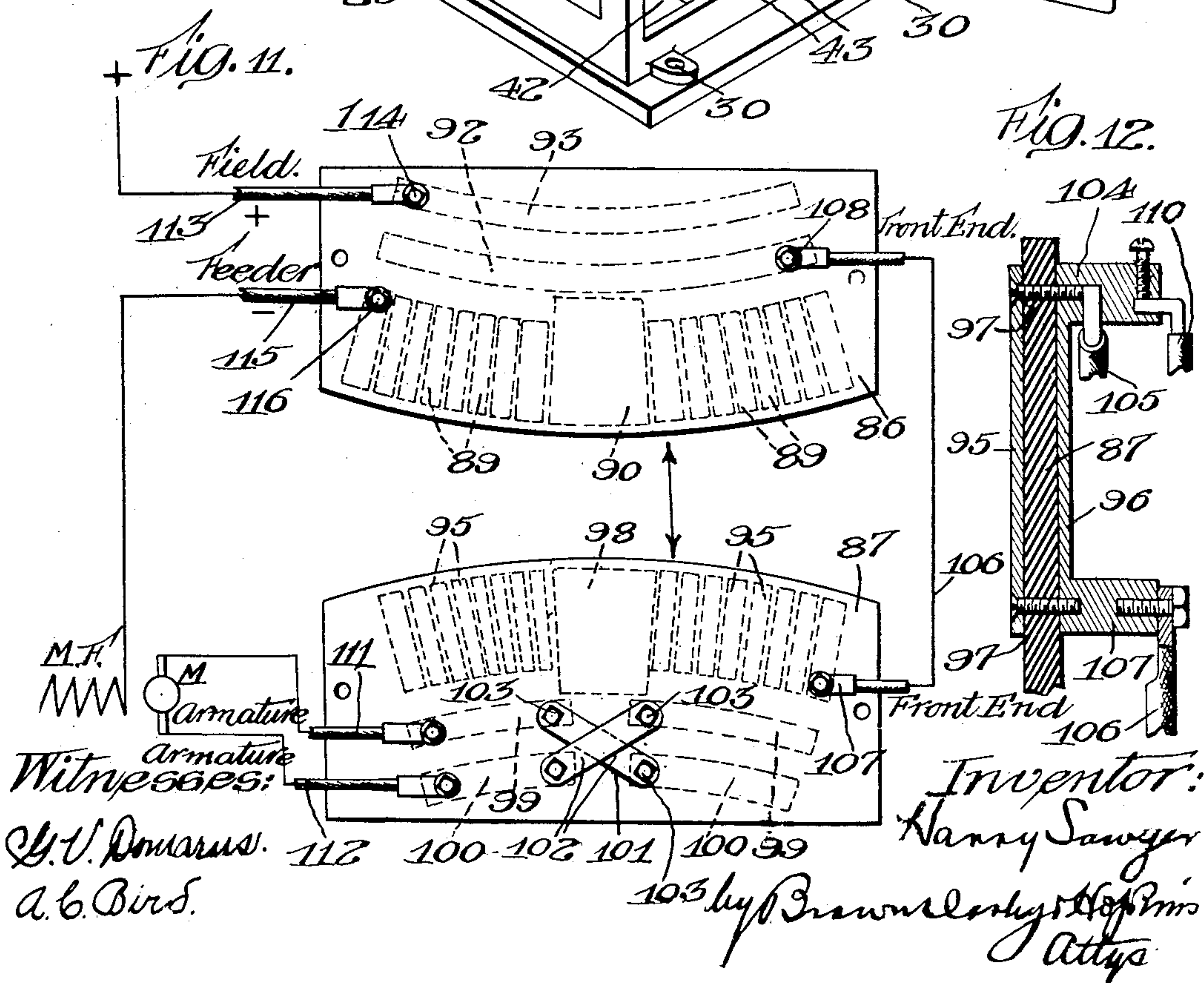
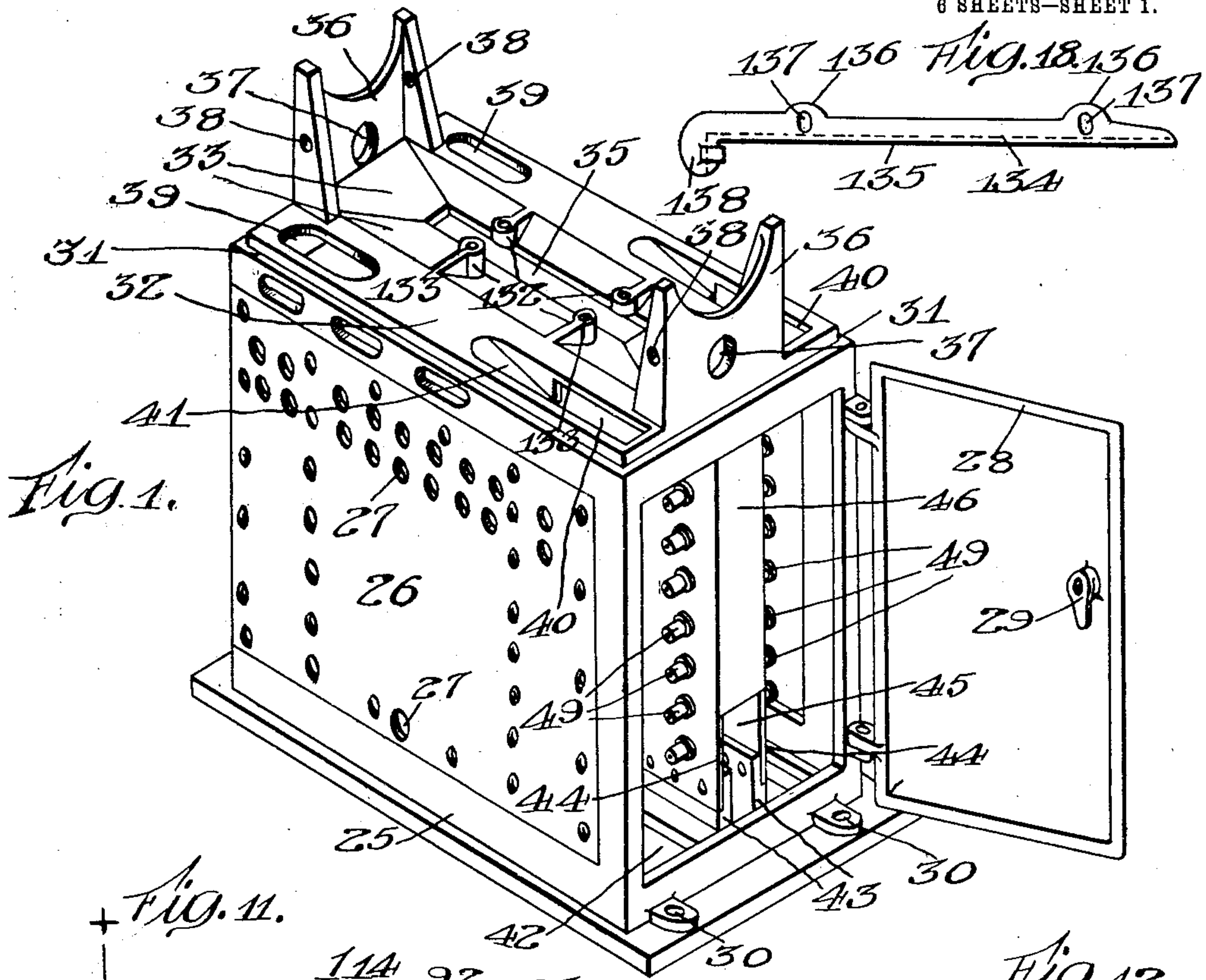


No. 842,342.

PATENTED JAN. 29, 1907.

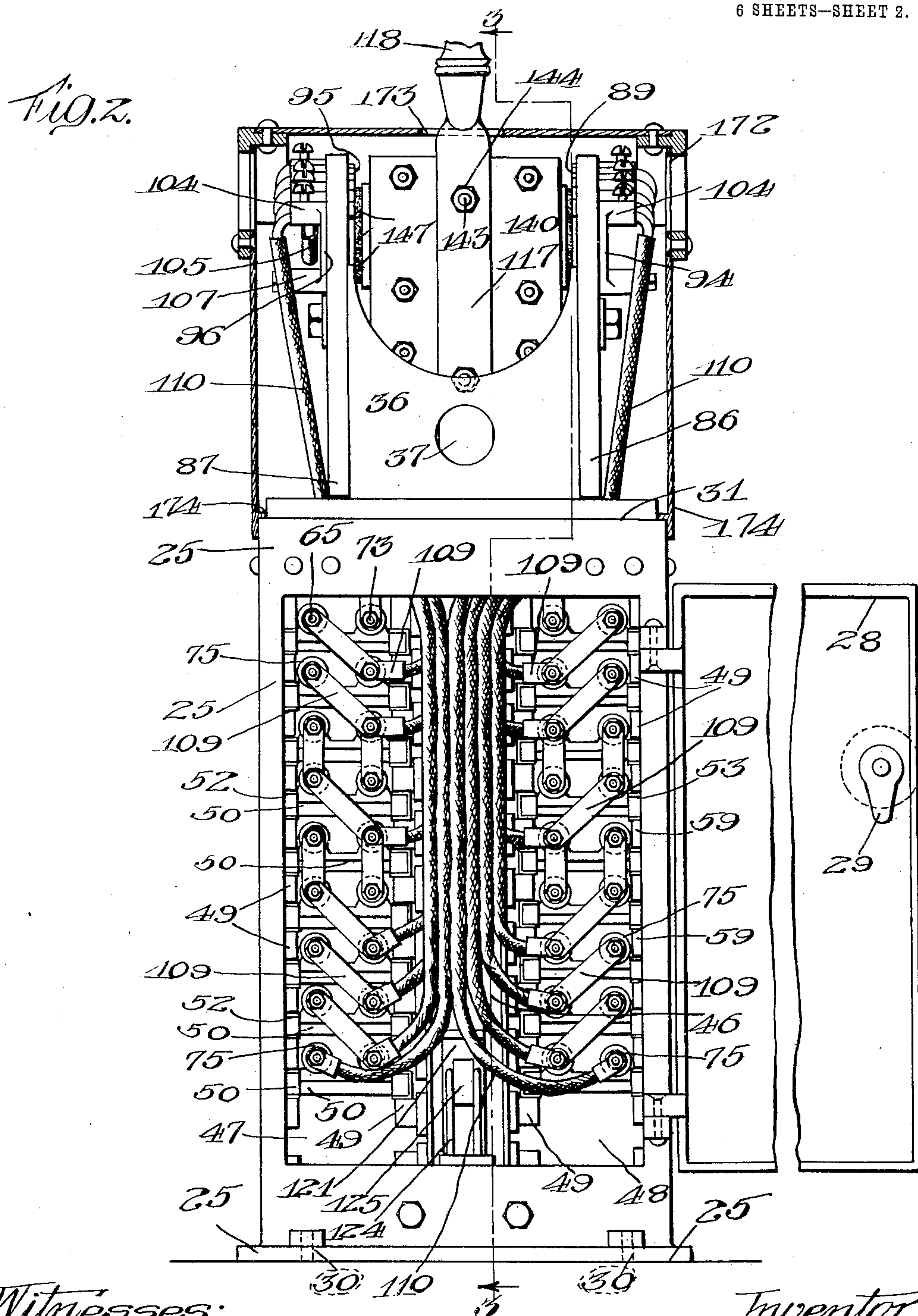
H. SAWYER.  
ELECTRIC CONTROLLER.  
APPLICATION FILED FEB. 5, 1906.

6 SHEETS—SHEET 1.



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ELECTRIC CONTROLLER.  
APPLICATION FILED FEB. 5, 1906.

6 SHEETS--SHEET 2.



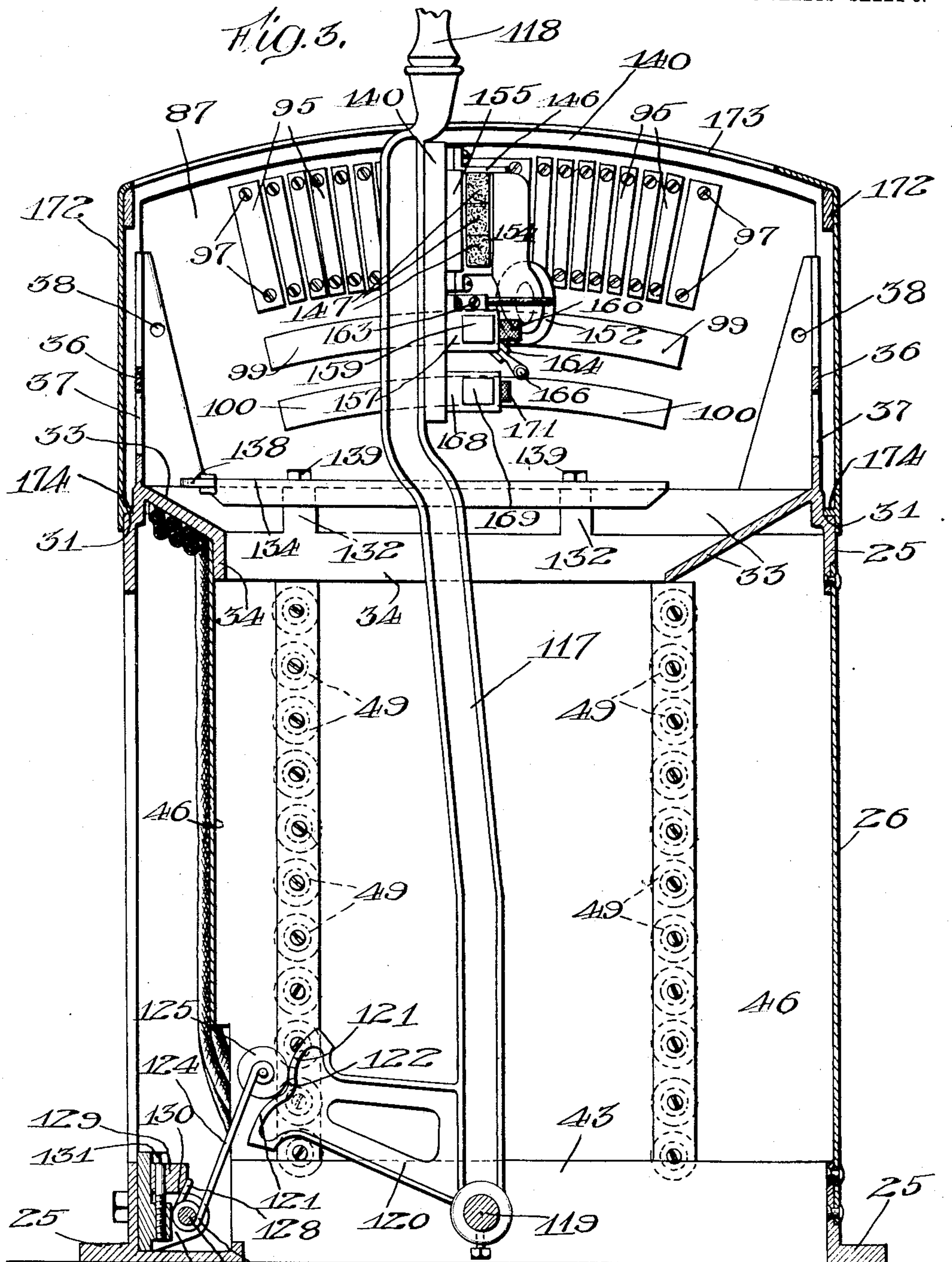
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6 SHEETS—SHEET 3.

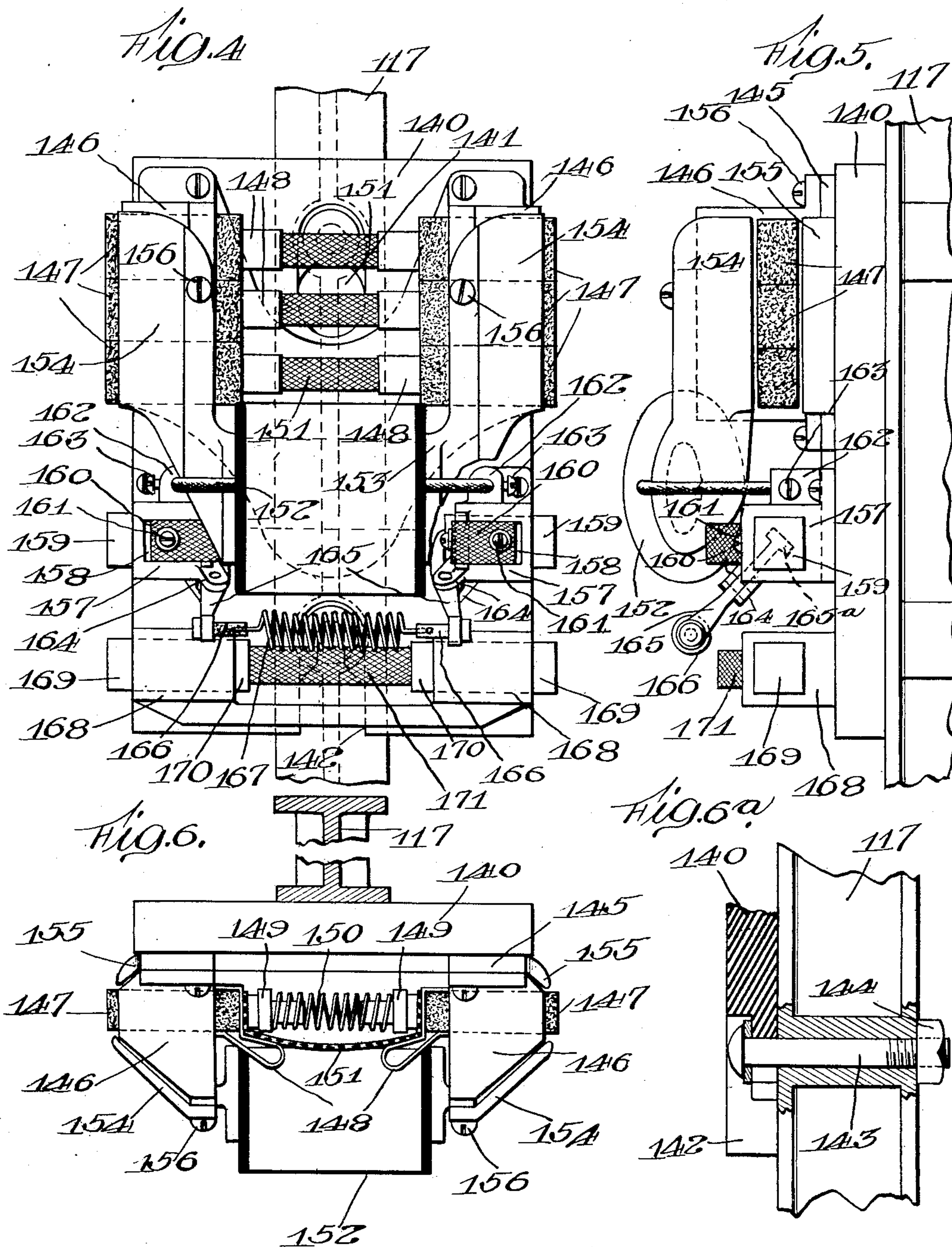


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APPLICATION FILED FEB. 5, 1906.

6 SHEETS—SHEET 4.



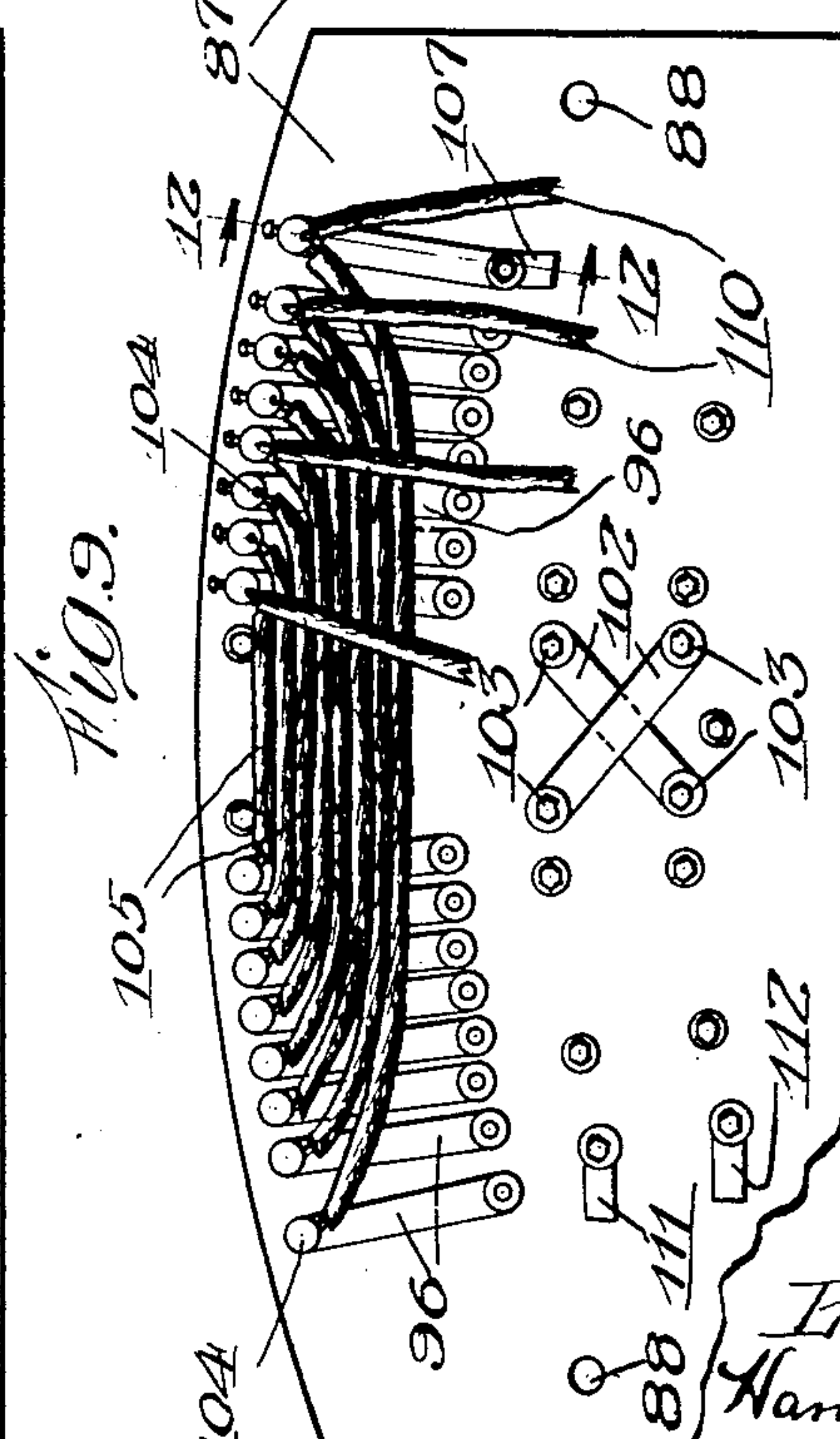
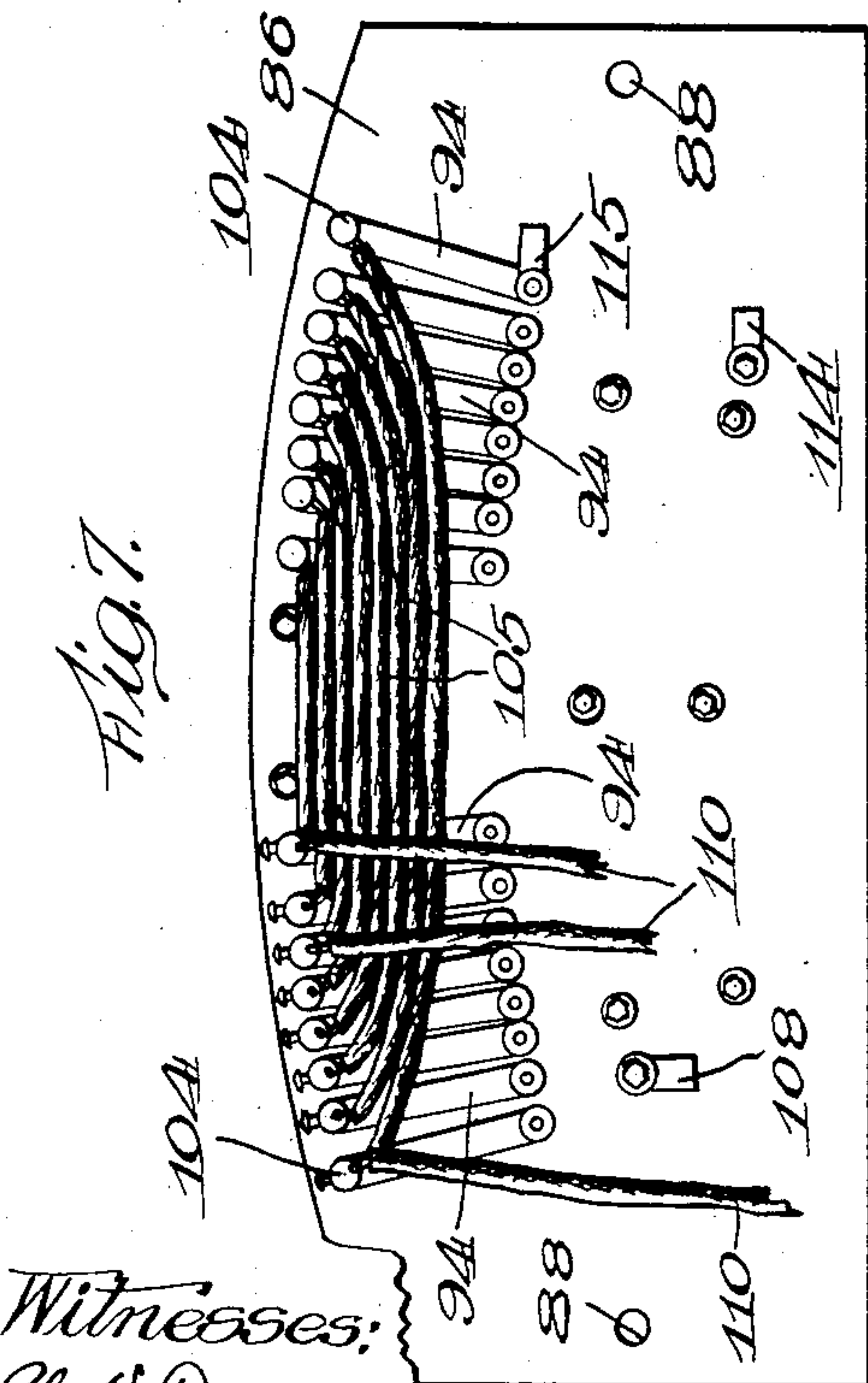
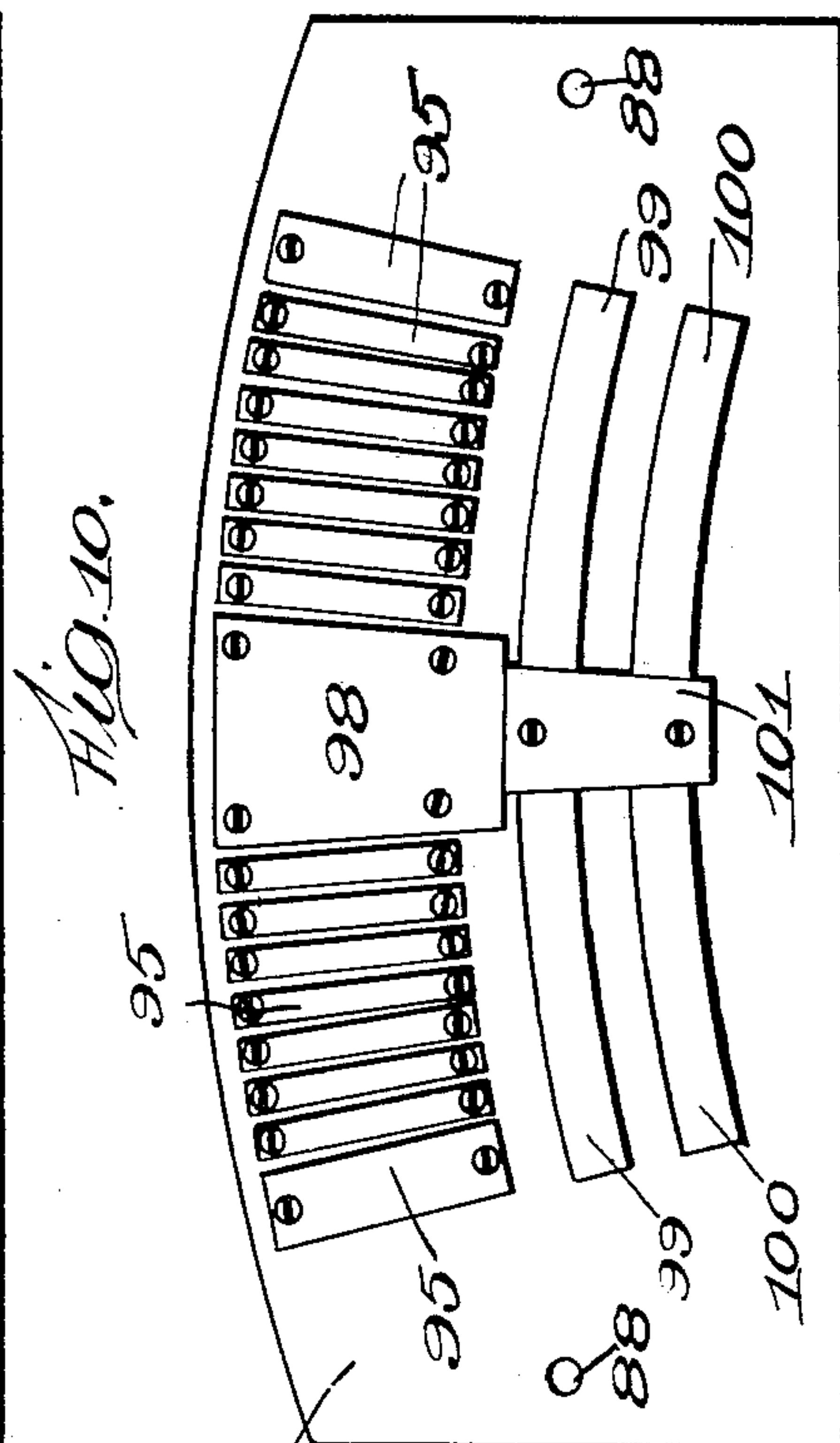
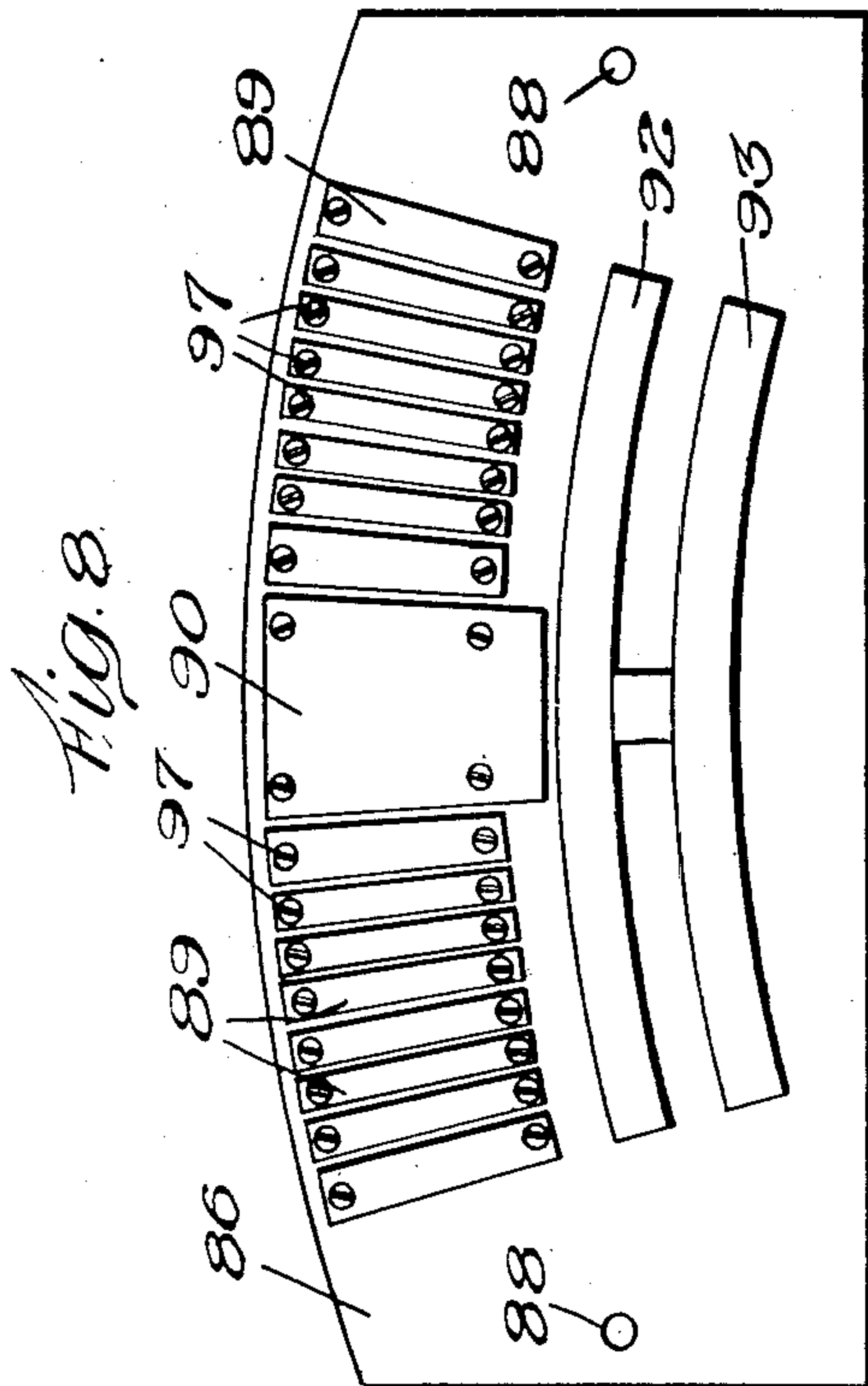
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APPLICATION FILED FEB. 5, 1906.

6 SHEETS—SHEET 5.



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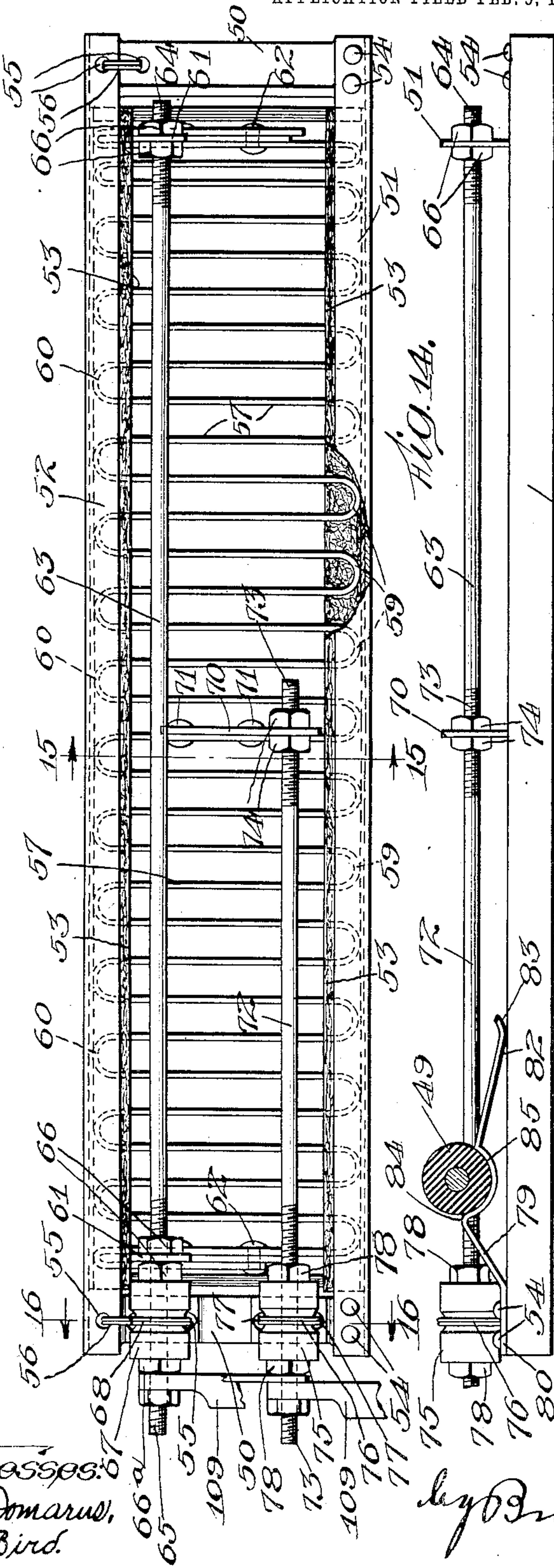
No. 842,342.

PATENTED JAN. 29, 1907.

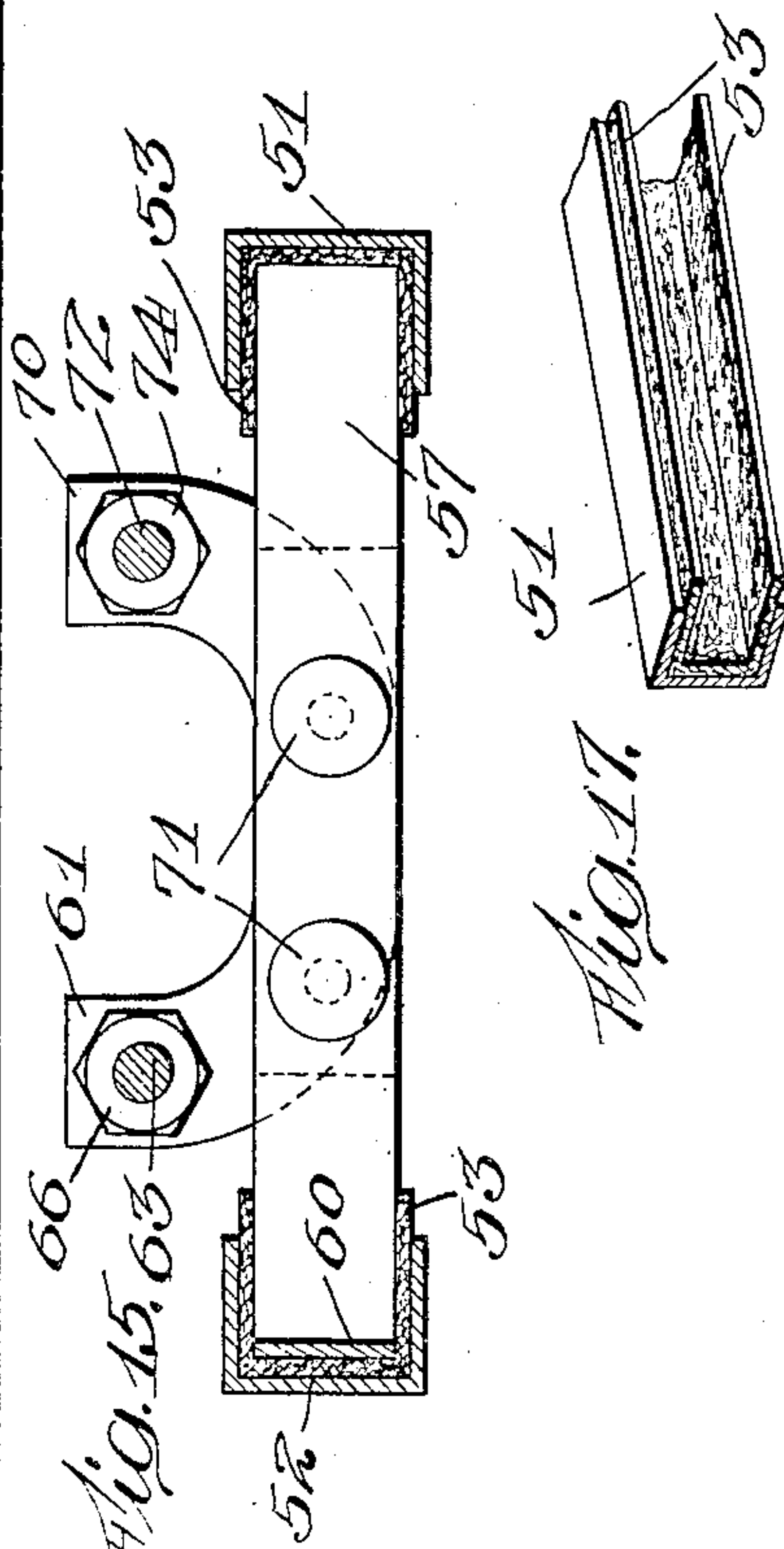
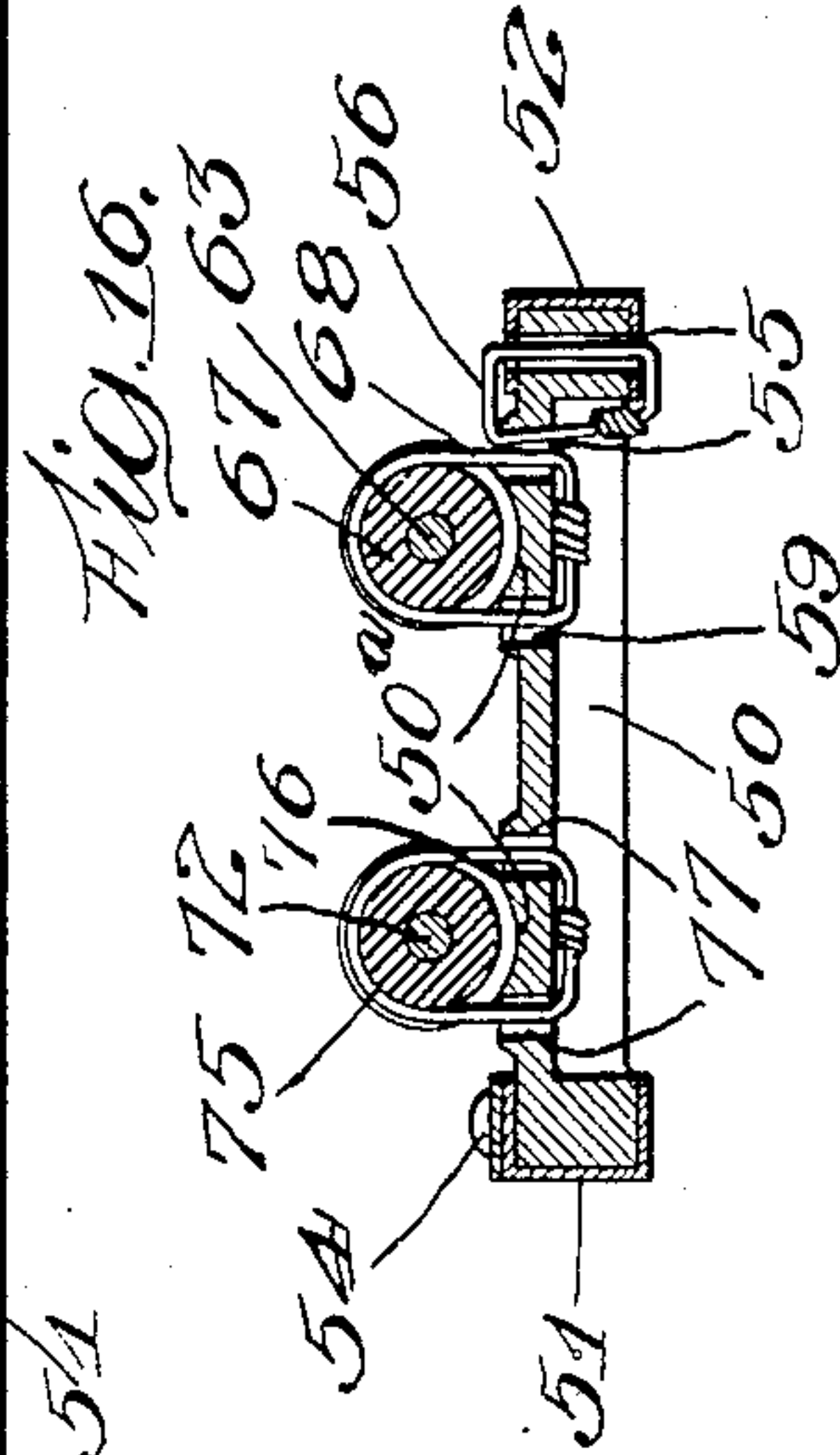
H. SAWYER.  
ELECTRIC CONTROLLER.  
APPLICATION FILED FEB. 5, 1906.

6 SHEETS—SHEET 6.

Fig. 13.



Witnesses:  
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A. C. Bird.





# UNITED STATES PATENT OFFICE.

HARRY SAWYER, OF MUSKEGON, MICHIGAN.

## ELECTRIC CONTROLLER.

No. 842,342.

Specification of Letters Patent.

Patented Jan. 29, 1907.

Application filed February 5, 1906. Serial No. 299,660.

*To all whom it may concern:*

Be it known that I, HARRY SAWYER, a citizen of the United States, residing at Muskegon, in the county of Muskegon and State of Michigan, have invented certain new and useful Improvements in Electric Controllers, of which the following is a full, clear, and exact specification.

This invention relates to improvements in electric controllers, and more particularly to that class of controllers used in cranes or other hoisting machinery. Heretofore in devices of this character considerable difficulty has been experienced in gaining access to the parts, which has usually been done through the sides of the casing, thus necessitating the spacing of the controllers where several machines or motors are used, and thereby occupying considerable floor-space. Furthermore, when the controllers are sufficiently spaced the operating-levers are placed out of convenient reach of the operator. In instances where the controllers are placed close together to concentrate the operating-levers it is necessary to remove the entire controller and take it to the repair-shop when repairs are necessary.

To overcome these difficulties and to construct an improved controller wherein all of the parts which are likely to require attention or renewal may be readily removed from the casing is the primary object of this invention.

A further object is to construct an improved controller, that a plurality may be placed close together so as to concentrate the operating-levers, and yet permit the internal mechanism to be easily and quickly removed without taking the controller out of position.

A further object is to construct an improved device of this character in such a manner that the carbon-dust which wears and falls from the brushes when carbon brushes are used will not be deposited upon any of the electrical parts of the machine, thereby obviating the danger of causing short circuits or grounds.

A further object is to construct an improved device of this character in which the casing is provided with ventilating apertures or openings at the top of the resistance-chambers in order that the heat from the resistance material may be carried off freely without coming directly in contact with the brush-holder.

A further object is to provide an improved manner of insulating the parts.

A further object is to construct an improved resistance-card. 60

A further object is to provide an improved manner of mounting and securing the resistance cards or frames in position.

A further object is to provide an improved construction of contact-slates. 65

A further object is to provide an improved arrangement of contact-plates.

A further object is to produce an improved construction of brush-holder.

A further object is to provide an improved construction of brush which may be readily detached and removed from the controller without removing the controller from position. 70

A further object is to construct an improved resistance-card constructed from a strip of resistance material folded or bent upon itself into a zigzag shape, the adjacent walls thereof being spaced to dispense with the necessity of an insulating material between the adjacent faces of the walls; and a final object is to construct an improved device of this character in which the various parts may be readily removed from the casing and which will be simple in construction, cheap to manufacture, and effective in operation. 75 80 85

To the attainment of these ends and the accomplishment of other new and useful objects as will appear the invention consists in the features of novelty in the construction and arrangement of the parts, as will be hereinafter more fully set forth and claimed, and shown in the accompanying drawings, illustrating an exemplification of the invention, and in which— 90 95

Figure 1 is a perspective view of the casing or framework with the door open and all parts removed. Fig. 2 is a front elevation of a controller constructed in accordance with the principles of this invention with the parts assembled, the door of the casing being open and the cover being in section. Fig. 3 is an irregular longitudinal sectional view on line 3 3 of Fig. 2. Fig. 4 is an enlarged elevation of the brush and upper portion of the operating-lever. Fig. 5 is an end elevation of the brush-holder and brush shown in Fig. 4. Fig. 6 is a top plan view of the brush-holder with the operating-lever in section. Fig. 6<sup>a</sup> is an enlarged detail elevation, partly in section, showing the manner of connecting the brush-holder to the lever. Fig. 7 is a 100 105 110



face view of the right-hand slate, showing the connections of the resistance-contact plates. Fig. 8 is an obverse view of Fig. 7, showing the contact plates or strips. Fig. 9 is a view similar to Fig. 7 of the left-hand slate. Fig. 10 is an obverse view similar to Fig. 8 of the slate illustrated in Fig. 9. Fig. 11 is a diagrammatic view of the two slates, showing the manner of wiring or the connections between the terminals. Fig. 12 is a sectional view on line 12 12 of Fig. 9. Fig. 13 is a top plan view of one of the resistance-cards. Fig. 14 is a side elevation of the resistance-card illustrated in Fig. 13. Fig. 15 is a cross-sectional view on line 15 15 of Fig. 13. Fig. 16 is a sectional view on line 16 16 of Fig. 13. Fig. 17 is an enlarged detail perspective view of a portion of one side of the resistance-card frame, showing the insulating material seated therein; and Fig. 18 is an enlarged detail view of a guide and stop for the operating-lever.

Referring more particularly to the drawings, in which the same reference-numerals designate similar parts throughout the several views, the numeral 25 designates generally a frame comprising the base of the controller or casing for the resistance-cards, as will be set forth. The sides and one end, constituting the rear end of the casing, are closed by walls 26, which latter are provided with a plurality of apertures or openings 27, suitably arranged and for a purpose to be hereinafter specified. This base or casing may be of any desired shape and constructed of any suitable material, preferably heavy cast-iron. The front of the base or casing is open and serves as a means by which access may be had to the interior thereof. This opening is closed in any suitable manner, but preferably by means of a hinged door 28, which may be held in a closed position by means of a suitable catch or fastening device 29. The base or casing may be provided with suitable apertures 30, by means of which it may be secured to the floor and held from movement.

The upper edge of the casing or base 25 is provided with a reduced portion forming a circumferential shoulder 31, and 32 designates the top or cover of the base or resistance-card chambers. This top or cover is provided with inclined portions 33, which form a tapering recessed portion, (best shown in Figs. 1 and 3,) the edges of which terminate short of each other and are disposed substantially parallel to the sides of the casing or base 25, as at 34, Fig. 3, to form a longitudinal slot or opening 35, Fig. 1.

Centrally-disposed flanged uprights 36 project above the top or cover 32, one at the front and one at the rear of the casing or base 25. These uprights are provided with ventilating apertures or openings 27 and also apertures 38 in the flanged portions thereof.

The cover or top 32 is also provided with apertures or openings 39 and 40, the apertures or openings 40, which are located at the front of the casing, being provided with a communicating recessed portion provided with an inclined bottom 41, as best shown in Fig. 1. The base or bottom of the casing or chamber 25 is open, as at 42, and extending longitudinally thereof are centrally-disposed spaced bars or portions 43.

Plates or partitions 44 are secured in any desired manner at their lower edges to the bars or portions 43 and at their upper edges to the flanged portions 34 of the top or cover 32 to form a housing or compartment 45, which is closed in front by a plate or partition 46 and in the rear by the wall 26, and in which housing or compartment the operating-lever is pivoted and operates, as will be more fully set forth. This compartment or housing 45 divides the base 25 into two chambers 47 48. (See Fig. 3.) A plurality of rows of insulators or insulated supports 49 are secured to the walls of each of the chambers 47 and 48 and are so located as to support the resistance cards or frames and guide the same while being inserted and withdrawn through the opening or door in the front of the base or casing 25.

The resistance-cards, any number of which may be used, are all of the same construction and comprise a frame having side pieces 50 and 51, connected by end members 50. Suitable resistance material 57 is secured within the frame thus formed and is suitably insulated from the sides thereof by means of insulating material 52. The resistance material is preferably bent back and forth into a serpentine shape, so that the walls formed by the bent portions will be spaced from each other, with the extremities of the material terminating short of the ends of the frame. Suitable rods or bars 63 and 72 are secured by one end to the resistance material 57 at suitable points intermediate its length by means of arms or brackets 61 and 70, and their free ends 65 and 73 preferably pass through suitable insulators 67 and 75, which latter are secured, preferably, to one end of the frame in any desired manner to form an insulation between the frame and the end of the rods.

Secured to the upper face of one side of the resistance or card frame, preferably the stationary member 51, and adjacent the forward end thereof is a spring 79, one end 80 of which is permanently secured thereto by means of the bolts or rivets 54, the free end 82 being slightly rounded, as at 83, so as to have a yielding bearing with the face of the frame member 51. This spring is bowed upward or raised intermediate its ends, as at 84, and is provided with a seat or depressed portion 85, and the end 82 is preferably inclined from the seat or depressed portion 85



to its extremity 83. (See Fig. 14.) These resistance frames or cards in the construction shown are superimposed within the chambers 47 and 48 and form two tiers. Each frame is inserted through the door or opening in the front of the frame or casing and is slid in and withdrawn in the same manner as an ordinary drawer, each of the sides passing between two rows of the insulators or insulated supports 49, the space between these rows of supports being of a size slightly larger than the height of the frame, the bottom rows of the insulators 49 serving as supports for the frames. The frame is shoved in until the inclined end 82 of the spring engages one of the insulators or supports in the upper row. A further insertion of the frame will cause the spring to be depressed until its seat or depressed portion 85 is adjacent the insulator or support, when it will spring into engagement therewith, and thus lock the frame in position and hold the same securely until extra force is applied to the outer end of the frame to withdraw the same. This applied force will cause the spring to yield and permit the frame to be withdrawn.

Although there is shown and described a specific form of spring for fastening or holding the resistance frames or cards in position, it is to be understood that any other form of fastening or securing means may be employed.

Secured to the flanges of the uprights 36 are spaced plates of slates 86 87, which are arranged parallel to each other and are held in position by bolts, which pass through the apertures 88 therein and the apertures 38 in the flanges of the uprights 36 and with which they register.

Arranged upon or secured to the inner face of the slate 86 and suitably spaced or insulated from each other are resistance contacts or plates 89, which are preferably mounted vertically in relation to the slate and held by means of bolts or screws 97. Any number of these contact-plates may be used, according to the number of resistance frames or cards used. In Fig. 8 there is illustrated a slate to which is secured sixteen resistance-contacts 89, which are divided into two groups of eight each and are separated by a dead block or plate 90. Contact plates or strips 92 93, suitably spaced and insulated from each other and from the resistance-contacts 89, are secured to the face of the slate 86. These contact strips or plates are preferably located beneath and extend the entire length of the resistance-contacts 89.

To the outer face of the slate 86, and as shown in Fig. 7 of the drawings, are connecting strips or members 94, which are arranged opposite the ends of the resistance-contacts 89. The resistance contact plates or strips 95 on the face of the slate 87 and the connecting strips or members 96 on the outer

face thereof are respectively of the same construction and arrangement as the contact-plates 89 and connections 94 of the slate 86. Electrical connection is obtained between the plates 89 and 95 and connections 94 and 96 by means of bolts or screws 97, which pass through the plates 89 and 95, slates 86 and 87, and into the connections 94 and 96, as shown in Fig. 12 of the drawings. The dead block or plate 98, carried by the slate 87 and which separates the groups of resistance contact-plates 95, is preferably of the same construction as the dead-block 90 of the slate 86. Carried by the inner face of the slate 87 are contact-strips 99 100, arranged in the same manner as the contacts 92 93 of the slate 86, but are not continuous, as the plates 92 93. On this slate the contacts 99 100 are not continuous, but comprise four short strips, with a dead block or plate 101 disposed between their adjacent ends. This block or plate 101 may be a continuation of the block or plate 98, or a separate plate or block may be used for this purpose. In order to secure an electrical connection between these short spaced strips or contacts 99 100 and to secure the proper direction of the current for reversal, as will be set forth, the sections of the contacts 99 100 are connected by means of the cross-pieces or strips 102, arranged on the outside of the slate 87, each strip connecting the diametrically opposite sections of the contacts 99 100, and said strips are held in position and secure electrical contact with the said strips by means of bolts or screws 103, which pass through said strips and slates and into their respective contact-strips 99 100 in a manner similar to the connection made by the screws or bolts 97 between the resistance-contacts 95 and connections 96, as shown in Fig. 12 of the drawings, or in any other suitable manner. Any other form of connection may be used which would be suitable for the purpose; but this form has been found to be a simple and effective one, although it is not desired to be limited to this specific form of connection.

Each of the connections or connecting members 96 are provided, preferably adjacent their upper end, with a suitable binding-post 104. The two groups of resistance-contacts 89 and 95 of the plates or slates 86 87 are arranged in pairs—that is, each of the resistance-contacts of one group is coupled to the corresponding resistance-contact of the other group carried by the same slate. This is accomplished by means of the wires or conductors 105, the ends of which engage and are secured to the connecting member 96 in any suitable manner, either by means of the binding-posts or by being soldered there-to or otherwise connected.

A suitable connection is obtained between the first resistance contact strip or plate 95 at the front end of the slate 87 and the con-



tact-strip 92, carried by the slate, 86 by means of a suitable conductor or wire 106, the ends of which engage the respective contacts and are secured in any desired manner, preferably by means of binding-posts 107 and 108. This conductor or wire 106 passes down around the lower edge of the slate 87, through the opening 40 in the top of the resistance-chamber 47, then up through the corresponding opening 40 on the other side to the point of connection 108 on the outside of the plate or slate 86.

The resistance-cards comprising each tier may be connected in any desired manner by means of the connections 109, engaging the threaded extremities 65 and 73 of the rods or bars 63 72, and 110 are suitable conductors or wires, one end of which engage one of the bars or rods 63 72 of the resistance-cards and the other ends suitable binding-post 104 on each one of the respective front groups of connections 94 and 96, the conductors from each tier of resistance-cards engaging the connections on their respective slate.

The beveled or inclined wall 41 of the aperture or openings 40 permits the wires or conductors 110 to pass through the top of the resistance-chambers without danger of being cut or having the insulation scraped off by the sharp edge of the opening. These wires or conductors 110 (a few of which are shown in Figs. 7 and 9) are connected to the front group of resistance-contacts 94 96 of their respective slate.

The resistance-cards may be connected in any desired manner and so arranged that as the operating-lever is advanced or moved any number of cards may be cut out, thereby varying the strength of the current; but for the purpose of illustration there is illustrated an arrangement and system of coupling in which all of the resistance-cards are coupled to the first resistance contact-strips on each slate adjacent the dead blocks or plates 90 98. The cards are so wired to the next advancing contact that one card of each tier is cut out. The next advancing contact has two cards cut out, and so progresses to the last contact, which is so wired that all of the resistance-cards are cut out, thereby driving the machine at the greatest speed and with the most power.

The two ends of the conductor-wires 111 112 leading to the armature are connected, respectively, to the contact strips or plates 99 100, carried by the plate or slate 87, preferably at the rear thereof. The + field conductor 113 is connected to the contact strip or plate 93, as at 114, and the end of the - feeder-wire 115 is secured, as at 116, to one of the resistance contacts or plates 88, as shown in diagram in Fig. 11.

A lever 117 stands and moves within the housing or compartment 45, and its upper end projects above the top of the resistance-

compartments 47 48 and moves between the slates 86 87, the upper extremity thereof terminating in a suitable handle 118. This lever is pivotally mounted at its lower end within the casing or housing 45 by means of the bolt or axle 119, suitably supported. An arm or projection 120 extends from the lever, preferably adjacent its pivot-point, and said arm or projection is provided with a curved bearing-face 121, having a central depressed portion or recess 122.

Secured to the casing or base 25 and adjacent the front of the housing or casing 45 is a bracket 123. Pivoted to the bracket is an arm 124, to the free end of which is journaled a roller 125, which is adapted to engage and bear against the face 121 of the arm or projection 120. This arm is preferably constructed of spring metal, such as heavy wire, and its point of pivotal connection with the bracket 123 is preferably formed by winding or twisting its end around a bolt or axle 126 to form a spring-coil 127, terminating in an upwardly-projecting free extremity 128.

A block 129, provided with a beveled or inclined face 130, is secured to the bracket 123 by means of an adjusting screw or bolt 131, which passes through said block and into the bracket. This beveled or inclined face 130 is adapted to engage the free extremity 128 of the arm 124, and by adjusting the block up or down by means of the bolt 129 greater or less pressure is exerted upon the projecting end 128, thereby increasing or decreasing the pressure of the roller 125 upon the bearing-face 122 of the projection or arm 120 carried by the lever 117. The bracket 123 is preferably located outside of the housing or casing 45, so that the extremity of the arm 124, carrying the roller 125, will project through the front thereof. Thus it will be seen that the roller 125 has at all times a bearing upon the face 121 of the arm or projection 120 and serves to retain the lever in any position to which it may be moved. The depression or recess 122 serves as a means for centering and holding the lever in its inoperative position.

Carried by or secured to the inclined portions 33 of the top or cover of the resistance-chambers 47 48 and adjacent the slot or opening 35 therein are projections or bosses 132; each of which is provided with a screw-threaded aperture 133. A guide-plate 134 is provided with a straight front edge 135 and ears or projections 136, extending from its rear edge, which latter are provided with slots 137, and at one end thereof is a forwardly-projecting hook or stop 138. One of these plates is placed on each side of the slot 35 with the hooks 138 toward the front and back end of the casing extending across the slot and in the path of movement of the lever 117 and are held in position by means of bolts or screws 139 passing through the registering apertures. The front edges 135 of these



plates stand adjacent and serve as a guide for the lever 117 and may be adjusted as desired by means of the slots 137 and bolts 139, and the projecting ends 138 serve as stops to be engaged by the lever 117 to arrest its forward and backward movement and to prevent the brushes which are carried by the lever from passing beyond the end contact-plates, as will be set forth.

The brushes which are carried by the lever and which pass over the resistance-contacts and also those which pass over the armature and field contacts are all mounted upon or carried by a single block or plate 140, which is preferably constructed of some insulating material or may be of metal with any suitable insulating material secured between it and the electrical parts. This block is provided with two keyhole-slots 141 142, the lower one of which preferably opens through the edge of the block, as shown. Carried by the lever 117 are two bolts 143, which are provided with heads adapted to pass through the enlarged parts of the slots 141 142, so that the shanks of the bolts may enter the smaller portion thereof when the brush is lowered into position, after which the nuts 144 may be tightened for securing the brushes onto the lever and in proper operative position. Mounted upon or carried by the face of the block or plate 140, preferably near the top and extending across the same, is a plate or pole piece 145, carried also by the plate or block 140, and disposed adjacent the edge thereof and located over or in close proximity to each end of the pole-piece 145 are guides or housings 146, which are preferably secured in position by means of bolts or screws 156, passing through flanges carried thereby, through the pole-piece 145, and into the block or plate 140, and these bolts serve as a means for holding the parts assembled. Suitable brushes 147 of any desired material, such as carbon or the like, are slidingly mounted in the guides or housings 146 and are disposed diametrically opposite each other.

A clip 148 engages the inner extremity of each of the brushes 147, and each clip is preferably provided with a lug or projection 149, of suitable insulating material, and disposed between each two diametrically opposite brushes is a spring 150, which is preferably in the nature of a coil, the extremities of which surround the projection 149 and tend to normally hold the extremities of the brushes 147 beyond the edges or sides of the block or plate 140. A suitable flexible electrical conductor 151 also connects the inner extremities of the brushes 147. Mounted also upon the face of the block or plate 140 is an electromagnet comprising a coil 152, surrounding a pole-piece 153, the extremities 154 of which project beyond the ends of the coil and stand adjacent the projecting extremities of the brushes 147 and prefer-

ably above the extremities 155 of the pole-piece 145, which are preferably bent out of the plane of its body portion and toward the brushes, so that said brushes stand and move between the extremities of the pole-pieces. Any number of these brush-sections may be provided, and by constructing the brushes of sections one or more sections may yield to the uneven surface of the resistance-contacts should the same become worn and yet insure a good contact. The electromagnet may be secured and held in position in any desired manner, such as by means of screws or bolts 156, and may be of any desired shape. Mounted also in the block or plate 140 and diametrically opposite to each other and near the edge thereof are boxes or housings 157, which are preferably provided with an opening or aperture 158. Moving in these boxes and projecting beyond the edges thereof are brushes 159, of any suitable material, such as brass or the like, and 160 designates a flexible electrical conductor one end of which passes through the aperture or opening 158 and is secured to the brushes in any suitable manner, such as a bolt or screw 161. The other end is secured to the boxes or housings 157, which latter are constructed of suitable conducting material, such as brass or the like. The ends of the electric coil 152 are electrically secured to the boxes or housings 157 in any suitable manner, preferably by means of the ends of the wire entering a socket 162 and are held therein by means of screws 163.

The boxes 157 are provided with ears or projections 164, located, preferably, at one corner thereof, and pivoted therein are levers or arms 165, the extremities 165<sup>a</sup> of which engage and rest against the inner extremities of the brushes 159. Carried by the free end thereof are lugs 166, of any suitable insulating material, and connecting these lugs is a spring 167, which normally tends to draw the levers 165 inward, thereby forcing their other ends outward, causing the brushes 159 to normally and yieldingly project beyond the sides of the plate or block 140. Boxings or housing 168 are also carried by the plate or block and are located adjacent the edges thereof and preferably near the bottom of the lower end. These latter boxes may be constructed of a single piece of material or connected in any suitable manner. Brushes 169, of suitable material, such as brass or the like, are mounted to move in the boxings or housings 168, and carried by the inner and adjacent ends thereof are insulated lugs or projections 170. A suitable expansive spring (not illustrated, but similar to the spring 150) is disposed between and engages the lugs or projections 170 and serves as a means for holding the extremities of the brushes 169 normally and yieldingly projecting beyond the sides of the block or plate



140, and a suitable flexible electrical conductor 171 is disposed between and connects the inner ends of these brushes similar to the manner in which the brushes 147 are connected.

With this construction of brush and holder it will be seen that in order to place the same into position all that is necessary is to unscrew the nuts 144 sufficient to permit the heads of the bolts 143 to be shoved forward, so as to pass through the enlarged openings in the block or plate 140, after which the latter is lowered into proper position and the nuts tightened. The brushes and holder may be removed by simply unscrewing the nuts 144 and raising the block or plate 140 until the enlargements of the slots 141 are opposite the heads of the bolts 143, when it may be removed by slipping the same over the bolt-heads. The brush-holder block or plate is of such a size that when in position and when secured to the lever 117 between the slates or plates 86 and 87 the edges thereof will be in close proximity thereto, and the ends of the brushes will project beyond the edges of the block 140 a distance greater than the distance between the two slates, so that when forced into position the springs between the brushes will be compressed, thereby insuring a positive and good connection between the brushes and their respective contacts.

It will be noted that when in position the carbon or resistance brushes 147 engage the resistance contact-plates 89 95. The brushes 159 engage the contacts 92 99 and constitute the upper reversing-brushes, while the lower reversing-brushes 169 engage the contacts 93 100. Obviously the contacts carried by the slates 86 87 may be mounted in any desirable manner, and the brushes may be arranged in accordance with the contacts, and any number of brush-sections may be employed; but the form and arrangement shown and described is the preferred form of the invention and is illustrated as a simple exemplification of the invention. It is, however, to be understood that in this form the brushes make electrical connection directly across from contacts on one slate to the contacts directly opposite on the opposite slate. The operating-lever 117 normally stands in a central position with the extremities of the various brushes adjacent the dead-blocks 90 98, and in this position no current passes through the controller. The resistance-cards may be connected in any desirable manner and are also connected to the terminals or contact-plates 89 95, so that as the lever is advanced and the brushes engage the contact-plates 89 95 any number of resistance-cards may be cut out. In the form shown the cards on each side are preferably connected with the diametrically opposite contacts 94 96, located at the front of the

machine and on one side of the dead-blocks 90 98 by means of the conductors or wires 110, and the front set of contacts are in turn connected to their respective rear set by means of the conductors 105. The cards being so connected or arranged that when the handle is started from the central position and the brushes moved from the dead-blocks and into engagement with the first contact, the current will pass through all of the resistance-cards, and as they advance from one contact to the next succeeding one one or more resistance-cards will be successively cut out, as already explained.

A cover 172, of any suitable material and construction, is provided as a protection for the contact slates and brushes and is provided with a slot 173 in the top and flanges 174, adjacent the bottom thereof. This cover is adapted to be inserted over the slates and brushes, so that the flanges 174 rest upon the shoulders 31, formed by the reduced portion of the base or resistance casing, so that the extremity or handle 118 of the lever 117 projects through the slot and above the top of the cover, so as to be accessible to the operator. Starting with the lever in such a position that the resistance-brushes 147 engage the first diametrically opposite resistance-contacts 89 95 adjacent the dead-blocks 90 98 and designated by a double arrow, the current will take the following course: Entering through the wire 113 to the contact-plate 93, through the brushes 169 across to the diametrically opposite contact-plate 100, through the connecting-strip 102 to the upper contact-plate 99 on the same slate, through the conductor 111, motor M, back through conductor or wire 112 to the other connecting-strip 102 and across to the contact-plate 99, across to the diametrically opposite contact 92, through the contacting brush 159, coil 152, and brush 159, back through the conductor 106 to the resistance-contacts 95, through wires or conductors 110, resistance-cards on one side, resistance-brushes 147 across to resistance-contacts on other side, wires 110, resistance-cards on other side, out through conductor 115, motor-field M F, and back to the source of supply. Should the lever be moved so that the brushes engage the contacts on the other side of the dead-blocks, the direction of the current will be the same, except that by means of the separated contacts 99 100 and the arrangement of the connecting-pieces 102 the current will pass through the motor in the opposite direction or through conductor 112, motor M, and back through conductor 111, thereby reversing the motor.

A very effective construction and arrangement of the magnetic blow-out for extinguishing the arc formed by breaking the circuit on the resistance-contacts as the brushes are moved is herein illustrated. In this ar-



5 rangement the pole-pieces are arranged on either side of and very close to the active faces of the brushes, where the electric arc is formed, and by surrounding one of the poles with the coil the length of the magnetic circuit and the air-gap between the poles is greatly reduced, thereby greatly increasing the power of the magnet and the effectiveness of the blow-out. The coil receives its energy by means of the brushes 159 engaging the diametrically opposite contacts 92 99.

15 It will be observed that the inclined portions 33 of the cover or top 32 of the resistance-chambers communicates with the housing 45, in which the lever 117 operates. In devices of this character considerable difficulty has been experienced when carbon-brushes are used, as the carbon-dust usually falls upon some of the active parts, thereby often causing short circuits and defective operation of the parts. In this construction any dust or powdered carbon which comes from the brushes falls upon the top or cover 32 of the resistance-chambers and will be deflected by means of the inclined portions 33 into the lever-housing 45 and between the tiers of resistance-cards. The bottom of this housing being open, the dust will be deposited upon the floor or ground. By providing the ventilating-apertures 27, 37, and 39, together with having the bottom of the chambers open, a circulation of air is provided which passes freely through the casing, carrying off any heat which may be generated from the resistance material to prevent the same from coming directly in contact with the brush-holder.

40 The parts may be easily removed when worn or for other purpose and new ones substituted without moving the machine or entirely dismembering it.

It is to be understood that it is not desired to be limited to the exact details in the construction and arrangement of the several parts, as various changes may be made without departing from the spirit of the invention.

50 If desired, the positive and negative current may be reversed with respect to each other, and the motor-fields may be included in either of the conductors 113 or 115. Furthermore, if desired, the magnetic coil may surround a core connecting the pole-pieces 145 and 154 instead of surrounding the pole-piece 154.

55 What is claimed as new is—

1. In a controller, the combination of a casing, resistances and contacts therefor, a movable contact member projecting from the casing, and means for catching and confining the particles discharged from the contact member.

2. In a controller, the combination of a casing, resistances and contacts therefor, a movable contact member projecting from the casing, and means for housing the contact member

ber and catching and confining the particles dislodged from the contact member.

3. In a controller, the combination of a casing, resistances and contacts therefor, a movable contact member projecting from the casing, a housing for the contact member and means communicating with the housing and extending downwardly from the top of the casing and adapted to catch the particles dislodged from the contact member and conduct the same to the bottom of the casing.

4. In a controller, a frame comprising a casing, having a perforated top and walls, and a door at one end, spaced partitions arranged longitudinally within the casing to form a central chamber, the top being provided with a slot, having an inclined side communicating with the central chamber, and standards or uprights extending from the top of the casing adjacent the ends of the slot and extending beyond either side thereof.

5. In a controller, a frame comprising a casing, having a perforated top and walls, and a door at one end, spaced partitions arranged longitudinally within the casing to form two separated chambers, said top being provided with a slot communicating with the space between the chambers, the edges of the slot being inclined, a closure for the front of the space, and flanged uprights extending above the top of the casing adjacent the ends of the slot, said flanges standing on either side of the slot.

6. In a controller, a controller-frame comprising a closed casing provided with a door at one end, a centrally-disposed longitudinal closed housing arranged within the casing to form two separated chambers, the top of said housing being provided with a longitudinal slot, uprights extending above said top, adjacent the ends of the slots, and supports within the chambers and carried by each of the walls thereof.

7. In a controller, a controller-frame comprising a closed casing provided with a door at one end, a longitudinal closed housing arranged within the casing to form two separated chambers, the top of the housing being provided with a longitudinal slot, and uprights extending above the top adjacent the ends of the slot.

8. In a device of the class described, the combination of a casing open at one end, a door for said opening, spaced partitions within the casing to form two separated chambers, resistance-cards within each of the chambers, and removable through the door, the top of the casing being provided with a slot communicating with the space between the chambers, contacts secured to the top, connections between the contacts and the resistance-cards, a lever projecting through the slot into and movable in the space between the chambers, and brushes carried by the lever and adapted to engage the contacts.



9. In a device of the class described, the combination of a casing open at one end, a door for said opening, spaced partitions longitudinally disposed within the casing to form two separated chambers, resistance-cards within each of the chambers and removable through the door, the top of the casing being provided with a slot communicating with the space, insulating-supports secured to the top on either side of and adjacent the slot, contacts carried by the adjacent faces of the supports, connections between the resistance-cards and the respective contacts, a lever pivoted within the space between the chambers and projecting through the slot, and brushes removably secured to the lever above the top, said brushes moving between the supports and engaging the contacts carried thereby.

10. In a device of the class described, the combination of a casing open at one end, a door for said opening, spaced partitions centrally disposed within the casing to form two separated chambers, resistance-cards adapted to be inserted into the chambers through the front of the casing, the top of the casing being provided with a slot communicating with the space between the chambers, uprights extending above the top on each side of the slot, insulating-supports secured to the uprights adjacent the slot, contacts carried by the adjacent faces of the supports, connections between the resistance-cards and the contacts, a lever pivoted between the chambers, and brushes removably carried by the lever, said brushes standing between and adapted to successively engage the contacts when the lever is moved.

11. In a device of the class described, the combination of a casing having an opening in one end, a closure for said opening, said casing being divided to form two independent separated chambers, resistance-cards removably seated within the chambers, the top of the casing being provided with a slot communicating with the space between the chambers, and an aperture communicating with each of the chambers, said top being also provided with a recessed portion communicating with the apertures and having an inclined bottom, insulating-supports secured to the top adjacent the sides of the slot, contacts carried by the supports, conductors secured to the contacts and resistance-cards and passing through the apertures and recesses, a lever pivoted between the chambers, and projecting through the slot, and brushes carried by the lever, said brushes being disposed between the supports to engage the contacts thereon.

12. In a device of the class described, the combination of a casing having an opening at one end, a closure for said opening, an inclosed space within the casing, the top thereof being provided with a slot, resistance-

cards removably seated within the casing and on both sides of the inclosed space, contacts secured to the face of the top adjacent to and on both sides of the slot, connections between the contacts and the resistance-cards, a lever pivoted within the space and extending through the slot, brushes carried by the lever and engaging the contacts, an adjustable guide secured to the top adjacent the slot, and a stop carried by the guide and standing within the path of movement of the lever.

13. In a device of the class described, the combination of a casing having an opening at one end, a closure for said opening, an inclosed space within the casing, resistance-cards removably seated within the casing and on both sides of the inclosed space, the top of the casing being provided with a slot communicating with the space, and having inclined edges, uprights extending above the top adjacent the ends of the slot, insulating-supports secured to the uprights and standing on both sides of and adjacent the slot, contacts carried by the supports, connections between the contacts and resistance-cards, and brushes carried by the lever, said brushes standing between the supports and engaging the contacts thereon.

14. In a device of the class described, the combination of a casing, having an opening at one end, a closure for said opening, an inclosed space within the casing, dividing the casing into two separated chambers, resistance-cards removably seated in the chambers, the top of the casing being provided with a slot having inclined edges and communicating with the space, contacts carried by the top, connections between the contacts and resistance-cards, a lever pivoted within the space and extending through the slot, brushes carried by the lever and moving between and engaging the contacts, and a centering device engaging the lever for holding the same in an inoperative position.

15. In a device of the class described, the combination of a casing having an opening in one end, a closure for said opening, an inclosed space within the casing, resistance-cards within the casing, the top of the casing being provided with a slot communicating with the inclosed space, contacts secured to the top, connections between the resistance-cards and contacts, a lever pivoted within the space and extending through the slot, brushes carried by the lever and engaging the contacts and located in close proximity to the slot, an arm carried by the lever within the inclosed space, said arm being provided with a bearing-face having a centrally-disposed recess, and a retaining-roller engaging the face and adapted to be seated in the recess for holding the lever in its central position.

16. In a device of the class described, the



combination of a casing having an opening in one end, a closure for said opening, the top of the casing being provided with a slot, spaced partitions within the casing and disposed on opposite sides of the slot, a lever pivoted between the partitions and extending through the slot, said lever being provided with a bearing-surface having a recessed portion, a spring-supported roller engaging the bearing-surface and adapted to enter the recess for centering the lever, means for varying the tension of the arm, resistance-cards removably seated in the casing, contacts carried by the top of the casing, connections between the contacts and resistance-cards, and brushes carried by the lever, said brushes being adapted to engage the contacts.

17. In a device of the class described, the combination of a casing open at one end and having a longitudinal slot in the top thereof, a closure for the opening, spaced partitions within the casing and located on either side of the slot, a lever pivoted between the partitions and extending through the slot, an arm carried by the lever between the partitions, said arm being provided with a bearing-surface, a bracket, a spring-arm pivoted intermediate its ends to the bracket, a roller carried by one end of the arm and engaging the arm carried by the lever, a movable block mounted on the bracket and engaging the other end of the arm, means for adjusting the block to vary the tension of the roller against the bearing-surface, resistance-cards within the casings, contacts adjacent the lever, connections between the resistance-cards and contacts, and brushes carried by the lever for engaging said contacts.

18. In a device of the class described, the combination of a casing open at one end and having a longitudinal slot in the top thereof, a closure for the opening, spaced partitions within the casing and disposed on opposite sides of the slot, uprights extending above the top of the casing adjacent the ends of the slot, flanges carried by the uprights and standing on either side of the slot, parallel insulating-supports secured to the flanges and adjacent the sides of the slot, resistance-cards within the casing, contacts carried by the adjacent faces of the supports, connections between the contacts and the resistance-cards, a lever pivoted between the partitions and extending through the slot, a brush-holder removably carried by the lever between the supports, and brushes carried by the holder and engaging the contacts.

19. In a device of the class described, the combination of a casing open at one end and provided with a slot in the top thereof, spaced partitions within the casing adjacent the sides of the slot, a lever pivoted between the partitions and extending through the slot, uprights secured to the top of the casing and

on either side of the slot, contact-supports secured to the uprights on either side of the lever and parallel with the sides of the slot, a brush-holder removably carried by the lever and extending across the slot, brushes carried by the holder and engaging the contacts, resistances within the casing, and connections between the resistance material and the contact-supports.

20. In a device of the class described, the combination of a casing open at one end and provided with a slot in the top thereof, spaced partitions within the casing adjacent the sides of the slot, a lever pivoted between the partitions and extending through the slot, spaced contact-supports secured to the top of the casing adjacent the sides of the slot and parallel therewith, a lever pivoted between the partitions and extending through the slot in the top of the casing, a brush-holder removably carried by the lever between the supports, brushes carried by the holder, said brushes extending across the slot and engaging the contacts, resistances within the casing and on both sides of the space formed between the partitions, connections between the resistances and the contact-supports, and a removable cover for the contact-supports and brushes, said cover being provided with a longitudinal slot through which the lever passes.

21. In a device of the class described, the combination of a casing having a slot in the top thereof, spaced parallel contact-supports secured to the top adjacent the slot, a lever projecting through the slot and moving between the supports, a brush-holder, said holder comprising a block or plate having keyhole-slots therein, brushes carried by the holder and yieldingly projecting beyond the edges thereof, said holder being disposed across the slot in the top of the casing with the brushes engaging the contacts, means carried by the lever and adapted to pass through the slots in the holder for removably securing said holder to the lever, resistance-cards, and connections between the contacts and resistance-cards.

22. A device of the class described containing spaced parallel vertical contact-supports of insulating material, a lever movable between the supports, a brush-holder within the space between said supports, means carried by the lever detachably engaged by the holder, and brushes mounted upon the holder, said brushes being adapted to engage the contacts, and being disposed transversely across the space formed between the supports.

23. In combination, in a device of the class described, a pair of vertically-disposed parallel contact-slates, a dead-block secured to the adjacent faces of each slate, near the upper edge and adjacent the center thereof, a plurality of diametrically opposite contacts



secured to the slates on each side of the blocks, a pair of contact-strips secured to each slate respectively, diametrically opposite each other, each of the contacts on one slate being divided into two sections, cross-connections between the diagonally opposite sections of the said contacts, and brushes disposed between the slates and engaging respectively the diametrically opposite contacts carried by the slates.

24. In a controller, the combination of a pair of plates, contacts carried by said plates, a lever moving between the plates, a brush-holder, said holder comprising a base, resistance-brushes carried by the base and projecting beyond the edges thereof, an electrical connection between said brushes, an electromagnet carried by the base, the poles of said magnet being disposed adjacent the active faces of said brushes, a second set of brushes carried by the base, arranged in pairs diametrically opposite each other, the terminals of the magnetic coil having electrical connection with one pair of diametrically opposite brushes of the second set, connections between the other pairs of brushes, and means carried by the lever for engaging the holder to removably secure the same between the slates and with the brushes engaging their respective contacts carried by said slates.

25. A brush-holder for controllers and the like, comprising a base, an electromagnet carried thereby, the poles of said magnet being spaced from each other and disposed adjacent the edges of the base, resistance-brushes moving between the poles, electrical connections between said brushes, contact-brushes carried by the base, connections between said contact-brushes and the ends of the coil, a second set of contact-brushes, and an electrical connection between said second set of brushes.

26. A brush-holder for controllers and the like, comprising a base, an electromagnet carried thereby, the poles of said magnet being spaced from each other and disposed adjacent the edges of the base, diametrically opposite resistance-brushes moving between the poles, electrical connections between the brushes, diametrically opposite contact-brushes carried by the base, connections between said contact-brushes and the ends of the magnet-coil, a second set of diametrically opposite contact-brushes, electrical connections between said second set of brushes, and means disposed between each pair of diametrically opposite brushes for normally holding their ends beyond the edges of the base, said means being insulated from the brushes.

27. A brush-holder for controllers and the like, comprising a base, spaced pole-plates carried thereby, the ends of said plates being located adjacent the edges of the base, a pair of diametrically opposite contact-brushes, a coil surrounding one of the pole-plates, and

having electrical connection with each of the brushes, diametrically opposite resistance-brushes movably mounted between the ends of the pole-plates, a second pair of diametrically opposite contact-brushes, connections between the respective diametrically opposite brushes of each pair, and means insulated from and disposed between each pair of brushes, for normally and yieldingly holding the free ends thereof beyond the edges of the base.

28. A brush-holder for controllers and the like, comprising a support, spaced pole-plates secured thereto and having their ends adjacent the sides of the support, diametrically opposite contact-brushes, a coil surrounding one of the pole-plates with each end in electrical connection with one of the brushes, resistance-brushes movably mounted between the ends of the plates, an electrical connection between said resistance-brushes, the ends of the pole-plates being deflected toward each other and in close proximity to the active face of the resistance-brushes, a second pair of diametrically opposite contact-brushes, an electrical connection between said brushes, and an expansible member insulated from and disposed between each pair of brushes for causing their active faces to normally and yieldingly project beyond the sides of the support.

29. In a controller, the combination of a supporting-frame, a plurality of resistance-cards supported by and independently removable from said frame longitudinally, contacts for said resistance-cards, respectively, and a movable contact member for said contacts.

30. In a controller, the combination of a casing, having an opening at one end, a closure for said opening, a compartment within the casing, insulated supports secured to the walls of the compartment and disposed opposite each other, resistance-frames resting upon said supports and adapted to be withdrawn through the front of the casing, contacts secured to the casing, connections between the resistance-frames and the contacts, a lever pivoted within the casing and outside of the compartment, and brushes carried by the lever and adapted to engage the contacts.

31. In a controller, the combination of a casing, having an opening at one end, a closure for said opening, a compartment within the casing, vertically-spaced insulated supports secured to the walls of the compartment, the supports on one wall being arranged diametrically opposite those on the other wall, resistance-frames resting upon said supports and adapted to be withdrawn through the front of the casing, and means carried by each frame and adapted to engage the next adjacent support for holding said frame within the casing.



32. In a controller, the combination of a casing having an opening at one end, a closure for said opening, a compartment within the casing, vertically-spaced insulated supports secured to the walls of the compartment, superimposed resistance-frames resting upon the supports and adapted to be inserted through the front of the casing and between the supports, and a yielding member carried by the frame and adapted to engage the next adjacent support for holding the frames against displacement.

33. In a controller, the combination of a casing having an opening at one end, a closure for said opening, a compartment within the casing, vertically-spaced and oppositely-disposed supports secured to the walls of the compartment, resistance-frames resting upon said supports and adapted to be withdrawn through the front of the casing, and an upwardly-bowed spring, one end thereof being secured to the frame, said spring being provided with a recessed portion intermediate its

ends, the free ends of the spring being inclined and terminating adjacent the face of the frame, said spring being adapted to engage and be depressed by the next adjacent support when the frame is inserted, so that the recess therein will engage the said support.

34. In a controller, the combination of a casing having an open front end, insulated supports carried by the walls thereof and serving as guides, resistance-cards, comprising a frame, resistance material carried thereby and insulated therefrom, said cards being adapted to be inserted through the front of the casing and guided between the insulated supports within the casing.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, on this 27th day of January, A. D. 1906.

HARRY SAWYER.

Witnesses:

T. C. AKIN,  
OTTO ALBERT.