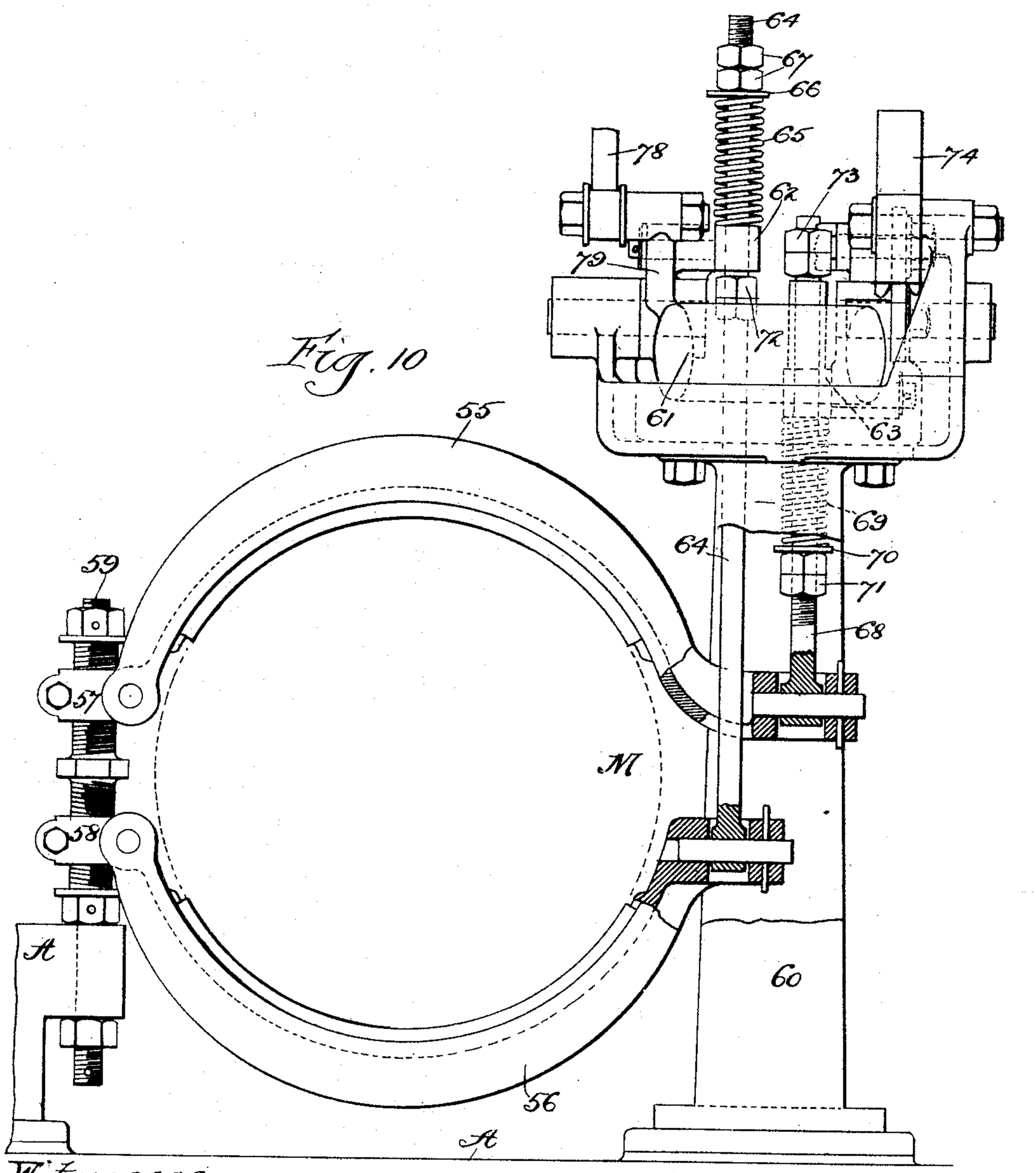
T. W. HEERMANS & N. WHICHELLO.

ELECTRIC ELEVATOR.

(Application filed Jan. 29, 1898.)

(No Model.) 7 Sheets—Sheet 5.

Fig. 10



Witnesses
Wm. F. Hemming
Wm. N. Rheem.

Inventors
Thaddeus W. Heermans
& Norman Whichello
by Brown & Darby Atty's

No. 622,430. Patented Apr. 4, 1899.

T. W. HEERMANS & N. WHICHELLO.

ELECTRIC ELEVATOR.

(Application filed Jan. 29, 1898.)

(No Model.) 7 Sheets—Sheet 6.

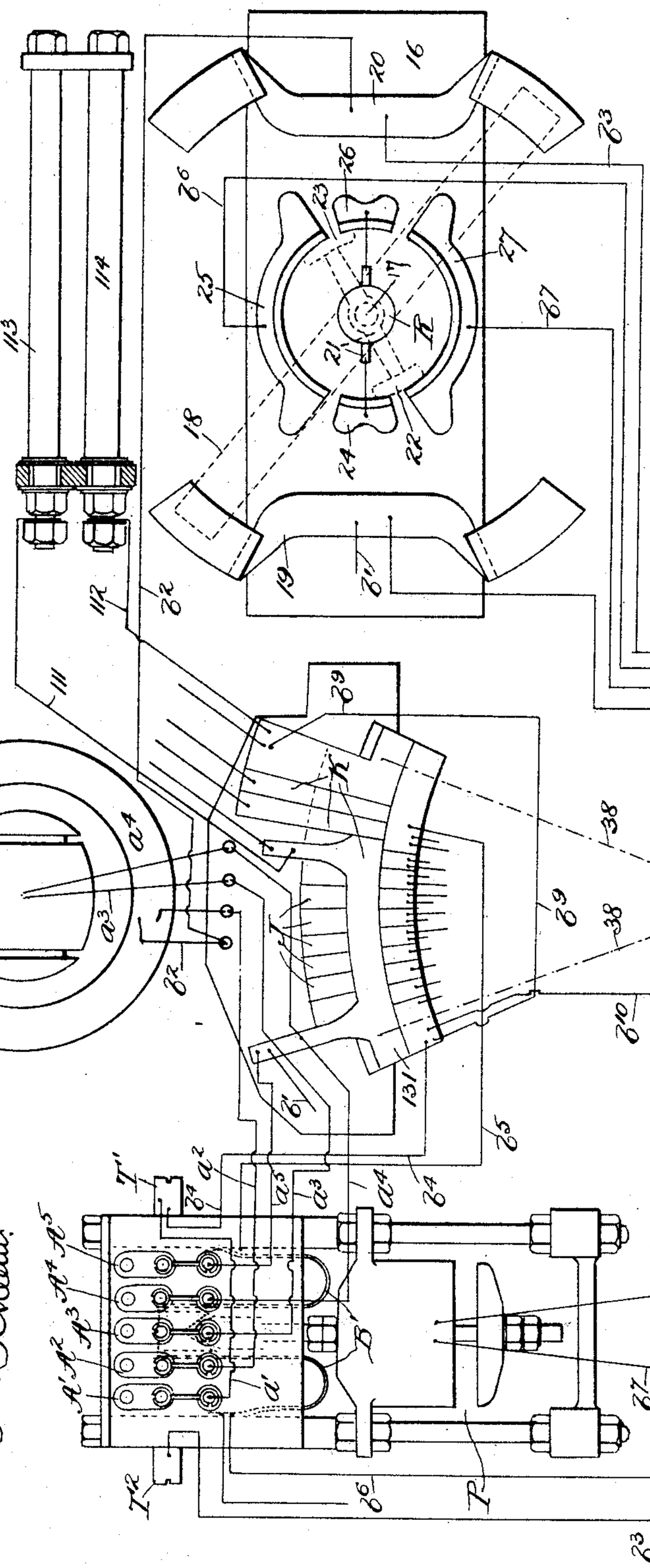


Fig. 11.

Witnesses
Wm. F. Hunning
Sam'l. W. Shearman

Inventors
Maddeus N. Heermans
and Norman Whichello
by Brown & Clarkey
Attys.

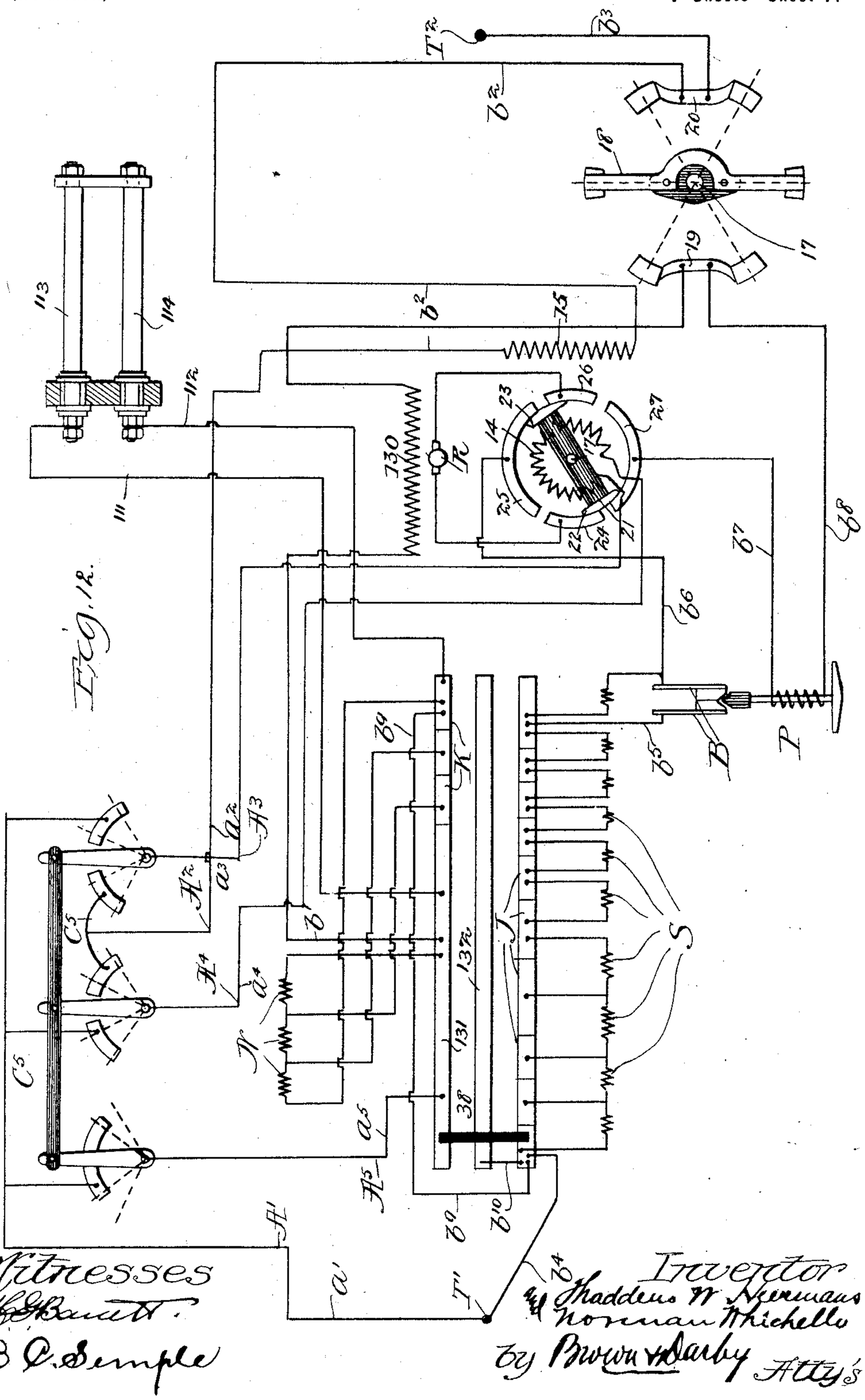
No. 622,430. Patented Apr. 4, 1899.

T. W. HEERMANS & N. WHICHELLO.

ELECTRIC ELEVATOR.

(Application filed Jan. 29, 1898.)

(No Model.) 7 Sheets—Sheet 7.



UNITED STATES PATENT OFFICE.

THADDEUS W. HEERMANS, OF EVANSTON, AND NORMAN WHICHELLO, OF CHICAGO, ILLINOIS, ASSIGNORS TO JOHN A. ROCHE, OF CHICAGO, ILLINOIS.

ELECTRIC ELEVATOR.

SPECIFICATION forming part of Letters Patent No. 622,430, dated April 4, 1899.

Application filed January 29, 1898. Serial No. 668,454. (No model.)

To all whom it may concern:

Be it known that we, THADDEUS W. HEERMANS, a citizen of the United States, residing at Evanston, and NORMAN WHICHELLO, a subject of the Queen of Great Britain, residing at Chicago, in the county of Cook and State of Illinois, have invented a new and useful Electric Elevator, of which the following is a specification.

This invention relates to electric elevators.

The object of the invention is to simplify and improve the construction and arrangement of the hoisting-motor of electric elevators and the means for controlling the same.

A further object is to provide simple and efficient means for automatically arresting the motor when the car reaches the limits of its travel or in cases where for any reason the hoisting-cable should become slack around the hoisting-drum.

Other objects of the invention will appear more fully hereinafter.

The invention consists substantially in the construction, combination, location, and relative arrangement of parts and improvements, all as will be more fully hereinafter set forth, as shown in the accompanying drawings, and finally specifically pointed out in the appended claims.

Referring to the accompanying drawings and to the various views and reference-signs appearing thereon, Figure 1 is a view in plan of the entire machine constructed and arranged in accordance with the principles of the invention. Fig. 2 is a broken detail view showing the relative arrangement of the motor-shaft and hoisting-drum driving-gear. Fig. 3 is a detail view, partly in elevation and partly in vertical section, on the line 3 3, Fig. 1, looking in the direction of the arrows, showing the arrangement of motor-magnet and its connections and the eccentrics for actuating the contact-arms. Fig. 4 is a view similar to Fig. 3, taken from the opposite side of the motor-magnet, showing the arrangement of automatic centering device and the connections between the motor-magnet and brake mechanism. Fig. 5 is a detail view in plan of the automatic speed-reducing device arranged to so control the main hoisting-motor circuits as to reduce its speed in advance of the action of the automatic stop mechanism. Fig. 6 is a detail view in transverse section on the line 6 6, Fig. 1, looking in the direction of the arrows, illustrating the construction, arrangement, and mode of operation of the automatic speed-reducing mechanism. Fig. 7 is a view in elevation, showing the arrangement of the automatic slack-cable stop. Fig. 8 is a detail view in section on the line 8 8, Fig. 7, looking in the direction of the arrows, showing a detail of the slack-cable stop. Fig. 9 is a detail view in section on the line 9 9, Fig. 1, looking in the direction of the arrows, showing the arrangements and connections for swinging the centering-weight. Fig. 10 is a detail view, partly in elevation and partly in vertical section, showing the arrangement of the brake mechanism. Fig. 11 is a view, partly in plan and partly in diagrammatic development, showing the circuits of the controlling mechanism. Fig. 12 is a complete diagram of the circuits and electrical connections of the entire machine.

The same part is designated by the same reference-sign wherever it occurs throughout the several views.

Reference-sign A designates the framework, upon which are supported the various parts of the apparatus; B, the main hoisting-motor; C, the motor-shaft; D, the hoisting-drum upon which the hoisting-cables are wound; E, the guide for the hoisting-cables, and F and G the gears for driving the hoisting-drum from the motor-shaft. These parts may be of the usual or any convenient or suitable construction and arrangement familiar to persons skilled in the art.

We will first describe the relative arrangement of the motor-shaft and the drum-shaft and constituting an important feature of improvement, particular reference being had to Figs. 1 and 2. It will be observed that gear G, which is mounted on and rotates with the motor-shaft, is a worm with a plurality of teeth (technically called a "spiral pinion") and that gear F, which constitutes the drive-gear of the hoisting-drum and which intermeshes with and is driven by spiral pinion G, is a spur-gear. By this particular construction and arrangement of these intermeshing gears the motor-shaft is relieved of undue friction

and thrust on its step, and the machine is enabled to run more easily, smoothly, and with less noise and friction than with other forms of gearing heretofore employed, and a greater percentage of efficiency is secured. In order that this particular form of gearing may be employed, it is necessary to so arrange the motor-shaft and the shaft of the hoisting-drum that the developed spiral-pinion teeth are parallel with the drum-shaft. This result is secured by arranging the motor-shaft angularly in two directions with reference to the axis of the drum—that is, by arranging said shaft angularly with respect to a plane containing the axis of said drum and also angularly with reference to a plane cutting such axis at right angles.

We have found in practice that the particular arrangement and relation of parts as above described greatly improve the hoisting-motors of elevators in that the friction of operating the same is reduced, thrust on the motor-shaft step is decreased, and the machine runs smoother and with less noise than formerly, and the efficiency of the machine is generally improved.

We will now describe the means for controlling the various functions and operations of the machine, particular reference being had to Figs. 1, 3, 4, and 11, wherein reference-sign H designates generally what we shall term the "motor-magnet" and which is arranged to control the various operations hereinafter to be more fully explained. This motor-magnet comprises an armature 14 of the Siemens H type and a field 15, suitably supported. Reference-signs *a b*, Fig. 3, designate the terminals of the motor-magnet field-windings; and *c d* designate the terminals of the motor-magnet armature-windings. From these terminals suitable conductors extend to suitable contacts on the car, (indicated generally at C^5, Fig. 12,) whereby the movements of the motor-magnet armature may be controlled. Upon shaft 17 of the motor-magnet armature is mounted to rock the main-motor break-switch arm 18. (Indicated in full lines in Fig. 1 and in dotted lines in Figs. 4 and 11 and which coöperates with the contacts 19 20 to make or break the main-motor circuit.) The shaft 17 of the motor-magnet also carries an arm 21, (indicated in dotted lines in Fig. 12,) upon which are mounted, at the ends thereof, the contact-shoes 22 23, arranged to coöperate with suitably-arranged stationary contacts 24 25 26 27, mounted on an insulating slab or plate 16 and constituting the reversing-switch, through which the main-motor circuit is reversed. Upon the other end of the motor-magnet shaft is mounted a disk 28, having a cam-surface 29 and a peripheral notch 30. (See Fig. 3.) A pivotally-suspended lever 31 carries an arm 41, weighted, as at 32, whereby its normal tendency is to engage in the peripheral notch 30 of disk 28 and lock the same. The lower end of lever 31 carries an adjustable pin or stop 33, arranged to be engaged by a lug 34 on the hub of a sleeve 35, which sleeve is mounted to rock on a stud 36. This sleeve has an arm 37, carrying contact-levers 38, which coöperate with a suitable series of contacts J K for controlling the action of the main motor, as will presently be more fully explained. Another arm 39 of said sleeve carries a weight 40, the normal tendency of which is to maintain said contact-levers 38 in their fully-retracted position. Said arms 38 are advanced against the action of weight 40 by a series of arms 42, actuated by eccentrics 43, mounted on a shaft 54, which is rotated through gears 44 (see Fig. 1) from a shaft 45, which receives rotation from the shaft 46 of the hoisting-drum through gears 47. The free ends of arms 42 are arranged to engage behind a lug or shoulder 42′, formed on sleeve 35, and said arms are set to varying positions of eccentricity with respect to shaft 45, whereby the advancing movement of contact-arms 38 is gradual and whereby said arms are maintained in their advanced position until released by the arms 42. This release is effected by means of a lever 48, arranged to be engaged and rocked by cam portion 29 about its supporting-pin 49. Said lever is provided with an arm 50, arranged to engage underneath the series of arms 42 when said lever 48 is rocked, thereby raising all of the series of arms 42 out of engagement with the lug or shoulder on sleeve 35, thus permitting weight 40 to return the contact-levers 38 to their normal or retracted position. An adjustable stop 51 may serve to regulate the normal position of arm 50. The construction, function, and mode of operation of these parts are more fully set forth and explained in our joint application for patent executed January 17, 1898, filed January 29, 1898, Serial No. 668,453, and except in their coöperative arrangement and relation with respect to other features set forth more particularly herein forms no part of our present invention. It will be seen, however, that when the contact-arms 38 are once set in motion to be advanced along the series of contacts J K they cannot be released or returned to their normal position until the motor-magnet armature is suitably rotated to cause the cam portion 29 of disk 28 to engage lever 48.

We will now describe the construction and arrangement of the brake mechanism and the connections between the same and the motor-magnet, whereby the operation of the brake is interdependent to the extent hereinafter to be explained with respect to the operation of the motor-magnet, particular reference being had to Figs. 1, 3, 4, and 10.

The brake now to be described is of the strap type and comprises the halves or segments 55 56, pivotally mounted at one end respectively on blocks 57 58, which in turn are mounted upon a threaded stud or bolt 59, suitably supported in a fixed part of the frame A. By this construction the brake segments

or straps 55 56 may be suitably adjusted. These segments or straps are arranged to embrace the periphery of a brake-wheel M, mounted on motor-shaft C. In suitable standards 60 of the framework is journaled a rocking frame 61, in which are mounted the sleeves 62 63. Through sleeve 62 extends loosely a rod 64, if desired, a spring 65 being interposed between said sleeve and a washer 66, mounted on the free end of said rod. Set-nuts 67 serve to adjust the tension of said spring. The other end of rod 64 is pivotally connected to the free end of the lower brake strap or segment 56. The sleeve 63 is arranged on the opposite side of the axis of rocking frame 61 from sleeve 62 and receives loosely therethrough a rod 68, which is pivotally connected at its end to the free end of the upper brake-strap 55. If desired, a spring 69 is interposed between the under side of sleeve 63 and a washer 70, mounted on rod 68, set-nuts 71 serving to adjust the tension of said spring. Each rod 64 68 carries a set-nut 72 73 on the opposite side from the springs 65 69 of the sleeves through which said rods extend. Preferably the normal position of the rocking frame 61 is such as to maintain the sleeves 62 63 in the same vertical plane, but, as above mentioned, on opposite sides of the axis about which frame 61 rocks. In this normal position the brake straps or segments are applied to the periphery of the brake-wheel. When, however, the frame 61 is rocked about its axis in either direction by reason of the engagement of sleeves 62 63 with set-nuts 72 73, respectively, on rods 64 68, said rods are projected endwise in directions such as to relieve the brake-straps from their application to the brake-wheel; but when said frame is returned to its central or normal position the sleeves 62 63, operating through springs 65 69, yieldingly draw the rods 64 68 in the opposite direction to that above described, thereby setting the straps yieldingly upon the brake-wheel. The rocking frame is held in its normal position by means of a lever 74, pivotally mounted at one end upon a fixed part of the framework and carrying a weight 75. This lever is arranged to bear on rocking frame 61 at points on opposite sides with respect to each other of the axis about which said frame rocks. If desired and in order to reduce friction, these bearings may be in the form of antifriction-rollers, as shown at 76 77. From this construction it will be readily seen that in whatever direction the frame 61 is rocked lever 74 will be raised against the weight carried thereby, which weight constantly tends to lower said lever and to return the rocking frame to its normal or central position. Thus it will be seen that the raising of the weighted end of lever 74 serves to store up energy, the tendency of which is to set the brake, and the raising of said lever is coincident with the release of the brake. By suitably regulating the size of weight 75 and its position on lever 74 it will be seen that when the rocking frame is released by the mechanism which rocks it in whichever direction it may be rocked it is quickly returned under considerable force to its normal position, thereby quickly and forcibly setting the brake-straps. The frame 61 is rocked by means of a rod 78, connected at one end to an arm 79, formed on said frame, and at the other end pivotally connected, as at 80, to the disk 28, mounted on the shaft of the motor-magnet armature. Thus it will be seen that the release and settting of the brake is dependent upon and is governed by the actuation of the motor-magnet, which in turn is controlled from the car or automatically, as will be explained more fully hereinafter.

We will now describe the construction and arrangement of the automatic stop and its relation to the motor-magnet, particular reference being had to Figs. 1, 4, and 9.

We have already described how the rotations imparted to shaft 45 through the gears 47 from shaft 46 of the hoisting-drum effects a rotation of shaft 54 and the consequent actuation of the series of eccentrics 43, mounted on said shaft 54, and we have explained how the action of these eccentrics and the arms 42 connected therewith is affected by the motor-magnet. In the arrangement of automatic stop mechanism we employ the same shaft 45. On this shaft is loosely sleeved a frame 81, having a depending portion forming a weight 85, by which said frame is held against swinging movement about said shaft 45. Suitably formed or mounted on to rotate with shaft 45 is an exteriorly-threaded portion or sleeve 82. An internally-threaded block or nut 83 is mounted on said threaded portion. On opposite sides of said nut are blocks 86 87. Block or nut 83 is provided with a wing or projection 84, arranged to extend into a slot in the depending or weight portion 85 of said frame 81. (See Fig. 9.) By this construction it will be seen that said block or nut 83 is held against rotation about the axis of shaft 45 without carrying with it the weighted portion 85 of frame 81. It will also be seen that by reason of the construction described said block or nut 83 travels on the threaded portion 82 of shaft 45 back and forth between the blocks 86 87. The operation of the parts is so timed that nut 83 travels the entire distance between the blocks 86 87 only when the elevator-car makes a complete trip from one limit of its travel to the other. The relative positions of these blocks 86 87 may be adjustable. Suitable shoulders are formed on the opposed faces of blocks 86 87 and nut 83 and which are arranged to engage each other, respectively, when said nut approaches the limits of its travel, thereby causing said block 86 or 87, as the case may be, to engage and rotate block 83 about the axis of shaft 45, thereby causing frame 81 to be swung about the same axis and into one or the other of the positions indicated in dotted lines in Fig. 1. From this description it will be seen that

when the car reaches or approaches either of the limits of its travel the sleeve forming part of frame 81 is axially rotated. Mounted on this sleeve is a segment-gear having segment-teeth 88 and a plane portion or surface 89, the segment-teeth arranged to engage and rotate a similar gear 90 on a short shaft 91, journaled in the frame, the plane portion or surface 92 of gear 90 being engaged by the plane surface or portion 89, whereby shaft 91 is locked against rotation except when the gear-teeth 90 and 88 are intermeshed. Carried on the other end of shaft 91 is a two-armed lever 93, the extremities 96 97 of the two arms of which are upturned to form stops or shoulders. Mounted on the shaft of the motor-magnet armature is a crank-arm 94, having a pin 95, arranged to project into the path of the upturned extremities or shoulders 96 97 of the two-armed lever 93. The operation of this part of our invention is as follows: When the car reaches the limit of its travel in either direction, a rotation of shaft 91 is automatically effected through the arrangement above described, thereby rocking lever 93 in one direction or the other, as the case may be. This rocking movement of said lever causes the upturned end 96 or 97 to engage the pin or projection 95 in arm 94 in case the elevator-conductor has failed to properly operate the motor-magnet to arrest the action of the main hoisting-motor, thereby rocking said arm 94 in a direction to cause the motor-magnet to break the main-motor circuit and to perform its other functions, as above explained. Of course if the elevator-conductor has already caused the motor-magnet to be operated then the upturned end 96 or 97 will not engage the pin 95 on crank-arm 94, but the main motor will be arrested by reason of the actuation of the motor-magnet by the control of the elevator-conductor. In such case, however, the upturned end 96 or 97 will serve as a stop to prevent the crank-arm 94, and hence the motor-magnet, from being rocked back in the opposite direction to that in which it has just been rocked, whether by the elevator-conductor or the stop-lever 93. Therefore it will be impossible for the motor-magnet to be turned in a direction to cause the main motor to carry the car beyond its ordinary limits of travel, at the same time leaving said motor-magnet free to turn to a position such as to control the circuits of the main motor to cause said motor to move the car in the opposite direction from its limit of travel. In other words, it will be seen that when arm 93 has been rocked it will be held in rocked position until shaft 45 is rotated in a direction opposite to that in which it rotated to effect a rocking of the lever 93, and hence the motor-magnet armature is held in the position to which it is rocked by said arm 93 or by the elevator-conductor and against reverse movement. This position in which said motor-magnet armature is held is the one occupied thereby when the main-motor circuits are broken, but further rotation of the motor-magnet armature in the same direction is permitted in order to reverse the main motor, thereby reversing the direction of rotation of the hoisting-drum D, and hence of shaft 45. This reverse rotation of said shaft causes nut 83 to be moved out of engagement with block 86 or 87, as the case may be, and hence permits weighted frame 81 85 to return to normal position, thereby returning arm or lever 93 to its normal position through the engagement of gears 88 90. Thus it will be seen that we provide a simple and efficient arrangement of mechanism which coöperates with the motor-magnet to form an automatic stop for the elevator-car when it reaches the limits of its travel and wherein danger of so operating the main or hoisting motor as to cause the car to be carried beyond its limits of travel is absolutely and positively provided against and prevented even in case the car-conductor through carelessness, inattention, or inexperience should attempt to start up the main hoisting-motor in the wrong direction when the car is standing at its extreme upper or lower limits of travel.

It sometimes becomes desirable to arrest the main motor automatically before it reaches its limit of travel—as, for instance, should one or more strands or runs of the hoisting-cable break or get out of order. In such case the run or runs of cable which are wound on the hoisting-drum would sag down into loose bights below the drum. We have provided an arrangement wherein when such sags or bights are formed in the windings of the hoisting-cable about the hoisting-drum the main motor is automatically arrested. This arrangement is known in the art as a "slack-cable stop," and while we have shown and will now describe a specific construction and arrangement for securing an automatic slack-cable stop we do not desire to be limited or restricted to the exact details of construction and arrangement thereof shown and described in this application. In the form shown, referring particularly to Figs. 1, 7, and 8, we provide the swinging frame 81 with clutch-teeth, as indicated at 100, and we mount a collar or sleeve 101 to slide back and forth on and rotate with shaft 45, and said collar or sleeve is provided with coöperating clutch-teeth arranged when said collar is moved in the proper direction to engage clutch-teeth 100, thereby causing frame 81 to rock or swing about shaft 45. This swinging movement will, as above explained, cause the stop-lever 93 to rock through the segment-gears 88 90, thereby turning the motor-magnet armature to position to break the main-motor circuits. In order to suitably and properly actuate the sliding clutch-collar 101, we provide a forked lever 102 and arrange the same to engage in a peripheral groove in said collar. This lever is mounted on a rock-shaft 103, suitably journaled in the framework. A crank-arm 104, also mounted on said rock-shaft, is en-

gaged by one end of a spring 105, the other end of said spring being secured to the frame. This spring constantly tends to rock said shaft 103 in a direction to cause the clutch-collar 101 to move into engagement with the clutch-teeth 100 of swinging frame 81. The normal action of spring 105 is opposed by a trigger arrangement shown more in detail in Fig. 8 and comprising a crank-arm 106, mounted on shaft 103 and arranged to be engaged by a pin 107, carried in an arm 108, mounted on a shaft 109, suitably journaled in the frame. So long as the pin 107 is in engagement with the end of arm 106 rotation of shaft 103, under the influence of spring 105, is prevented, and the clutch-sleeve 101 is thereby held out of engagement with the clutch-teeth 100 of frame 81; but when the pin 107 is moved or swung out of the path of arm 106 said shaft 103 is rocked by spring 105, and an engagement of clutch-collar 101 with teeth 100 is effected, thereby swinging the weighted frame 81, and hence causing the motor-magnet armature to rotate in a direction to break the hoisting-motor circuits, thereby stopping the car. A wing or plate 110 is mounted on to rock with shaft 109 and is arranged to extend into proximity to the periphery of hoisting-drum D. By this arrangement it will be seen that when the hoisting-cable windings on said drum become slack through accident or otherwise the sagging slack portions or bights will strike the wing or plate 110, thereby rocking the same and with it shaft 109, thereby releasing arm 106 of shaft 103, and hence automatically throwing into commission the mechanism for breaking the main-motor circuits, thereby stopping the car.

It is desirable to slow down the hoisting-motor somewhat in advance of its complete arrest at the extreme limits of travel of the car in order to overcome the momentum developed by the car in its travel. Many specifically different arrangements for accomplishing this result may be devised. While, therefore, we have shown and will now describe a simple and efficient arrangement of automatic devices for accomplishing this desired end, we do not desire to be limited or restricted thereto. In the particular form shown we arrange in the main-motor field shunt-circuit an auxiliary resistance (indicated diagrammatically at N, Figs. 11 and 12, and preferably composed of a series of coils of fine wire.) The series of contacts K (indicated in Figs. 3, 11, and 12) control these auxiliary shunt resistance-coils, and in order to slow down the main motor just in advance of the car reaching its limits of travel we provide means for automatically cutting out this auxiliary resistance in the main-motor field-circuit, thereby strengthening the field at the expense of the speed of the main motor, and hence slowing down the main motor. In Figs. 1, 5, 6, 11, and 12 is shown an arrangement for automatically cutting out these auxiliary field resistance-coils. The terminals 111 and 112 of these coils are electrically connected, respectively, to suitable bars or rods 113 114, suitably insulated from each other. On each rod or bar is mounted a block 115 116, carrying a contact 117 118. The block 115 is mounted on rod 113, and presents toward one end thereof, while block 116 is mounted adjacent to the opposite end of rod 114 and is presented in the opposite direction. These contacts 117 118 are respectively in electrical connection with the rods 113 114. Coöperating with but normally disconnected from and out of contact with each contact 117 118 is a contact 119 120, which is in electrical connection with the other rod, respectively, of the pair of rods 113 114. The contacts 119 120 are preferably carried on one end of a conducting bow-spring 121, as clearly shown in Fig. 6. Upon an extension of shaft 45 is an externally-threaded sleeve 122, and mounted thereon is an internally-threaded nut or block. This nut or block is composed of two jaws 123 124, yieldingly coupled together by means of bolts 125 and springs 126. The jaw 124 carries the bolts 125, which bolts project loosely through sockets formed in jaw 123, and the springs 125 are interposed between set-nuts carried on the ends of bolts 125 and the jaw 123. By this construction the jaws 123 124 are clamped upon the threaded sleeve 122, but are permitted a slight yielding movement relative to each other. The action of the rotating sleeve 122 is to normally rotate the nut formed by the jaws 123 124; but said nut is held against rotation by means of an arm 127 of suitable insulating material carried by jaw 124 and depending into the space between the rods 113 114. This arm 127 engages rod 113 or 114, according to the direction of rotative tendency imparted thereto by sleeve 122—that is, according to the direction of rotation of shaft 45—and by such engagement the nut is held against rotation, and therefore a travel thereof lengthwise upon sleeve 122 is imparted thereto. The blocks 115 116, carried by rods 113 114, are arranged in the path traversed by depending arm 127, and are engaged by said arm, according as it is moved in one direction or the other. In the form shown in Fig. 5 said arm is in engagement with block 116. This engagement causes said arm 127 to be rocked away from rod 113 or 114, as the case may be, against the tension of springs 126 and the rotative tension imparted by sleeve 122. In order to facilitate the riding over or past the blocks 115 116 by arm 127, said arm and also said blocks are provided with corresponding and coöperating beveled corners, as indicated at 128. The spring-supported contacts 119 120 and their coöperating contacts 117 118 are arranged slightly in advance of the blocks 115 116 with respect to the direction in which said arm 127 travels. The operation of this mechanism is so timed relative to the other apparatus of the hoisting-motor that as the car approaches the extreme limit of travel in either direction and just in ad-

vance of the operation of the automatic stop mechanism above described the arm 127 rides off of the block 115 or 116, as the case be, and snaps against the spring-supported contact 119 or 120 and causes the same to make electrical connection with the corresponding stationary contact 117 or 118, thereby cutting out or short-circuiting the auxiliary main-motor field-resistances N, and hence strengthening the main-motor field and causing a reduction in speed of such motor. This action enables the car to be brought to rest quickly and smoothly and avoids shock or jar.

Of course it will be readily understood that instead of cutting out resistance in the main-motor field-circuit in order to reduce the speed of the motor as the car approaches the limits of its travel the same result may be accomplished by introducing resistance in the main-motor armature-circuit or in many other ways well known and familiar to persons skilled in the art.

To the left of Figs. 4 and 11 is shown what we term an "overload" or "weighing" magnet P, (see also Fig. 12,) the function of which is to increase the power of the motor automatically in case of an overload or to relieve the motor-windings of danger resulting from overloading. By reference to Figs. 11 and 12 it will be observed that one terminal of the overload-magnet is connected through wire b^8 to contact 19, while the other terminal of said magnet is connected through wire b^7 to contact 27. The armature of this overload-magnet carries a block 203 of insulation arranged when said armature is attracted by the sufficient energization of the coils of said magnet to enter between and to effect a separation of the contacts 201 and 202. The contact 202 is in electrical connection with contact-plate K through wire b^5. The contact 201 has two connecting-wires b^6 and b^{25}, the wire b^6 leading to contact 25, while wire b^{25} leads to the terminal of resistances S. Thus it will be seen that when contacts 201 and 202 are in contact with each other circuit is completed through wires b^6 and b^5; but when said contacts are separated—that is, when the overload-magnet is energized to a sufficient degree—circuit is broken between wires b^6 and b^5, thus requiring the current through b^6 to traverse wire b^{25} and the resistances S. The construction and arrangement of this overload or weighing magnet, however, form no part of the present invention, and hence specific description of the details thereof is unnecessary herein.

We will now describe the electrical action and operation of the entire apparatus, particular reference being had to the diagrammatic views, Figs. 11 and 12.

It will be seen that the armature 14 and the field 15 of the motor-magnet are in series with each other. It will also be seen that the main-motor field shunt-coils 130 and the auxiliary speed-varying resistance-coils N are in series, supposing both to be included in circuit—that is, before the auxiliary coils N are cut out or shunted—and that the main-motor armature R is in series with a series of coils S. These last-mentioned coils may comprise auxiliary windings arranged in series or resistance coils or a combination of both, as will be readily understood by persons skilled in the art. T' T^2 designate, respectively, the positive and negative terminals of the main circuit and suitably and conveniently arranged with reference to the machine. A series of terminals A' A^2 A^3 A^4 A^5 are arranged to be connected by independent conductors to a suitable switch device, which is arranged on the car and indicated generally at C^5, Fig. 12. Car-terminal A' is electrically connected through connection a' to the main terminal T'. Car-terminal A^2 is connected through conductor a^2 to one side of the motor-magnet field. Car-terminal A^3 is connected through conductor a^3 to one side of the motor-magnet armature. Car-terminal A^4 is connected through conductor a^4 to the other side of the motor-magnet armature, and car-terminal A^5 is connected through conductor a^5 with one of the terminal plates 131 of the series of plates or contacts K. A conductor b' leads from said plate 131 through the main-motor shunt-field coils and finally connects to switch-plate 19. We have mentioned that one side of the motor-magnet field 15 is connected to car-terminal A^2. The other side of this motor-magnet field is connected through conductor b^2 to switch-plate 20, said plate being connected through conductor b^3 to the main negative terminal T^2. The switch-arm 18 serves to bridge the space between the switch-plates 19 20. A conductor b^4 leads from main binding-post T' to the first of the contact-segments of the series coils or resistances S. The last of these segments is connected through conductor b^5 to the separable contacts B', controlled by the weighing or overload magnet P, thence through wire b^6 to part 25 of the reversing-switch, thence through the armature R of the main hoisting-motor to part 27 of the reversing-switch, thence through wire b^7, the coils of weighing or overload magnet, wire b^8 to plate 19 of the main switch, then through spanning-lever 18 to plate 20 of said switch, and finally through wire b^3 to the negative terminal T^2. The positive main terminal connection b^4 is electrically connected up in series through wire b^9 with the coils of the auxiliary shunt series coils N. A connection b^{10} leads from the first segment of the series of contacts J to a suitably-arranged stationary contact-plate 132, from which circuit is completed through the bridging-levers 38 to the various segments of the series of contacts K J. Suppose the car is at the lowest limit of its travel and the entire apparatus is out of action, except that the brake-straps are set. The elevator-conductor manipulates the car-switch so as to electrically connect car-terminal A' with terminals A^4 and A^5, and also so as

to electrically connect car-terminals A^2 A^3. Thereupon the following circuits are completed: from main positive terminal T′ through wire a', car-terminal A′, switch device on the car to terminal A^4, wire a^4, the motor-magnet armature 14, wire a^3, terminal A^3, switch device on the car to terminal A^2, wire a^2, the motor-magnet field 15, wire b^2, plate 20, wire b^3 to negative binding-post T^2. Thereupon the motor-magnet armature begins to rotate, thereby causing the switch or bridging arms 18 and 21 to complete the main-motor circuits, as will presently be explained. At the same time the rotation of the motor-magnet armature causes disk 28 to be rotated and in a direction to permit lever 48 to rock, thereby permitting the eccentric-arms 42, which at the start were raised, to again be lowered into position, enabling them at the proper time to drop down behind the shoulder formed on the sleeve of contact-arms 38, ready to cause said arms to be rocked forward to pass over the series of contacts J K by which the main-motor circuits are controlled. Simultaneously with the rotation of disk 28 the rod 78 is moved endwise, thereby rocking frame 61 and releasing the brake-straps, at the same time elevating the weighted lever 74. The completion of the main-motor circuits starts up said motor and the travel of the car begins. The rotation of the hoisting-drum by the motor sets in rotation shafts 45 and 54, whereupon the eccentric-arms 42 begin to advance contact-arm 38, thereby accelerating the speed of the motor by changing the resistance or cutting in or out the rheostat or series coils S, included in the motor-circuit. It will be remembered that under the conditions above stated the car-conductor electrically connected up car-terminals A′ and A^5, a portion of the main-motor field energizing-current is shunted from main terminal T′ through wire a', car-terminal A′, the switch device on the car-terminal A^5, wire a^5, plate 131, wire b', through shunt-winding 130 to switch-plate 19, and thence on to negative terminal T^2, through bridging-lever 18, plate 20, and wire b^3. Therefore the car will begin to move slowly. If it is desired to increase the speed, the car-conductor breaks the connection between the car-terminals A′ and A^5 and removes the short circuit around the auxiliary resistance N, thus increasing the resistance in the shunt-field circuit, and hence decreasing the strength of the field, and thereupon the motor increases its speed. The action of the motor-magnet, above explained, causes the switch-arm 18 to be rocked into position to bridge the space between plates 19 and 20, and also causes the contact-shoes 22 and 23 to bridge the space, say, between plates 24 27 and 25 26. Thereupon the main-motor field and armature circuits will be made from T′ through wire b^4, then, dividing, part goes through b^9, the auxiliary field-coils N, to plate 131, wire b', through the shunt field-coils 130, to plate 19, and thence on to the negative terminal T^2, as above explained. The other part traverses the rheostatic or series coils S, wire b^5, contacts B′, wire b^6, plate 25, shoe 23, plate 26, the main-motor armature R, plate 24, shoe 22, plate 27, wire b^7, weighing-magnet P, wire b^8, to plate 19, and thence to the negative wire. The motor thus proceeds until it is desired to stop, when the conductor merely breaks the connection between car-terminals A^2 A^3, thereby breaking the motor-magnet circuits, whereupon the weighted lever 74 causes the motor-magnet armature to return to central or its normal position, thereby causing switch-levers 18 and 21 to break the main-motor circuits. In order to reverse the main motor, the car-conductor changes the order in which the car-terminals are connected up. For instance, instead of connecting A^2 and A^3 together and A′ and A^4 together A′ is connected to A^3 and A^2 is connected to A^4, as indicated in dotted lines, Fig. 12, thus reversing the motor-magnet, and hence reversing the switch-arms 18 and 21, and hence also reversing the main motor. This reversal of the motor-magnet, however, does not affect the action of the brake, which operates in the same manner as above described whenever the motor-magnet armature is rocked, whether in one direction or the other. The reversing of the main motor causes the car to travel in the opposite direction to that above described. Suppose the car should approach a limit of its travel. The rotation of shaft 45 from the shaft of the hoisting-drum will cause nut or block 123 to travel lengthwise with respect to rods 113 114, thereby causing arm 127 to move over one of the blocks 115 or 116, and hence causing contacts 117 and 119 or 118 and 120 to snap into contact with each other. This action, as above explained, causes the speed of the main motor to be reduced—as, for instance, by short-circuiting the auxiliary shunt-field resistance-coils N, thus strengthening the field at the expense of speed. Immediately following this operation the traveling nut 83 engages one or other of blocks 86 87, thereby rocking the frame 81 and gear 88, thus rocking the two-armed lever 93 in a direction to engage and rock lever 94, and with it the motor-magnet armature, to its neutral position in case the elevator-conductor should for any reason fail to cause said armature to rock to such position. In case the elevator-conductor has attended properly to this duty then the two-armed lever is rocked into position to form a stop for the motor-magnet armature, thereby locking said armature against rocking movement in the reverse direction to that in which it has just been rocked, while permitting said armature to be rocked from its neutral position in a direction to reverse the main-motor circuits.

In case the cable for any reason should become slack on the hoisting-drum the wing or plate 110 is rocked, thereby rocking shaft 109 and releasing the holding-trigger of shaft 103.

Thereupon clutch-collar 101 is moved into engagement with clutch-teeth 100, thus causing the automatic stop to perform its function to stop the car.

From the foregoing description it will be readily seen that we provide an exceedingly simple and efficient mechanism for controlling the various operations and functions of the hoisting-motor for elevators. It will also be seen that the "motor-magnet," so called, is the prime mover of all the switches. It throws the controlling apparatus into commission. By its action the weight which applies the brake is raised, and therefore the normal action of the weight is to set the brake, and said weight is in commission at all times except when raised by the motor-magnet. It will also be seen that the brake-weight operates as a centering device for the motor-magnet armature—that is, when current is cut off from the motor-magnet circuits said armature is free to return to its neutral or central position. This return is effected and insured by the brake-weight operating through the connecting-rod 78. Thus when the weight after being raised is released it always operates to return the motor-magnet armature to central or neutral position.

While we have shown and described a specific form and arrangement of apparatus for performing the several operations and functions above set forth, it is obvious that many changes, alterations, and variations in the details of construction, arrangement, and relative location would readily suggest themselves to persons skilled in the art and still fall within the spirit and scope of our invention. We do not desire, therefore, to be limited or restricted to the exact details shown and described; but

What we do claim as new and useful and of our own invention, and desire to secure by Letters Patent, is—

1. In an electric elevator, a winding-drum having a spur-gear thereon, a motor having the shaft thereof arranged angularly with reference to a plane containing the axis of said drum and also with respect to a plane cutting such axis at right angles and having a spiral pinion thereon arranged to engage and drive said spur-gear, as and for the purpose set forth.

2. In an electric elevator, a winding-drum having a spur-gear thereon, a motor having an operating-circuit, and a starting and speed circuit, and means for controlling said circuits, and a spiral pinion mounted on the shaft of said motor and arranged to engage and drive said spur-gear, said motor-shaft arranged angularly with respect to a plane containing the axis of said drum, and also with respect to a plane cutting such axis at right angles, as and for the purpose set forth.

3. In an electric elevator, a winding-drum, a spur-gear mounted thereon, a driving-motor therefor having the shaft thereof arranged angularly with respect to a plane containing the axis of said drum and also with respect to a plane cutting such axis at right angles and carrying a spiral pinion arranged to mesh with and drive said spur-gear, said motor having different circuits for starting and speeding the same and for operating the same, as and for the purpose set forth.

4. The combination with the motor-magnet and means for controlling the movements thereof, of a controller-arm, a rotatable shaft, a crank or eccentric connection between said shaft and arm, means for rotating said shaft, and means actuated by the movements of said motor-magnet for throwing said crank or eccentric connection into and out of connection, as and for the purpose set forth.

5. The combination with the motor-magnet and means for controlling the movements thereof, of a main motor, a controller-arm for the circuits thereof, a plurality of eccentric or crank arms of varying periods of throw arranged to engage and actuate said controller-arm, means for actuating said eccentric-arms, and means actuated by the movements of the motor-magnet for engaging or disengaging said eccentric-arms from said controller-arm, as and for the purpose set forth.

6. The combination with the motor-magnet including an armature and shaft, means for controlling the movements of said armature and shaft, a cam mounted on said shaft, a main motor, a movable contact for controlling the circuit of said main motor, eccentric-arms having varying positions of throw for actuating said movable contact, means for actuating said eccentric-arms, and a lever arranged to engage and disengage said arms and contact, said lever arranged to be actuated by said cam, as and for the purpose set forth.

7. The combination with a hoisting-motor, circuits therefor, a main switch and a reversing-switch arranged in said circuits, of a motor-magnet for actuating said switches, both of said switches mounted on and moving with the shaft of said motor-magnet, and means for controlling the movements of said motor-magnet, as and for the purpose set forth.

8. The combination with a hoisting-motor, circuits therefor, main and reversing switch contacts arranged in said circuits, of a motor-magnet including an armature and shaft, a main-switch arm and a reversing-switch arm mounted on the shaft of said motor-magnet armature and coöperating with said contacts, and means for controlling said motor-magnet, as and for the purpose set forth.

9. The combination with a hoisting-motor, a brake therefor, a weight normally operating to set said brake, a motor-magnet for controlling the circuits of said hoisting-motor, means for controlling the movements thereof, and crank connections between said weight and motor-magnet, as and for the purpose set forth.

10. The combination with a hoisting-motor, a brake therefor, a rocking frame for operating said brake, a weighted arm connected to

said frame, and normally operating to set the brake, a motor-magnet for controlling the circuits of said main motor, and a rod having crank connections with said motor-magnet and rocking frame, respectively, as and for the purpose set forth.

11. The combination with a hoisting-motor, a brake-wheel mounted on the shaft thereof, brake-straps arranged to be applied thereto, a rocking frame, connections between the free ends of said brake-straps and opposite sides of the pivotal axis of said frame, whereby when said frame is rocked in either direction from its normal position said brake-straps are applied, and means for rocking said frame, as and for the purpose set forth.

12. The combination with a hoisting-motor, a brake-wheel mounted on the shaft thereof, straps arranged to be applied to said wheel, a rocking frame, connections between the free ends of said straps and opposite sides of the pivotal axis of said frame, a weight normally acting to hold said frame in position to set said straps, a motor-magnet for controlling the circuits of said hoisting-motor, and crank connections between said motor-magnet and said rocking frame, as and for the purpose set forth.

13. The combination with a hoisting-motor, a motor-magnet, main and reversing switch arms for controlling the circuits of said hoisting-motor, said switch-arms mounted on and rocking with the shaft of said motor-magnet, and means for controlling the movements of said motor-magnet, of an automatic stop arranged to operate said motor-magnet, when the car reaches the extreme limits of its travel, in a direction to arrest the hoisting-motor, as and for the purpose set forth.

14. The combination with a hoisting-motor, a motor-magnet for controlling the circuits of said motor, and means for controlling the movements of said motor-magnet, of an automatic stop mechanism and connections between the same and the motor-magnet whereby when the automatic stop is in commission the motor-magnet is locked against movement in a reverse direction from that in which it has just been moved, but is permitted free movement in a direction to reverse the main motor, as and for the purpose set forth.

15. The combination with a hoisting-motor, a circuit-controller therefor, an automatic stop for actuating said controller at the extreme limits of travel of the car to a position such as to break the hoisting-motor circuits, and to lock the same against reverse movement from said position while permitting movement of said controller in the same direction to reverse the hoisting-motor, as and for the purpose set forth.

16. The combination with a hoisting-motor, a circuit-controller therefor, stops for engaging said controller and locking the same against movement in one direction or the other according to the direction in which said stops are moved, said stops permitting movement of said controller in a direction opposite to that against which it is locked, and means for automatically operating said stops only at the extreme limits of travel of the car, as and for the purpose set forth.

17. The combination with a hoisting-motor, a circuit-controller therefor, a lever having two arms arranged when rocked to alternately engage said controller on opposite sides, and means for rocking said lever only when the car attains the extreme limits of its travel, as and for the purpose set forth.

18. The combination with a hoisting-motor, a circuit-controller therefor, a crank-arm connected with said controller, a lever having two arms arranged to straddle said crank-arm, and means for rocking said lever only when the car reaches the extreme limits of its travel, as and for the purpose set forth.

19. The combination with a hoisting-motor, a motor-magnet including a rocking armature for controlling said motor, a crank-arm connected to the shaft of said armature, an independently-mounted lever having two arms arranged to straddle said crank-arm, and means for rocking said lever only when the car reaches the extreme limits of its travel, as and for the purpose set forth.

20. The combination with a hoisting-motor, a motor-magnet including a rocking armature for controlling said motor, a crank-arm mounted on the shaft of said armature, an independent shaft, a lever mounted thereon, said lever provided with two arms arranged to straddle said crank-arm, mutilated gears for rocking and locking said last-mentioned shaft, and means arranged to operate only when the car reaches the extreme limit of its travel for actuating said gears, as and for the purpose set forth.

21. The combination with a hoisting-motor, a motor-magnet for controlling the circuits of said motor, an auxiliary field resistance for said hoisting-motor, and automatic means for short-circuiting said auxiliary field resistance, thereby strengthening the hoisting-motor field and reducing the speed of said motor, as and for the purpose set forth.

22. The combination with a motor, a hoisting-drum geared thereto, a shaft arranged to be driven by said drum, a block arranged to move back and forth lengthwise of said shaft, said block actuated by said shaft, an automatic stop for said motor, and means arranged to be engaged and actuated by said block only at the extreme limits of travel thereof for actuating said automatic stop, as and for the purpose set forth.

23. The combination with a motor, a hoisting-drum geared thereto, a shaft arranged to be driven by said drum, an arm arranged to be engaged and moved in opposite directions by said shaft according to the direction of rotation of said shaft, and means actuated by said arm as it approaches the extreme limits

of its travel in either direction for varying the speed of the motor, as and for the purpose set forth.

24. The combination with a hoisting-motor, a controller therefor, means for actuating said controller, of auxiliary means arranged to be actuated by slack in the hoisting-cable for actuating said controller, as and for the purpose set forth.

25. The combination with a hoisting-motor, a motor-magnet for controlling the circuits of said motor, and means for operating said motor-magnet, of independent means arranged to be actuated by slack in the hoisting-cable for automatically moving and locking said motor-magnet into position to arrest the hoisting-motor, as and for the purpose set forth.

26. The combination with a hoisting-motor, a hoisting-drum driven thereby, a shaft arranged adjacent to said drum and adapted to be rocked by slack in the cable wound on said drum, and means actuated by the rocking of said shaft for breaking said motor-circuit, as and for the purpose set forth.

27. The combination with a hoisting-motor, a drum actuated thereby, a shaft arranged in proximity to said drum, a frame mounted on said shaft and arranged to be engaged and rocked by slack in the cable wound on said drum, a motor-magnet for controlling said motor, and means actuated by the rocking of said shaft for automatically actuating said motor-magnet to position to arrest said motor, as and for the purpose set forth.

28. The combination with a motor, a hoisting-drum actuated thereby, a rock-shaft suitably journaled in proximity to said drum, a frame mounted on said shaft and arranged to be engaged and rocked by slack in the cable wound on said drum, a motor-magnet for controlling said motor, auxiliary gearing, normally held out of action, for moving said motor-magnet into position to break the motor-circuit, and means actuated by the rocking of said rock-shaft for throwing said gearing into action automatically, as and for the purpose set forth.

In witness whereof we have hereunto set our hands, this 26th day of January, 1898, in the presence of the subscribing witnesses.

THADDEUS W. HEERMANS.
NORMAN WHICHELLO.

Witnesses:
S. E. DARBY,
E. C. SEMPLE.